

ROBERT E. CANFIELD  
Ph. 607-292-3800  
9941 Keuka Hill Road  
Dundee, NY 14837-9603

**KEUKA LAKE WATERSHED SURVEY**

**FINAL REPORT**

**BY**

**JOHN POWELL  
AND  
JOHN HERRING**

**APRIL 1988**

**Commissioned by the Yates County Aquatic Vegetation  
Committee, Penn Yan, New York.**

**Support for this research came from the Aquatic Vegetation  
Project funds of Yates County which were provided by the New  
York State Legislature.**

## ACKNOWLEDGEMENTS

This study was initially begun in the Summer of 1986 but unforeseen delays in funding caused postponement for a year. The questionnaire design went through many transformations in this period which, hopefully, have produced a better product. The survey would not have occurred without the hard work and dedication of many people. Rob Schwarting provided the initial impetus, which was then continued by members of the Yates County Aquatic Vegetation Committee. Bob Pinckney, Dick Curbeau, Les Travis, Bill Webber, and Bill Marht, have been invaluable for their helpful suggestions and encouragement.

Jane Irwin was instrumental in ensuring that the survey was conducted efficiently and on schedule. Both Jane Irwin and Paul Soper provided countless hours conducting the stuffing envelopes, and later coding and entering the information onto a computer data-base. Anne Austermann shared her office, provided material supplies for the task, and fielded the many inquiries about the survey. Cornell University provided a mainframe computer to conduct the analysis. Putting all the information together took time and was reviewed by a number of people whose comments helped improve this report.

The author is solely responsible for any errors or omissions in this report.

## TABLE OF CONTENTS

- I. INTRODUCTION
- II. METHODOLOGY
- III. SAMPLE DESIGN
- IV. DATA COLLECTION
- V. DATA ANALYSIS
- VI. CHARACTERISTICS OF PROPERTY OWNERS
- VII. PERCEPTION OF LAKE WATER QUALITY
- VIII. ATTITUDES TO REGULATIONS TO PROTECT LAKE WATER QUALITY
- IX. PAYING THE COSTS OF WATER QUALITY PROTECTION
- X. POTENTIAL GENERALISATIONS FROM SURVEY RESULTS
- XI. CONCLUDING COMMENTS

### APPENDICES:

- APPENDIX A: RESULTS FROM THE WATERSHED SURVEY - ALL RESPONDENTS
- APPENDIX B: SAMPLE SURVEY QUESTIONNAIRE AND COVER LETTER
- APPENDIX C: ADDITIONAL SURVEY DATA

## LIST OF ILLUSTRATIONS

- FIGURE 1. Map of the Keuka Lake Watershed and Political Boundaries
- FIGURE 2. Property Owner Characteristics - Total Watershed
- FIGURE 3. Property Owner Characteristics - Year Round and Seasonal Residents
- FIGURE 4. Membership in Keuka Lakeshore Property Owner's Association - Total Watershed
- FIGURE 5. Lake Frontage and Length of Residence - Percent of Total Watershed
- FIGURE 6. Water Quality Rating - Percent of Total Watershed
- FIGURE 7. Deterioration in Lake Water Quality - Percent of Total Watershed
- FIGURE 8. Belief That a Weed Problem Exists in the Lake - Percent of Total Watershed
- FIGURE 9. Perceived Seriousness of the Weed Problem - Percent of Total Watershed
- FIGURE 10. Perceived Deterioration in Lake Water Quality By Groups With and Without Frontage
- FIGURE 11. Perceived Seriousness of the Weed Problem - Groups With and Without Frontage
- FIGURE 12. Attitude to Specific Regulations for Households to Control Nutrient Loading to the Lake - Percent of Total Watershed
- FIGURE 13. Attitude to Present Regulations for Protecting Lake water Quality - Percent of Total Watershed
- FIGURE 14. Attitude to Specific Regulations for Households to control Nutrient Loading to the Lake - Groups With and Without Frontage
- FIGURE 15. Attitude to Present Regulations for Protecting Lake Water Quality - Groups With and Without Lake Frontage

- FIGURE 16. Attitude to Land Use Regulations for Protecting Water Quality in Keuka Lake - Mean Scores From the Likert Scale
- FIGURE 17. Willingness-to-Pay to Keep the Lake Clean. Annual Payment Per Household - Total Watershed Figures
- FIGURE 18. Effect of Lake Water Quality on Property Value Near the Lake - Total Watershed figures
- FIGURE 19. Willingness-To-Pay to Keep The Lake Clean. Annual Payment Per Household - Groups with and Without Frontage
- FIGURE 20. Effect of Water Quality on Property Value Near the Lake - Groups With and Without Frontage

LIST OF TABLES

- TABLE 1. Lake Water Quality Ratings For Three Activities -  
Percent of Total Watershed
- TABLE 2. Averaged Lake water Quality Ratings For Sub-  
Groups in the Watershed
- TABLE 3. Average Scores for Preferred Methods of  
Controlling Excessive Nutrient Loading to the Lake
- TABLE 4. Mean Scores for Type of Government Most Suited  
To Controlling Land Use in The Keuka Lake  
Watershed
- TABLE 5. Mean Scores for Who Should Pay to Keep the Lake  
Clean

## I. INTRODUCTION

In the Summer of 1987, as part of its work towards dealing with the the aquatic vegetation problem in Keuka Lake, the Yates County Aquatic Vegetation Committee conducted a mail survey of property owners in the Keuka Lake watershed. A 70% response rate was attained, representing property owners in the following towns: Jerusalem, Milo, Barrington, Pulteney, Urbana, Wayne, Wheeler, and Bath. Figure 1 is a map showing the watershed boundary and location of the eight towns around the lake.

The survey was designed to answer four basic questions:

1. What are the characteristics of property owners in the watershed?
2. What is the property owner's perception of water quality in Keuka Lake?
3. What are property owner attitudes to regulations for protecting lake water quality?
4. Who do property owners feel should pay the costs of water quality protection?

