Sustainable Development for Minnesota Lakes

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Abstract

Sustainable development is progress that maintains or enhances economic opportunity and community well-being while protecting and restoring the natural environment upon which people and economies depend. Sustainable development meets the needs of the present without compromising the ability of future generations to meet their needs. Sustainable development is gaining acceptance and being applied by localities and states in the United States and throughout the world. The Legislative Commission on Minnesota Resources (LCMR) funded the creation of a sustainable development plan for Minnesota's lakes. The Sustainable Development for Minnesota Lakes Project attempts to answer the question of what should lakes and their watersheds look like in the next two generations. The Sustainable Development project created an outline plan so that major local and public developments can be planned and prioritized and can be reproduced for other lakes and their surrounding watersheds.

Introduction

Some individuals believe that population and consumption growth on a finite planet can not be perpetual. These people are suspicious of sustainable development because they feel that it means economic growth for an area. Others believe that ongoing economic growth is the definition of progress and feel wary of sustainable development because to them it seems like a no-growth program that stifles progress (MN Planning, June 1998). A distinction between what should continue to grow and develop, such as jobs, capital, and knowledge, and what should not continue to grow, including pollution, and waste, needs to be established.

Interest is growing globally in finding better ways to create and maintain a balance between the social, economic, and environmental aspects of change and development. The traditional approaches of focusing on one aspect at a time are costly and often fail to yield results that serve the long-term interests of communities, (Crookston County Board, 1994).

In the past, economic development and environmental quality have been seen as mutually exclusive goals, jobs versus conservation, and economic prosperity versus environmental protection. There has been some economic development that has been detrimental to the environment and some environmental arguments have ignored the need to make a living.

The goal of sustainable development is to make human activities inherently compatible with the environment, (MN Planning, April

1998). Sustainable development recognizes the essential interdependence of people, economic activities, and the environment; growth or change in any of these areas will affect the others. Sustainable development strives to counterbalance and anticipate those effects for the long-term well being of a community. A key strength of sustainable development is that it lends itself to global thinking, that everything done in one area has consequences for other areas near and far. Sustainable development needs to occur at a local level where most real decision making takes place that shapes the future (Crookston County Board, 1994).

Sustainable development is gaining acceptance and being applied by localities and states in the United States and throughout the world. Early in the 1980's, members of the United Nations Commission on Environment and Development traveled the globe surveying the overall development of the world's nations. They identified each country's economy and the condition of its people and its environment. They found that a combination of poverty, unemployment, resource use and environmental deterioration has created unsuitable conditions and that a new model for development was needed (MN Planning, June 1998). The commission concluded that the nature of economic development and human impacts on the environment must change. The world must begin to implement sustainable development, which the commission defined as communities meeting the needs of the present without compromising the future (MN Planning, June 1998). In 1992, the United States and nearly 180 other nations met at the "Earth Summit" in Rio de Janeiro, Brazil, and agreed that sustainable development should be the goal for governments, businesses, and individuals around the world. More then 150 nations, including the United States, committed to a plan called United Nations Agenda 21, which asked each country to develop a plan to implement sustainable development. The United States established the President's Council on Sustainable Development that consists of corporate executive officers, cabinet members and other civic leaders who produced a plan of action (MN Planning, June, 1998).

Canada's response to the World Commission report was the establishment of the National Task Force on Environment and Economy. The Task Force members were drawn from the private sector, government, academic, and environmental organizations. The mandate of the Task Force was to foster and promote environmentally sound and sustainable economic development (Manitoba Round Table, 1992). In 1989, the first Ontario Round Table on Environment and Economy was formed, with a mandate to prepare a sustainable development for Ontario. This mandate was fulfilled with the release of the report "Restructuring for Sustainability" in September 1992. The Second Round Table was formed in January 1993, which was designed to foster and promote community sustainability initiatives.

The Sustainable Communities Resource Package is a response by the Round Table to its new Mandate (Ontario Round Table, 1992). The objectives of the Resource Package are to support community-based sustainability initiatives already in operation and to stimulate use in communities that may not otherwise

consider using sustainability. The Resource Package is not a comprehensive guide to all of the sustainability issues that a community faces but rather it offers ideas and approaches that a community can use to start sustainable projects. The package has a special orientation towards the environmental side of sustainable development. It does not advocate a specific type of sustainable community initiative but shows that there are many types of initiatives, each serving distinct but complementary goals (Ontario Round Table, 1992).

