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An Investigation of Land Prices and Related Factors in Wellington County from 1961–71

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AN INVESTIGATION OF LAND PRICES AND RELATED FACTORS IN WELLINGTON COUNTY FROM 1961-71

by

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ABSTRACT

Factors affecting land prices in the open countryside of Wellington County from 1961-71 are investigated in this study. Land use was the major determinant of price and the significance of location, size and time varied according to land use. Soil had no effect on land prices. These factors were poor predictors of price which suggested that formation of land prices was a complicated process. The fragmentation of rural land into residential parcels from 1966-1969, combined with favourable economic conditions caused dramatic price increases for residential land and smaller increases in farm land and farm prices. The amount of rural land converted to non-farm use was small in comparison to the total farming acreage of the study, but represented approximately 28 percent of the land lost in the County from 1961-71. Dominant land uses, as expressed by the number of properties in the countryside were farms, houses, residential land and farm land.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Chapter 1

INTRODUCTION

In recent years, there has been increasing concern about the removal of farmland from agricultural production. The loss of farmland to urban uses is of most serious consequence, since this loss is irreversible (Pearson, 1973). The conversion of farmland in the rural-urban fringe to residential, commercial, transportation, waste disposal, mineral extraction and recreational uses has been well documented but studies of conversion in the open countryside, an area of generalized urban influence, are few.

The invasion of non-farm uses into a rural area can have devastating effects on agriculture. During the 1960's, in particular 1966 to 1969, the demand for residential land and non-farm houses in the countryside greatly increased (Martin, 1977A) and had negative effects on the agricultural economy. Farms, which became smaller and irregular in shape because of land severances, were less economical to operate. Taxes were increased and conflicts between non-farmer and farmer over noise and odours developed. However, the most important effect was the increase in price of land.

High land prices have the potential for destroying farming by inhibiting expansion of existing farms, entry of new farmers and investment in modern equipment, but recognition of these dangers has not generally been given (Rodd, 1977). Most studies acknowledge rising

land values and prices as a result of urban influence; however none to this author's knowledge, has concentrated exclusively on spatial variation in land price and factors affecting price in a countryside locale.

Wellington County, which is an area of good farmland, with mainly Class 1 soils, experienced a loss of farmland from 1961 to 1971. During this time land prices rose, most appreciably from 1966 to 1970, when severance activity was at its peak. The potential danger of non-farm residential development was only recognized by West Luther township, but not until 1968. Today, all townships regulate estate lot severances to various extents.

Land prices and factors which affected price in the open countryside of Wellington County from 1961-71 are investigated in this study. This area, excluding the township containing the city of Guelph and all lots adjacent to towns, hamlets or villages, represented the agricultural base of the County. Because of the effects of high land prices on farmland, spatial explanations of price variation and identification of factors which affect price are important. Examination of existing land uses and changes in land use from 1961 to 1971 is a necessary supplement to a land price study. Through this study, an increased understanding of the operation of the rural land market and its effects upon farmland is obtained.

A) Related Literature

The study of land price and factors affecting land price in the countryside requires several different topics to be discussed as

background literature. It is essential to distinguish between land price and land value. Studies of land prices and factors influencing price are necessary. Other literature of relevance to this study concerns the impact of urbanization upon agricultural land and subsequent loss of farmland in affected areas. A discussion of the differences between land price and land value will be presented first. It will be followed by a review of the literature discussing land prices and a brief examination of urban impact upon surrounding land areas.

i) Price versus Value

Land value and land price are not synonomous, but are closely related.

> Value is an overall general quality of worth which exists in a thing; price is the measure of this worth in terms of money (Murray 1969, p. 30-31).

In order for a product to have a cash value, in terms of economic theory, it must have a use, must be capable of ownership and must be limited in supply (Turner 1977). Land satisfies these criteria, therefore it has a cash value. Value is a comparative measure, in that the worth of one object is determined by comparison with another. Value can either be subjective or objective (Murray 1969). Subjective value is the worth of the object in the mind of the individual, while objective value is measured by the open market price. Market price is not necessarily a good indicator of value, since value includes sentimental, historical or beneficial aspects which are not necessarily reflected in its market price.

Similarly, price includes a number of components unrelated to value and therefore not indicative of open market value. Sales which are rushed or forced, or restricted to a particular buyer or groups of buyers are not representative (Turner 1977). The identity of the buyer, whether a private individual or a corporate organization, and the market knowledge of the seller influence the transaction. Cash purchases or mortgage financing affects final price. Retention of use rights for buildings or settlement of an estate within the family distorts sale price. A farmer's price includes the costs of selling, buying, moving, forced sale of inventory and anticipated lower initial yields at a new farm caused by unfamiliarity with climate and soil (VanVuureen 1976).

The value of the buildings or property improvements on the land greatly affect the transaction price or the appraised value. Small residential parcels tend to have a relatively high dollar value per acre because of the worth of the house, whereas the value of large parcels, with or without improvements is mainly based on land value alone (Martin 1974).

In addition to the above, the characteristics of the rural land market will have a bearing on land prices. The description of these which is given by Sargent (1962) is summarized in the following. The heterogenety of land makes every sale unique and the value of every unit a special case. Demand for land may be based on the desire of a potential purchaser to use the space for a wide range of activities. The land market is peculiar because of the difficulty in knowing the exact market value of any specific unit. There are no market reports

based on actual sales, selling price is often not known until the transaction is completed and asking price may be far removed from the lowest price the seller would accept.

Sargent (1962) also gives a detailed explanation of price formation, the main points of which are summarized below. The price of land is determined by its use, its supply and the demand for it. Endogenous and exogenous factors affect economic supply and demand. Principal endogenous factors are land characteristics such as soil, terrain, vegetation and water. Four categories of exogenous factors can be specified. Geographical factors refer to location with respect to urban areas, transportation facilities or perhaps water. Economic factors which affect price are an individual's income and leisure time, and prevailing economic conditions for investment or speculation. Technological advances such as the use of planes to spray herbicides, affect the cost of agricultural production and hence the price of land. Population growth causes land price to rise, since the supply of land remains constant, but demand rises.

In summary, land value represents the worth of the property which is measured by price in dollars. Land prices are determined by factors independent of value such as conditions of the sale, the uniqueness of the land market and the economic supply and demand which is controlled by endogenous and exogenous factors.

ii) Land Price Studies

There have been very few studies dealing solely with land price

and these have concentrated on regions influenced by urban pressures. Canadian studies have combined examinations of land prices and values with other characteristics of the rural-urban fringe.

Clonts (1970) studied the influence of rapid urbanization on rural properties in Prince William County, Virginia. Using a series of linear multiple regression equations, he found that variables relating to urban development explained from 30 to 99 percent of the variation in land value for five land use classes. Generally, the most important variables were land improvements, location, nearness to highways and property size. However, different factors were significant in each of the use categories. The house and the size of the lot explained 97 percent of the variation in value of residential lots located in large subdivisions. Location and access to highways was not significant. The residential analysis was not based on price per acre, so Clonts was only able to note that the value per parcel rose as the parcel size increased. Variation in value of tracts of residential was explained almost completely by the urban variables. The building value of small rural residential lots was the major determinant of land value. Urban influences accounted for only 30 percent of the variation in agricultural land while forested or idle land had 39 percent of its value explained by these variables.

Rancich (1970) examined the differential rise in land values for vacant and/or agricultural land from 1956 to 1966 in the northern section of the Green River Valley, Washington, located within the Seattle metropolitan area. Prices from bonafide transactions were

collected and a mean price per acre per year, based on the total price and total acreage for each year was calculated. The inflationary effect was removed by the consumer index which indicated a change in the value of the dollar. Over the ten year period, an increase in the number of transactions and mean land values was found. The major determinants of land price were accessibility and the existing land uses nearby, but the timing of urban development was also important.

A study by Sargent in 1959 found that the distance from Metropolitan Toronto was a major influence on prices and uses of land. Average land values based on various non-farm uses were ten times higher in an area about 30 miles (48 kilometers) from Toronto than they were in an area 70 miles (112 kilometers) from Toronto.

VanVuuren (1972) examined agricultural land values in southern Ontario on a township basis, using 1966 census data and 1967 to 1970 assessment data. Variables which had the greatest influence on land values (sale prices) were the value of farm machinery and equipment per acre, location of the townships relative to Toronto and soil quality.

Martin (1975) studied land use dynamics on the Toronto urban fringe from 1968 to 1972. Land uses varied according to location. Analysis of sale prices of parcel transactions including sales within families, was based on parcel size. Land uses felt to be associated with the property size were assigned to the four size classes. Although the dollar value declined by 25 percent of its value, the dollars were not adjusted to the decreased purchasing power however Martin acknow-

ledged that the Consumer Price Index could be employed as a measure of inflation. He found that the value of sale prices tended to increase through time. Since the mean price per acre for parcels decreased as size increased, highest prices were obtained for modest income non-farm residences (less than 5 acres), country estates (5 to 14.9 acres), a variety of land uses (15 to 49.9 acres) and commercial farming (greater than 50 acres) respectively. Transaction prices were affected by location, that is closeness to Toronto or small towns, and aesthetically pleasing site characteristics. Martin suggested that a concentration of multiple sales in a specific area or frequent sales of a particular property indicated strong speculative pressures. His work also involved a description of land use patterns and changes in land use using aerial photography. The last section dealt with the impact of urbanization upon farming in the fringe area, but Martin's findings were inconclusive.

Punter (1974) included a limited examination of land price in his work on the impact of exurban development on land and landscape from 1954 to 1971 in the Toronto centred region. His analysis was also based on the size of the property and in general, he observed that the smaller the parcel, the higher the price per acre. Price was adjusted for inflation by the Consumer Price Index for Toronto, and a greater increase in price over time was found for smaller sized lots. He noted two periods, 1946-48 and 1966-69, in which sales activities increased. Inter-family and Veteran Land Act sales were included, although he did acknowledge that Veteran Land Act transactions were often

the result of completion of mortgage payments.

Another study in the Toronto - centred region was done by Rodd (1975). The sample townships selected for study were described as:

> lying outside the urban fringe of dense subdivision development, but within the sphere of influence of the metropolitan centre of Ontario (1975, p. 6).

By excluding whole townships which were adjacent to major urban centres and local sites within the built-up area of small towns or villages, the study focused on the "open countryside" or the rural regions, including the townships of Nichol, Erin and Eramosa in Wellington County. The study had three main objectives: to identify the land uses of recently purchased land and site characteristics of that land, the site used by existing land uses and any changes in land demand indicated by recent transactions. In order to produce a sufficient number of land sales for analysis, sales of parcels over ten acres were collected from 1969 to 1971 and weighted to represent sales in 1972. Sales for properties of less than 10 acres were obtained in 1972. Any effect that time might have on price was therefore obliterated. The land uses for both the transacted properties and the land use sample was taken in 1973 by actual site observation. With regard to site, Rodd found that non-farm residences of less than one acre in size were on Class 1 and Class 2 soils, while estates preferred Class 4. As far as price was concerned, he found that the average price per acre was higher on smaller properties and that farms with buildings had the lowest price per acre.

Using data from Rodd's study, Brooksbank (1976) attempted to

determine the impact of non-farm development upon agricultural land resources and examine the influence of soil capability on economic decisions in the rural land market. He found that for farmland properties less than 10 acres in size, price per acre increased as the soil capability decreased, for simple residences on less than or equal to 10 acres, price per acre increased as parcel size decreased and on vacant land, higher prices per acre were paid for higher quality land, smaller land parcels and properties nearest to Toronto.

From the reviewed literature, factors which affect land price are value of the building or land improvements, location in relation to roads and urban centres, land use, size of the property, date of sale and soil quality or site characteristics. It should be noted that not only did price vary according to land use, but also the factors which affected price varied with use.

iii) Urban Impact Upon Land

The impact of an urban centre upon surrounding land has many facets. The most important to this study are the rise in land values and the loss of farmland. It is therefore important to briefly survey the activities which have been taking place in the countryside.

The conversion of rural land to an urban land use results in an increase in property value (Schmid 1969). To the base agricultural value is added the developmental costs such as landscaping, transportation networks and sewage systems. Since the final lot value is greater than the agricultural value and the developmental costs, there is a built-in

appreciation factor, (i.e. profit).

In the countryside, the sale of a land parcel for a rural non-farm house has far reaching effects as it causes the land values around it to rise (Rodd 1976). Since opportunity costs for existing farmer and real costs for new or expanding farmers will rise, the new real estate value will become part of the cost structure of agriculture. This higher price of land discourages new farmers, farm expansion and modernization. Older or less efficient or less dedicated farmers will sell out. Rodd concluded that the high prices and the resultant uncertainty would erode competitive efficiency and productivity over wide areas.

Loss of farmland to urban uses has been well documented by many authors, such as Crerar (1961), Hindsmith-Gertler (1961), Russwurm (1967), Patterson (1968), Higbee (1967), Krueger (1970) and Gierman (1977). The purpose of this section is not to review the loss of farmland literature, but rather to outline events which are occuring in the countryside and contributing to the loss.

Urban influences often cause subtle shifts in land use in agricultural areas. Rodd (1972A) cited the following examples of this:

> Fruit production becomes combined with recreation (for example, pick-it-yourself), pasture becomes sod, rocky hills attract chalets, swamp becomes truck garden, food lots replaces dairy pasture, or saddle horses replace holsteins (1972A, p. 21).

However, there are many overt changes taking place. Land severances for non-farm residences fragment the rural landscape and as previously noted, contribute to increasing land prices. Incidents of trespassing and vandalism of farmland increase (Bryant, 1974, Hoffman 1976): the non-farm

population demand urban services of schools, sewers, power, water, snow removal and improved roads, causing taxes to rise; and golf courses, parks and trails are introduced (Hoffman 1976, Thomson 1976). The Agricultural Code of Practice, first introduced in 1970 and local bylaws legislating against farm odours and noise, discourages farm expansion (Hoffman 1976, Rodd 1976). Resource industries also demand land from the countryside (Thomson 1976).

A summary of this section is simply that urban pressures are causing farmland to be lost to other uses and that these uses, in particular non-farm residences are driving up land prices.

In conclusion, it has been shown that high land prices, associated with non-agricultural activities in a rural area have adverse effects upon agriculture. Land value and land price are closely related, but not synonomous since land price is determined by factors which are independent of value such as sale conditions and economic supply and demand. Studies on land values and prices have shown that the factors which affect price or value are land improvements, highway access, location, property size, time, land use, value of buildings or equipment, soil quality and site characteristics.

Chapter 2

STUDY OUTLINE AND METHODOLOGY

The purpose of this study was to investigate land prices and factors affecting land price in the open countryside of Wellington County from 1961 to 1971. In addition, the land uses and changes in land use were examined. From the literature, certain variables were selected for study and hypotheses formed to test their relationship with land price. This chapter outlines the hypotheses, the study area and methodology which comprises the sample selection, data collection, conversion of data into units for analysis and statistical analysis.

A) Hypotheses

Studies on land price revealed that the value of the buildings, location, land use, size, time and soil quality were the main factors affecting the spatial variation in land prices. Of these, all but building value were selected for study. Up until 1970, the value of land and buildings were recorded separately, however in 1971 a combined assessment was given, and building value could not be distinguished from land value. Since there was then no method of determining building value, this component of price formation was omitted from study.

It was hypothesized that:

1. Agricultural land uses would have the lowest price per acre. In areas where there was a large number of non-farm residences, the

surrounding farm values would be higher.

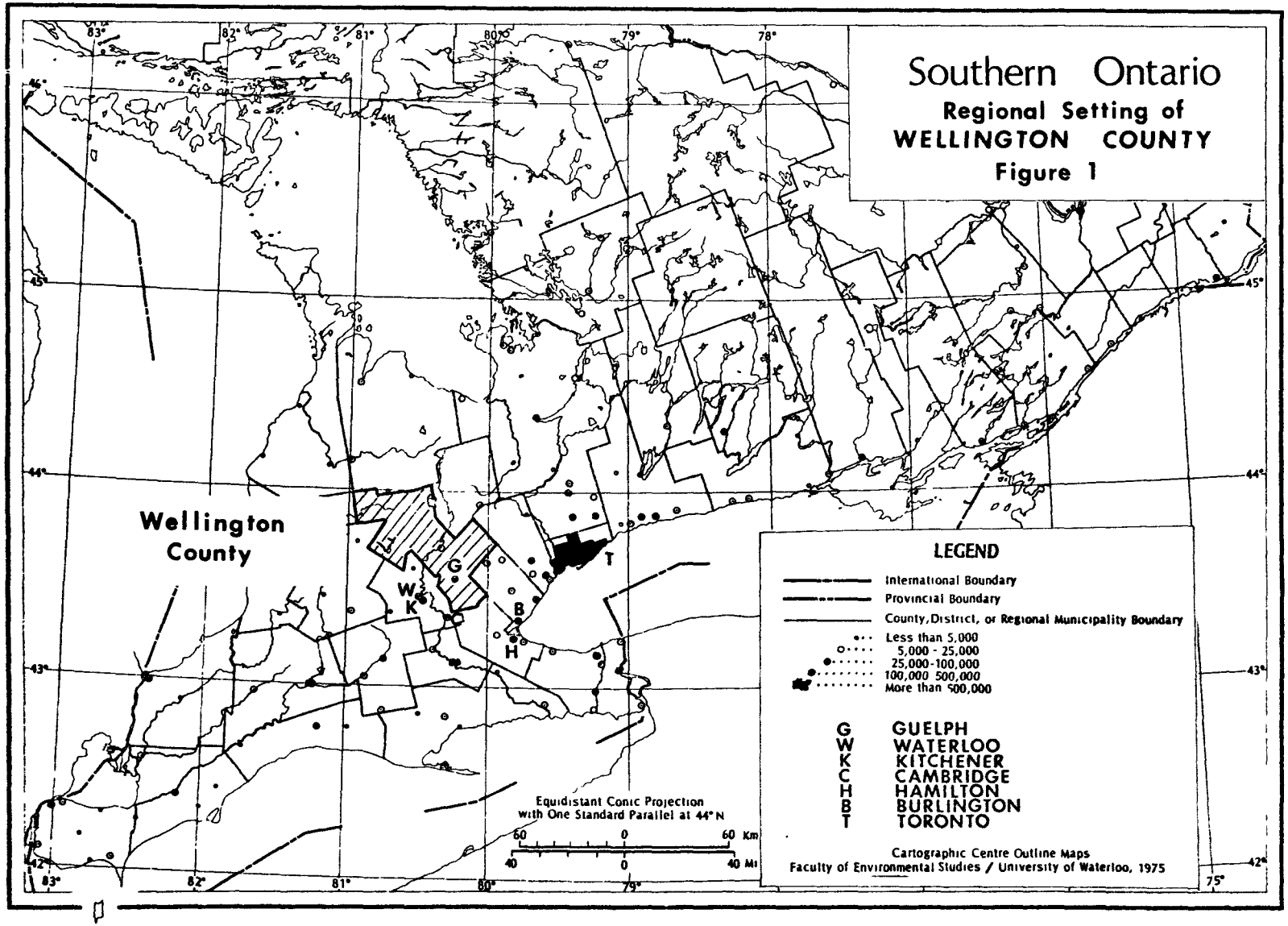
2. Land prices would increase from 1961 to 1971. The increase in sales activity from 1966 to 1969 (Martin 1977A) in the Toronto centred region would also be present in the Wellington County.
3. Land price would increase as the distance to Guelph decreased.
4. Land price per acre would increase as size of property decreased.
5. Prices for farmland would be higher for higher quality soils.