The Yates County Aquatic Vegetation Committee believed that obtaining answers to these questions was a necessary first step in designing long term solutions to lake water quality issues.

## II. METHODOLOGY

The survey instrument was a mail questionnaire consisting of 19 questions, all but one being of the closed format type. Many of the questions required respondents to rank their preferences on a 1 to 5 scale, thus allowing comparisons within and between populations of respondents. In addition a Likert scale (Question 12) was developed to measure property owners attitudes to land use regulations for protecting lake water quality. To develop a Likert scale,

"...a set of items, composed of approximately an equal number of favourable and unfavourable statements concerning the attitude object, is given to a group of subjects. They are asked to respond to each statement in terms of their own degree of agreement or disagreement. Typically they are instructed to select one of five responses: strongly agree, agree, undecided, disagree, or strongly disagree. the specific responses to the items are combined so that individuals with the most favourable attitudes will have the

highest scores while individuals with the least favourable attitudes will have the lowest scores." (McIver and Carmines, 1981)

The original scale in this survey consisted of 14 items chosen from a larger set of items by 50 respondents in the Keuka Lake watershed. The items were chosen on the basis of correlation analysis. Specifically, an item-to-total correlation was conducted. Items with the highest correlations and which appeared to fit together, were chosen for the scale. When the questionnaires were returned and this scale was analysed, four of the 14 items in the scale were dropped to improve scale reliability. Thus the final scale consists of 10 items assessing attitudes to land use regulations for protecting lake water quality.

### III. SAMPLE DESIGN

A systematic random sample of property owners in the watershed was taken, using the county property tax rolls from Steuben and Yates counties. These, combined with the use of tax maps to locate properties, allowed us to draw the sample from within the Keuka Lake watershed itself. A one sixth sample was drawn from the tax rolls: a random number between 1 and 6 was chosen and every sixth name was included in the sample (i.e. approximately 17% of watershed property owners). If a property that is not in the watershed was chosen by the systematic sampling, it was ignored. This amounted to a sample size of 1,326. Tax rolls were found to be most useful as they included not only the property location but also permanent address of the property owner, an important consideration as seasonal residence was known to be high.

### IV. DATA COLLECTION

Dillman's total design method for conducting a mail survey was followed. (Dillman, 1978) Four mailings were carried out: the first consisted of the survey and a cover letter sent to the permanent addresses of everyone in the sample group. The second mailing, carried out one week later to non-respondents, was a reminder letter. The third mailing, sent out ten days later to non-respondents, was a second copy of the survey and cover letter. The fourth and final mailing, sent out one week later to non-respondents, was a final reminder. Each member of the sample population was assigned a code number to assist in identifying the town location and to avoid repeat mailings. A 70% response rate



was achieved, amounting to 928 questionnaires. Approximately 3% of these were returned without their respondent identity number and another 2% were returned but not completed. Not included in this 70%, a further 1.5% were returned as undeliverable by the Post Office.

Not all questionnaires were fully completed, with the number of missing values varying from question to question. Some of the questions, such as Question 19 inquiring about average incomes, had as much as a 20% non-response rate.

Appendix A reveals that 60% of respondents live on the lake (but do not necessarily have lake frontage) and an additional 18.7% live less than two miles from the lake. As distance from the lake increases, the number of respondents decreases: this may be due to a declining interest in the lake with distance, or a reflection of the higher density of population close to the lakeshore.

A follow up survey of non-respondents was not conducted owing to bias that would be introduced by ease of access to year round residents and difficulties of reaching seasonal residents.

## V. DATA ANALYSIS

The returned questionnaires were coded, creating a matrix of 57 variables by 928 respondents, and the data entered into a worksheet. The data were analysed on a mainframe computer using the Statistical Package for the Social Sciences (SPSS).

The data were analysed to answer the four questions mentioned above. First all respondents representing the entire watershed were analysed, then the sample was broken down into a number of sub-groups to enable comparisons to be made. Results are reported from the following groupings of respondents:

1. All respondents in the watershed
2. (a) Those with lake frontage  
(b) Those without lake frontage
3. (a) Members of the Keuka Lakeshore Property Owners Association (KLSPPO)  
(b) Non-members
4. (a) Recent residents (arrived in the last 15 years)

(b) Long-term residents (lived in area for over 15 years)

The data were also divided into seasonal and year round residents but these will not be reported on in detail here as in many cases the values obtained were similar to those obtained for residents with and without lake frontage. This is not surprising, as 80% of seasonal residents have lakefront property.

## VI. CHARACTERISTICS OF PROPERTY OWNERS.

### 1. Total Watershed

Initial analysis looked at all respondents from the survey and thus represents frequencies and averages from the watershed as a whole. In general, the population is well educated and has high average income. 71.4% of the population have had some college education and 28% have had some graduate school. The income question was the least well answered question, with over twenty percent not answering. Of the respondents, one fifth have incomes below \$20,000/year and one third have incomes above \$50,000/year. A full breakdown by income and education appears in Appendix A (in Questions 18 and 19).

These figures are similar to a study done on 18 communities (13 of which were around lakes and 5 were on the Atlantic coast) in the North-East, where over half of the sample had some college education and incomes were considerably higher than the average for the areas in which those communities were located (Gamble, et al., 1975).

The property owners in the watershed are fairly evenly divided between those with and without lake frontage, and whether they are Seasonal or Year Round residents. 53.7% of the property owners have lake frontage and 46.3% do not. 46.7% of property owners are Seasonal and 53.3% are Year Round. (Seasonal residence is examined in more detail in Appendix A, Question 2.) Figure 2 gives a breakdown of respondents by whether or not they have lake frontage and are seasonal or year round. This reveals some interesting characteristics, showing for example that 34% of respondents are year round residents without lake frontage, and that only 19% of residents are year round with frontage. Figures 3(a) and 3(b) examine this in more detail, revealing that while 80% of seasonal residents have lakefront property only 35% of Year Round residents are similarly situated.