Community prosperity and well-being are dependent upon a sufficient supply of clean water. A clean and adequate water supply provides crucial benefits such as irrigation for agriculture, habitat for myriad plants and animals, aesthetics, recreational opportunities and a symbol of vitality (Center for Excellence-Sustainable Development, 1993). Fresh water resources are an essential component of the earth's hydrosphere and an indispensable part of all the terrestrial ecosphere (United Nations Agenda 21, 1992). The general objective of Agenda 21 on the protection of freshwater is to make certain that sufficient supplies of water are preserved for the entire population, while sustaining the hydrological, biological and chemical functions of the ecosystems, and while acclimating human activities within the ecosystem (United Nations Agenda 21, 1992). The widespread scarcity, destruction and pollution of freshwater, demand integrated water resources, planning and management. Water resource development in the context of urban development must be recognized, as well as the utilization of water resources for sanitation, agriculture, industry, hydropower generation, fisheries, transportation, recreation, and other activities (United Nations Agenda 21, 1992). The management of freshwater as a finite and vulnerable resource, and the integration of water plans and programs are of great importance in the 1990's and beyond. Water resource management that includes integration of land and water related aspects should be carried out at the watershed or sub-watershed level (United Nations Agenda 21, 1992). The plan for the sustainable utilization, protection, and management of water resources should be based on community needs and have full public participation. According to the council, the development of detailed databases, forecasting methods and economic planning models for managing water resources in an efficient and sustainable manner will require the application of new techniques such as geographic information systems (GIS) to optimize decision making (United Nations Agenda 21, 1992).

In 1993 Minnesota Governor Arne H. Carlson, the Environmental Quality Board and the Commissioner of Trade and Economic Development launched the Minnesota Sustainable Development Initiative, which was staffed by Minnesota Planning. The effort to create a sustainable development plan began with 105 business, environmental and community leaders organizing into seven teams who mapped out a long-range vision for Minnesota. The plan's mission was to serve as a public channel for sustainable development fostering public and private cooperation, reaching out to Minnesotans to encourage interest in and communicate the importance of achieving sustainable development (MN

Planning, April, 1998). The Legislative Commission on Minnesota Resources (LCMR) followed the advice of the Minnesota Sustainable Development Initiative and funded the creation of a sustainable development plan for Minnesota's lakes. The LCMR funded the University of Minnesota's Center for Urban and Regional Affairs (CURA), the University of St. Thomas, and the Science Museum of Minnesota, to develop comprehensive plans for five pilot lakes in Minnesota. This plan, the Sustainable Development for Minnesota Lakes, was charged to answer the question of what each lake and its surrounding watersheds should look like in the next two generations. Other Lake Associations will be able to develop their own sustainable lake programs through a format package, which will be produced through this project. The project will create an outline plan so that major local and public developments can be planned and prioritized and can be reproduced for other lakes and their watersheds.

The content of the plan involves many issues, including development, water, and management issues. Development issues incorporate how much and what type of shoreline development are desired while looking at the differences between seasonal homes, permanent homes, townhouses, assisted living, resorts, undeveloped lakeshore, etc. What type of recreation experiences are possible, and currently going on? Where are the best locations for public uses throughout the watershed and lake? Water issues addressed include elements such as how to maintain high water quality. How much and what type of management use is appropriate for the watershed and the lake? What are the factors leading to high or low water levels, as well as what management actions can be taken to stabilize desired levels? How good is the fishing, and what is the balance between managing people and fish? Should aquatic management goals be set for each specific lake? Management issues incorporate such needs as what should the role of public management be, and how should that management be structured? What is the role of the lake association in community building, education, and management? How can the goals of the plan be fulfilled for each lake and its watershed?

Four phases have been outlined for the process of preparing the plans for the Sustainable Lakes Project. The first phase is the development of an information base collected from the physical resources of the lake, its watershed, water quality, development patterns, and present and future levels of recreational use. The second phase is the analysis of the information database for public use and review. The third phase is the information driven focus groups composed of residents, users and managers who can discuss the information and develop issues and potential solutions to these issues. The last phase is the creation of a plan, with goals and implementation steps, so that Lake Associations and their local water planning process can continuously evaluate and update them.

The five lakes were chosen for the pilot from the five different ecological regions in Minnesota. The five lakes were Deer Lake, the Whitefish Chain, Sugar Lake, Clitherall Lake, and Kabekona Lake. Due to time and financial constraints this paper will focus on Deer Lake and its watershed.

Methods

Deer Lake is located in Itasca County, in northeastern Minnesota (Figure 1). Deer Lake is a 3,391-acre lake, with a littoral area of 678 acre, and a watershed of 28,710 acres. The maximum depth is 121 feet with water clarity of 11 feet.

