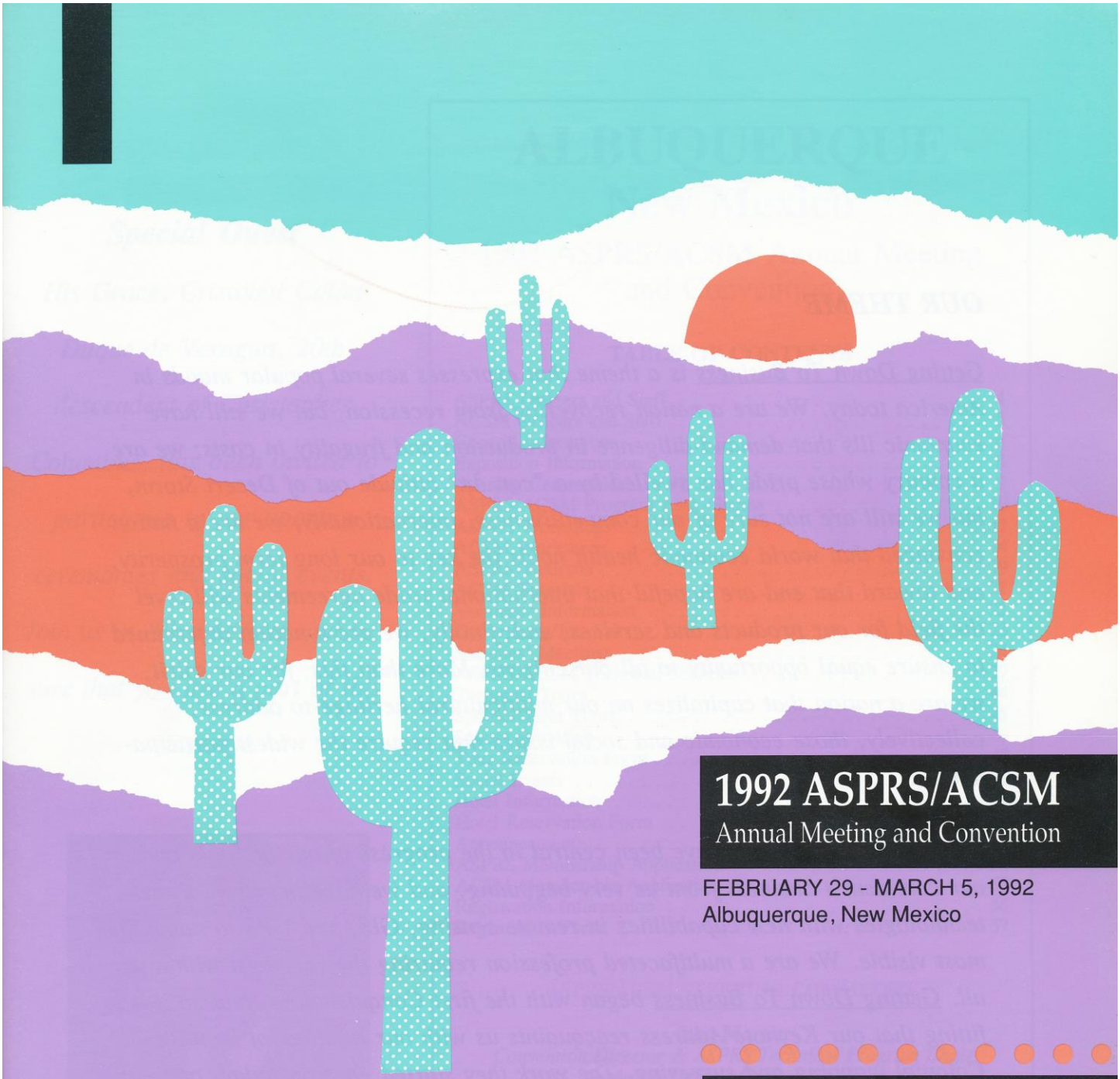

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PRELIMINARY PROGRAM

IDENTIFYING ROAD ZONE CONDITIONS USING A GEOGRAPHIC INFORMATION SYSTEM: OTSEGO LAKE DRAINAGE BASIN AS A CASE STUDY AREA

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ABSTRACT

This paper examines through the use of a geographic information system road zone areas within the Otsego Lake Drainage Basin of New York State. This basin forms the headwaters for the Susquehanna River and contains as its largest community the village of Cooperstown which has approximately 2500 full time residents. Road zones are those areas on either side of a road where economic development and environmental impact might occur. As more people from the densely populated metropolitan areas seek rural retreats through second/vacation homes, many environmentally attractive rural areas face unplanned development along their roads. Citizens within the Otsego Lake Basin have formed the Otsego County Conservation Association (OCCA), a private, non-profit organization concerned about the lack of objective planning and development within the Basin. OCCA has funded the development of a detailed geographic information system of the Otsego Lake Basin and this paper reviews how this system was used to study the issue of road zones in order to detect potential development areas for second homes.