The average number of occupants per residence varies from 0 to 60, the latter value reflecting a summer camp's residents. The average is 3.02 people per residence. Of the entire watershed, 30% are members of the Keuka Lakeshore Property Owners Association (KLSP0).

Length of property ownership in the watershed ranged from zero to 80 years, with a mean of 19.3 years. 49.1% of respondents have lived in the watershed for over 15 years, 50.9% have arrived in the last 15 years. Both recent and established residents are divided almost equally between seasonal and year round property owners. (47.2% of Recent and 45.2% of the Established groups are seasonal residents.)

## 2. Comparison: With and Without Lake Frontage.

Property owners can be divided into those with and those without lake frontage: 53.7% have frontage and 46.3% do not. Distance from the lake for those without frontage averaged 0.99 miles.

Of those with lake frontage, 33.5% are year round residents. Thus, one third of lakeshore residences are occupied permanently. This last figure verifies information obtained from the septic survey data and from conversations with the watershed inspector (Marht, 1987). There is a strong relationship between Seasonal residence and lakefront property ownership. 80% of seasonal residents have lake frontage. However, only 53.5% of lakefront property owners (28.6% of the total watershed population - see Figure 4), are members of the lakeshore property owners association.

Those with lake frontage also have higher levels of income and education than those who live away from the lake. Almost 64% of those with frontage have had some graduate education compared to 36% for those without lake frontage. 75% of those with frontage have incomes of over \$30,000/yr. compared to 42.6% of those without frontage.

## 3. Comparison: Member of KLSP0 Assoc. v. Non-member

Similar socio-economic differences are noted when the population is broken down into those who are members of the property owners association and those who are not. Nearly 75% of members are college graduates or have had some graduate school, against 42% for non-members. 53% of members have incomes above \$50,000/yr., while the figure for non-members is just under 25%.

Members tend to own lake frontage, which is to be expected in such an organization. 96.1% of members have lake frontage whereas only 35.4% of non-members have frontage. Members also tend to be seasonal residents. 68.9% of members are seasonal versus 35.9% for non-members. Nearly one-third (29%) of residents in the watershed are members of the KLSPO.

#### 4. Comparison: Length of Residence.

Recent residents (those who have arrived in the last 15 years) are evenly divided between those with lake frontage (49.6%) and those without (50.4%), see Figure 5. A slightly higher proportion of Established residents (those who have been in the watershed for over 15 years), have lake frontage (31% to 24%). Approximately half of both groups are seasonal though slightly more of the Recent arrivals are in that category. Fewer of the Recent arrivals are in the KLSPO Association, 25.2% against 36.7% for Established residents, but this may be due to the fact the a smaller percentage have lake frontage. The new arrivals also tend to have more education and higher incomes than the more established residents.

## II. PERCEPTION OF LAKE WATER QUALITY.

This section consisted of four questions (Questions 5, 6, 7, and 8) to investigate views on water quality and aquatic vegetation problems. Question 7 was open format, requesting comments on changes in water quality that have affected use of the lake.

### 1. Total Watershed

In general, respondents rated the water quality as high. 85% rated the quality as Good or Excellent for swimming. 92.4% rated the quality as Good or Excellent for boating and only slightly fewer, 68%, gave the same ratings for fishing. Table 1 gives the percentage in each category for the entire watershed. The majority of respondents appeared to indulge in all three activities as no more than 5% marked any one category as "Not Applicable". Figure 6 shows that more people rated the lake as Excellent for Boating than for Swimming or Fishing, and the lake was rated

poorest for Fishing. This is surprising but perhaps indicates near-shore water quality problems. A 1973 study of Canadarago Lake in New York state gave similar results. There the water quality was generally rated high and rated best for Boating, Swimming and Fishing, in that order (Saint, et al., 1973).

Question 6 asked about deterioration in lake water quality. Figure 7 gives the percentage figures for deterioration in various time periods. 37.1% said they had not seen any deterioration. Of those who noted deterioration, the largest number, 27.1%, noted it had occurred in the last 5 years. Care should be exercised in interpretation here because the distribution of respondents by length-of-residence will skew the figures.

Question 7 asked information on how changes in lake water quality have affected respondent's use of the lake. Almost half of respondents mentioned some type of problem here. By far the most significant problem was weeds, 43.7% of those who commented mentioned some aspect of weeds as affecting their use. Other quality changes of importance were, "Not as Clean" (6.6%), "Sediment" (5.9%), "Algae" (5.5%), and "Oil/gas film on the surface" (4.3%). Over 30 different quality problems were mentioned ranging from the Flood of 1972 to trash, and from overcrowding to raw sewage. The results are listed in Appendix A.

The perceived influence of weeds is also seen in Questions 8 and 9 where respondents asked about the existence of an aquatic weed problem and its seriousness. Figure 8 shows that 80% of the property owners in the watershed said that there was a weed problem. More of those with lake frontage thought there was a problem than those without. Figure 9 indicates that one fifth of the entire watershed rate aquatic weeds as a serious problem and over half (56%) rate it as more than a minor problem.

## 2. Comparison: With and Without Lake Frontage.

Rating the lake for swimming, fishing, and boating there are few differences between the groups. They both follow the pattern of rating the lake best for boating and worst for fishing, though in all cases a large percentage of respondents rated the water quality as good or excellent. Table 2 contains averaged water quality ratings for the Total Watershed and all sub-groups revealing that there are no significant differences between those with, and those without, lake frontage.

When Question 6 (Perceived deterioration in lake water quality over time) is analysed however, some striking differences between the two groups emerges. Figure 10 illustrates that those with frontage are more likely to perceive a deterioration. 72.5% of those with lake frontage said there had been some deterioration in water quality within the past 25 years, as opposed to 49.2% of those without frontage. 32% of those with frontage perceive a decrease in quality over the last 5 years compared to 20.4% of those without frontage. Thus it would seem that those closest to the lake perceive a greater water quality problem.