Figure 1. Locator Map

Data Collection

The data for this project originated from various sources throughout Minnesota. The majority of the data was obtained from the Minnesota Department of Natural Resources (DNR). The different Lake Associations also contributed to the database, with legal documents on mainly the cultural resources of the area (Welch, 1998). The soil data originated from soil surveys from individual counties who obtained them from the United States Department of Agriculture (USDA). The data for much of the soil information for the Deer Lake watershed came from the book Soil Survey of Itasca County. All coverages were developed in Arc/Info, ArcView 3.0a and 3.1. All themes were projected into the Universal Transverse Mercator (UTM) zone 15, North American Datum 83. They were at a scale of 1:40,000, which provided easy overlay and interpretation.

Creation of Coverages

The coverages produced for this project have been placed into four categories: single variable, multiple variable, parcel, and lake basin coverages. The single variable coverages included physical resources of the watershed and cultural resources of the watershed. The multiple variable watershed coverages included land sensitivity, land suitability/ capability and conflict coverages. The parcel coverages included complete parcel data as well as photos of each water front parcel taken and classified. The lake basin coverages included contours of the lake basin and of the aquatic vegetation. This paper will not encompass discussion of the parcel coverages and their development because of the limited experience during the pilot project.

Each coverage was chosen to help place the data about Deer Lake into one database to help build the Sustainable Lakes project. Some of the coverages were created to give a general layout of the watershed and where it fits into the bigger picture of the state. These coverages included the base coverage, DNR Eco-regions coverage, government boundaries, topography, land use, forest cover, and watershed boundaries. The slope coverages, such as neighborhood roughness, shaded relief, and slope, were all created to determine the watershed topography. These coverages were also developed to be used to help create multivariable coverages such as the erosion coverages. The ownership coverage was created to determine the amount of public versus

private land that is located in the watershed, and was used to create other multivariable coverages. The pre-settlement coverage was constructed to show how the watershed looked prior to European settlers entering the area. This coverage, along with the present land use cover, was used to create a preservation coverage of the watershed to determine how much the watershed has changed since the European settlers entered the area. One of the largest sources of data was the soils coverage for the area. These data became a large factor for much of the project contributing to erosion coverages, soil suitability coverages, and groundwater coverages. These data are vital to any watershed or community that wishes to better itself through sustainable means. The scenically attractive series of coverages were developed to determine the most pristine areas within the watershed according to the criteria of slope, forest cover, and proximity to water. These coverages also show the public versus private land ownership that may have these scenically attractive areas located within them.

For each grid theme, the percentage of area for each coverage was calculated by utilizing the cell count total. The cell count was multiplied by 900 and then multiplied by 0.000247, which produced acres. This total was then divided by the total number of acres located within the watershed and multiplied by 100 to derive the percentage.

Analysis of Data

This project attempted to model land use that would logically occur in a watershed. These analyses and models are just the beginning; they were built within the time and budget of the project and define the areas most important for the focus groups.

Several analyses of the data were deemed important for the completion on the project. The amount of land today and its use that is the same as with the pre-European land use was the first. This data gives the Lake Association an idea of the change that has occurred in the watershed over time. This will also show the areas of land that have not changed and should be considered for protection. The Preservation coverage shows all the areas that were in the watershed before European settlers that are still present today. The pre-settlement coverage and the present land use/cover coverage were intersected using the utilities tools intersect. Then, selecting deciduous and hardwoods from the intersected table, a new theme was created under the theme to create a new shapefile. The new shapefile table "hardwood" was selected from the land_use field and again a new shapefile was created, which showed the area preserved in the watershed that was of deciduous forest origin. This was done for conifer forest, mixed wood forest, lakes, coniferous bogs and swamps. These shapefiles were then joined together and the area that was left was labeled "altered area."

All areas of potential erosion for the watershed were also deemed as an important data source for the Lake Association as they try to maintain areas and slow or stop the erosion process. The Erosion (Run-Off) Susceptibility coverage was created using the land-use, slope, and soil data. The land use data were reclassified to land cover classes (potential to restrict run-off) which included: high - water, wetlands, forests, medium - grasslands and young forests,

and low - farmland, rural/urban development, and gravel pits and mines. The slope was reclassified to slope classes (potential to increase run-off), which included 0-3%, 3.001-8%, and 8.001-22%. The soils were also reclassified to include clay and all the rest. The three reclassified themes were then combined to create areas as, high, medium, and low for potential erosion. The areas of land that have potential for erosion are the most important if they are near a water sources (lakes, streams, etc.) because of the debris runoff that may cause problems such as fill, or create high turbidity within the water. The Erosion (Run Off) Potential and Water Orientation coverage shows the potential for erosion and if it is near a water source. The erosion (run off) susceptibility theme was buffered with the buffer command on the utilities tool bar 1/8-mile from all water resources. The classification for this then became: non-water oriented, nonsensitive; non-water oriented, 2 or more sensitive resources; water oriented, farmland, rural/urban development; water oriented, 8-25% slope; water oriented, clay soil; and water oriented, 2 or more sensitive resources.