INTRODUCTION

The earth's shrinking natural environment represents one of the great issues that humanity faces as the world's population rapidly moves toward 6.3 billion by the year 2000 and 8.3 billion by 2020. Deforestation, desertification, and global warming are some of the well publicized aspects of this shrinking environment as more and more people strive to find good and reasonable living space. However, other indicators exist, ones that are not as apparent or well identified. One such indicator are road zones, areas adjacent to roads that have a high potential for economic development and environmental impact. In 1987, the United States had 3,874,000 miles of roads of which 3,164,000 were classified as rural roads and 88.4 percent possessed surfaced conditions. If the average legal width of a road was 50 feet, the United States would have 36,685.6 square miles of roads, an area larger than the entire state of Indiana with over 250 square miles to spare. However, as large as these figures might appear, the amount of area dedicated to roads in the United States based on these calculations represents less than one percent (.997%) of its total area. This situation drastically changes when road zones are considered, especially with respect to land cover within the zone areas. Using a geographic information system this study examines road zone conditions within the Otsego Lake drainage basin of upstate New York. This area is representative of many rural regions throughout the United States that are trying to maintain their natural landscape while dealing with the outward movement of people from large urban centers. In addition, the detailed geographic data base for the basin

was developed at the request and support of a group of local citizens concerned about their shrinking rural landscape.

STUDY AREA

Otsego Lake is located northwest of the Catskill Mountains in New York State on the Appalachian Pleateau. The lake and its basin forms the headwaters of the Susquehanna River, one of the major river systems on the east coast of the United States. Elongated in shape the lake extends for about eight miles in length and one and one-half miles across at its widest point. Although not one of the Finger Lakes, it possesses similiar features. Hills parallel the length of the lake and little flat land exists between the lake edge and the hills. The northern portion of the basin is represented by more rolling topography. The village of Cooperstown - a small, affluent community and a tourist center with the Baseball Hall of Fame - is situated at the southern end of the lake where the Susquehanna River begins. The drainage basin covers 50,649 acres (79.14 sq. mi.) and focuses on the lake and Cooperstown.