When property owners were asked about aquatic weeds however, a majority of both groups see a problem: 88% of those with lake frontage said there was a weed problem as did 69.8% of those without frontage. Figure 11 indicates that both groups also perceive it a serious problem. T-tests on average scores for each group on the seriousness of the problem were significant at an alpha level of .05, indicating a difference between the groups. Those with frontage (ave. score of 3.75 on a scale where 1 = Not at all serious, 5 = A serious problem) perceive a more serious problem than those without frontage (ave. score of 3.57).

Within the Lakefront property group, 37.6% of the year round residents rated weeds a serious problem, compared to only 17.6% of the seasonal residents. The year round residents with lake frontage appear to be more aware of water quality deterioration also, which would be expected as they spend much longer in close contact with the lake and through all seasons.

### 3. Comparison: Member of KLSPO Association v Non-member.

Both members and non-members rate lake water quality for swimming, boating, and fishing highly, but in general non-members are less inclined to mark the quality as "Excellent" and more inclined to see it as "Good". For instance, only 32.6% of non-members rated water quality as excellent for swimming as opposed to 45.3% of members. Yet 50.6% of non-members rated it as good compared to only 42.6% of members. When average water quality ratings are studied (see Table 2), there is a significant difference over the quality rating for swimming between members and non-members. It is interesting to note that members give the lake a higher rating for swimming than non-members. This may be a reflection of the water quality at public beaches rather than of water quality in general.

Again the pattern of seeing lake water quality highest for boating and lowest for fishing is followed.

On Question 6 (Deterioration in Lake Water Quality) fewer members of the Association (28%) than non-members (41%), marked that there had been no deterioration. Both groups had the largest percentage of respondents indicating that deterioration had occurred in the last five years, 33.3% for members and 24.6% for non-members.

When asked, 88.3% of members and 77.5% of non-members said there was a weed problem. Of these, over one fifth in each group rated the problem as serious. Thus it would appear that people are separating the issue of lake water quality from that of aquatic vegetation (or weeds).

#### 4. Comparison: Recent Arrivals v. Established Residents

When water quality ratings for swimming, boating, and fishing are averaged, there are significant differences (at  $\alpha = .05$ ) between the two groups. Table 2 shows that the groups both give the lake a score of 3.2 for Swimming but the Established residents give lower scores for Boating and Fishing. Overall the Recent residents rate the water quality higher.

Again, on the issue of deterioration in lake water quality, fewer of the Recent residents have noted a decline. 39.4% of Recent arrivals said that there had been no deterioration, compared to 35.2% of Established residents. Of those who saw deterioration, a higher percentage of new residents see the decline in quality as more recent. For example, 8.2% of new residents see a deterioration in the past year, compared to 1.4% of old residents. Almost 23% of established residents have seen a decline in the last 10 to 25 years. This would indicate that any deterioration in water quality has been ongoing for some time and is not just a recent phenomenon.

Large percentages of both groups said there was a weed problem and that it was serious. 79% of Recent and 84% of Established residents stated that the lake has a weed problem and over 50% of each group rated it as more than, "A Minor Problem".

## VIII. ATTITUDES TO REGULATIONS TO PROTECT LAKE WATER QUALITY

This section consisted of five questions (Questions 9, 10, 11, 12, and 16) asking about a variety of issues from attitudes to regulations to the best ways of dealing with protection.

### 1. Total Watershed

Question 9 asked respondents whether they would be in favour of specific regulations for households to control the nutrient loading to the lake. 73.2% of total respondents said they would favor or strongly favor such regulations. The mean response for the watershed as a whole was 3.97 (on a scale where 1 = STRONGLY AGAINST, 3 = UNDECIDED, 5 = STRONGLY FAVOR), indicating that overall, people would be in favor of such regulation. Figure 12 shows the percentage of the Total Watershed in each category.

Question 10 addressed the issue of dealing with excessive nutrient loadings to the lake. In the watershed as a whole the most preferred method was "Increased Regulation of Lakeshore Property Septic Systems", which received an average score of 4.2. The second most preferred method was "Place Stricter Controls on Development Near the Lake", (average score of 3.9) and least preferred was the use of weed killing chemicals, with an average score of 1.7. "Mechanical Harvesting of Weeds" received a score of 3.5.

Question 11 asked about adequacy of present regulations to protect the lake water quality. Figure 13 reveals that 41% of the sample feel the regulations are inadequate, with almost as large a proportion being undecided. Only 9.5% rated the present regulations as adequate.

Question 12 is the Likert Scale measuring respondent's attitudes to land use regulations for protecting lake water quality. Respondents scored each of 14 items individually on a 1 to 5 scale, where 1 represented strong disagreement with the item and 5 meant strong agreement with it. The items were written to assess whether respondents agreed or disagreed with land use regulations as a means for protecting lake water quality. Each respondent's scores for the 14 items were then summed and averaged to give a mean scale score between 1 and 5 on the attitude continuum. Four items, (a), (d), (f), and (h), were dropped from the final scale as analysis revealed that they did not correlate well with the other items. On close inspection the wording of these items appears somewhat ambiguous and directed more to



general attitudes to land use regulations, rather than to activities on this lake in particular. Thus the final scale consists of 10 items.

Reliability analysis of the scale was conducted using Cronbach's Alpha. This is a measure of internal consistency of the items in the scale. Alpha is based on a measure of the average intercorrelation among all items on the scale (Carmines and Zeller, 1979). Essentially, alpha is giving a measure of whether each of the items is measuring the same thing. A low alpha (Alpha takes a value between 0 and 1) would mean that items in the scale were not addressing the same construct. Alpha levels below 0.7 are generally considered to be unacceptable. By dropping four of the items from the scale an alpha of 0.912 was attained. Thus, we can assume that the scale reliably measures the construct, "Attitude to land use regulations for protecting the water quality in Keuka Lake".