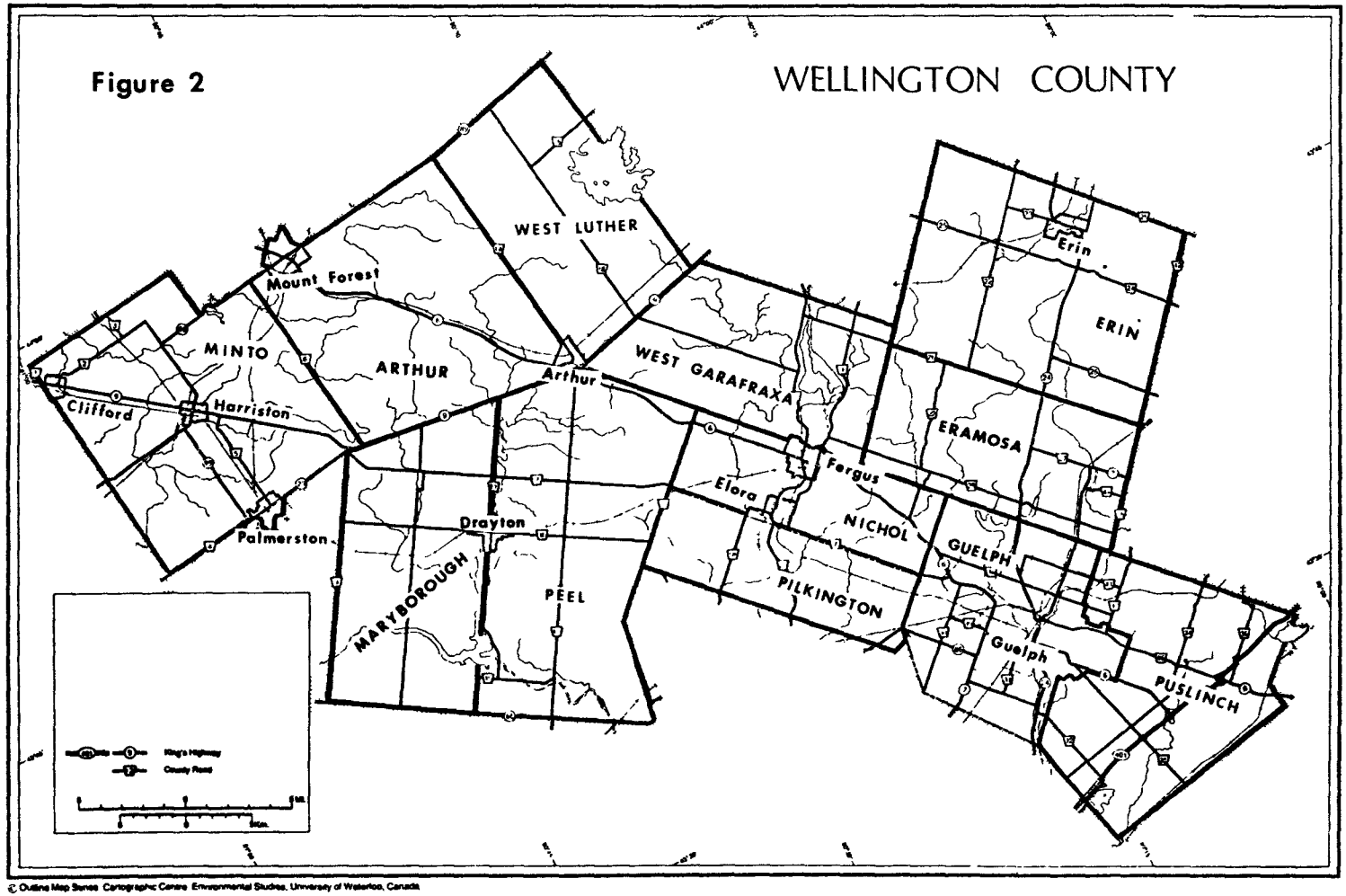
B) Study Area

The study area was the open countryside of Wellington County from 1961 to 1971. Open countryside refers to:

> The land outside the built-up areas of cities, towns and hamlets, where there is increasing competition for land between farming and other uses (Rodd 1976, p. 7).

Wellington County, which is situated in south western Ontario (Figure 1) is an area of primarily Class 1 soils (Appendix 1), with the townships of Erin and Puslinch (Figure 2) having predominantly Class 3. The agricultural base between 1961 and 1971 was animal husbandry, and an increase in the value of cattle, chicken and egg production was experienced (Bryant 1976). Bryant also noted that values for dairy produce and pigs remained stable and that changes in crops reflected the orientation of the area to animal husbandry. Wellington County is subject to generalized urban influence and parts of it have been included in urban studies which will be discussed later with reference to land uses. Census data revealed that a decline in farmland acreage began between 1931 and 1951, and was greatest for the majority of


Southern Ontario
Regional Setting of
WELLINGTON COUNTY
Figure 1
Wellington County
LEGEND
International Boundary
Provincial Boundary
County, District, or Regional Municipality Boundary
Less than 5,000
5,000 - 25,000
25,000-100,000
100,000 500,000
More than 500,000
G GUELPH
W WATERLOO
K KITCHENER
C CAMBRIDGE
H HAMILTON
B BURLINGTON
T TORONTO
Equidistant Conic Projection
with One Standard Parallel at 44° N
60 0 60 Km
40 0 40 Mi
Cartographic Centre Outline Maps
Faculty of Environmental Studies / University of Waterloo, 1975



townships between 1961 and 1971 (Appendix 2). All townships were examined except the township of Guelph, because most of its area was occupied by the city of Guelph and Pilkington since assessment rolls were not available prior to 1966 (Figure 2).

C) Methodology

i) Sample Selection

A modified systematic random sampling technique was used to obtain a 10 percent sample of the countryside lots by selecting one lot from each group of ten, using a different random number for each concession and maintaining a continuous count throughout Wellington County. A ten percent sample is usually considered large (Snedecor 1946) and for this study, it provided a 95 percent confidence level with an absolute error of plus or minus 2-3 percent (Griffen 1962). This sample size therefore provides an accurate representation of the total population of lots.

A lot refers to the unit of land into which the township was subdivided by the original land survey. The standard lot size for Wellington County is 200 acres, except for the townships of Minto and Nichol, which are only 100 acres. This lot is sectioned into properties of parcels of land which are owned by various individuals.

In order to be considered as being located in the countryside, the lot must not lie adjacent to nor be partially located in a village, town or hamlet. In effect, this study excluded not only the built-up areas of towns, but also land bordering the centres. Lots surrounding Conestogo, Belwood and Luther Lakes were excluded, firstly, because the heavy concentration of cottages represented a built-up area, and

secondly, because of initial financial restrictions. In order to obtain equivalent land areas for all lots, only lots of the standard township size were included. Based on this criteria, 271 lots were selected, on which 957 properties were located.

ii) Data Collection

Transaction and use data were obtained from local township offices and the Land Registry Offices in Guelph and Arthur. Soil capability and measurements of location were derived from appropriate maps.

The assessment rolls contain details of property, location, value, use, size and tenancy, plus the resident's age, occupation and address. Information pertinent to this study was the use, size and location of properties on the selected lots. Since assessment was based on the total amount of land owned by an individual, it was necessary to include portions of land which were on a non-sample lot. Not only was it impossible to distinguish a use for sections on the sample lot, but if the property was sold, land outside the sample lot was included in the sale price. The percentage of acreage represented in the study was therefore greater than 10 percent.

There was no pre-selection of land uses and the land use categories (Table 1) represent all activities which were found in the area. Differences in the spelling of farmland, that is either as one word or two, is significant in this paper. Farm land refers to the land use found in the countryside of Wellington County, while farmland is a general reference to agricultural land which may or may not have farm

TABLE 1

LAND USE CATEGORIES

Category	Land Use
1	Residential land - vacant land with no buildings, classified as residential by the assessment
2	Houses - land with buildings classified as residences
3	Farm land - vacant land with no buildings, classified as having a farm use
4	Farms - farm land with buildings for farm use
5	Conservation land - land owned by the Grand River Conservation Authority
6	Commercial
7	Private club - eg. Optimist
8	Municipal or Provincial land (Ontario Dept. of Highways)
9	Nursing home
10	Cemetery
11	School - former school house
12	Church
13	Unclassified - section of land remaining after a severance, for which no use was given.

buildings on it.

From 1961 to 1967, properties were listed on assessment rolls by their respective school district. After 1967, all assessment rolls were computerized and township areas were reorganized based on polling districts. This changeover resulted in an apparent deletion of some properties and additions of others, such as cemeteries and school houses.

The Land Registry Offices record each transaction as an "instrument" or deed, on which the name of the buyer, purchaser, description of property location and size, and date of price of sale are given. Most of this information is condensed into an Abstract Book which serves as an index for each instrument[1].

Ownership changes in the assessment rolls were assumed to indicate a land sale, for which confirmation was sought in the Land Registry records. In some cases, ownership changes were not supported by an actual deed. The lack of a transaction could be attributed to assessment error, the listing of the property under a different concession or lot of which it was a part, or registration of the sale in Toronto. The Land Registrar in Guelph estimated that approximately 10 percent of the sales were registered in Toronto.

Soil capability for each lot was obtained from the map of the Soil Capability for Agriculture for Kitchener. The dominant capability

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[1]A fee of $1.00 is usually charged for the use of the Abstract Book and 25¢ for each deed requested.

class was chosen to represent the lot and all properties on it.

Two measurements were taken to establish the location of each lot. Location was measured in relation to the centre of the city of Guelph, as represented by the inter-section of highways 6, 7 and 24. The first measurement taken was road distance from the centre of each lot to the centre of Guelph. The second was an attempt to determine which areas of the County would be more susceptible to urban influence from a city other than Guelph. This was done by drawing a base line of 0 degrees from Guelph's centre due north, and measuring the angle formed by the lot and the city centre. The assumption behind this method, was that if Waterloo was located in the same sector (formed by grouping angles together), as a township or a number of lots in Wellington, then Waterloo's influence would be stronger in that area than in another. Limitations of this method, which were not initially apparent will be discussed later.

Changes in property lines within lots posed some problems. Lot 27, Concession 11 in Eramosa Township is an example of a few of the changes in the measured parameters which could occur during the study period (Table 2). Parcel 1, classified as a 108 acre farm, was severed into two parcels in 1969. The 10.058 acre parcel (1 A) which became residential land was divided into two sections, 1 A 1 and 1 A 2, but no price was given for the 'sale' suggesting that transfer occured between family members. The remaining 97.942 acres (1 B) continued to operate as a farm. Parcel 2 was originally a 163 acre farm. In 1964, .447 acres (2 A) of residential land was severed and sold for $200.

TABLE 2

DATA COLLECTION FOR LOT 27, CONCESSION II ERAMOSA TOWNSHIP

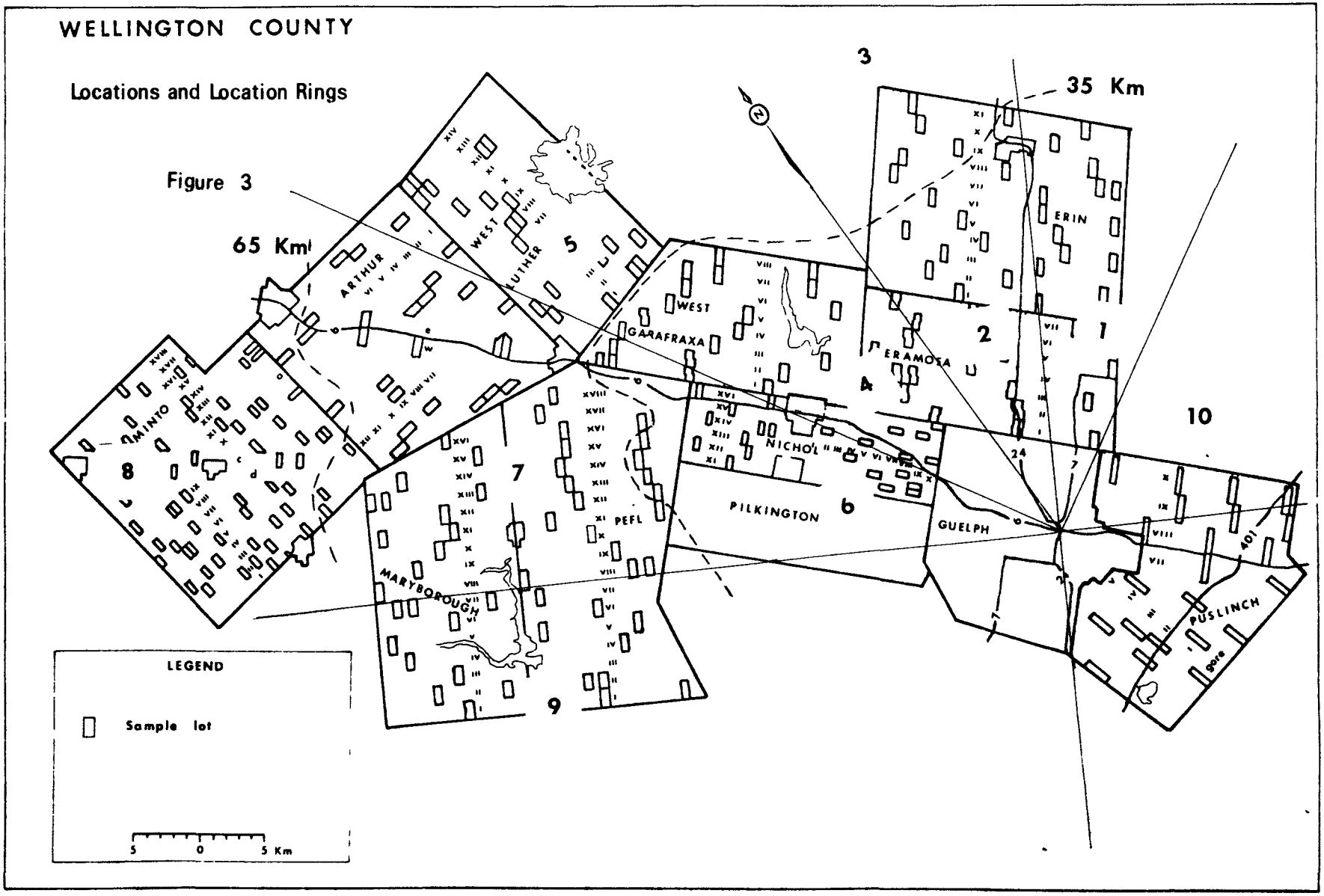
Road Distance	Orientation	Soil	Parcels				Size	Date of Sale		Price	Use
			Original	One Severance	Two Severances	Three Severances		Month	Year		
19.9 km	347°	3	1	-	-	-	108.00	-	-	-	Farm
			1	A	-	-	10.058	11	69	$ 1,200	Res. land
			1	A	1	-	2.012	10	70	no price	Res. land
			1	A	2	-	8.046	-	-	-	Res. land
			1	B	-	-	97.942	-	-	-	Farm
			2	-	-	-	163.00	-	-	-	Farm
			2	A	-	-	.447	04	64	$ 200	Res. land
			2	A	-	-	.447	06	71	$ 2,600	Res. bldg.
			2	B	-	-	162.553	-	-	-	Farm
			2	B	1	-	100.00	10	69	$80,000	Farm
					2	-	62.553	-	-	-	?

A residence was built on this land and was sold in 1971 for $2600. The remainder of Parcel 2, (2 B) functioned as a farm until 1969, when 100 acres (2 B 1) which included farm buildings was sold for $80,000. The use of the remaining 62.553 acres (2 B 2) was probably farm land, but a positive identification of this could not be made from the available data.

iii) Analysis Units

The example of Lot 27, Concession 11 in the previous section presented the raw data as it had been collected. To perform statistical analysis, it was necessary to convert some of the data into analytical units. The representation of land use and soil classification and size by acres was readily accomodated in an analysis. However, time (day, month and year), location (road distance and angle) and price (sale value) required transformation. Transaction date was expressed as the number of months from January 1961, for example, January 1961 = 1, January 1962 = 13. Location data was grouped and price was stated as price per acre and was adjusted for inflation.

Road distance and angles were combined to form distinct locations throughout the study area. Angle measurements were aggregated into 30^{o} sectors (60 or 90 degrees if sample size was small) and bisected by road distances of radii 35 and 65 kilometers from Guelph's city centre. Division of the sectors by road distance established two location rings, or areas less than or greater than 35 kilometers from the centre of Guelph (Figure 3).


WELLINGTON COUNTY
Locations and Location Rings
Figure 3
65 Km
35 Km
3
ARTHUR
WEST LUTHER
5
WEST GARAFRAXA
ERAMOSA
ERIN
2
1
4
10
MINTO
8
7
NICHOL
PILKINGTON
6
GUELPH
24
PEEL
MARYBOROUGH
9
PUSLINCH
401
LEGEND
Sample lot
5 0 5 Km

Comparison of prices between properties of different sizes and uses is most effective if price is expressed as the price per acre. Comparison of prices between different uses, locations or years required calculation of the mean price per acre, computed by dividing the total transaction price for each use, year or location by the total acreage of the appropriate category (Rancich 1970).

Inflation affected the value of the dollar, hence the price of land, at unequal rates from 1961 to 1971. Use of the Consumer Price Index as a means of deflating the dollar was acknowledged by Rancich (1970), Martin (1975), and Punter (1974). The Consumer Price Index for Canada, 1971 = 100, for all items (housing, food, transportation, clothing, health and personal care, recreation and reading, and tobacco and alsohol) represented the monetary rate of inflation (Appendix 2). Application of this index caused the 1961 dollar to be inflated to 1971 dollars. For example, the price per acre for 100 acres sold in April 1961 at $13,800 is $138. Since the price index for this date was 74.9, the adjusted 1971 price per acre is $\frac{13,800}{100} \times \frac{100}{74.9} = \$184.25$.

The raw data and the above transformations, produced the following units for analysis. Price was stated as the adjusted price per acre. All the data was grouped into classes of location, use and soil. The varying factors of time and size were expressed as months and acres respectively.

iv) Statistical Analysis

Certain transacted properties were omitted from analysis. A lot

in the hamlet of Eramosa, which had been mistakenly included in the sample was deleted. Farms and farm land of less than 50 acres in size were excluded because the building value of farms less than 50 acres would distort the price (Brooksbank 1976). Since use classification in the assessment often varied between farm and residential during the study time, it was felt that farm land of less than 50 acres could have been incorrectly identified. Sales between family members were omitted because in most cases there was either a nominal charge or no price. Due to the overwhelming majority of sales which occured in residential land, houses, farms and farm land (Table 3) were the only uses analysized.

The Veterans' Land Act provided financial assistance (loans and grants) to qualified veterans who wished to purchase land as a full-time farmer, part-time farmer or settler (Duhamel 1968). Property desired by a veteran must be appraised by the Veteran Land Administration to determine the suitability of the property, and to give approval for the purchase and purchase price. Sales to the Director of Land Veterans are therefore a form of mortgage and sales from the Director are often a completion of mortgage payments. For these reasons, sales to the Director were omitted.

The most appropriate statistical analysis for this study was a weighted analysis of covariance. Since analysis of covariance is not commonly used by geographers, its use requires further justification. In order to provide this, the following topics will be briefly discussed; where this analysis has been used, why other methods were not appropriate and how this analysis was performed.

TABLE 3

TRANSACTIONS FROM 1961-1971

Category	Transactions
Residential land properties	132
Houses	60
Farm land	59
Farms	219
Conservation Authority	3
Commercial	2
Municipal or Provincial land	2
Nursing home	1
School houses	5
Unclassified parcels	1
Sales to Director of Land Veteran's	4
No price or pre 1961 sale	7
	495

An analysis of covariance is commonly used in precise sciences. Taxonomy, which is a branch of zoology studying the classifications of animals, often employs this method. Sokal (1965) suggests that analysis of covariance is especially useful where there are relatively few variables and where relations between these are of importance. McIntosh (1955) is cited by Sokal as using an analysis of covariance to compare differences in body and skeletal measurements in two races of deer mouse. The importance of partial correlations are also recognized by Sokal.

> By keeping one or more variables constant, the change in correlation pattern among the remaining variables can be observed and conclusions drawn about the interrelations of the variables (1965, p. 368).

Sokal cites the following two examples of studies using partial correlations. Mosimann (1956) kept the length of underneath shell of turtle constant when examining the separate underneath scales. Kermack (1954) studied changes in correlational patterns of seven variables of fossil sea urchins, by keeping length, height and breadth of the fossil constant.

The form of this study's data eliminated certain statistical techniques. Since this study was concerned with the distribution of one variable, land price, the analysis is univariate (Marriott 1974) and the use of multivariate techniques such as factor analysis, cluster analysis, discriminant analysis or canonical correlations was therefore inappropriate. Common univarate methods which measure the effect of several independent variables upon one dependent variable and calculate a prediction equation are stepwise regression, multiple regression and analyses of variance and covariance. A stepwise regression reduces the

number of independent variables by subsequently adding a variable which explains the most of the unexplained variance remaining in the model, until an optimum prediction equation is produced (Nie et al. 1975). Since this type of analysis does not describe relationships between the variables, it was not considered to be appropriate. For an analysis of variance to be performed, all data must be in categories, and since time and size were not classified, this method could not be used. Multiple regression will be discussed later, since it is the general technique for handling analysis of covariance (Nie et al. 1975).