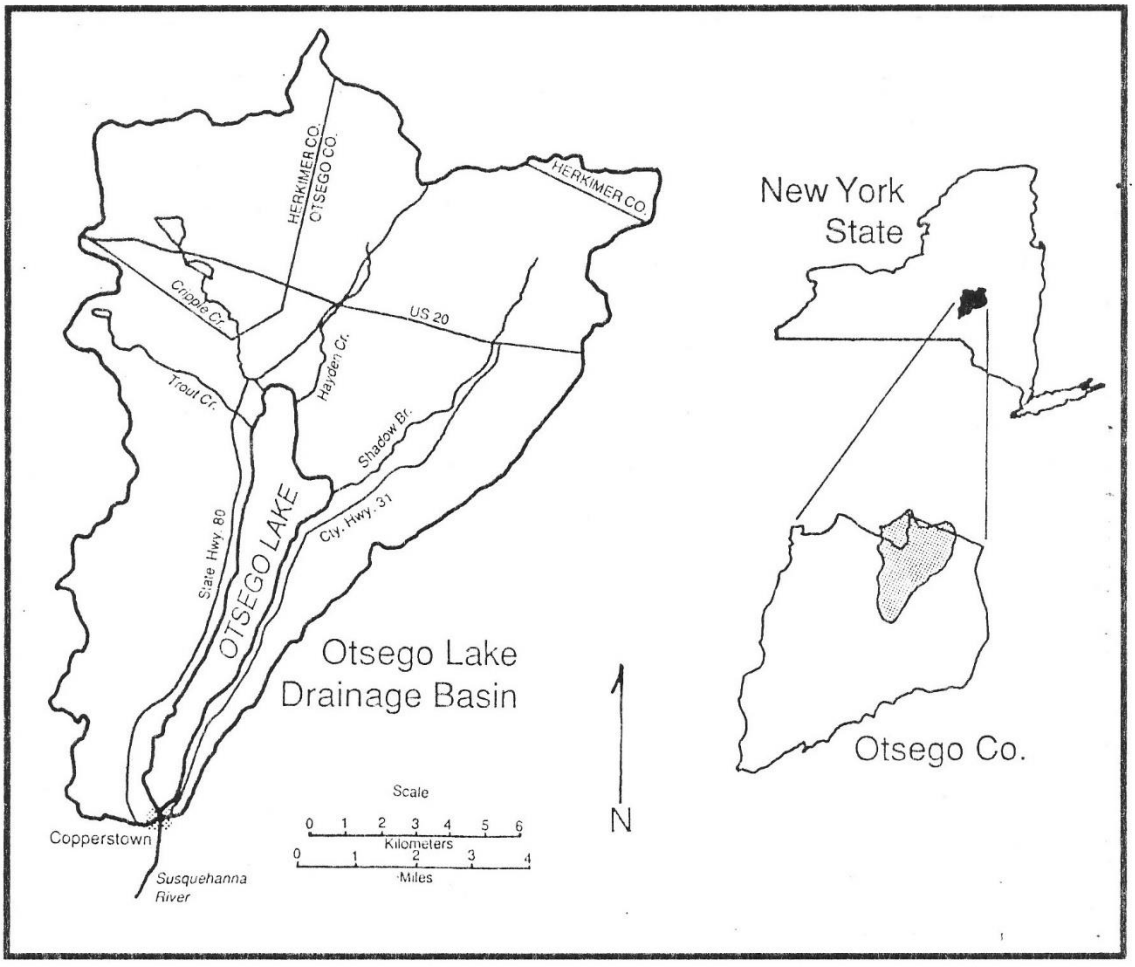

Figure 1. General location map of the Otsego Lake Basin

OCCA AND GEOGRAPHIC DATA BASE

In recent years, due to various federal and state tax policies and the changing national economic picture, many marginal farms have been acquired by people from nearby urban centers who are seeking land for rural residential development and subdivision. They are also seeking a rural environment that

is perceived to be more secured and less polluted than the urban environment in which they presently reside. This situation exists in the Otsego Lake drainage basin where a growing percentage of local property owners are now part-time residents who visit on weekends and during vacation periods from New York City, Albany, and Syracuse. Farms which consist mainly of pasture and forested lands are now rapidly giving way to second homes and some condo projects. Public concern over the protection and future of the drainage basin has resulted in several public agencies and private organizations working together to plan for better use of the land within the basin. The Otsego County Conservation Association (OCCA) - a private, non-profit organization - has spearheaded this endeavor by funding applied research on the lake and surrounding land.

Founded in 1968, OCCA with an annual membership varying between 200-500 local citizens has some clearly stated objectives pertaining to the rural environment of Otsego County. They are:

- o To promote the conservation and the proper use and development of public and privately owned land, water, air, and related resources of timber, soil, wildlife, and outdoor recreation in Otsego County.

- o To promote maximum benefit from privately owned rural land through (1) activities directed by the Association, (2) cooperation with other organizations of a similar nature, and (3) collaboration with and assistance from County, State, and Federal agencies.

- o To foster a fuller appreciation of the potentials and rewards of rural living.

OCCA is recognized in the community as an organization which provides leadership on environmental management issues and supports basic research on the environment. OCCA is now supporting the development of a geographic information system for the drainage basin. This undertaking by OCCA represents a situation where a local organization of concerned citizens is looking at GIS as a means to address environmental issues in a particular region.

The GIS data base is organized in a raster format with each grid cell corresponding to a 25 square meter (.1544 acres) area. The data base is geometrically rectified to the Universal Transverse Mercator (UTM) coordinate system and has a theme layer for each of the following topics: land cover, elevation, slope, aspect, political units, subbasins, and roads. A layer is now being developed for soils. Generalized land cover was developed from a Landsat TM data set taken in July, 1988. With some modification, the land cover classes that were established correspond to Anderson's Level 1 classification scheme. Road data were taken from 1943 7 1/2 minute USGS maps that were updated in 1969 by New York State's Department of Transportation. No major new roads have been introduced into the basin since 1969. The roads fell into five categories: federal, state, county, township, and village roads.