For development purposes, all scenically attractive areas, which included hilly, tree, and near water, were found. The scenically attractive areas show all land that would be appealing to a person. The Scenically Attractive Areas coverage was created to show all areas that were close to water, slightly hilly for better views, and forested. To create this view, all the lakes were buffered at 1/4 mile. Land use was reclassified to included deciduous forest, mixed wood, and coniferous forest, urban/ rural development, grasslands, wetlands, open water, and gravel pits and mines. For the slope the neighborhood roughness theme was used, but it was reclassified so that flat included flat, and gently rolling, and hilly included hilly and steep. All three themes were converted into a grid for use with the map calculator. The equation of proximity to water + forest cover + neighborhood roughness was used to produce attractiveness classifications ranging from > 1/4 mile from water, nonforested, flat; to < 1/4 mile from water, forested, hill. The best (i.e. most scenically attractive) areas were near water, forested and hilly and decreasing from there. After these areas were selected the data were then overlain with public versus private ownership and distance from roads.

Many communities are implementing a mandatory buffered area adjacent to the lakeshore. This buffered area ranges from 50 feet to 100 feet in most areas depending on the development level in the area. For Deer Lake, a 50 foot buffered zone coverage was constructed.

Within the project error may have occurred. These errors may have altered the final numerical results but the trends present should still be accurate. Examples of potential error in this project include error entering attribute data and error from overlaying of coverages. Errors may also occurred from the digitizing of soil and lake depth maps. In addition faulty data that was given to the project for use may also have introduced error. Finally possible error also includes base map errors such as the minimum 40-ft. accuracy on a 1:24,000 quad.

Results and Discussion

During the time that the database for Deer Lake was being created, surveys were sent to property owners on Deer Lake to find their concerns. A total of 214 surveys were returned, for a 56% response rate (Welsh, 1998). Residents felt very strongly about the lake, its beauty, isolation and the opportunity to enjoy it. Owners wished to maintain the beauty of the environment of the lake and watershed. They felt there were problems that were jeopardizing the lake and their ability to enjoy it. These included personal watercrafts, improper alterations and the failure to monitor permits, pollution (including noise pollution), and erosion. They also felt that large areas of mowed and fertilized lawns, loss of trees, and expanding development in the area have a negative impact on the lake. The accumulation of the vast amounts of data for Deer Lake and its watershed should provide information for the Lake Association to address the problems.

The Preservation map (Figure 2) shows all land cover unchanged since European settlers arrived in the area. The amount of land that has changed from pre-European settlers to today is 18,714 acres, 65.27%, and the amount of land that has not changed totals 9,958 acres or 34.73% (Table 1). There are 470 acres of conifer forest, 886 acres of deciduous forest and 3,166 acres of mixed forest that still remain in its original location. The majority of the land within the watershed has been altered in some way, and so the remaining unaltered land should be considered for protection from change. This protection could come from the government or private organizations committed to these areas.

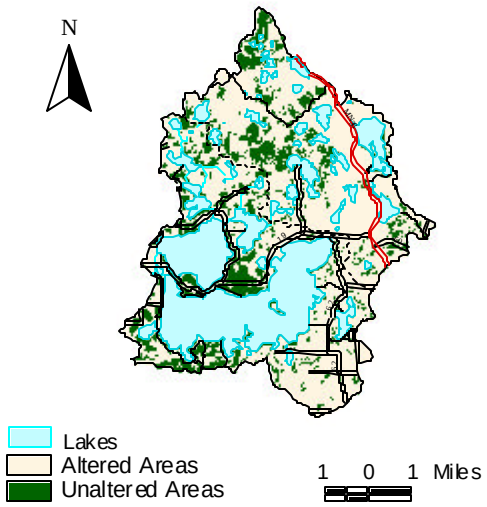

Figure 2. Preservation Map

The areas within the watershed that have a high susceptibility to erosion became an important part of the overall analysis.