The reason for data analysis was to determine which of the variables had a significant effect on price and to what extent they explained variation in price. In order to accomplish this, it was necessary to adjust for sources of bias which is given by Snedecor (1972) as being a use of covariance. A comparison of land price between different locations, land uses and soils requires that the effects of the date of purchase and property size be corrected. However, location, land use and soil also affect price and therefore it is necessary to correct for their influence as well. Thus, the influence of all variables is of equal interest and partial correlations are calculated to measure their effects.

Since multiple regression is the technique used to perform an analysis of covariance, brief discussion of this analysis as outlined by Nie et al. is necessary. It is used to find the best linear prediction equation and to control for other variables in order to evaluate the effect of a specific variable or combination of variables. In

general, multiple regression requires that variables are measured on an interval or ratio scale and that their relationships are linear and additive. However, the use of 'dummies' enables nominal variables (categorical variables) to be analysized and an analysis of covariance which determines the effect of independent variables which are factors (non-metric) and covariates (metric) upon a dependent variable can be performed.

Based on the foregoing rationale, a weighted analysis of covariance program was used to analyze the data (Barr et al. 1976). The dependent variable was price and because it was expressed as price per acre, the analysis was considered weighted by size. Since location, land use and soil measurements grouped the data into classes, the independent variables are referred to as factors or categorical variables (Nie et al. 1975). The independent variables of time and size which were assumed to have a linear relationship with price, were covariates (Nie et al. 1975). Since residuals in an analysis of covariance have the same role as residuals in regression models, which is to indicate a lack of linearity and therefore suggest alternate or further analysis (Draper and Smith 1966), it is necessary to plot these. The residual which is the difference between the observed price per acre and the predicted price per acre indicates where errors in the model lie.

Chapter 3

LAND USE, LAND USE CHANGE AND FACTORS AFFECTING PRICE IN WELLINGTON COUNTY COUNTRYSIDE

This chapter presents the results of the investigation of the relationship between price and the selected variables, and of the land uses and land use change in Wellington County from 1961 to 1971. Since the major emphasis of the paper is on price and the factors which affect it, land uses and land use change will be examined first, but only in a general manner. In order to provide a logical format for discussion of price, the results of the weighted analysis of covariance will be followed by a separate discussion of each of the five variables: use, time, location, size and soil.

A) Land Uses - 1971

Land uses which occurred in the open countryside of Wellington County in 1971 are summarized in Table 1 (p. 19). Dominant uses in terms of acreage and the number of properties between 1961 and 1971 were farms, farmland, houses and residential land (Table 4). The preponderance of residential and farm uses was in agreement with Rodd (1975, 1976) who observed the virtual absence of any activities other than farms, residences and vacant land in the countryside around 1970. Since he classified vacant land by site inspection, as land which had

TABLE 4

ACREAGE AND PROPERTY NUMBERS FOR LAND USE CATEGORIES IN 1961 and 1971

Land Use Category	1961 Acres	% of Total Acreage	No. of Properties	1971 Acres	% of Total Acreage	No. of Properties
Residential land	75.39	.13	11	930.366	1.67	120
Houses	278.502	.50	26	543.171	.97	74
Farm land	2496.09	4.46	80	4104.629	7.33	115
Farms	52527.988	93.84	406	49320.057	88.09	398
Conservation land	97.0	.17	1	278.93	.50	4
Commercial	254.0	.45	3	267.125	.48	5
Private club	45.0	.08	1	50.72	.09	2
Municipal or provincial land	73.63	.13	4	80.74	.14	5
Nursing home	-	-	-	10.166	.02	1
Cemetery	21.5	.05	4	26.5	.05	4
School house	5.0	.007	4	5.0	.007	5
Church	2.0	.003	1	2.0	.003	1
Other	101.0	.18	3	362.696	.65	8
	55982.1	100.000	544	55982.1	100.000	742

no visible use, this category was beyond the scope of the present study. Rodd found that residential properties outnumbered farm properties by a large margin. Such was not the case in this study, perhaps suggesting that the intensity of urban influence was not as great in the countryside of Wellington County.

Rodd's study area, which was defined as the major field of urban influence of Toronto, included the Wellington townships of Nichol, Erin and Eramosa. Because of differences in data collection between Rodd's study and the present investigation, it is possible to compare only the number of farm, farm land and residential properties. Residential uses included Rodd's houses and estates, and this study's houses and residential land parcels. A comparison of the estimated property numbers for each township revealed that Rodd, in 1973, had found almost twice as many farms and residences in Erin and Eramosa as this study had in 1971. In Nichol, this study found slightly more farms but considerably fewer residences. The number of properties in farmland for all three townships was similar.

These differences in property counts can largely be explained by sampling technique. The present work employed a random systematic technique whereas Rodd used a stratified systematic approach by drawing:

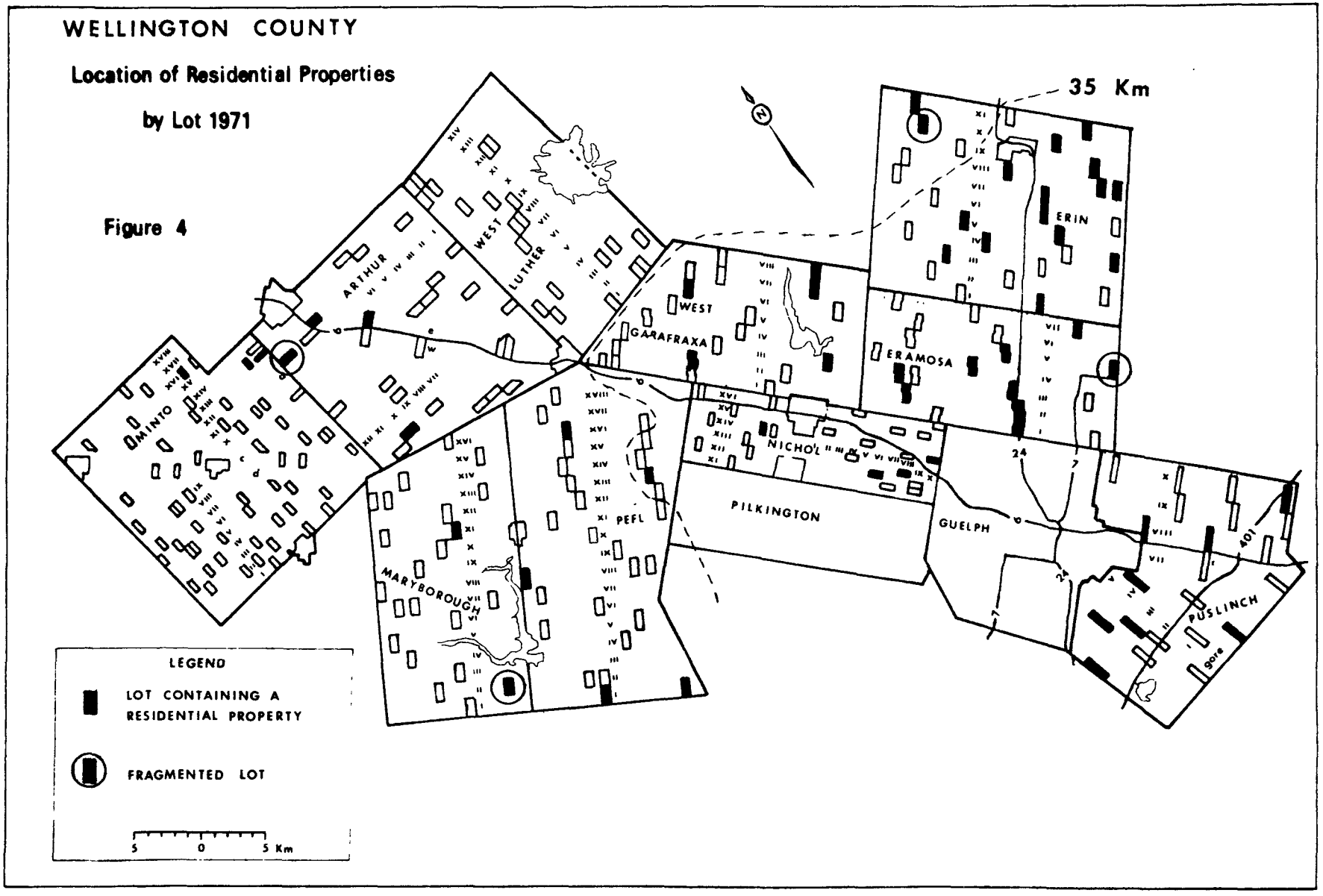
> a one-eighth sample of land use by selecting every second odd-numbered lot in the odd numbered concession (Rodd 1975, p. 10).

Although local sites within the built-up perimeter of a small settlement were excluded, considerable bias would be introduced if any of the odd-numbered lots were adjacent to a major road. For example, in

Erin township, Rodd's sample would have included all lots along County Road 22 (see Fig. 2, p. 16). In Erin and Nichol townships, his sample lots were adjacent to township roads. This suggests that Rodd's study had a systematic bias, since the alternative that the additional farms and houses were built in two years is not viable.

Townships having the largest number of houses in the sample in 1961 were Eramosa (21), Erin (17) and Puslinch (14). Figure 4 illustrates the location of both residential land and houses by lot. The number of properties in residential land was greatly influenced by lot fragmentation and will be discussed later. West Luther had no residential uses.

The comparatively large number of residential use properties in Eramosa and Erin is explained by the scenic terrain (glacial moraine) which made this area more susceptible to urban influence (Russwurm 1971). Rodgers (1970) and Goheen (1964) both cited in Dahms (1971) suggested that the city of Guelph had stronger links with Toronto than with Kitchener-Waterloo. An urban proximity index devised by MacKrandilal (1978) to measure the total potential influence of a city on a township using population and distance, indicated that of all the townships in Wellington County, Eramosa and Erin were most subject to Toronto's influence. Russwurm (1971) gives further evidence of urban effects on these townships. In 1966, the number of landholding acres, that is, all parcels of land, not residential, open space or other where the owner had a non-farm occupation, was 13,400 acres for Erin and 6,137 for Eramosa. Twenty-two percent of the owners in Erin were non-farm and 16.4 percent in Eramosa.


WELLINGTON COUNTY
Location of Residential Properties
by Lot 1971
Figure 4
35 Km
ARTHUR
WEST LUTHER
MINTO
WEST GARAFRAXA
ERAMOSA
ERIN
NICHOL
PILKINGTON
GUELPH
MARYBOROUGH
PEEL
PUSLINCH
401
LEGEND
LOT CONTAINING A RESIDENTIAL PROPERTY
FRAGMENTED LOT
5 0 5 Km

In addition to having a high number of houses and residential land parcels (no lot fragmentation was found), Puslinch township had the most variety in land uses including two private clubs, two sand and gravel operations, two restaurants, a gas station and land owned by the Ontario Department of Highways, the City of Guelph, Halton Conservation Authority and a foreign (German) investor. This wide variation contrasted sharply with the remaining townships, but was not unexpected since Russwurm (1971) had identified Puslinch as one of the three most urbanized townships in Waterloo County and South-east Wellington County (Eramosa, Erin, Nichol, Pilkington and Puslinch townships). The number of land holding acres in 1966 was 18,372 and 15.7 percent of the properties had a non-farm use. Thirty-nine and a half percent of the land owners were not farmers. MacKrandilal's (1978) urban proximity index showed that Puslinch, as well as Guelph, Eramosa and Erin townships were affected more by cities of populations over 100,000 (possibly Kitchener-Waterloo or Hamilton-Burlington) than other townships in Wellington County. A city of between 10,000 and 100,000 (possibly Guelph or parts of Cambridge) exerted more effect on Puslinch than on any other township.

The physiography of Puslinch is moraine and esker deposits, explaining the presence of sand and gravel industries. Since this area is poorer farmland, but aethestically appealing, it is more readily converted to non-farm uses such as residential or private clubs and also subject to urban pressures.

Using census data, Dahms (1978) characterized the south-eastern townships of Puslinch, Guelph, Erin and Eramosa from 1961 to 1976 as

being an area of decreasing farmland with relatively poor soil, undergoing rapid population growth and increasing urbanization. The inhabitants of the area had relatively high incomes (in comparison with the rest of the county) with a large number living in rural non-farm dwellings and employed in non-farm occupations.

In the remaining townships, additional land uses of a nursing home (Eramosa), school house (Eramosa and Maryborough), cemetery (Peel, Maryborough, Eramosa), church (Peel), Grand River Conservation Authority (Eramosa, Erin) and the Ontario Department of Highways (West Luther) were found. The only evidence of an agribusiness was Amos Martin Ltd. (drainage tiles) in Peel township. In West Garafraxa, Nichol and Arthur only farm and residential activities were found. There were very few houses or residential land parcels in any of these townships. A comparatively large number of residential land properties were found in Arthur (14) and Maryborough (20), but the subdivision of one lot into residential land created all the parcels in Maryborough and all but three in Arthur.

The dominance of farm uses north of the city of Guelph was expected. Russwurm (1971) observed that a rapid drop in the urbanization measures occurred north of Guelph. In 1971, Dahms (1978) noted that the townships in the north west of the county had the greatest number of people employed in the agriculture industry. These townships experienced the slowest population growth and had a higher proportion of persons over 65 years of age. These areas, which had better soils than the southern half of the county, seemed to resist major change. The central townships

of West Garafraxa, Nichol and Pilkington were identified as a transition zone between the stable north and the urbanizing south east.

In summary, the major land uses in the open countryside of Wellington County were farms, farm land, houses and residential land. The number of properties in the land use categories contrasted to Rodd (1975, 1976) but it is suggested that Rodd's study had a potentially large sampling bias. Various activities, which have been associated with the urban fringe by Wehrwein (1942), Hind-Smith and Gertler (1962), Russwurm (1971, 1977A), Martin (1974), Pearson (1972) and Gierman (1972), such as non-farm residences, residential land, recreation, commercial, industrial, cemeteries and roads were present, but in very small numbers. Puslinch had the most variety of land use, while Erin and Eramosa had the greater number of residential use properties. It is therefore concluded that only a small amount of urban influence was exerted in the open countryside and that this was strongest in the south eastern townships of Puslinch, Erin and Eramosa. Centres responsible for this influence were Toronto, Guelph, Kitchener-Waterloo and perhaps Cambridge or Hamilton-Burlington.

B) Land Use Change 1961 to 1971

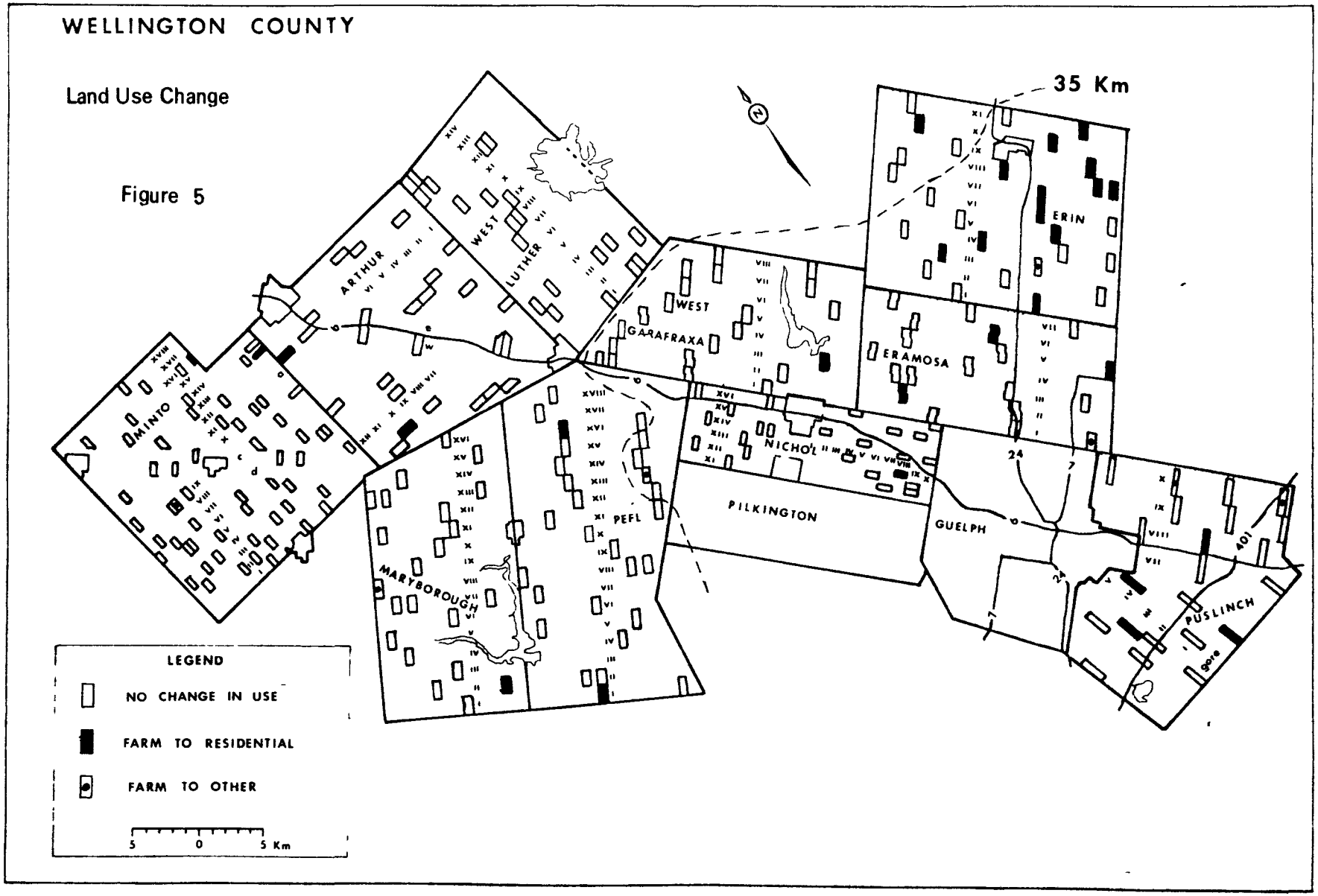
The major changes in land use acreage and property numbers from 1961 to 1971 were the drop in farm acreage and farm property numbers and the increase in residential acreages and properties (Table 4, p. 32). Since half of the land lost from farms became farm land, only 1600 acres, 1120 (70 percent) were converted to residential uses and the remaining

to other uses. The increase in acreage and number of unclassified properties was caused by remaining portions of severed properties for which no use was given by the assessment. Figure 5 shows the lots on which a change in land use occurred.

Extrapolating the results of this sample to the entire countryside of Wellington County, a figure of 16,000 acres for farmland loss between 1961 and 1971 is derived. From the Census (Appendix 2), the total farmland lost in the townships of Wellington County during this time was 58,000 acres. Assuming that this study's sample was representative, then 27.5 percent of the loss in farmland occurred in the open countryside and the remainder on land adjacent to hamlets, villages and towns. This land surrounding the built-up areas of hamlets was included in Rodd's study but was excluded in this study.

The census indicated that the loss of farmland was greatest in Erin, Puslinch, Peel, Arthur and Eramosa. Using the number of residential properties created and the drop in number of farms, as indicators of loss of farmland, this study showed that Erin, Eramosa, Puslinch and Arthur respectively, were the townships which lost the most farmland in the countryside.

A comparison of the number of acres in this study which were converted to urban uses, and the number found by Gierman (1977) illustrates the difficulty in devising a method which detects potential as well as actual land conversion. The results from the present study showed that 1120 acres in the sample, or 11,200 acres in Wellington County had been converted from rural to urban uses. By measuring the


WELLINGTON COUNTY
Land Use Change
Figure 5
35 Km
ARTHUR
WEST LUTHER
WEST GARAFRAXA
ERAMOSA
ERIN
MINTO
NICHOL
PILKINGTON
GUELPH
PEEL
MARYBOROUGH
PUSLINCH
401
LEGEND
NO CHANGE IN USE
FARM TO RESIDENTIAL
FARM TO OTHER
5 0 5 Km

changes in urban boundaries from aerial photographs for all urban centres in Canada between 1966 and 1971, Gierman found that the city of Guelph had lost rural land at a rate of 243 acres per year or 1213 acres over five years. Since the demand for land for urban purposes is considerably greater around a city, the amount of land lost in the countryside from 1961 to 1971, would suggest that Gierman's estimates of actual conversion presented a limited view of land conversion. Aerial photogrpahs give no indication of ownership change and therefore a one hundred acre parcel which would appear as pasture in a photograph could in fact be future residential land. Although no actual building had taken place, perhaps the land was already converted to an urban use.