ROAD ZONE DEVELOPMENT

Using the geographic data base, road zones of 1/8 and 1/4 miles were established along each of the public roads within the basin. The 1/8 mile zone,

a distance of 660 feet, has the potential to contain a great many building lots with easy and direct access to public maintained roads. Driving along many of the town and county roads within this basin, particularly in the hilly, more forested sections of the southern half of the basin, one can observe a large number of lots that have or are in the process of being developed for either full or part-time residential use. This type of development has been especially noticeable since the federal tax laws were changed in 1986 making second or recreational homes more desirable to acquire with respect to tax deductions. The Cooperstown area with Otsego Lake has been a particularly attractive area for second home development with its various cultural amenities and rustic landscapes. Little development has occurred within the village due to high density conditions and extremely high real estate prices. Most development has occurred outside the village within the road zones of the less highly traveled roads.

The 1/4 mile zone reaches back 1320 feet from a road. A common approach for a farmer to reduce property tax is to sell 10, 20, or 30 acre lots with road frontage. One frequently observes in the local newspapers or real estate guides undeveloped lots of this size with road frontages ranging in length from 300 to 3000 feet. To avoid New York State's regulations associated with establishing subdivisions the farmer generally elects to sell a few large lots rather than many small lots. To have lots of this size without using a tremendous amount of valuable road frontage the farmer develops elongated shaped lots that reach well back from the road; thus, the farmer creates a balance between the number of lots and the size and shape of the lots to be sold. Under this approach a farmer can sell lots periodically as additional income might be needed and receive a considerably higher price per acre of land than would be obtained by selling the entire farm at one time.

The individuals who purchase these large lots generally have little interest in farming. They are particularly interested in wooded lots with some slope conditions that allow for panoramic views. They are less interested in cultivated or pasture land which provides too much open space and less "natural" landscape. The southern half of the basin with its hilly, forested environments and nearest to Cooperstown contains more desirable lots than the northern portion of the basin with its cropland and rolling, open topography. The owners of these lots, like the farmers, might elect over time to subdivide their land and sell lots ranging in size from 2 to 5 acres. Again, the price per acre on these smaller lots will be generally greater than what was paid per acre on the larger lots. Access to these smaller lots might be a problem. Depending on the amount of road frontage provided with the original lot the owner might create several long, narrow lots each with direct access to the public road. Another possibility is to improve on an existing farm road developed by the farmer, and thereby, provide access to lots back from the public road. The third possibility is to develop a small subdivision with roads. This approach is generally done by a land developer who is required to follow State land development regulations. These various land use scenarios of farm land being replaced by residential conditions illustrate how the 1/8 and 1/4 mile zones are being developed, and in the process, creating a shrinking natural environment.

To illustrate the process of rural land sale in the Otsego Lake region, a local newspaper this past summer provided a supplement entitled "Summer Vacation Guide '91." A supplement of this type is published each year at the height of the tourist season when urban dwellers retreat to the rustic and rural

life of upstate New York. In addition to adds about the local bed and breakfast establishments and craft and antique stores, nearly every page of the supplement contained adds describing land and vacation homes for sales. The supplement is obviously directed at the urban tourist and not the local population. Below are listed some samples of adds pertaining to land for sale within road zone areas:

o 9 wooded acres on town road with electric and spring well, just $37,000.

o land - 18 acres w/incredible view - town road - electric - borders state land, $129,900.

o 40 acres with 2800' rd frontage, could subdivide, nice views $55,000.

o 43 acres all woods, good hunting, paved road, electric $55,000.

These prices for so much land appear to be great buys for people from Long Island and Westchester County who are accustomed to paying $10,000 or $12,000 per one-third acre building lot. Even people from the smaller urban areas of Albany and Syracuse find these prices extremely reasonable.

ROAD ZONE MAPS

As previously indicated the basin covers an area of 50,649 acres of which 45,879 acres represent various land surface conditions. Excluding village streets, 150.21 miles of road lace through the basin and if each road is physcially 50 feet wide, the amount of land dedicated to roads within the basin is 910.36 acres, not a large percentage (1.98%) of the total land area. (Table 1 provides a mileage breakdown by road type.) However, with a road zone of 1/8 of a mile on either side of a road, the amount of acreage increases drastically to 22,256.67 or 48.51 percent of the total land surface. These figures again increase drastically with a 1/4 mile road zone. The total acreage is 34,655.11 or 75.54 percent of the land area. These figures were obtained using the theme layer established for roads within the geographic data base. The distance from each 25 meter grid cell from a road was calculated and those within 1/8 and 1/4 mile distance were identified and formed a new theme layer. Obviously, some cells fell within the road zone of more than one road and might be viewed as having a greater potential for development.