Land Cover	Acres	%
Altered Areas	18,714	65.2
Coniferous Forest	470	1.64
Mixedwood Forest	3,166	11.04
Deciduous Forest	886	3.09
Lakes (open water)	5,390	18.8
Coniferous Bogs & Swamps	46	0.1
Total	28,672	99.87

Table 1. Summary of presettlement vegetation

The data for erosion potential came from the Erosion (Run Off) Susceptibility coverage which showed the total area of potential erosion within the Deer Lake watershed (Figure 3). The totals for each slope class were high potential for erosion 913 acres, 3.18%, medium potential for erosion 6,697 acres, 23.32%, low potential for erosion 9,958 acres, 34.73%. The areas of highest concern for erosion runoff into streams

and lakes are located within a 1/8 mile of these waterways. The amount of sediment that can enter the water greatly increases because of the closeness to the water

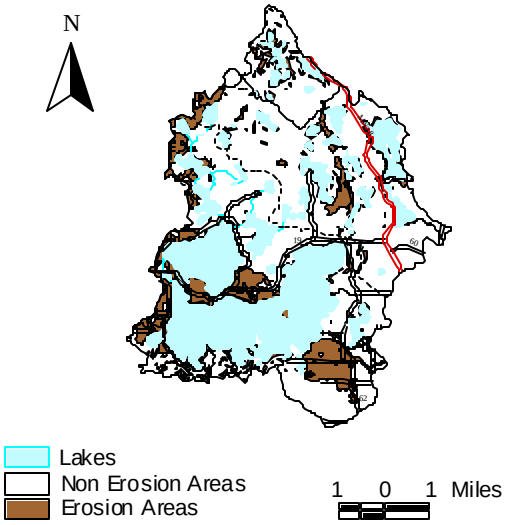

Figure 3. Erosion map

The areas of high erosion were buffered to 1/8 of a mile to show the areas of potential concern. The amount of land that is located within 1/8 of a mile from a water source and has a high potential for erosion is 8,567 acres. Focus should be placed on these areas to slow the erosion process.

The Scenically Attractive series of coverages were created to show the areas of land that are scenically attractive and if the land is located on private or public land. These data were then displayed to show their proximity to roadways. More private land, within the Deer Lake watershed, is located closer to the roads then public lands. This is because of the development that is occurring within the area. There is more private land then public land (Figure 4) within this watershed. Housing developments will be drawn towards the scenically attractive areas within the watershed. Future developments within these areas should be done in such a manner that the pristine nature of the land is maintained. The private lands consist of 62.5% of the scenically attractive land within the watershed. There is 30% of the scenically attractive lands that is federal land and the Chippewa National Forest encompasses the top half of the Deer Lake watershed.

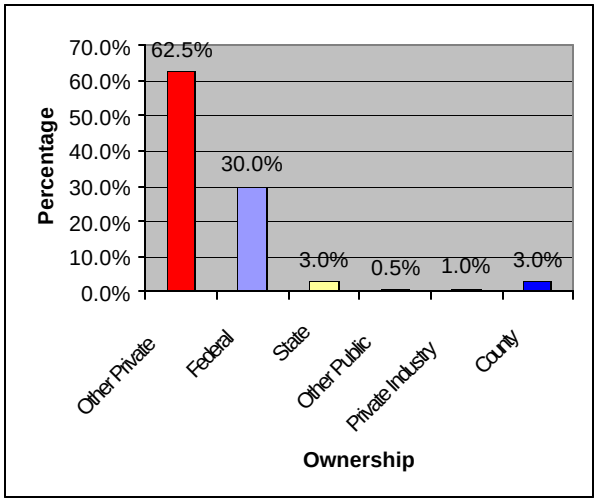

Figure 4. Land Ownership

To add to this analysis, the area of land that would be most suited for real-estate purposes was found. Real-estate markets have made particular areas of land much more valuable then others. Land that is scenically attractive as well as private and areas that have a low potential for erosion would be highly valued for development. An attempt is made here to model these areas.

The area of land with these development characteristics would be scenically attractive land that is within ¼ mile of water. Second only private lands included as it is most likely to be the land sold for possible real-estate development so the public land that fell

into the scenically attractive category was deleted. From the data, highly eroded land or areas of high erosion potential were also removed. This left all areas that could be used for real-estate development that would be appealing, and have a low potential for erosion. The total came to 6,453 acres. The areas of preservation located within this watershed are limited and should be protected. Hence the area of preservation was removed. This produced the area of possible development within the watershed while protecting the areas of preservation (Figure 5). The total for the area of possible development that does not contain preservation land is 1,063 acres.