There was a considerable increase in the number of properties for residential land uses (Table 4, p. 32). This increase was caused by an increasing number of severances which in turn caused fragmentation of lots. Severances occured on 63 lots, 37 of which experienced only one severance, 11 had two and 15 had three or more. Eramosa, Erin, Maryborough and Arthur townships each had one lot on which 100 acres or more was completely subdivided into 4 to 10 acre residential uses (Fig. 2, p. 16).

Conversations with the township clerks revealed that generally there was no control on the number of severances allowed between 1961 and 1971 and that severances were readily attainable. The exception to this was West Luther which prohibited estate-residential severances in 1968. The laissez-faire attitude of the other townships changed considerably after 1971. At present, Peel, Maryborough and Nichol are zoned mainly for agriculture and have no areas designated as estate-residential zoning. Eramosa allows 6 estate severances per year, while

Erin allows 20. No estate lot severances are permitted in Puslinch. In all townships, severances between family members or farmer to farmer are allowed and approval is dependent upon the merit of the application.

Changes in land use occurred on 57 of the 271 lots sampled. Only seven of these did not experience a change in residential uses. Figure 3 illustrates the major change in land use for each lot, given that more than one change could occur. If only one acre of the 200 acre lot was converted to residential, then that lot would be said to have undergone a change in land use.

In summary, the major land use change was the loss of farmland to residential uses. The increase in the number of severances resulted in land fragmentation and the creation of additional residential properties. This loss of land was most pronounced in the townships of Erin, Eramosa, Puslinch and Arthur.

C) Weighted Analysis of Covariance

The purpose of the analysis of covariance was to determine the effect of land use, location, time, size and soil on price, which was stated as the adjusted price per acre. Five weighted analyses of covariance were performed. This section will present the results of these analyses, but the significance of each variable will be discussed later.

Land sales occurred on 157 lots involving 488 properties. Two hundred and sixty-three parcels were sold once, while 225 experienced two or more sales. Distribution of sales throughout the County was fairly even. The south eastern townships of Erin, Eramosa and Puslinch

had the highest number of sales (233), followed by the north western townships of Arthur, Minto, Peel and Maryborough with 190 sales. West Luther, West Garafraxa and Nichol had a total of only 61 sales. Location of the lots on which sales occurred are shown in Figure 6. Since Rodd (1976) found a strong variation in land sales with many more sales occurring close to Toronto, one would have expected to find a much larger number of sales in West Garafraxa and Nichol, and considerably less in the north western townships. Martin (1974) observed that the occurrence of sale parcels was influenced by Metro Toronto, small urban centres and desirable natural features such as streams or wooded areas.

Of the 488 properties which were involved in land sales. 435 were selected for analysis. The properties omitted were sales to the Director of Land Veterans (4), other uses (14), farms and farm land less than 50 acres (20) and a lot in Eramosa (20). The actual number of transactions which occurred from 1961 to 1971 are recorded in Table 3 (p. 27).

A preliminary weighted analysis of covariance (Table 5) revealed that the five variables were very poor predictors of price. However, in the 28 percent of the model that was explained, these variables were highly significant. Within the explained variation, the variables of use, time and size were significant at the .05 level. Plotting the residuals of price for each use revealed that the error in the model was greatest for residential land and houses, particularly for parcels less than ten acres. While considerable error existed for farm land

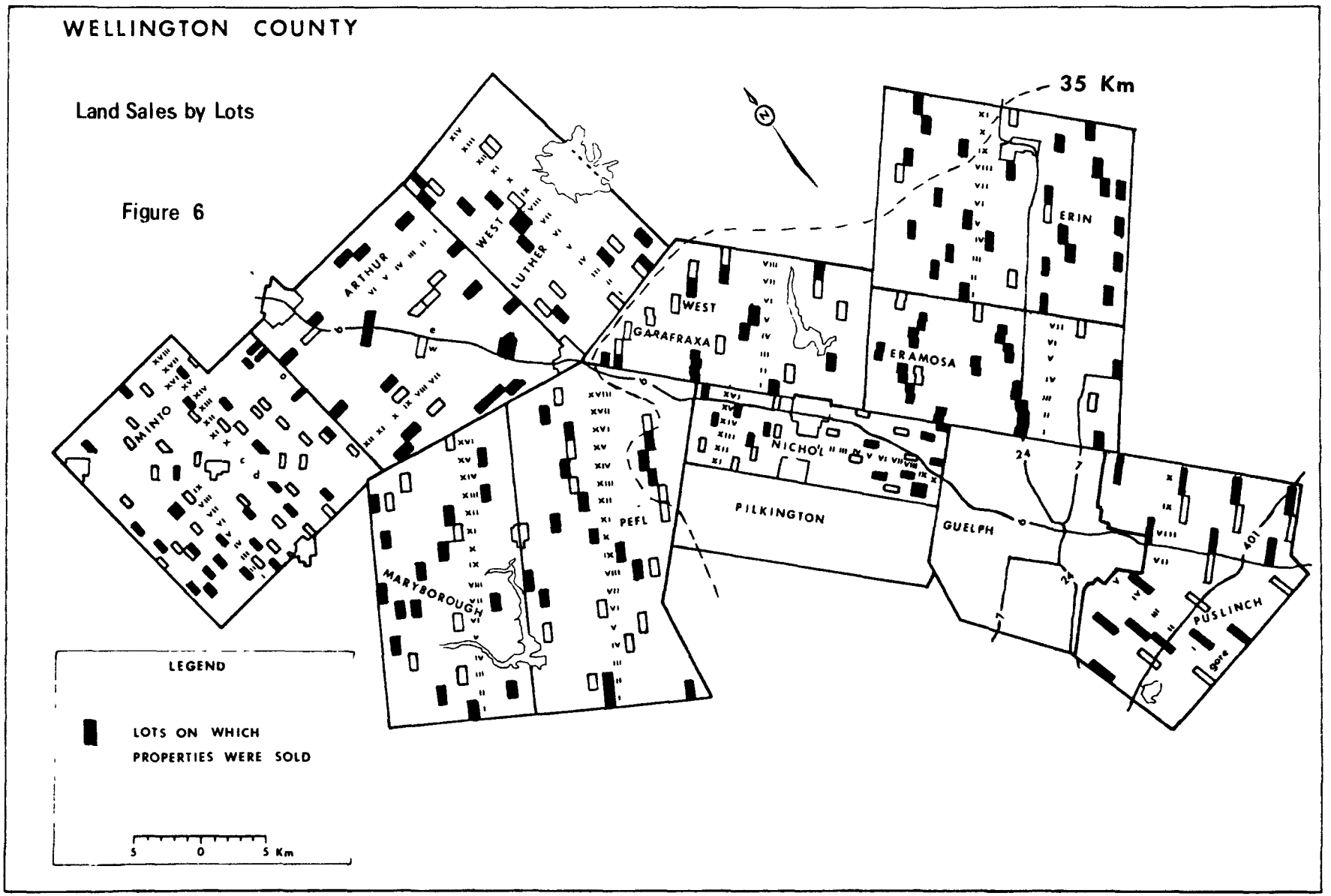

WELLINGTON COUNTY
Land Sales by Lots
Figure 6
35 Km
ARTHUR
WEST LUTHER
MINTO
WEST GARAFRAXA
ERAMOSA
ERIN
NICHOL
PILKINGTON
GUELPH
MARYBOROUGH
PEEL
PUSLINCH
401
24
LEGEND
LOTS ON WHICH PROPERTIES WERE SOLD
5 0 5 Km

TABLE 5

WEIGHTED ANALYSIS OF COVARIANCE - PRELIMINARY MODEL

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F	Observed Significance Level	R-Square
Model	20	2559556389.57	127977819.48	8.41	.0001	.288817
Loc	10	166000329.33*	16600032.93	1.09	.3680	
Use	3	1505932318.07*	50197743.93	32.97	.0001	
Time	1	176410406.94*	176410406.94	11.59	.0007	
Size	1	60995349.64*	60995349.64	4.01	.0460	
Soil	5	36219255.85*	7243851.17	0.48	.7963	
Error	414	6302660225.05	15223816.97			
Corrected Total	434	8862216614.62				

*Partial sum of squares

and farms, the distribution of the error was relatively uniform over size (Appendix 4).

Due to the high significance of use, the sharp contrasts between residual plots for each use and observed differences in collected price data for each use, the data were divided into use subsets for further analysis. Results of these analyses are summarized in Tables 6, 7, 8 and 9. A higher percent of the variation in price was explained for each use by variables, because the effects of the other uses on price was removed. Farm uses had the highest R-square value (.56 for farm land and .48 for farms) and therefore the best prediction of prices. The variables which were significant in the explained portion of the model varied for each use (Table 10) as had been found in Clonts (1970). The large unexplained residuals made the fitted regression equations of little value, as had been the case with the preliminary model (Appendix 5). The residuals for each of the use models were smaller, but the pattern of the plots was very similar (Appendix 6).

D) Effects of the Selected Variables on Price

i) Land Use

Land use was very significant in determination of land price. The highest price per acre was paid for houses, residential land, farms and farm land respectively. Table 11 is a summary of the differences in average price per acre for each use by location ring and for the whole study area. This finding is at variance with Rodd (1975, 1976) who found that farms had a lower price per acre than bare farmland. This

TABLE 6

WEIGHTED ANALYSIS OF COVARIANCE - RESIDENTIAL LAND

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F	Observed Significance Level	R-Square
Model	14	115293491.49	8235249.39	4.69	.0001	.371922
Loc	9	21695486.72*	2410609.63	1.37	.2076	
Soil	3	3323950.55*	1107983.51	.63	.6000	
Time	1	30687639.96*	30687639.96	17.50	.0001	
Size	1	54789500.17*	54789500.17	31.24	.0001	
Error	111	194699858.80	1754052.78			
Corrected Total	125	309993350.01				

*Partial sum of squares

TABLE 7

WEIGHTED ANALYSIS OF COVARIANCE - HOUSES

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F	Observed Significance Level	R-Square
Model	12	2556791052.86	213065921.07	2.63	.0116	.453753
Loc	8	733182652.32*	91647831.41	1.29	.2800	
Soil	2	57901814.49*	28950907.24	.36	.7018	
Time	1	61424065.89*	61424065.89	.76	.3893	
Size	1	503100109.29*	503100109.29	6.21	.0172	
Error	38	3077974932.43	80999340.33			
Corrected Error	50	5634765985.29				

*Partial sum of squares

TABLE 8

WEIGHTED ANALYSIS OF COVARIANCE - FARM LAND

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F	Observed Significance Level	R-Square
Model	14	90243170.36	6445940.74	3.29	.0021	.568569
Loc	9	65682801.60*	7298079.06	3.73	.0023	
Soil	3	10522808.66*	3507602.88	1.79	.1665	
Time	1	12658377.81*	12658377.81	6.47	.0155	
Size	1	559342.18*	559342.18	0.29	.5962	
Error	35	68476523.98	1956472.11			
Corrected Total	49	158719694.33				

*Partial sum of squares

TABLE 9

WEIGHTED ANALYSIS OF COVARIANCE - FARM

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F	Observed Significance Level	R-Square
Model	17	359920148.61	21171773.45	10.73	.0001	.489825
Loc	10	112427987.00*		5.70	.0001	
Soil	5	10006981.63*		1.01	.4110	
Time	1	107517389.98*		54.49	.0001	
Size	1	40779924.29*		20.67	.0001	
Error	190	374873112.97	1973016.38			
Corrected Total	207	734793261.58				

*Partial sum of squares

TABLE 10

SIGNIFICANT VARIABLES FOR EACH USE

(DESIGNATED BY *)

	Time	Size	Location	Soil
Residential Land	*	*	-	-
Houses	-	*	-	-
Farmland	*	-	*	-
Farms	*	*	*	-

TABLE 11

MEAN PRICE PER ACRE FOR EACH USE BY LOCATION RING

Location	Use				
	Res. Land	Houses	Farm Land	Farms	A
< 35 km	738	2036	268	339	403
	680	415	2451	8900	12446
	75	41	27	79	222
> 35 km	771	3342	102	205	214
	401	57	2237	16309	19004
	51	10	23	129	213
B	750	2193	189	252	
	1081	472	4688	25209	31450
	126	51	50	208	435

Note: 1. The total number of acres in this table and in subsequent tables will not be equal due to errors in rounding.

2. In this table and all subsequent tables, the first figure is the mean adjusted price per acre, the second, the number of acres and the third, the number of transactions upon which the price was based, unless otherwise stated.

For example: 738 mean adjusted price acre
680 no. of acres
75 no. of transactions

A. In this table and all subsequent tables, this column gives the summary of all data in each row. That is, the mean adjusted price per acre for the row, the total number of acres and transactions.

B. In this table and all subsequent tables, each group of data in the row, gives a summary of the data in the column above it.

difference could be partially explained by Rodd's inclusion of farmland parcels of less than 50 acres in his analysis, which could have caused the average price per acre to exceed that of farms because of their potential value for residential land. Also, considerable error could lie in Rodd's study, since the transactions took place at different date (in 1972, if under ten acres and from 1969 to 1971 for properties over ten acres) and the land use was identified in 1973.

ii) Location

The purpose of establishing location sectors was to define the influence of nearby urban centres. If Kitchener-Waterloo was located in the same 30^{o} sector as a township or a number of lots in Wellington County (the sector defined in relation to the centre of the city of Guelph), then it would be assumed that Kitchener-Waterloo would influence land prices in that sector. For this reason, the data were not analysized by township units. In order to compare the township land use characteristics, which were described earlier in this chapter, with the location units for analysis, the following generalizations can be made. The south-eastern townships of Erin, Eramosa and Puslinch are represented by Locations 1, 2, 3, 10 and 11. The central townships of Nichol and West Garafraxa correspond to Locations 4 and 6. The remaining locations, 5, 7, 8 and 9 encompass the north-western townships (Figure 3, p. 24).

Location was a significant variable at .05 level in price determination of farm land and farms. The mean adjusted price per acre

for each land use by location during the study time are presented in Table 12. The number of acres and transactions upon which the mean price was based are also given. A definite transition from the highest prices in the south east to the lowest prices in the north west is evident. Minto, Location 8 is the furthest from Guelph and has the lowest prices per acre. Farm land exhibited the same pattern. The low price of farm land in Location 3 (north east corner of Erin) was possibly caused by its distance from Guelph.

Based on the characteristics ascribed to these areas by Dahms (1978) during 1961 to 1971, the above pattern of price variation was expected. The south east was an area having a large number of people employed in non-farm occupations, with relatively high incomes. The converse of this was found in the north west. In addition, Locations 1, 2 and 3 (Erin and Eramosa) were subject to the urban influence of Toronto and Guelph and Locations 10 and 11 (Puslinch) was considered by Russwurm (1971) to be the most urbanized township.

In Table 11 (p. 52), the mean price for each use by location ring, that is, a distance less than or greater than 35 kilometers from Guelph is presented. An analysis of variance showed significant differences in price between the two rings for houses, farm land and farms (Table 13) at the .05 level. Although location was significant for houses in this analysis, when given the presence of soil, time and size, it was not, so this apparent significance is of little value. The contrast in the number of properties between the two location rings could also have contributed to the significance. Based upon the foregoing discussion of location, the higher prices for farms and farm land

TABLE 12*

MEAN PRICE FOR EACH USE BY LOCATION

		Residential Land	Houses	Farm Land	Farms	A
South Eastern Region		774	1102	452	431	563
	1	323	129	200	872	1524
		30	7	3	9	49
		694	1681	405	393	511
	2	127	188	225	1869	2409
		15	15	3	18	51
		742		94	331	312
	3	196		521	1523	2240
		10		5	9	24
		367	2650	327	497	442
	10	13	14	506	535	1068
		2	1	3	4	12
		735	4966	379	404	629
	11	192	54	249	855	1350
		21	10	5	9	43
Central Region		1285	8491	173	283	275
	4	12	4	707	3331	4054
		5	5	6	27	43
		173	1771	164	247	242
	6	12	25	564	1437	3038
		1	3	7	12	23
North Western Region					167	167
	5				3138	3138
					23	23
		1420	1281	111	220	215
	7	9	13	545	6360	6927
		5	2	6	54	67
		695	812	84	150	152
	8	85	31	863	3909	4888
		17	1	8	32	58
		827	10786	150	236	338
	9	112	14	308	1380	1814
		20	7	4	11	49
		750	2193	189	252	
	B	1081	472	4688	25209	31450
		126	51	50	208	435

*See Table 11 for explanation of data.

TABLE 13

ANALYSIS OF VARIANCE FOR LOCATION RINGS FROM TABLE 11

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F	Observed Significance Level	R-Square
Use 1						
Res. Land						
Model - Loc	9	15101210.50	1677912.28	.66	.7446	.048715
Error	116	294892139.80	2542173.62			
Corrected Total	125	309993350.30				
Use 2						
Houses						
Model - Loc	8	1884897180.57	235612147.57	2.64	.0193	.334512
Error	42	3749868804.73	89282590.59			
Corrected Total	50	5634765985.30				
Use 3						
Farm Land						
Model - Loc	9	61356148.87	6817349.88	2.08	.0120	.386569
Error	40	97363545.46	2434088.64			
Corrected Total	49	158719694.33				
Use 4						
Farms						
Model - Loc	10	199690280.76	19969028.08	7.35	.0001	.271764
Error	197	535102980.82	2716258.79			
Corrected Total	207	734793261.59				

within 35 kilometers of the city was anticipated.

The high number of transactions in the north west was not unusual, since this area had more than twice the number of farm properties than either the central or south eastern locations. The number of farm properties in the central and south east was equivalent. Similarly, more farms were sold further than 35 kilometers from Guelph (Table 11).

Location was not significant in price determination of residential land or houses. This finding was in agreement with Clonts (1970) but varied with other studies. Sargent (1962) found that non-farm land values in an area 30 miles from Toronto were 10 times higher than they were at 70 miles. Brooksbank (1976) observed higher prices per acre for properties nearer to Toronto. Archdekin (1974) recorded that land values rose nearer to urban centres. Brigham (1965) noted that land values became higher as distance to the city centre, nearest highway and work place decreased. Given the different characteristics of the south east and the north west areas, the lack of significance for location of residential land and house price was unexpected. However, it is possible that residential prices would be affected by location, if the distance from Guelph was increased.

In summary, location had a significant effect on farm use prices, but not on residential uses. The south east portion of Wellington County had higher prices for land because of the urban influences of Toronto, Guelph and perhaps Hamilton-Burlington or Cambridge. Moving across the county in a north west direction, prices gradually lowered as urban pressures were reduced. This pattern was not evident for residential uses.

iii) Time

Since price was adjusted by the Consumer Price Index to reduce the effects of inflation, the increases in price from 1961 to 1971 represent an increase in demand. Prices for residential land, farm land and farms all rose significantly at the .05 level from 1961 to 1971. Table 14 was constructed from the regression co-efficients of size and time. In spite of the error in value for prices evident in the large residuals, these data show that price decreased for each additional acre and increased every month. For example, the price for residential land dropped $20.44 for every acre added to the size of the property and increased by $8.08 for every month after January 1961.