Table 1: Road Mileage

Village	5.30 miles
Town	86.68 miles
County	40.73 miles
State	13.59 miles
Federal	9.21 miles
TOTAL	155.51 miles

A need exists to identify not only the road zones but the nature of the zones especially with respect to potential second home development. In describing second home development within the basin several important geographic variables were indicated, namely land cover, topography, road type, and, although not mentioned specifically but implied, Otsego Lake. The

decision making process of mapping and ranking each of these variables with respect to the potential development of the road zone areas requires considerable thought. This process becomes more complex when combining these variables to produce an overall composite map of potential second home development.

Land Cover

The geographic data base also contains a theme layer for land cover. When this layer is related to the road zone layer, one can determine what land cover conditions fall within each zone. Table 2 provides this information. Information on water cover was not calculated since it does not represent a potential residential environment even though many people might wish to live next to a water body, and information on villages was also not calculated since these areas are densely settled and not viewed as part of the rural landscape. The total acreage in Table 2 does not include these two categories.

Table 2: Land Cover Within Road Zones

Land Cover	Acreage	1/8 Mile Zone		1/4 Mile Zone	
Mixed Forests	16883	5410.34	32.04%	10391.35	61.55%
Coniferous	1214	767.88	63.25%	1021.77	84.16%
Brushland	6765	3649.73	53.95%	5539.45	81.88%
Agriculture	20405	12130.96	59.45%	17222.54	84.40%
Wetlands	612	297.76	48.65%	480.00	78.43%
Water Surfaces	4367	--		--	
Villages	404	--		--	
TOTAL	45879	22256.67	48.51%	34655.11	75.54%

The mixed forests, coniferous forests and brushland represent land cover conditions suited for second home development. The higher percentage values of brushland and coniferous forests within the road zone areas than mixed forests relate to the transitional change of active agricultural land, which is associated with good road access, to non-active agricultural land which initially becomes brushland followed by coniferous forests, namely white pine. In addition, poor accessibility has kept those areas beyond the road zones from being extensively developed for agricultural purposes and allowed them to remain forested.

A map was created showing land cover within both the 1/8 and 1/4 mile road zones. (This map as well as the other maps produced for this study do not appear in the paper due to the difficulty associated with reproducing reasonable black and white photographs from computer monitors for publication.) Land cover was placed into three levels. Since forested areas provide the most desirable land for development, the mixed forests and coniferous forests were combined and given the highest rank. Brushland was also included in this rank since it represents in most cases land being returned to forest conditions and many second homes are constructed at the edge of forest-brushland areas in order to have a viewshed. This land cover was assigned the arbitrary rank of 3. The 1/8 mile road zone was given a rank of 2 and 1/4 mile zone a rank of 1. When combined, the forest land cover and 1/8 mile rankings produced an overall rank of 5. With the 1/4 mile ranking the combination created a rank of 4. Agricultural lands and wetlands were merged and given a land cover rank of 2 and when related to the road zone

areas a total rank of 4 existed for the 1/8 mile zone and 3 for the 1/4 mile zone. Finally, the villages or built-up areas were assigned the land cover rank of 1 and when combined with the road zones produced ranks of 3 and 2.

Topography

Many people wish to enjoy the hilly topography within the basin and want their second homes located in such an environment. The geographic data base contains information on the elevation, slope, and aspect of each grid cell but none of these attributes truly defines a "hilly" versus a "rolling" topography. In addition, identifying a hilly or any other topographic condition is difficult when the basic grid cell covers an area of only 25 meters by 25 meters. The best guage for describing a topographic setting is local relief which should be measured over a small but reasonable size geographic area. One of the theme layers in the geographic data base defines eigthteen physical regions within the basin. Most of these regions are subbasins. Using the thousands of grid cell elevation readings associated with each of these regions a mean elevation and standard deviation were calculated for each region. The greater the deviation the more hilly an area is likely to be. After determining the standard deviation for each region certain natural breaks within the range of deviation values allowed the regions to be grouped into three categories which were labelled as hilly, moderate, and rolling topography. They were assigned the arbitrary rankings of 3, 2, and 1 respectively. These topographic rankings were integrated with the road zone rankings in the same manner as indicated above with land cover. Table 3 shows the acreage associated with each topographic ranking as well as land cover ranking.