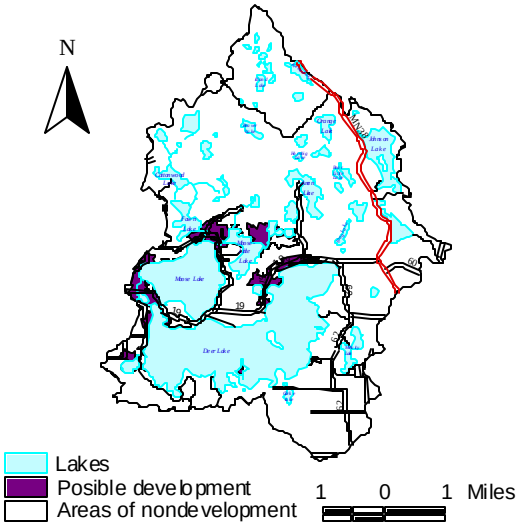

Figure 5.Possible development outside preservation areas

The Deer Lake Zoning and Planning Commission had wanted to rezone an area from agriculture to rural development, the parcels located west of County Road 256 and adjacent to Deer Lake. To analyze this possible development, the parcels that are adjacent to the lakeshore were digitized into a coverage. The coverage was then overlain on Digital Orthophoto Quads to show the approximate locations of each parcel. These parcels were then classified into areas that were inappropriate for residential development, as well as areas that were appropriate for residential development.

The areas that were deemed inappropriate for residential development were coded such based on several reasons. First septic system suitability is severely hampered due to the wetness of the soil in the area west of County Road 256. Secondly between County Road 256 and the shoreline of Deer Lake, the soil is severely limited by slow percolation. The data used in this analysis was the septic system suitability coverage. The suitability of lawn maintenance and landscaping is also severely limited in the area west of County Road 256 due to ponding and/or flooding. Between County Road 256 and the shoreline of Deer Lake, these limitations are slight.

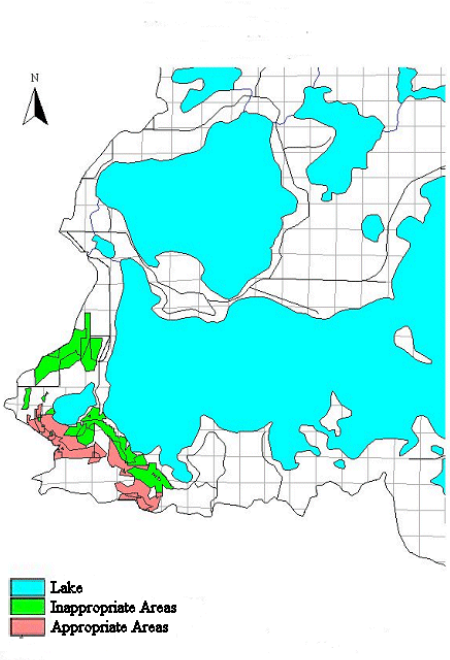

Figure 6.Possible Rezone Areas

This analysis was done with the soils best suited for lawns and landscaping which include loam to clay loam soils. The last remaining stand of mixed forest and one of the few remaining natural properties is also contained within this area (Figure 6).

Some of the area questioned by the Deer Lake Zoning and Planning Commission was also classified into areas that do not have limitations on residential development. This area does not have steep slopes that would make storm water runoff a significant issue. This was determined by using the erosion (runoff) susceptibility coverage. In addition, the potential for groundwater contamination in this area is low, according to the analysis of the groundwater contamination potential coverage. The shoreline area adjacent to these parcels does not contain any aquatic habitat that has been identified by the MN Department of Natural Resources.

Comprehensive land use planning is an effective nonstructural tool to control polluted runoff. Where possible, growth should be directed toward areas where it can be sustained with minimal impact on the natural environment. Development that is poorly planned has the potential to degrade and destroy natural drainage systems and surface waters. One effective method to control polluted runoff is to manage development adjacent to the lakeshore. Poorly managed development can increase erosion, increase the rate of runoff from paving natural surfaces, and increases pollutant concentration. Establishing minimum buffers between a development and the water is another method of protecting environmentally sensitive areas. Vegetated, undeveloped land can filter sediment and absorb pollutants from runoff. For example, vegetated buffers can filter pollutants from poorly functioning septic tanks, while a buffer of native vegetation between a wetland and a parking lot can strain automobile oil and grease.