The mean score for the watershed for the 10 item scale is 3.65, indicating that in general, people agree rather than disagree with such regulations. This is in agreement with the average score of 3.97 from Question 9, measuring attitudes to specific regulations for households to control nutrient loading to the lake.

Question 16 asked about the type of government that would be best for controlling land use in the watershed. Average scores for the entire watershed show that the "Watershed-wide District", with a score of 3.9, was rated as the most suitable form of government (on a scale where 1 = NOT AT ALL SUITABLE to 5 = MOST SUITABLE). The least suited government entity was held to be the "Local (Town)" level which has a mean score of 2.7.

## 2. Comparison: With and Without Lake Frontage.

In general those with lake frontage are more favorable towards regulations for protecting lake water quality. On Question 9, those with lake frontage (mean score = 4.12) favor specific regulations for households slightly more than those without frontage (mean score = 3.77). Figure 14 however, reveals that large percentages of both groups favor regulation.

Question 10, illustrated in Table 3, revealed some interesting differences between the groups. Highest ratings were given to, "Increased Regulation of Lakeshore Property Septic Tank Systems" (c), "Require all farmers in the watershed to use soil conservation methods" (e), and "Place

stricter controls on development near the lake" (h). Those without lake frontage, predictably perhaps, were more in favor of item (c) than those with frontage. For item (e) the reverse is the case, those with frontage having a much higher preference (mean = 4.1) for this item than those without frontage (mean = 3.6). The situation is the same for item (h): those with frontage had a significantly higher score (mean = 4.1) than those without frontage (mean = 3.8). This indicates that those with lake frontage are concerned about development around the lake, and are prepared to be regulated to control it. Other major differences between the groups occur for items (d) and (f). Item (d), "Require all lakeshore properties to have holding tanks", was understandably not popular with lake front property owners but those without frontage gave a mean score of 3.7. Item (f), "Restrict fertiliser use in the watershed", was not a preferred method by those without frontage, no doubt because of the large agricultural use of land around the lake.

When asked about adequacy of present regulations, those without lake frontage tend to be more undecided. Figure 15 reveals that nearly half of the without frontage group (46.7%) are undecided over adequacy of present regulations. The large percentage of people in this category may be the result of lack of knowledge over what regulations are presently in existence. The figure also shows that those with frontage are less inclined to think the regulations as adequate. When scores were averaged, those with frontage rated present regulations as less adequate (mean = 2.6) compared to those without frontage (mean = 2.9).

Question 12, the Likert Scale, showed that those with frontage have a significantly more favorable attitude to land use regulations for water quality protection than those without frontage. The mean scores were 3.87 and 3.37 respectively. Figure 16 illustrates the mean scores for all the sub-groups and the total watershed. It must be kept in mind that these scores are relative and not absolute. To say that the group with frontage has a score 0.5 higher than the group without frontage means nothing. However we can say that the difference in scores does indicate that the group with frontage has a more favorable attitude to land use regulations than the group without frontage, and the distance between the scores does signify to some extent, how far apart the two groups are in their attitudes. In this case there is a statistically significant difference between the groups at  $\alpha = 0.05$ .

Question 16, suitability of government types for controlling land use in the watershed, also reveals some significant differences between groups, as illustrated by Table 4. Both groups favor the watershed-wide district as

most suited to dealing with the problem. The group with frontage has a higher mean score (4.1) than the group without frontage (3.7), indicating that lakefront owners are more inclined to prefer this form of government entity. Again, the local government body is the least favored, though those without frontage are slightly more favorable towards it (mean = 2.9), than those with frontage (mean = 2.6).

### 3. Comparison: Member of KLSPO Assoc. v Non-member

This grouping of the respondents shows similar characteristics to the grouping by lake frontage. Members tend to be more in favor of specific regulations (Quest. 9) than non-members, though over 70% of each group favors, or strongly favors them. For both groups regulating lakeshore septic systems (c), is the most preferred method of dealing with the problem. Item (h), "Place Stricter Controls on Development near the Lake" is also rated highly (4.2 and 3.8 for members and non-members respectively). Table 3 gives the complete breakdown of mean scores between the groups.

Members have a higher Likert score (3.97) than non-members (3.51) and again, the difference is statistically significant at an alpha level of 0.05.

On the matter of the most suitable government type (Question 16), both groups favor the watershed-wide district for controlling land use. Members have a mean score of 4.2 (slightly higher than that for the group with lake frontage), compared to 3.8 for non-members.

### 4. Comparison: Length of Residence

Compared to Established residents, the Recent residents tend to be more in favor of specific regulations (Quest.9) to control nutrients but again, over two thirds of both groups favor regulation. For dealing with the problems, both groups favor increased regulation of lakeshore septics, as in the other groupings described above. The only significant difference (see Table 3) is for item (d), the requirement for lakeshore properties to have holding tanks. Recent residents are more in favor of this method (mean = 3.4) than Established residents (mean = 2.9). This is unexpected since those with lake frontage are evenly divided between Recent and Established residents.

Figure 16 reveals that Recent residents have a slightly more favorable attitude to land use regulations for protecting lake water quality with a Likert score of 3.71, as opposed to a score of 3.58 for Established residents, a difference not great enough to be statistically significant. The closer proximity in attitudes between these two groups is possibly due to the even division of lake frontage among them.

Similarity of attitudes is also seen in Table 4, illustrating suitability of government type. Both groups have average scores of 3.9 for the the watershed-wide districts. Again this government entity was rated the most suitable and the local government body the least suitable.

#### IX. PAYING THE COSTS OF WATER QUALITY PROTECTION.

Three questions were of a monetary nature. Question 13 asked who should pay for the cost of keeping the lake clean. Question 14 asked for willingness-to-pay to keep the lake clean. Question 15 asked for perceptions on water quality effects on property values. Of these, the willingness-to-pay question was the least well answered, due perhaps to the difficulty of placing a value on such an abstract concept as clean water.