The mean price per acre for each year for residential land, farm land and farms (from Table 15) is plotted in Figure 7. Residential land prices were not only higher than farms and farm land, but also increased most from 1961 to 1971. It is possible to speculate that the fluctuations in price of residential land parcels from 1964 to 1971 can be explained in terms of supply and demand, since the number of residential properties formed from 1961 to 1966 was 23, from 1967 to 1970, 88 and in 1971, 6. The demand for residential land began in 1964 when the supply of parcels was limited and therefore higher prices were obtained. The supply of residential land would presumably reflect demand, but with a time lag which would allow for the time needed to perceive demand, time to enact severances and time to place the property on the market. The increase in residential land transactions between 1967 and 1970 reflects this time lag from the increased

TABLE 14

VARIATION IN PRICE PER ACRE FOR EACH USE BY SIZE AND TIME

	Res. Land	Houses	Farm Land	Farms
Size	-20.44	-101.47	-0.53	-0.78
Time	+ 8.08	+ 13.55	+2.54	+1.97

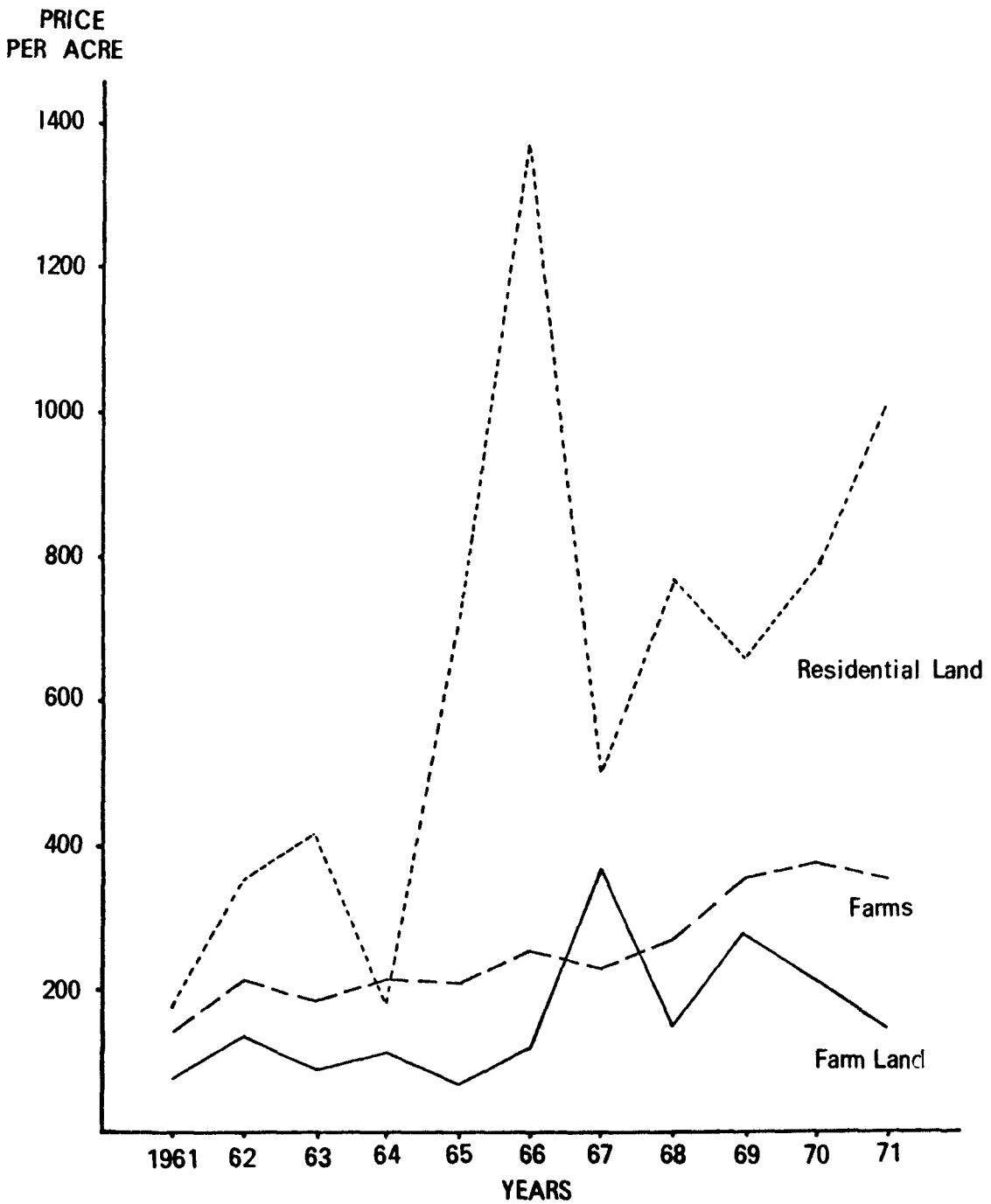
TABLE 15*

MEAN PRICE PER ACRE FROM 1961 TO 1971 FOR EACH USE

	61	2	3	4	5	6	7	8	9	70	1	A
Res.	174	354	414	177	710	1379	499	767	658	783	1096	
Land 1	24	4	19	33	24	17	74	250	287	154	196	
	3	2	3	5	5	5	10	23	22	19	29	126
Houses	1650	1285	4836	4697	2039	1519	1926	2163	2244	6186	4575	
2	21	73	6	5	34	103	40	90	59	32	5	
	3	6	2	3	3	7	3	9	6	7	2	51
Farm	79	136	87	112	66	119	366	143	277	206	140	
Land 3	349	116	182	433	290	341	848	736	578	438	378	
	4	2	3	5	2	3	9	8	6	4	4	50
Farms 4	142	208	184	209	205	232	223	264	355	385	349	
	1127	2071	2260	1975	3217	2612	3218	2004	3389	1619	1721	
	10	16	18	20	26	22	24	18	26	15	13	208
B	20	26	26	33	36	37	46	58	60	45	48	

*See Table 11 for explanation of data.

Figure 7 Mean Price per Acre for Residential land, Farm Land and Farms from 1961 to 1971



demand in 1964. The slight drop in price in 1967 could be explained by the emergence of the new properties on the market. Demand for the properties increased the price in 1968. A continual increase in supply resulted in prices dropping in 1969. Institution of provincial universal subdivision control in June 1970 (Martin 1976), prevented further fragmentation of land, making existing residential land properties more valuable and causing prices to continue to rise. Since the number of parcels increased from 1966, the increase in the number of sales was expected.

This finding was also documented by Martin (1974, 1976). Martin's examination of land dealer activity in the Toronto centred region showed that land prices were greatly influenced by the fragmentation of 100 acre parcels in 1968 and 1969, by fluctuations in the provincial economy and by government policies. Ontario's buoyant economy of 1968 and early 1969 was followed by an economic decline which lasted until mid 1970, when a slow recovery began (Martin 1976). Punter (1974) identified 1966-69 as a period of speculative activity associated with the creation of new properties, with increasing demand for such properties and with rapidly rising land values. Archdekin (1974) observed the same trends in Chinguacousy township in Peel County.

Farm land price fluctuations paralleled prices of residential land with a temporal lag of one year (Table 15, Fig. 7, pgs. 60 and 61). Obviously, this land was in demand for conversion to residential land parcels. The price of residential land was having a ripple effect, clearly demonstrating how land fragmentation caused surrounding land

prices to rise (Wagner 1975).

Since location had a significant effect on farm land price, comparison between the prices of land located within and beyond 35 kilometers of Guelph from 1961 to 1971 was warranted (Table 16). From mean prices in Table 16, the graph in Figure 8 was developed. This graph shows that farm land within 35 kilometers of Guelph was most affected by the changes in residential land prices. This would suggest that the location of three of the four lots which were fragmented, was not representative, and that the majority of subdivision activity was within 35 kilometers of Guelph.

Farm prices were also affected by time. Prices were stable until 1967 and then rose to a new plateau in 1970 (Table 15, Fig. 7, pgs. 60 and 61). This can be explained as a response to either the demand for residential land or economic prosperity. The levelling and decline of farm land and farm price in 1970 and 1971 can be attributed to either the economic recession or the drop in demand after universal subdivision control was introduced.

The large number of transactions which occurred for farms enabled a mean price per year to be tabulated for each location (Table 17). Due to the limited number of transactions and the years of missing data, it was only feasible to plot the values for Location 4, 7 and 8 (Fig. 9). These locations showed a steady increase in price, similar to that in Fig. 5, p. 40. The differences in price between each location was a function of location, with Location 4 having the highest prices, followed by 7 and 8. Prices in Location 4, which was within

TABLE 16

MEAN PRICE PER ACRE FROM 1961-1971 FOR EACH USE BY LOCATION RING

Use	Loc*	61	2	3	4	5	6	7	8	9	70	1	A
Res.	< 35 km	177	354	513	177	685	1256	501	848	647	878	1034	
Land		22	3	13	32	22	14	69	83	148	50	108	
1		2	2	2	5	4	4	8	21	10	6	11	75
	> 35 km	133		196		1867	3309	478	524	670	735	1170	
1		1		6		.5	1	4	62	132	98	81	
		1		1		1	1	2	2	12	13	18	51
Houses	< 35 km	1261	1285	4836	3561	5178	1359	1926	1796	2244	6315	5834	
2		10	73	6	2	2	100	40	85	57	24	.5	
		1	6	2	2	1	6	3	7	6	6	1	41
	> 35 km	2002			5605	1757	17836		19385		5407	4449	
2		11			2	31	1		1		4	4	
		2			1	2	1		2		1	1	10
Farm	< 35 km	80	222	95	106	66	137	456	262	318	437	337	
Land		100	50	131	330	290	86	647	180	481	103	50	
3		1	1	2	4	2	1	7	2	5	1	1	27
	> 35 km	79	70	64	129		113	72	104	66	135	110	
3		249	66	50	102		254	200	555	96	333	327	
		3	1	1	1		2	2	6	1	3	3	23
Farms	< 35 km	167	230	184	208	276	412	401	413	486	530	505	
4		577	1313	847	795	955	677	658	617	1114	598	739	
		5	9	8	8	8	7	7	7	9	5	6	79
	> 35 km	116	171	183	211	175	168	177	196	290	299	230	
4		550	756	1411	1179	2295	1933	2559	1386	2272	1020	980	
		5	7	10	12	18	15	17	11	17	10	7	129

*Road distance

*See Table 11 for explanation of data.

Figure 8 Mean Price per Acre for Farm Land from 1961 to 1971 by Location Ring

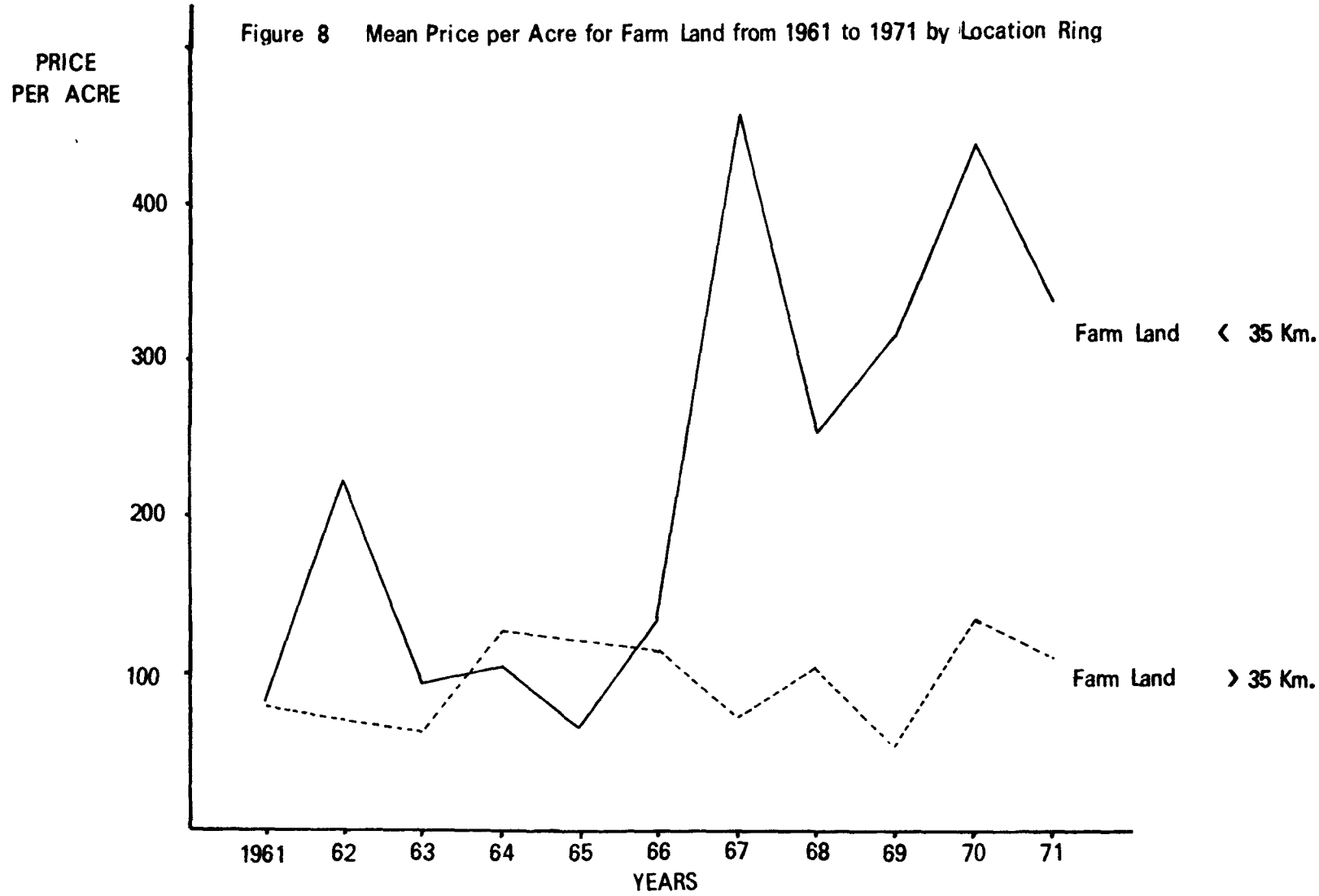


TABLE 17*

MEAN PRICE PER ACRE FOR FARMS BY LOCATION

	Year											
	61	2	3	4	5	6	7	8	9	70	1	A
		327			241		503	391	429	853		431
1		100			188		200	100	200	84		872
		1			2		2	1	2	1		9
		126	213	157	308	297	438		643	416	1182	393
2		193	183	100	329	100	159		327	420	58	1865
		2	2	1	3	1	2		3	3	1	18
	184			462	177	86	225		571	553		331
3	100			75	175	174	474		425	100		1522
	1			1	1	1	2		2	1		9
	117	172	179	237	255	283		347	510		394	283
4	400	284	357	495	189	398		344	385		476	3328
	3	2	3	5	1	4		3	3		3	27
			201		239	146	128	140	194	160		167
5			650		100	400	93	200	750	100		3137
			4		1	4	6	1	6	1		23
		118	180	127	235		314	550	242		424	247
6		370	108	100	150		300	100	202		107	1437
		2	1	1	1		3	2	1		1	12
	121	226	178	213	227	178	264	177	254	318	274	220
7	200	193	662	556	915	861	448	886	640	400	599	6358
	2	1	5	6	8	7	4	7	5	4	5	54
	84	152	87	164	66	199	134	169	237	182	150	150
8	250	564	100	448	527	498	600	100	457	215	150	3908
	2	6	1	4	4	3	4	1	4	2	1	32
				218	180		259	351		331	184	236
9				100	544		100	200		205	231	1380
				1	4		1	2		2	1	11
		415						574		752		497
10		367						74		94		534
		2						1		1		4
	279		169	192	339	763					729	404
11	178		200	100	100	179					98	854
	2		2	1	1	2					1	9
	142	208	184	209	205	231	222	263	354	384	349	
B	1127	2069	2258	1974	3214	2610	3217	2003	3386	1618	1719	25195
	10	16	18	20	26	22	24	18	26	15	13	208

*See Table 11, for explanation of data.

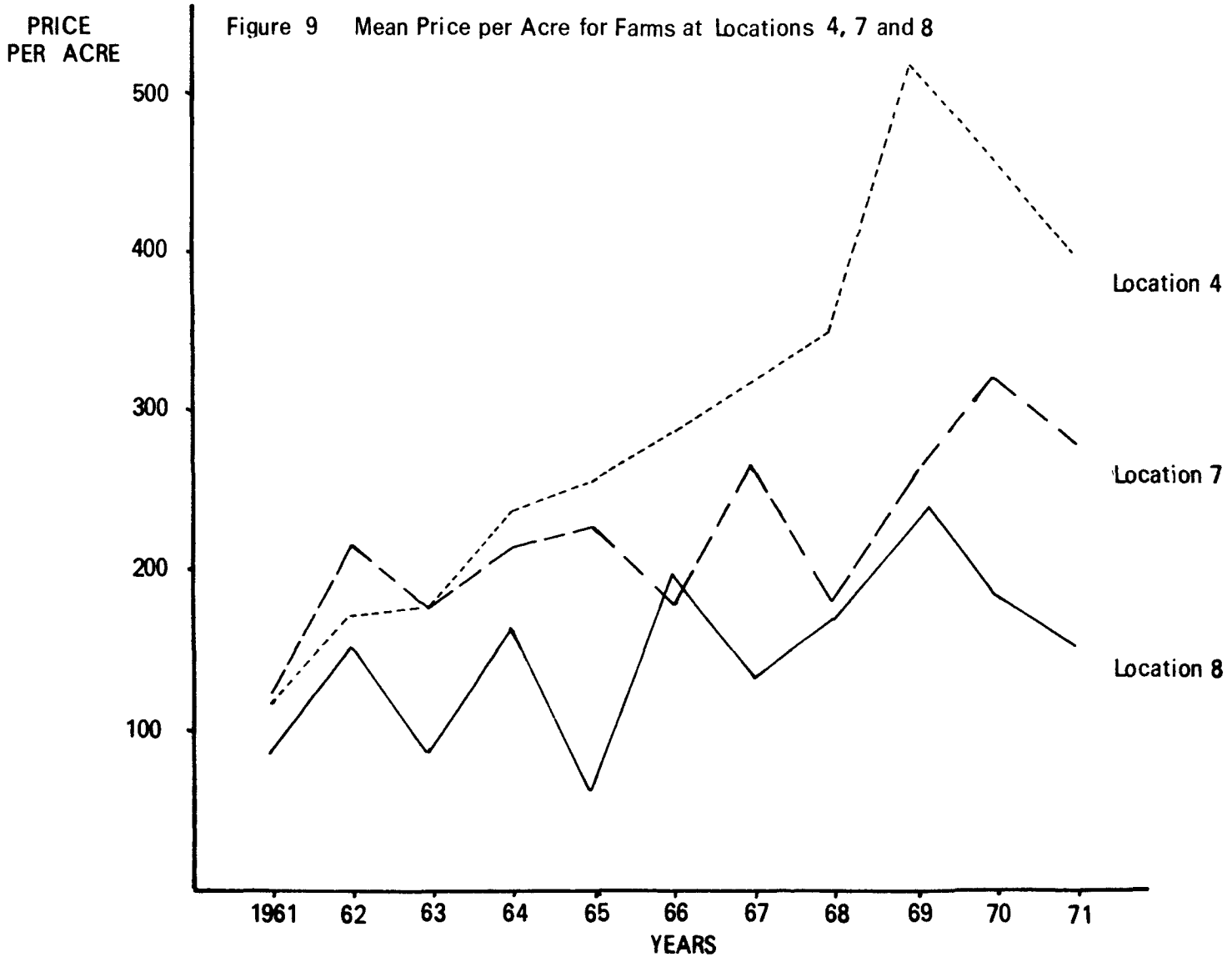


Figure 9 Mean Price per Acre for Farms at Locations 4, 7 and 8

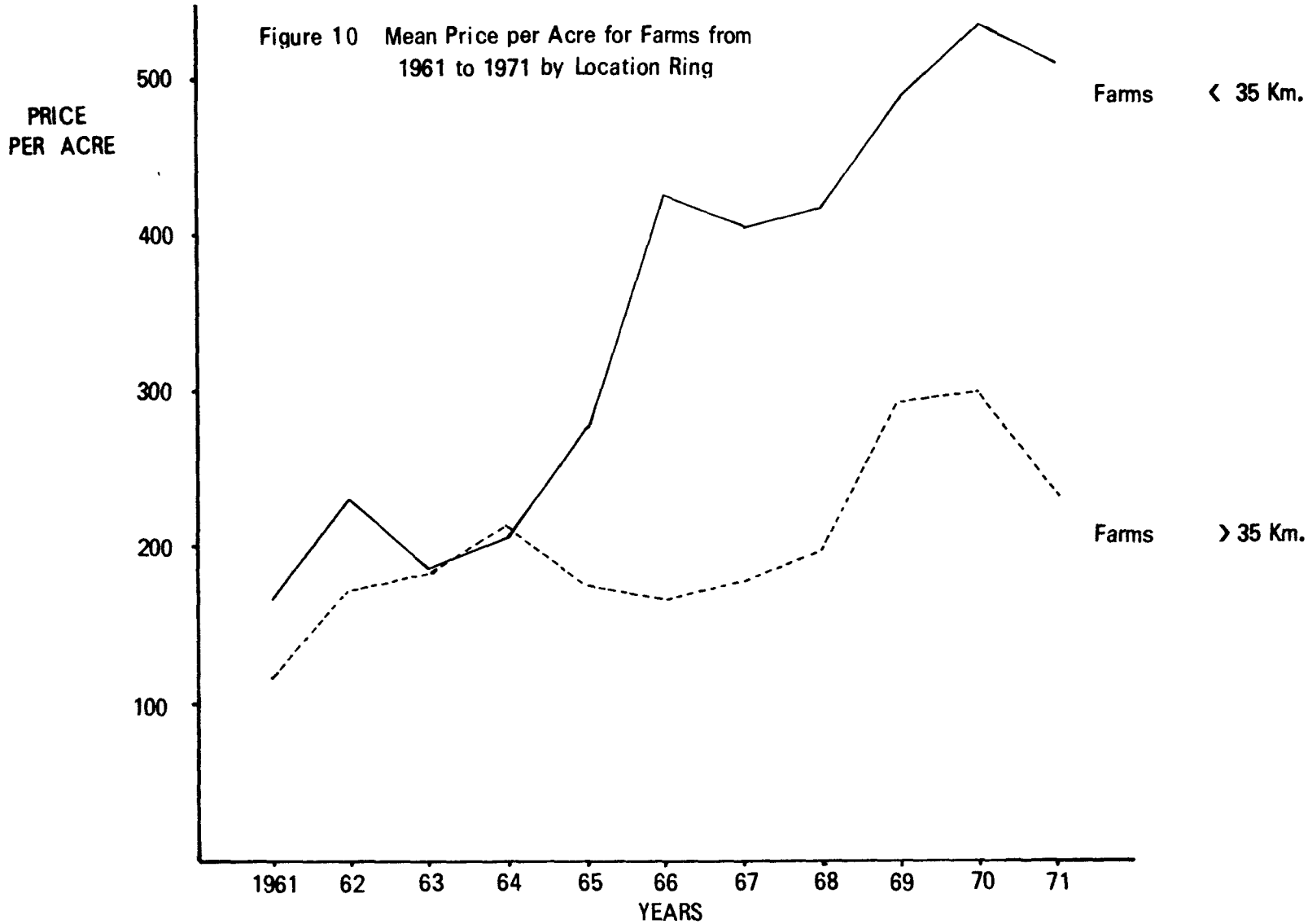
35 kilometers of Guelph were not greatly affected by land fragmentation.