The complex pattern of shoreline ownership suggests there is potential for inter- and intra- department and private cooperation between all levels of government, (Borchert, 1970). Many communities require that a minimum 100-foot buffer be maintained in its natural condition along wetlands; minimum buffers along streams vary from 100 feet in rural areas to 50 feet in urban areas. Local zoning ordinances incorporate buffer requirements, and restrict activities within the buffer zone, thus assuring their implementation.

With Deer Lake buffered with a 50-foot buffer zone, the total was 130 acres. For every lake in the Deer Lake watershed to be buffered with a 100-foot buffer zone, the total was 560 acres.

Watershed Database

Land use practices in the watershed directly impact water quality of the lake. When there are poor agriculture practices which create run off, chemicals, as well as dirt, tend to end up in the lake and create an imbalance of the natural water quality and produce an environment unfit for fish and other aquatic life. Improper agriculture practices as well as poor lawn management, such as lawns adjacent to the lake shore, streets and other non-soil oriented material that don't allow the water to percolate into the soil all can cause nutrient loading. Surfaces such as asphalt and concrete allow rainwater to run off directly into the lake. Large

clear cuttings of trees within the watershed can also cause irreversible damage to the lake. There are many land use practices that need to be monitored throughout the watershed in order to maintain the natural balance of the lake.

There is no standardized set of local watershed boundaries established across agencies or program lines. Agencies and program lines must construct standard watershed boundaries in order to protect the watersheds. If a problem does arise in a watershed, how can agencies properly construct and fix the damage inflicted if the agency doesn't know which watershed to treat?

This project has created the first integrated and computerized watershed database. It required a major effort, working between state agencies, local governments, and higher education institutions. After a plan is worked out for other Lake Associations to follow, the overall effort should be less. The plan will include what databases need to be assembled and allow each Lake Associations to emulate how the databases were used for the pilot lakes. The overall time and money needed by other Lake Associations should be less.

In the Deer Lake watershed only a small part of the watershed has a major impact on the water quality. These areas include the shoreline areas, steep slopes near water, urbanized areas, and cultivated areas. If these small areas of the watershed can be maintained in a manner that has little or no damage to the lake, the cost and time of trying to control the impact on the lake can be greatly decreased. After these areas are focused upon the other areas within the watershed could then be looked at for other concerns.

Public land, especially state land, in the immediate watersheds of the study do not have special management programs even though they are located near valued, high quality, high recreational lakes. Individual program goals of land management units are usually more important than lake management goals. The public land should be maintained at the same or even higher standards than the surrounding private land. The effects of what happens on the land has a large impact as to what happens in the water. Again the problem of agencies not working together comes into play.

Local or state zoning, both within the shoreland zone and outside the shoreland zone, do not contain special provisions for water quality or public health protection. This can be seen by the intensive irrigation and aerial application of herbicides and pesticides adjacent to urban settlements. Local and state lands make up 35% of the watershed and should be bound by the same laws of water quality and public protection. The harm that can occur to a lake, as well as to the individuals that live by these areas, can be irreversible.

One of the key variables in lake management is the soils coverage of the watershed. The latest and most expensive soil surveys are almost too detailed for watershed wide analysis, but not detailed enough for use with individual parcels and structures. Soil coverages are key to gauging such elements as erosion, irrigation and groundwater contamination. Soil surveys for parcels could be very valuable, such as locating proper soils that septic systems should be placed in for better environmental protection.

There are no systematic programs to keep the information that

has been collected and needed for lake management updated. The most obvious example is the land use/cover coverage. Land use is in constant change from day to day. The amount of data that has been collected for Deer Lake and its watershed is very large. A similar effort will be needed for any lake association that wants to perform a sustainable lake project for their lake. This large amount of data will also need to be stored somewhere that the lake association can have access to for updating.

The major need for data collection for lake management purposes is not water quality information but information and monitoring of land resources and settlement patterns. Actions done on the land have huge echoing effects within the lake. If land practices can be monitored and corrected before water quality becomes a problem, time and money can be saved. More time will be needed to fix a water quality problem than to start a land project correctly that has little effect on the water.

Findings from this project suggest that there appears to be no clear, easily used models linking water quality data to cumulative individual management actions in a lake watershed. In lakes with large watersheds in relation to lake basin size, management actions in key areas of the watershed are most important. In lakes with small watersheds, management of the shoreline is most important. Watershed size is a much more important element than a lake's ecological region.