##### 1. Total Watershed.

Question 13 did not reveal any strong preferences among the sample. For each item a large proportion of respondents marked 3 on the scale, indicating that this group should pay "some of the costs" of keeping the lake clean. However the "All Polluters Pay" category received the highest mean score, 3.9, suggesting that respondents feel those who cause the problems should be made to pay for the clean-up. Table 5 reveals that this category received the highest scores from all the sub-groups in the watershed, groups had very similar mean scores, either 3.8 or 3.9. "Lake Association Members" scored lowest out of the nine items with a mean score of 2.3.

On Question 14, willingness-to-pay to keep the lake clean, one fifth of the sample said they would pay nothing. At the same time one third would be willing-to-pay over \$50

per year. Figure 17 shows the percentage of respondents in each category.

The mean willingness-to-pay can be calculated two ways, first by ignoring those who did not respond to this question, and second by including them assuming that a non-response is equivalent to a zero payment. There were a total of 143 non-respondents for this question (approx 15.4% of total respondents). The first method of calculation involves taking the mid-point of each payment category, multiplying by the number of people in that category to obtain a contingent payment figure which is then divided by the total number of respondents (768). This gives a figure of \$36.23 per respondent per year. Using the second method, non-respondents are considered as paying zero, the figure obtained is \$30.54 per respondent per year. If we assume that each respondent represents a household, then by multiplying one of these figures by the number of households in the watershed we can arrive at a total willingness-to-pay on an annual basis for keeping the lake clean. Taking the more conservative figure, and assuming approximately 6,000 households in the watershed, the willingness-to-pay to keep the lake clean is \$183,240 per year.

Question 15, asked how residents thought lake water quality affected property values near the lake. 73% said that property values were much affected or very much affected. Figure 18 points to the fact that a large number of respondents think that their property values are influenced by water quality. The mean score for the watershed (on a scale where 1 = NONE, TO 5 = VERY MUCH AFFECTED) was 4.0.

These results support the findings reported by Young (1984) in a study of St. Alban's Bay on Lake Champlain. Decline in water quality in the Bay during the period of study had been attributed to high bacterial counts, the presence of aquatic vegetation (including milfoil), and algal blooms. Young compared properties located adjacent to the bay with similar properties on the larger, but cleaner lake, and concluded that property prices around the bay were depressed by approximately 20%.

## 2. Comparison: With and Without Lake Frontage.

The two groups show similar scores for Question 13, asking who should pay to keep the lake clean. The largest difference is on the item "Everyone in the Watershed", where those with lake frontage gave an average score of 2.9 and those without gave a score of 2.3. This indicates perhaps

that those without lake frontage feel that they derive fewer benefits from the lake and thus should bear less of the burden of keeping it clean. Those without frontage also felt that "Farmers in the Watershed" should bear less of the burden.

The willingness-to-pay question found that 22.6% of those with lake frontage would pay over \$100/yr. and over half would be willing-to-pay over \$50/yr. Figure 19 reveals that those without frontage are much less interested in paying. Only 3.1% would pay over \$100/yr. and only 8.9% would pay greater than \$50/yr. Also, only 11% of those with frontage said they would pay nothing compared to 30% of those without frontage.

Estimation of mean household payments reveals a considerable difference between the groups. The Conservative estimate (i.e. including non-respondents as zero payments) for those with frontage is \$51.86 per household per year, and for those without frontage the figure is \$18.31. per household per year.

Question 15, the effects of water quality on property value revealed that a greater proportion of lake front owners (51.7%) said they were very much affected compared to those without frontage (29.7%). Figure 20 indicates that those with frontage are very much aware of the issue.

It is clear that those with lakefront property feel that their property values are linked more directly with lake water quality. The fact that lakefront owners are willing to pay more for keeping the lake clean may reflect this concern (i.e. a desire to protect their investment), but it may also be a reflection of higher average income and education levels of this group.

## 2. Comparison: Members of KLSPO Assoc. v Non-members.

On Question 13, these two groups showed similar characteristics to the groups described above. Again the most favored tactic, by both groups, was to make the polluters pay. There was a similar disparity over making everyone in the watershed pay; members gave this item a score of 3.00 and non-members gave it 2.5, indicating again that those not intimately connected to the lake feel they should pay less. Surprisingly, Non-members indicated a low score (2.4) for the category of Lake Association members, implying that they do not think this group bears the brunt of the responsibility for paying for a clean lake.

On the contingent payment question, over 55% of members indicated they would pay over \$50 per year while only 23.9% of non-members would do the same. Members were more aware of water quality effects on property values, almost 54% indicating they would be very much affected, compared to 37% for non-members.

### 3. Comparison: Length of Residence.

Question 13 revealed the same pattern as in the other groups where it was felt polluters should pay most and lake association members should not be singled out for payment.

The contingent payment question showed less of a disparity between groups, 36.3% of new residents compared to 31.2% of old residents are prepared to pay over \$50 per year for a clean lake. This perhaps is due to the fact the the proportion of lake front owners is similar in both groups.

In the property value effect question, recent residents were slightly more concerned about the effects of water quality. 47.9% as opposed to 37.1% of Established resident said property values would be very much affected.

## X. POTENTIAL GENERALISATIONS FROM THE SURVEY RESULTS

It is felt that the survey data gives a relatively accurate description of conditions in the Keuka Lake watershed and as such the findings can be generalised from the sample to the whole watershed. Indications are that the information may be useful for other lakes in the Finger Lakes Region. Many of these lakes have similar morphology and are facing similar problems of aquatic vegetation growth. They reflect the similar types of land use, many have high levels of lakeshore development and draw their seasonal residents from a similar geographic area. Thus these results could be generalised to the Finger Lakes Region with a high degree of validity. It is doubtful however if these results could be used outside of this region, where population characteristics may differ markedly, and physical parameters of the lake may result in the need for other solutions to problems.