Examination of farms within and beyond 35 kilometers of Guelph (Table 16, Fig. 10) revealed a different pattern from the one outlined above. Prices within 35 kilometers rose from 1964 to 1966, remained stable to 1968 and then peaked in 1970. Beyond 35 kilometers, the price dipped between 1964 and 1968, when it rose sharply before dropping off in 1970. If the graph for prices in Location 4 (Fig. 4) was representative of the central area of Wellington County, then it could be assumed that the change in price was occurring mainly in the south east portion of the County. Since urban pressures were continually increasing in this area from 1961 to 1971, the resulting increase in land prices was expected. The north west section of the County or the area beyond 35 kilometers, which was dominated by agricultural activity and was not subject to very strong urban pressures, was relatively unaffected by the increases in residential land prices. However, the combination of a buoyant economy and land fragmentation did have an impact on land prices in 1968 and 1969.

The price of houses was not affected by time suggesting that there was no increase in demand. Martin (1976) noted that during the 1960's there was an increasing demand for second homes, estates and hobby farms throughout Ontario. He claimed that this demand was the cause of land fragmentation into ten acre parcels around the Toronto urban fringe. It would therefore appear that people preferred to build their own homes rather than buy existing buildings.

The distribution of the number of sales for all uses, except

Figure 10 Mean Price per Acre for Farms from 1961 to 1971 by Location Ring



residential land was fairly even between 1961 and 1971 (Table 14, pg. 59). There was a slight tendency for transactions to be more frequent from 1965 to 1969 for farms and from 1967 to 1969 for farm land. House sales peaked in 1968 and residential land sales rose sharply from 1966 to 1971. This increase in sales activity was also observed by Martin (1974, 1976), Punter (1974) and Archdekin (1974).

In summary, land prices in Wellington County were greatly affected by land fragmentation from 1966 to 1970 and the prevailing economic conditions at that time. The effect of these factors was most pronounced on residential land and appeared to have spillover effects on farm land and farms. Properties within 35 kilometers of Guelph were most influenced. The lack of demand for houses could be explained by the public's preference for building properties.

iv) Size

Price per acre generally decreased with an increase in the number of acres (Table 15, pg. 60). Higher prices per acre were obtained for small parcels of land. This was observed by Rodd (1975, 1976), however Brooksbank (1976) found this relationship only with simple residences less than 10 acres in size. Punter (1974) based his analysis of property prices on acreage sizes, rather than land use and found that in general, the smaller the parcel, the higher the price per acre. Martin (1974) who also used parcel size classes as the unit for analysis but assigned representative land uses to each category, found a similar pattern.

The effect of size on residential land and house prices was

expected and the same explanations can be applied to both. A lower transaction price is usually charged for a small property, although the actual price per acre is higher. Conversely, a large property with a lower price is often unaffordable for the average person. Error in price prediction was large for residential uses on properties less than ten acres in size suggesting that the relation between size and price was not linear. Parcel size would affect the slope of the curve.

Parcels of farm land were not affected by size. Since this use had the lowest prices per acre, it was possible that sale prices were based on a per acre figure, rather than total acreage. The range in size of farm land properties was 50 to 160 acres, with most of the parcels falling between 50 and 100 acres.

Size was significant for farm prices. Farm properties ranged from 50 to 325 acres. By excluding farms of less than 50 acres, the building component of the price was considerably reduced. In large properties of land, the dwelling component is insignificant or relatively constant (Brooksbank 1976). The buildings are only a small portion of the total price and are considered part of the land price (Punter 1974). Since size was significant, it was possible that the value of farm buildings did have some effect on the price, however the wide range in farm sizes would also have a bearing.

v) Soil

Soil was not significant in explaining price variations for any use. The composition of the sample (Table 18) was predominantly Class 1

TABLE 18

SOIL CLASSIFICATION BY ACRES FOR STUDY AREA
AND TRANSACTED PROPERTIES

Soil Classification	Study Area		Transactions	
	Acres	%	Acres	%
1	40653.0	72.62	22975.5	70.34
2	5102.4	9.11	2314.9	7.09
3	8069.5	14.41	5081.8	18.00
4	431.0	.77	460.0	1.41
5	300.0	.54	100.0	.34
6	1426.2	2.55	930.5	2.85
	55982.1	100.00	32662.7	100.00

soils (72 percent) and the transacted acreages reflected this distribution. Meek (1968) found that soil quality, soil condition and state of drainage were of low significance in explaining variations in farm sale prices from 1960 to 1966 in West Garafraxa and Nichol townships. Larger scale studies done by Rodd (1975, 1976), Brooksbank (1976) and VanVuuren (1972) found that soil was a significant factor affecting land prices or values. The lack of variation in soil quality was unexpected since Russwurm (1971) and Dahms (1978) both observed that soil conditions throughout the townships of Wellington County varied. The percentage of Class 1 soil found by Dahms for each townships was Puslinch 5.6%, Erin 23%, Eramosa 45.5%, West Garafraxa 57%, Nichol 70.8%, Minto 48.8%, West Luther 63%, Peel 71.5%, Maryborough 72.4% and Arthur 75.6%. Perhaps soils would have been significant if it had been possible to determine a soil classification for each property.

E) Conclusion

Location was the major determinant of land uses in the countryside of Wellington County. The major change in land use was the conversion of 1600 acres of farmland to other uses, 1120 of which became residential. Extrapolation of this result suggested that 27.5 percent of all farmland lost between 1961 and 1971 occurred in the open countryside. In general, the variables selected for analysis were poor predictors of price. Land use determined the extent of their significance. Location affected the prices of farm activities, but not residential uses. There was an increase in demand for all uses from 1961 to 1971 except

houses. Size had a significant bearing on prices for all uses except farm land. Given the variety in soil throughout the county, an effect on price should have been evident, but since the sample did not reflect the variations, no significance was found.

Chapter 4

CONCLUSION

The purpose of this study was to determine the effects of location, time, use, soil and size upon the spatial variation in price in the open countryside for Wellington County from 1961 to 1971. Land uses and land use change were examined generally. Urban influences in rural areas caused a loss of farmland and an increase in land prices. High land prices are a serious impediment to agriculture because farm expansion and investment are inhibited. Due to this danger to agriculture, studies dealing with spatial variation of price and factors affecting price are necessary.

The main findings of this study are best summarized by relating back to the hypotheses presented in Chapter 1. In general, all the hypotheses were supported except for Hypothesis 5. Land use was the most important variable affecting price and factors affecting price varied according to land use.

Hypothesis 1. Agricultural land uses will have the lowest price per acre. In areas where there was a large number of non-farm residences, surrounding farm values will be higher. The findings of this study supported this hypothesis. Farm land received the lowest price per acre, while houses had the highest. Residential properties were concentrated in the south west section of the County and highest prices for farm and farm land were paid in this area.

Hypothesis 2. Land prices will increase from 1961 to 1971. The increase in sales activity from 1966 to 1969 in the Toronto-centred region will also be present in Wellington County. Demand for all land uses except houses, increased during the study time. The years 1966 to 1969 showed increased sales activity and dramatic price increases for residential land and farm land, and to a lesser extent farms occurred. A large number of residential land parcels were created during this time, and the effects of this land fragmentation on land price was readily apparent. The vigorous economy at this time, was probably an important contributing factor. That houses were not in demand is perhaps explained by the preference for building homes, rather than buying existing houses.

Hypothesis 3. Land price will increase as the distance to Guelph decreases. Location with respect to Guelph was only significant for farm uses. This difference in price was apparent in the specified locations and in the location rings. The prices of residential uses was not affected by location. The literature indicated that Clonts (1970) was the only author to have similar findings. Specific reasons for this result were not obvious. Location had some effect on house price (see Table 13), but not when the other variables were included. It is possible that residential prices are constant over a larger area surrounding a city.

Hypothesis 4. Land prices per acre would increase as size of property decreased. The prices per acre of all land uses, except farm land, significantly decreased as the size of the property increased.

The regression co-efficients generated by the analysis of covariance indicated that the actual price per acre for farm land did decline with increasing size. The range in property size of farm land was also small.

Hypothesis 5. Higher prices will be paid for higher quality soils. In Wellington County, soil had no effect on land prices for any use.

The major land use in the countryside was farm-related and the increase in the number of residential uses accompanied by a reduction in the number of farms was the dominant change. The loss of farmland to other uses represented approximately 28 percent of the total loss in the county. Conversion of farmland to residential uses was the major cause of this loss.

Since the variables which were selected for study were generally poor predictors of price, it suggests that additional factors should have been included. The limitations of this study prevented examination of the following factors, but if it had been possible to conduct the required detailed field work, the inclusion of these variables could have made a significant contribution to the study. Population growth as an indicator of demand would have increased the R-square values. Characteristics of the buyer and seller of land would have been appropriate, although actual identity of these people is difficult to discern from the assessment rolls. Building value is obviously the dominant component of house sales, but actual site characteristics could also have a bearing. The nature of the agricultural enterprise, whether it

be crop or animal husbandry could influence price. It would appear that the explanation of price formation is complicated, since VanVuuren (1972) using 17 variables, was only able to explain 71 percent of the variation in agricultural values.

The use of location sectors to establish areas of Wellington County which would be susceptible to urban influence from centres other than Guelph was inadequate. Urban centres exert too broad an influence to be contained within a 30 degree sector and there was no method of determining the comparative strength of influence between two cities. Studies have shown that urban centres such as Guelph, Kitchener-Waterloo and Toronto affect parts of Wellington County, but the influence of Cambridge or Hamilton-Burlington could only be presumed.

The undesirable effects of residential development upon farmland has been recognized by all of the townships, since control over estate severances was instigated after 1971. That there is now control, suggests that there should be a reduction in pressure on residential land and perhaps the demand for existing houses will now increase, since building is restricted.

Further study in the area of land price is still warranted. Recommendations which were made for future research in Countryside Planning; A Pilot Study of Huron County, 1976 are relevant. This report advises that the relationships between the following be determined:

1. ....the degree and density of non-farm related development and land values.....

2. ....the impact of shifts in farming operations and activity as a result of changing land values.....

3. ....changes in rural land values and rates of loss of farmland and change in farming operations..... (1976, p. 188).

Based on the results of this study, it is suggested that Erin township would be a good area for study of these relationships. Farming is still viable and estate-residential severances are still permitted in relatively large numbers. Residential land has been steadily increasing in the countryside of the township from 1966 and its effects on farm land prices and farm operations should be readily apparent.

In addition to the above, a study of Wellington County between 1966 and 1976, concentrating on the countryside land in the immediate vicinity of towns or hamlets, would more clearly show the impact of non-farm development. Responses of individual townships to this pressure could then be compared. Land values for specific site characteristics for non-farm uses and this impact on surrounding land should be investigated. If Rodd's (1976) findings that estates prefer Class 4 soils are correct, perhaps the use of this land does not influence farmland prices as much as residential development on Class 1 or 2 soils.

In conclusion, this study has provided an increased understanding of the operation of the rural land market and its effects upon farmland. It is hoped that the insights gained from this paper will encourage further study.

APPENDICES

APPENDIX 1

DESCRIPTIVE LEGEND FOR SOIL CAPABILITY FOR AGRICULTURE

CLASS 1 - Soils in this class have no significant limitations in use for crops. The soils are deep, are well to imperfectly drained, hold moisture well, and in the virgin state were well supplied with plant nutrients. They can be managed and cropped without difficulty. Under good management they are moderately high to high in productivity for a wide range of field crops.

CLASS 2 - Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices. The soils are deep and hold moisture well. The limitations are moderate and the soils can be managed and cropped with little difficulty. Under good management they are moderately high to high in productivity for a fairly wide range of crops.

CLASS 3 - Soils in this class have moderately severe limitations that restrict the range of crops or require special conservation practices. The limitations are more severe than for Class 2 soils. They affect one or more of the following practices: timing and ease of tillage; planting and harvesting; choice of crops; and methods of conservation. Under good management they are fair to moderately high in productivity for a fair range of crops.

CLASS 4 - Soils in this class have severe limitations that restrict the range of crops or require special conservation practices, or both. The limitations seriously affect one or more of the following practices: timing and ease of tillage; planting and harvesting; choice of crops; and conservation methods. The soils are low to fair in productivity for a fair range of crops but may have high productivity for a specially adapted crop.

CLASS 5 - Soils in this class have very severe limitations that restrict their capability to producing perennial forage crops, and improvement practices are feasible. The limitations are so severe that the soils are not capable of use for sustained production of annual field crops. The soils are capable of producing native or tame species of perennial forage plants, and may be improved by use of farm machinery. The improvement practices may include clearing of brush, cultivation, seeding, fertilizer, or water control.

CLASS 6 - Soils in this class are capable only of producing perennial forage crops, and improvement practices are not feasible. The soils provide some sustained grazing for farm animals, but the limitations are so severe that improvement by use of farm machinery is impractical. The terrain may be unsuitable for use of farm machinery, or the soils may not respond to improvement, or the grazing season may be very short.

CLASS 7 - Soils in this class have no capability for arable culture or permanent pasture. This class also includes rockland, other non-soil areas, and bodies of water too small to show on the maps.

CLASS 0 - Organic Soils (not placed in capability classes).

SOURCE: Canada Land Inventory, Soil Capability for Agriculture, Map #40-P-O, Ottawa: Surveys and Mapping Branch, Department of Energy, Mines and Resources, 1968.

APPENDIX 2

FARM LAND AREA IN WELLINGTON COUNTY FROM 1951 TO 1971

	Farm Area 1951 (acres)	Farm Area 1961 (acres)	Farm Area 1971 (acres)	1951-61 Change	1961-71 Change
Wellington County	606,630	570,823	512,595	-35,807	-58,228
Arthur	66,674	63,530	57,417	- 3,144	- 6,113
Eramosa	41,556	40,647	35,627	- 909	- 5,020
Erin	64,736	59,243	45,305	- 5,493	-13,938
Garafraxa W.	45,794	43,251	40,191	- 2,543	- 3,060
Guelph	36,115	31,757	29,129	- 4,358	- 2,628
Luther W.	45,896	42,231	40,415	- 3,665	- 1,815
Maryborough	53,303	51,646	51,429	- 1,874	- 217
Minto	70,991	67,653	64,396	- 3,338	- 3,257
Nichol	26,215	26,437	25,087	+ 222	- 1,350
Peel	74,372	72,162	65,135	- 2,210	- 7,027
Pilkington	28,779	28,055	25,561	- 724	- 2,494
Puslinch	52,199	44,428	32,686	- 7,771	-11,742

SOURCE: Census of Canada

APPENDIX 3

CONSUMER PRICE INDEX

Date	01	02	03	04	05	06	07	08	09	10	11	12
61 01 00	75.0	74.8	74.9	74.9	74.8	74.8	74.8	74.9	74.9	75.0	75.3	75.3
62 01 00	75.3	75.3	75.3	75.6	75.5	75.7	76.0	76.2	76.0	76.3	76.5	76.5
63 01 00	76.6	76.6	76.6	76.8	76.8	77.1	77.4	77.7	77.4	77.5	77.7	77.9
64 01 00	77.9	78.0	78.1	78.3	78.3	78.5	79.0	78.9	78.7	78.7	78.9	79.4
65 01 00	79.5	79.6	79.7	79.9	80.1	80.7	81.0	80.9	80.7	80.8	81.3	81.7
66 01 00	81.9	82.5	82.6	83.1	83.2	83.4	83.7	84.1	84.2	84.3	84.4	84.6
67 01 00	84.7	84.8	85.0	85.8	85.9	86.4	87.2	87.6	87.4	87.3	87.6	88.1
68 01 00	88.5	88.6	88.9	89.4	89.4	89.7	90.3	90.5	90.8	91.0	91.4	91.7
69 01 00	91.9	91.9	92.4	93.4	93.6	94.4	94.8	95.1	94.9	95.1	95.5	95.9
70 01 00	96.1	96.5	96.6	97.2	97.2	97.4	97.8	97.8	97.6	97.7	97.7	97.3
71 01 00	97.7	98.1	98.4	99.1	99.5	99.7	100.5	101.2	101.0	101.1	101.5	102.2

Source: Consumer Prices and Price Index, Cat. 62-101, Qtrly.

Note: As of October 1978 the weights of the CPI were revised using 1974 expenditure patterns. The time reference base remains 1971 = 100 unless stated otherwise.