Table 3: Topography And Land Cover Compared To Road Zones

Rank	Zone(s)	Topography	Acreage	Land Cover	Acreage
5	1/8MZ	Hilly	8,238	Forest	9,170
4	1/4MZ 1/8MZ	Hilly Moderate	8,902	Forest Cropland	18,587
3	1/4MZ 1/8MZ	Moderate Rolling	10,857	Cropland Built-Up	5,591
2	1/4MZ	Rolling	5,387	Built-Up	37

Lake Access

For some people direct access to Otsego Lake is important with respect to their second home locations. Such access allows them the opportunity to participate in activities directly involving the use of the lake. Other people wish only to have a view of the lake and possess little interest in directly using the lake. A third group of people are happy to reside in the lake community but do not need to have a view of the lake from their property or direct access to the lake. Based on these various conditions with respect to lake access a map was developed showing the distance from the middle of the lake out to the various road zones. Distances were grouped into one, two, and three or more

mile zones. The middle of the lake was based on establishing a line down through the center of the lake and out through the center of its one major cove. Each grid cell of the data base was compared to this line and the shortest distance from the line was used. The middle of the lake was used rather than the lake edge since most people relate to the body of the lake rather than its shore line. The distances are integrated with the road zones and are ranked in the same manner employed with the previous attributes of land cover and topography. Table 4 shows the rankings and the amount of acreage associated with each rank.

Table 4: Lake Access Compared To Road Zones

Rank	Zone(s)	Lake Access	Acreage
5	1/8MZ	1 Mile	3788.57
4	1/4MZ	1 Mile	5472.74
	1/8MZ	2 Miles	
3	1/4MZ	2 Miles	15754.45
	1/8MZ	3 Miles	
2	1/4MZ	3 Miles	8368.80

Road Type

Second home owners generally prefer a high degree of privacy; consequently, roads with low levels of traffic and known traffic, that is traffic consisting predominantly of local residents, form the best conditions for second homes. Township roads normally meet these conditions more so than county roads, and county roads more so than state and U.S. highways. A fourth map was made relating road zones to road types based on town, county, and state and U.S. roads. Where an intersection occurred involving different road types, the intersection was assigned to the road type associated with the highest level of traffic. Thus, the road zone at the inter-section of a town and county road would be identified as a county road zone. Unlike the previous attributes of land cover, topography, and lake access, road types were grouped into six rankings ranging from 6 to 1 with 6 being associated with town roads and the 1/8 mile zone and 1 being state and U.S. and 1/4 mile zone.

Final Map

After completing a map on each attribute a final map was prepared based on all four attributes with respect to the road zone areas. This map showed areas ranked in terms of potential second home development within the road zones of the lake basin. Each attribute, possessing rankings ranging from 1 to 3 without considering road zones, was given equal consideration resulting in twelve ranks with the twelfth or top rank recording the highest score associated with each attribute. Table 5 provides the amount of acreage for each rank and the ranks have been grouped into four major classes based on geographic desirability of sites for second homes. One might argue justifiably that other attributes should have been used in determining second home development sites within road zone areas or a different ranking system should have been employed; however, one must work with the resources and information available.

Table 5: Road Zone Acreage For Second Home Development						
	Acreage	(Rank)	Acreage	(Rank)	Acreage	(Rank)
Preferred	141.63	(12)	1034.28	(11)	3483.71	(10)
Very Good	5079.23	(9)	4872.90	(8)	6393.52	(7)
Adequate	4524.63	(6)	3389.19	(5)	2228.42	(4)
Deficient	1559.23	(3)	671.66	(2)	6.18	(1)

SUMMARY

This entire project consisted of a series of difficult issues. First, little research has been done on road zone areas and second/vacation home development. Second, few geographic data bases have been developed to meet the planning interest of an association consisting of private citizens concerned about protecting their environment. Third, the process of identifying potential areas of second home development involved the difficult procedure of ranking and integrating various attributes. More research is needed on how to select, rank, and integrate spatial attributes in order for geographic information systems to be used in an effective manner.