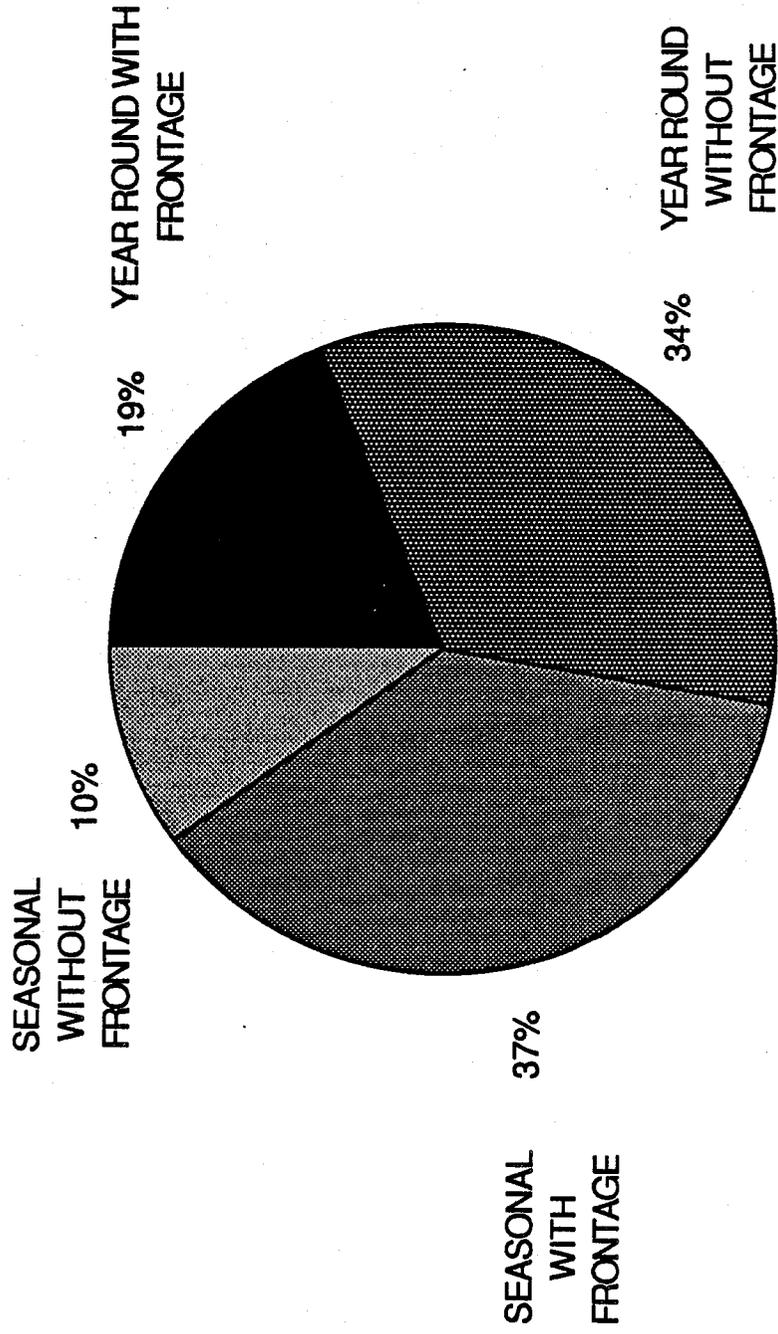
## CONCLUDING COMMENTS

In general there appears to be more concern on the part of those with lakefront property over the water quality and aquatic vegetation issues. This group is also more favorable towards land use controls and to being regulated to protect water quality in the lake. The data also indicate that these people are willing to pay more, on average, to protect lake water quality.

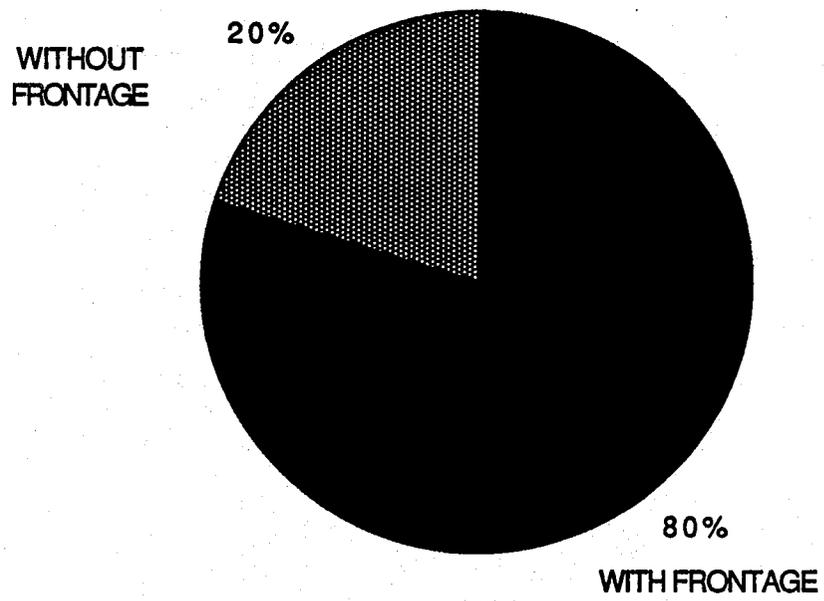
It is important to recognize however, that all groupings of respondents express a favorable reaction to controls for protecting lake quality, and approve of the institution of land use regulation. All segments of the population, including those which would be directly affected, are in favor of more stringent regulations to protect lake water quality.