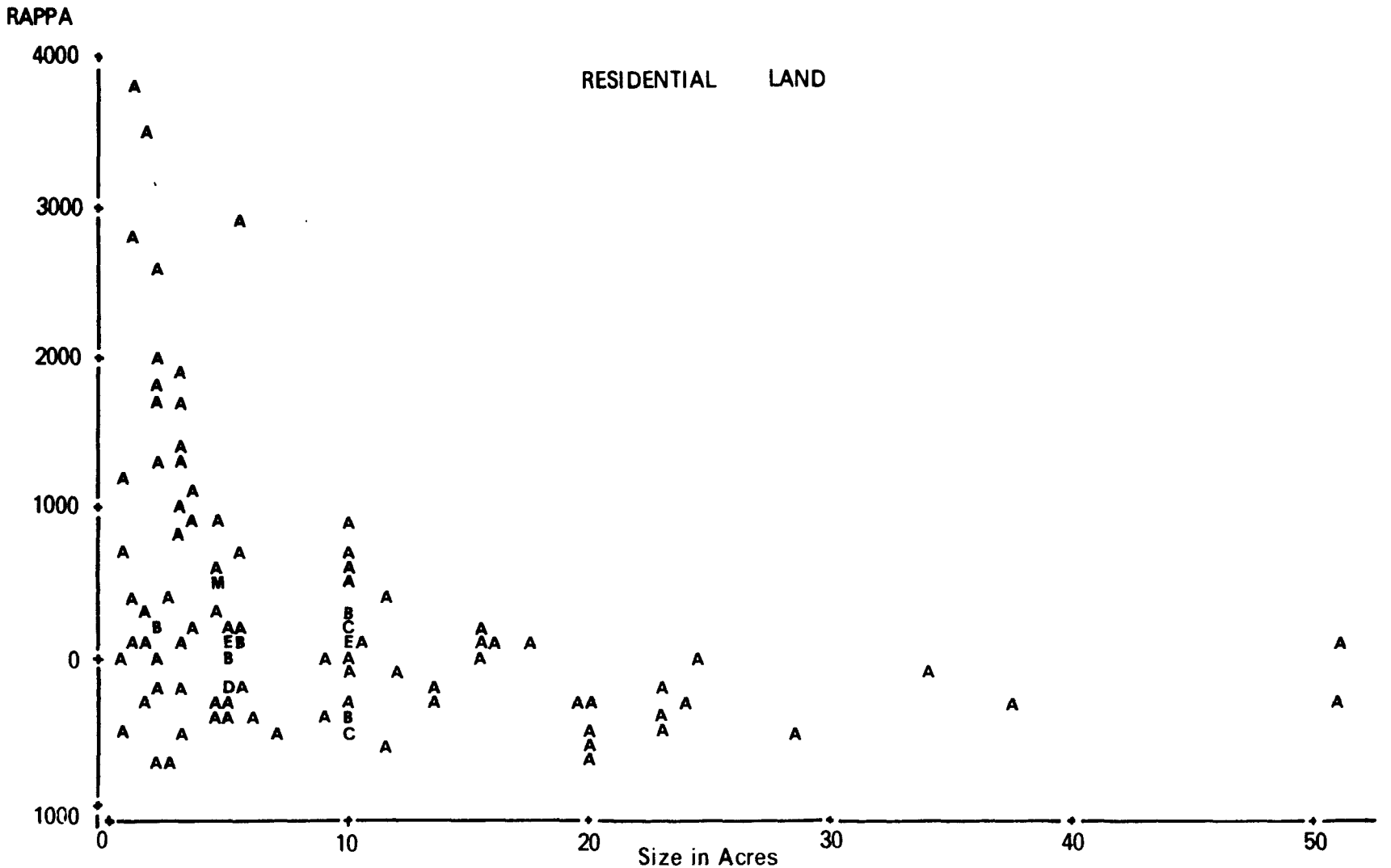
APPENDIX 4

Residual Plots by Use from Preliminary Model of Weighted Analysis of Covariance where;

RAPPA = Residual Adjusted Price Per Acre

A = 1 Observation

B = 2 Observations, etc.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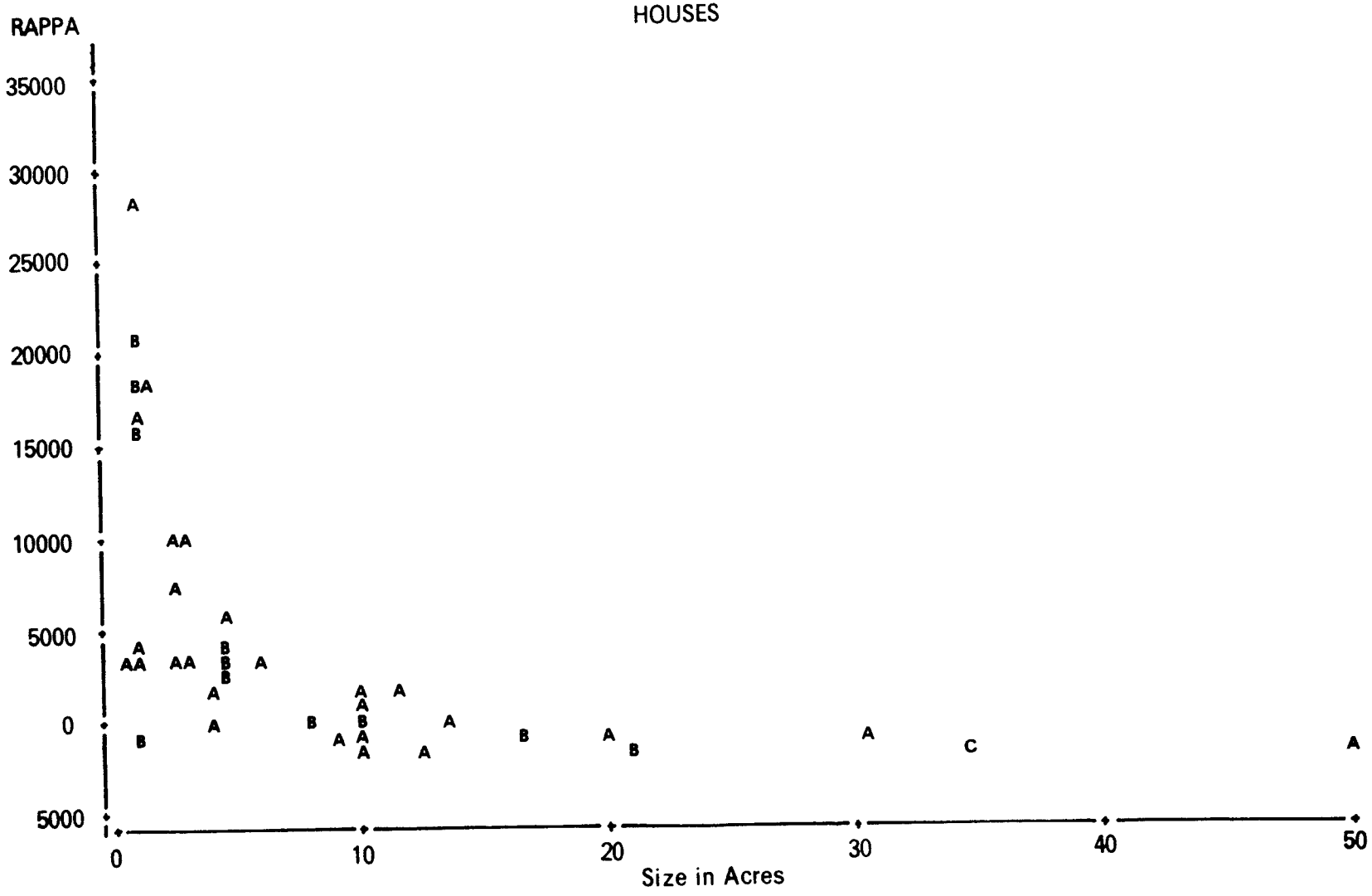
RESIDENTIAL LAND
0
10
20
30
40
50
Size in Acres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20000
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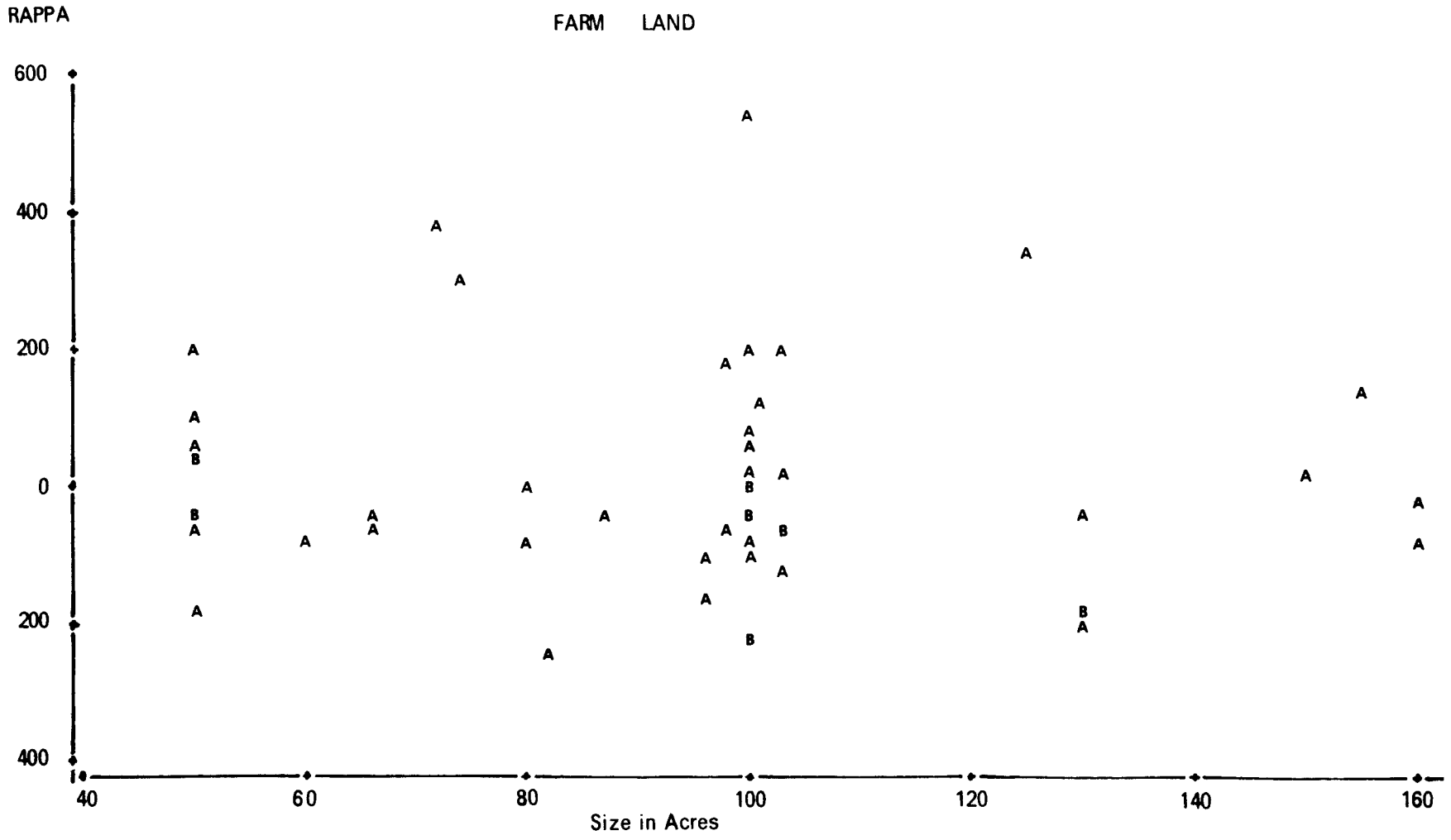
5000
0
10
20
30
40
50
Size in Acres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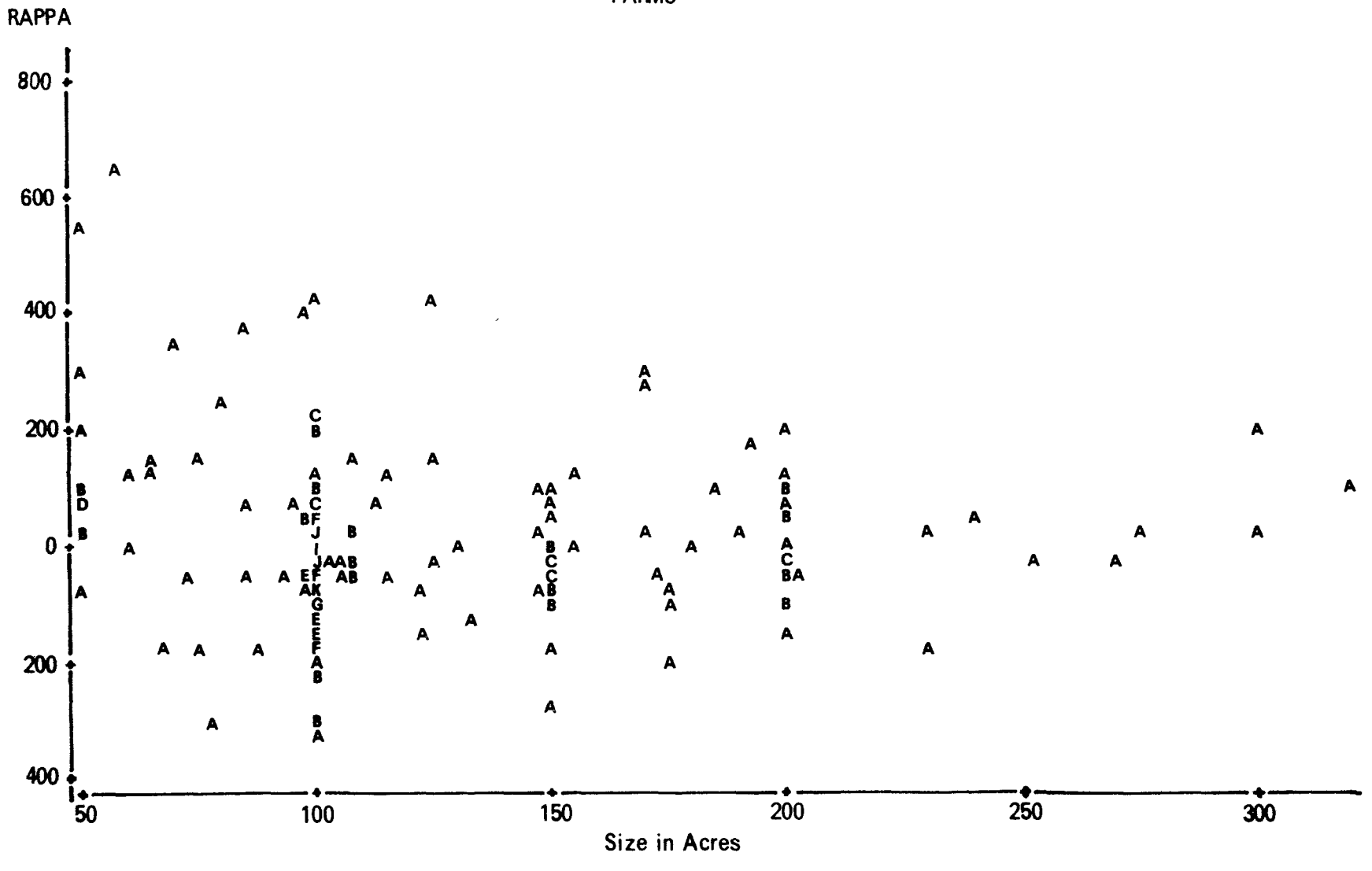
FARM LAND
600
400
200
0
200
400
40
60
80
100
120
140
160
Size in Acres


FARMS
RAPPA
800
600
400
200
0
200
400
50
100
150
200
250
300
Size in Acres

APPENDIX 5

FITTED REGRESSION EQUATIONS

A) PRELIMINARY MODEL

$$Y_{ijk}=\mu_1+\alpha_1+\rho_j+\tau_k+\beta_1 X_{1ijk}+\beta_2 X_{2ijk}+\xi_{ijk}$$

$$=307.99 + \begin{matrix}1.-175.68\\2.-145.65\\3.-187.33\\4.-160.32\\5.-289.78\\6.-153.61\\7.-232.97\\8.-267.77\\9.-122.22\\10.\ \ 78.29\\11.\ \ 0.00\end{matrix} + \begin{matrix}1.\ 227.88\\2.1758.98\\3.-173.31\\4.\ \ 0.00\end{matrix} + \begin{matrix}1.103.50\\2.219.31\\3.171.23\\4.\ \ 6.88\\5.128.10\\6.\ \ 0.00\end{matrix} + (2.26 \pm 1.30)\, X_1 + (-0.90 \pm .88)\, X_2$$

where
- Y_{ijk} = adjusted price per acre
- μ_1 = population mean
- α_1 = location (1-11)
- ρ_j = use (res. land, houses, farm land or farm)
- τ_k = soil (class 1-6)
- β_1 = regression co-efficient for time
- X_1 = time (months)
- β_2 = regression co-efficient for size
- X_2 = size (acres)
- ξ_{ijk} = residual

B) LAND USE MODELS

$$Y_{ij} = \mu_1 + \alpha_1 + \Upsilon_j + \beta_1 X_{1ij} + \beta_2 X_{2ij} + \xi_{ij}$$

where Y_{ij} = adjusted price per acre

μ_1 = population mean

α_1 = location

Υ_j = soil

β_1 = regression coefficient for time

X_1 = time (months)

β_2 = regression coefficient for size

X_2 = size (acres)

RESIDENTIAL LAND

$$Y_{ij} = 51.71 + \begin{matrix} 1.\ 122.94 \\ 2.\ 175.52 \\ 3.\ 298.98 \\ 4.\ 767.19 \\ 6.\ -403.19 \\ 7.\ 712.82 \\ 8.\ -114.73 \\ 9.\ \ 25.82 \\ 10.\ 249.78 \\ 11.\ \ 0.00 \end{matrix} + \begin{matrix} 1.\ -21.83 \\ 2.234.75 \\ 3.237.32 \\ 6.\ \ 0.00 \end{matrix} + (8.09 \pm 3.78)\ X_1 + (-20.44 \pm 7.17)\ X_2$$

HOUSES

$$Y_{ij} = 3216.20 + \begin{matrix} 1.\ \ 201.21 \\ 2.\ -362.72 \\ 4.\ 4148.58 \\ 6.\ -1850.14 \\ 7.\ -1592.84 \\ 8.\ \ -40.35 \\ 9.\ 6232.16 \\ 10.\ -740.56 \\ 11.\ \ 0.00 \end{matrix} + \begin{matrix} 1.\ 319.87 \\ 2.2155.96 \\ 3.\ \ 0.00 \\ 6.\ \ 0.00 \end{matrix} + (13.55 \pm 30.48)\ X_1 + (-101.47 \pm 79.80)\ X_2$$

FARM LAND

$$Y_{ij} = 67.55 + \begin{matrix} 1.\ 219.72 \\ 2.\ \ 58.27 \\ 3.-195.31 \\ 4.-248.87 \\ 6.-213.91 \\ 7.-295.65 \\ 8.-280.28 \\ 9.-270.00 \\ 10.\ 138.74 \\ 11.\ \ 0.00 \end{matrix} + \begin{matrix} 1.246.04 \\ 2.295.30 \\ 3.102.82 \\ 6.\ \ 0.00 \end{matrix} + (1.73 \pm 1.33)\ X_1 + (-0.47 \pm 1.72)\ X_2$$

FARMS

$$Y_{ij} = 328.84 + \begin{matrix} 1.-\ \ 4.17 \\ 2.-\ 22.68 \\ 3.-\ 63.08 \\ 4.-\ 67.99 \\ 5.-185.96 \\ 6.-\ 59.67 \\ 7.-135.89 \\ 8.-186.51 \\ 9.-128.31 \\ 10.\ 201.04 \\ 11.\ \ 0.00 \end{matrix} + \begin{matrix} 1.-8.99 \\ 2.49.80 \\ 3.73.38 \\ 4.-8.04 \\ 5.25.88 \\ 6.\ 0.00 \end{matrix} + (1.97 \pm .52)\ X_1 + (-0.78 \pm .33)\ X_2$$