Lake Basin Database

Most information on physical characteristics of lake basins is collected on a sample basis rather than an inventory basis, the exception being lake depth coverages. Most management decisions require inventory-based information in order to be effective. The example of this is aquatic vegetation mapping, which is done in transacts, but the decisions to approve or deny a permit for change require inventory information. For major basin decisions, data should be collected at an inventory basis in order to obtain a clear and detailed account of the problem. Although this will take much more time and money if agencies are serious about the outcome of a lake, the commitment must also be there. There are many Lake Associations that are willing to volunteer their time to see that their lake remains pristine.

The fish populations and relative growth is well known, as well as the impact of fish harvest. The hours-spent fishing per fish caught is increasing while the average size of fish is decreasing. Fewer fishermen are increasingly taking a larger percentage of the total harvest. Fishing knowledge and quality of equipment used is increasing. Fish management must deal with the growing concern of fishermen. Bag limits and fish-size limits must be incorporated into areas of the state, not just a statewide permit. Present angling bag limits bear little relationship to the ability of lakes to withstand a sustained basis of continuous fishing pressure. When a lake does acquire an above average population of larger game fish, that lake will have an immediate increase in fishing pressure that will change the population back to average or below. In order to improve fishing, a combination of very expensive catch-and-release fish management, limiting of fishing hours and equipment, and major reductions in catch limits are required.

The state does not have an effective policy or program to manage water-surface use. The numbers of boats, their speed, and maneuverability are continually increasing while the water resources remain essentially static. There are very few lakes and rivers that have restrictions placed upon them, such as no wake zones or amounts of boats that can be present at one time on a lake. More lakes need to have such restrictions placed upon them to maintain the resources that are there.

The Planning Process

No two places have exactly the same ecology, values, geography, businesses or culture, so what is sustainable in one place may not be in another (MN Planning, June 1998). A planning process can be constructed for other lakes to follow, but because no two places are exactly alike, the plan should be looked at as only an outline to follow. The planning process will operate through each individual Lake Association, which can follow this general outline. The Lake Associations need to look at such development issues as how much and what type of shoreline development is desired. The watershed development also needs to be looked at with such issues as what type of settlement and what land uses are desired, how should the landscape look, and what type of recreation experiences are possible? Water issues also need to be assessed, such as the quality of the water. Water quality should be the highest priority. How much and what type of water surface use and management is appropriate? What factors lead to high or low water levels and what management actions can be taken to stabilize the desired levels? How good and what is the balance between managing people or fish? Should aquatic plant management goals be set for the lake? For the management issues, what role should the public management (state and local government) be, and how should that management be structured? What is the role of the lake association in community building, education, and management? How can the goals of the plan be fulfilled?

Summary

Minnesota Statute 4A.07, subdivision, defines sustainable development as development that maintains or strengthens economic growth and community well-being while protecting and restoring the natural environment upon which people and economies depend. Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs (MN Planning, June 1998). For human activity to be sustainable over time, they should, gradually reduce reliance on and limit the release of toxic substances that do not readily break down in nature; use land in ways that meet diverse needs, conserve financial and natural resources, and preserve its ability to meet future needs; reflect the interdependence of social, economic and environmental conditions; and preserve the integrity of ecological processes and biological diversity (MN Planning, April, 1998). It is at the community level that many fundamental interconnections among environmental, economic and social issues become evident. This sustainable development may be achieved through the collaboration among citizens, businesses, civic groups, and

government agencies. Local communities must recognize how they can or should change to become more sustainable for the future.

The need for a sustainable development plan for lakes and their surrounding watersheds is far overdue. Water resources are the life of sanitation, agriculture, industry, urban development, and wildlife. The amount of water is limited and means to protect it must become a top concern for Minnesota, as well as the nation. The Minnesota State Legislature recognized that something must be done and created the Sustainable Lakes Project. Through the use of data that has been collected from the DNR, USGS, and other agencies, a plan for the preservation of Minnesota's lakes has been established. The Sustainable Lakes Project can help many Lake Associations and communities preserve and better their water resources. The vast amount of data, which was used to created this pilot study, is accessible to any individual or lake association through the Minnesota DNR. The outline will give an easy but helpful route to follow and create their own plan.

The Deer Lake Lake Association now needs to institute the plan and proceed to update the data. A documentation of the plan in action is also needed to see how effective it can be in sustaining the lake. A way to have other Lake Associations follow Deer Lake's example and institute their own sustainable lake project must be found. For the Sustainable Lakes Project, there were many individuals and agencies that contributed to create the final outcome.

All development is local, yet it can have profound consequences for Minnesota and the world at large. The collective results of local choices can affect the health of the local economy, whether or not a community shares a sense of place, and what sort of environment will be passed to the next generation.

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