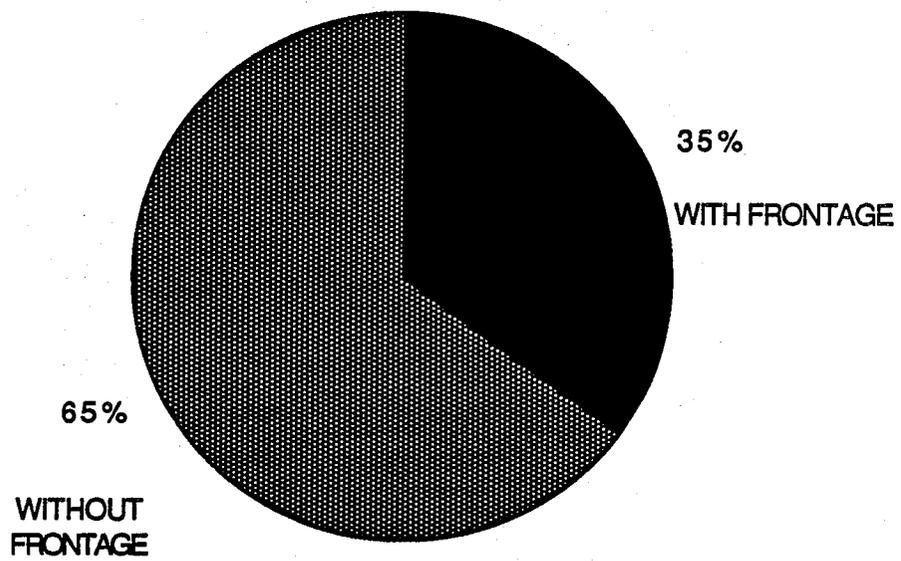
FIGURE 2: PROPERTY OWNER CHARACTERISTICS  
TOTAL WATERSHED



**FIGURE 3(A): SEASONAL PROPERTY OWNERS**



**FIGURE 3(B): YEAR ROUND RESIDENTS**



**FIGURE 4: MEMBERSHIP IN KEUKA LAKESHORE PROPERTY OWNERS ASSOCIATION - TOTAL WATERSHED**

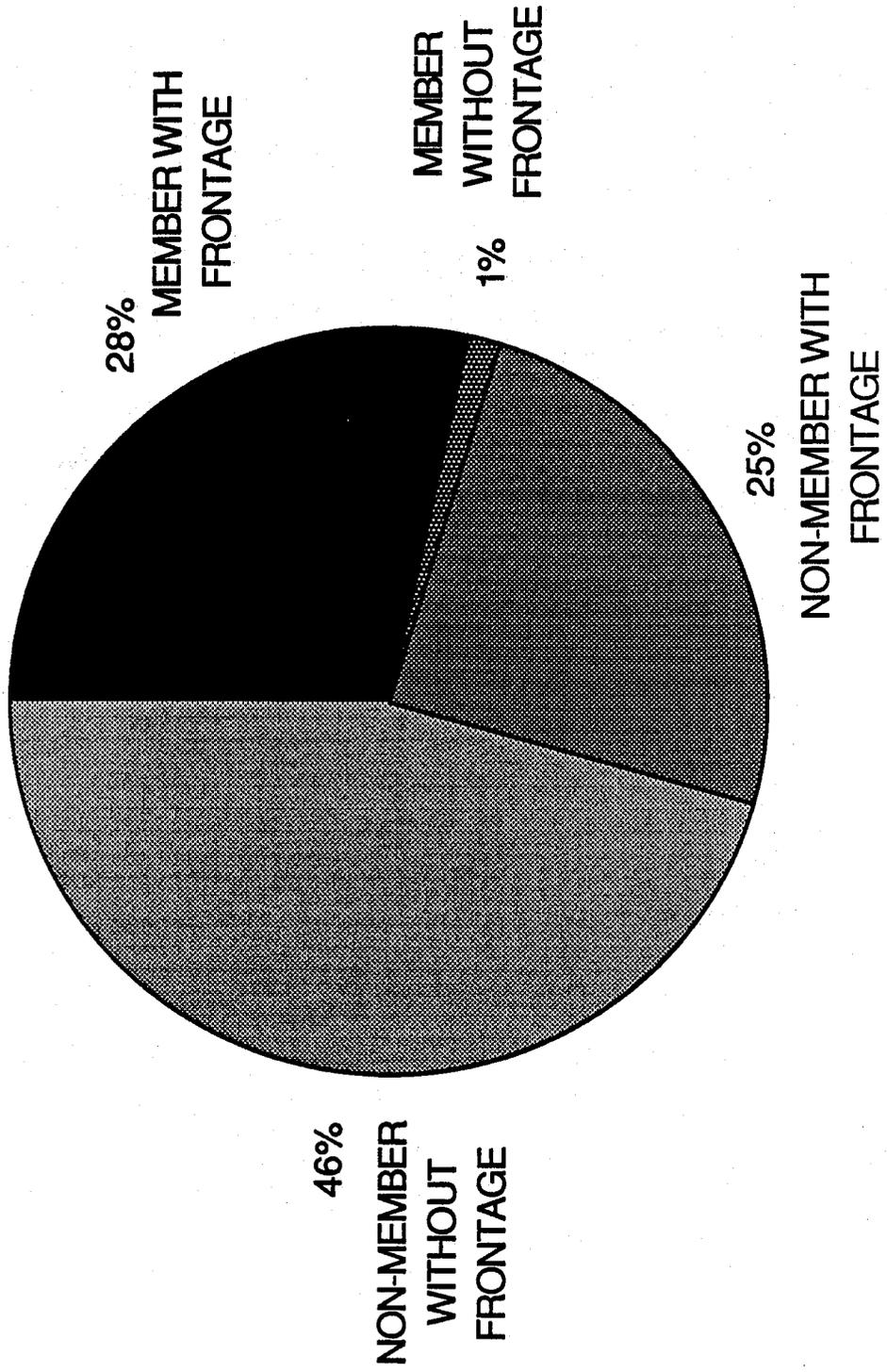


FIGURE 5: LAKE FRONTAGE AND LENGTH OF RESIDENCE-PERCENT OF TOTAL WATERSHED