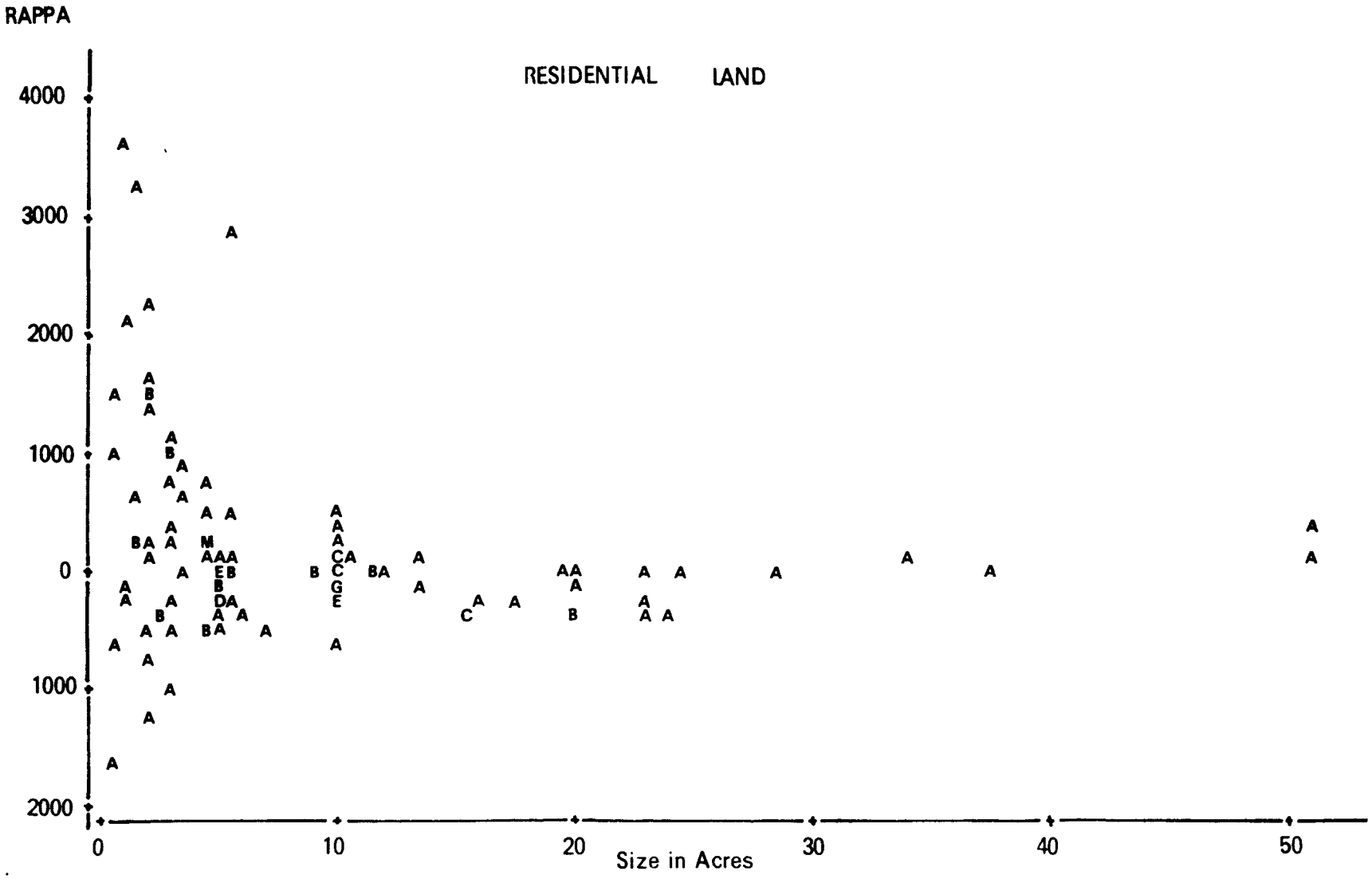
APPENDIX 6

Residual Plots of Weighted Analysis of Covariance by Land Use Model where:

RAPPA = Residual Adjusted Price Per Acre

A = 1 Observation

B = 2 Observations, etc.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2000
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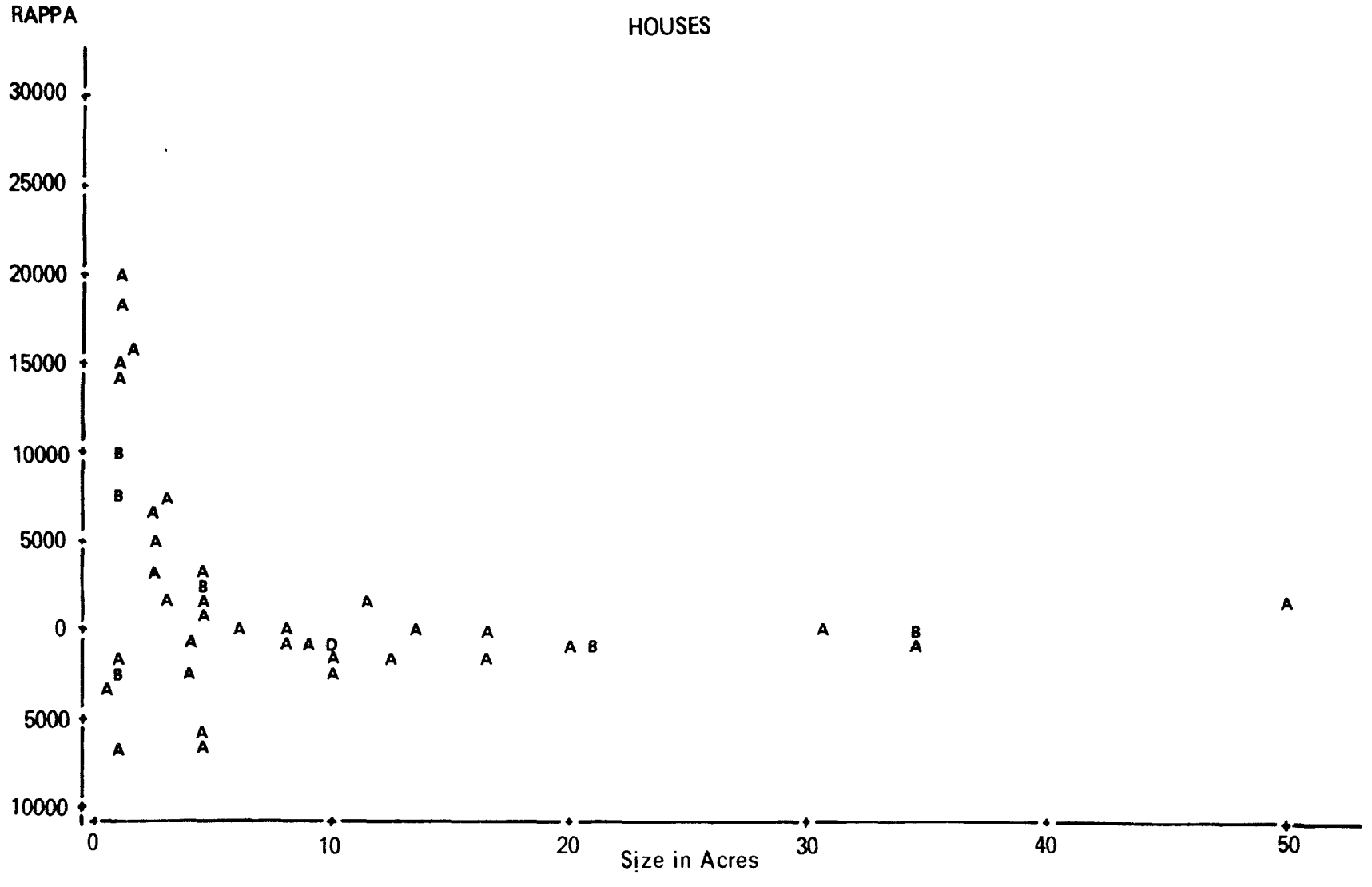
Size in Acres


RAPPA
HOUSES
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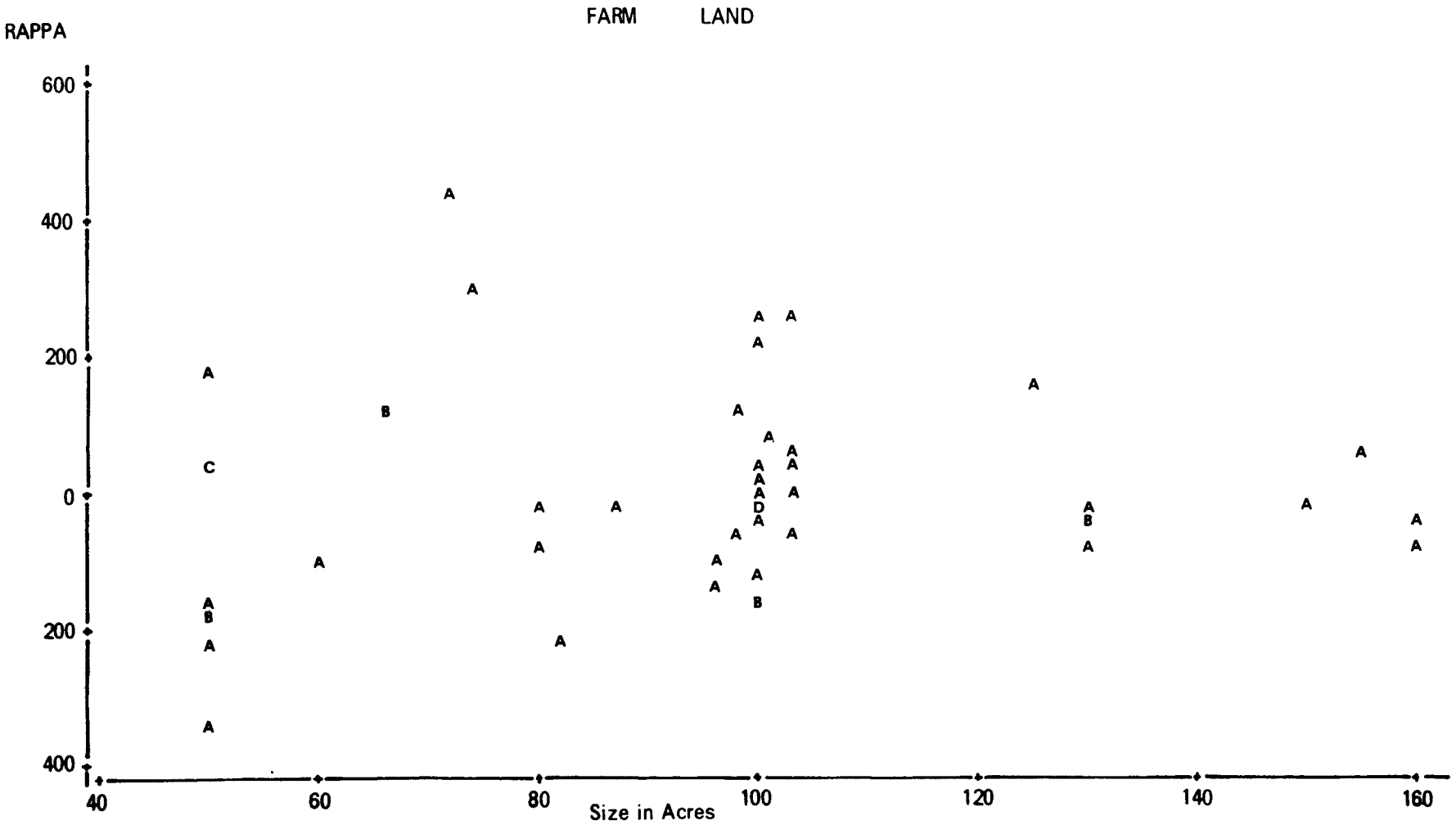
Size in Acres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200
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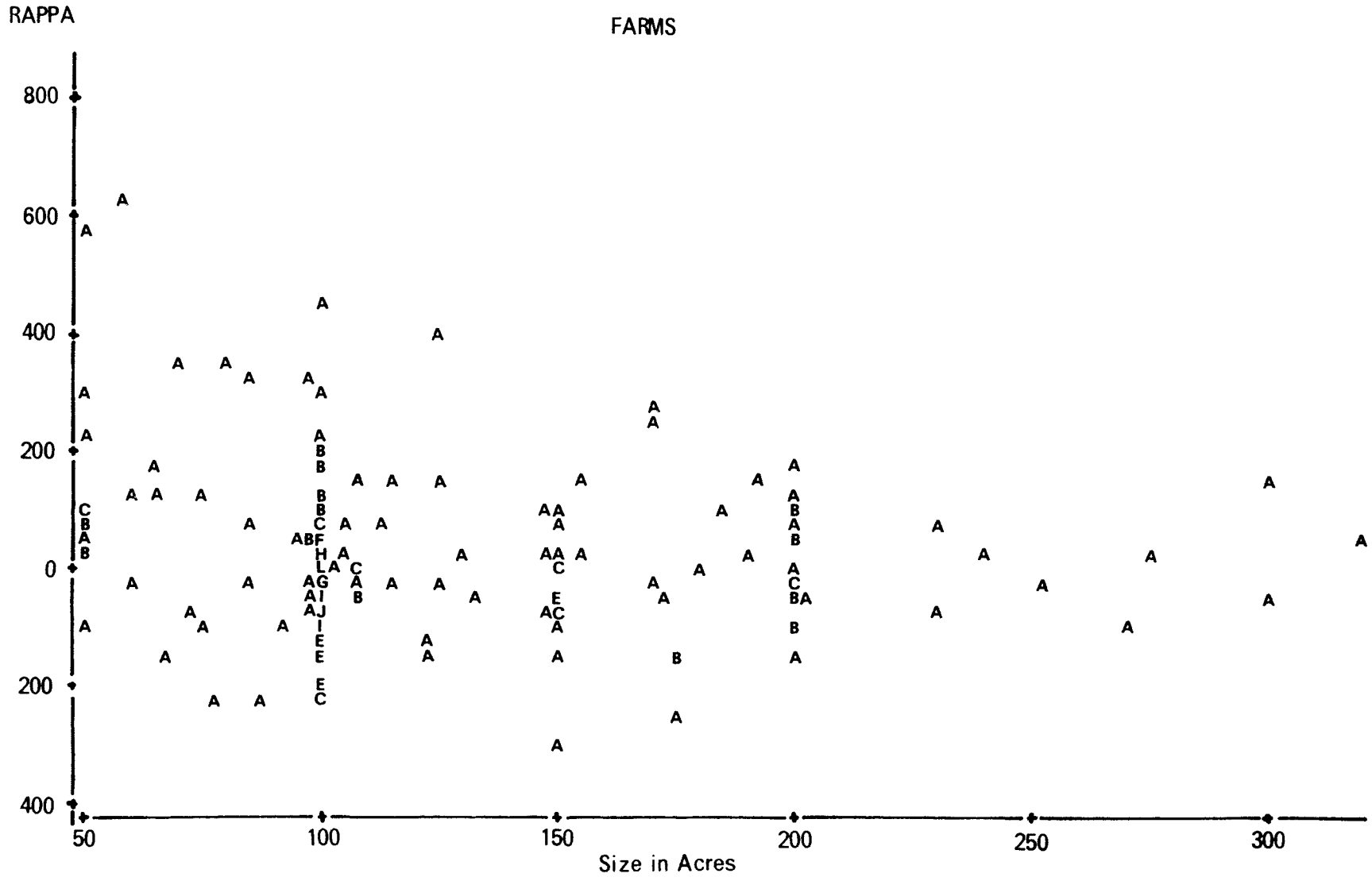
Size in Acres


RAPPA
FARMS
800
600
400
200
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200
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100
150
200
250
300
Size in Acres

BIBLIOGRAPHY

Archdekin, L. Changes in Land Ownership Patterns and Land Values in Chinguacousy Township. Unpublished B.A. Thesis, University of Guelph, 1974.

Assessment Rolls (Eramosa, Erin, Minto, Peel, Puslinch, West Garafraxa Townships), 1961-71.

Assessment Rolls (Arthur Township), 1961, 63, 65-71.

Assessment Rolls (West Luther Township), 1961, 1966-68, 1970-71.

Assessment Rolls (Nichol Township), 1961-68, 1970-71.

Assessment Rolls (Maryborough Township), 1961-67, 1969-71.

Barr, A. J., Goodnight, J. H., Sall, J. R., and Nelwig, J. T., A User's Guide to SAS. Raleigh: North Carolina, SAS Institute Inc., 1976.

Brigham, E. F. "The Determinants of Residential Land Values." Land Economics, Vol. 41, 1965, p. 325-334.

Brooksbank, R. J. Agricultural Land Resources and Land Use Change in an Urbanizing Region. Unpublished M.Sc. Thesis, University of Guelph, 1976.

Bryant, C. R. "The Anticipation of Urban Expansion." Geographica Polonica, Vol. 28, 1974, p. 93-115.

Bryant, C. R. "Farm-Generated Determinants of Land Use Change in the Rural-Urban Fringe 1961-1976." Ottawa: Environment Canada, 1975.

Bryant, C. R. "Some New Perspectives on Agriculture Land Use in the Rural-Urban Fringe." Ontario Geography #10, 1976, p. 64-78.

Canada. Census of Canada: Agriculture, Vol. VI, Part 11, 1951, Vol. 5.2-2, 1961, Vol. IV, Part 11, 1971.

Canada. Canada Land Inventory, Soil Capability for Agriculture, Map #40-P-O, Ottawa:Surveys and Mapping Branch, Dept. of Energy, Mines and Resources, 1968.

Clark, J. H. How Much Can You Afford to Pay for Land? Unpublished Mimeo., School of Agricultural Economics and Extension Education, University of Guelph, 1976.

Clawson, M. "Urban Sprawl and Speculation in Suburban Land.", Land Economics, Vol. 38, 1962, p. 99-111.

Clonts Jr., H. A. "Influence of Urbanization on Land Values at the Urban Periphery." Land Economics, Vol. 46, 1970, p. 489-496.

Crerar, A. D. "Loss of Farmland in the Growth of Metropolitan Regions of Canada." Resources for Tomorrow Conference, Background Papers, Department of Northern Affairs and Natural Resources, 1962.

Dahms, F. A., Pearson, N. A Study of the Fringe Areas North of Metropolitan Toronto. Report to the Central Ontario Regional Development Council, University of Guelph, 1969.

Dahms, F. A. and Forbes, J. A. "Central Places in the 'Golden Triangle': The Guelph System 1970." In the Waterloo County Area, Selected Geographical Studies, p. 113-127. Edited by A. G. McLellan. Geography Department, University of Waterloo, 1971.

Dahms, F. A. Historical Background; Population Change and Agriculture: Wellington County, 1840-1976. Centre for Resources Development, Pub. 89, Studies in Rural Adjustment, Department of Geography, University of Guelph, Report #7, 1978.

Draper, N. R. and Smith, H. Applied Regression Analysis. New York: John Wiley and Sons Inc., 1966.

Duhamel, R. The Veterans' Land Act: A Summary of Its Provisions. Ottawa; Queens Printer and Controller of Stationary, (Cat. No. V81-368), 1968.

Ferguson, S. The Pre-Development Land Market and the Initiative of the Rural-Urban Land Conversion Process: A Case Study in the Former Township of Waterloo, 1966-71, Unpublished M.A. Thesis, University of Waterloo, 1975.

Gierman, D. M. "Rural to Urban Land Conversion." Lands Directorate. Occasional Paper No. 16, 1977.

Gierman, D. M. "Rural Land Use Changes in the Ottawa-Hull Urban Region." Lands Directorate. Occasional Paper #9, 1976.

Gray, B., and Love, P. "Land Use in Ontario Agriculture." Research Report #3, Challenge of Abundance, Report of the Ontario Special Committee on Farm Income, Ontario Department of Agriculture and Food, 1969.

Griffen, J. I. Statistics - Methods and Applications. New York: Holt Rinehart & Winston, 1962.

Higbee, E. "Agricultural Land on the Urban Fringe." In the Metropolis on the Move. p. 57-66. J. Gottman and R. A. Harper, New York: Edited by John Wiley and Sons Inc., 1965.

Hind-Smith, J. and Gertler, L. O. "Impact of Urban Growth on Agricultural Land: A Pilot Study." Resources for Tomorrow Conference, Background Papers. Department of Northern Affaris and Natural Resources, 1962, p. 155-180.

Hoffman, D. W. "The Changing Land Situation." Notes on Agriculture. University of Guelph, Vol. Xll, No. 3, 1976, p. 9-11.

Hoffman, D. W. "Preservation of Arable Land - Problems and Policy Responses in Ontario." G.I.R.M.S. Vol. 7, 1976-77, p. 81-100.

Hoffman, D. W. Project Mississauga, and Evaluation of Agriculture in an Area Undergoing Urbanization. Centre for Resources Development, University of Guelph, Pub. #81, June, 1977.

Hoover, D. M. "The Computation of Returns on Agricultural Real Estate, 1940-1969." Land Economics, Vol. XLl, 1965, p. 81-86.

Krueger, R. R. "The Disappearing Niagara Fruit Belt." In Regional and Resource Planning in Canada, p. 115-129. Edited by R. R. Krueger, F. O. Sargent, A. deVos and N. Pearson. Toronto: Holt, Rinehart and Winston of Canada, Ltd., 1963.

MacKrandilal, V. Urban Influence on Agriculture in Southern Ontario. Unpublished M.Sc. Thesis, University of Guelph, Guelph, 1978.

Marriott, F. H. C. The Interpretation of Multiple Observations. London: Academic Press, 1974.

Martin, L. R. G. Land Use Dynamics on the Toronto Urban Fringe. Ottawa: Environment Canada, Map Folio No. 3, 1975.

Martin, L. R. G. "Land Dealer Behavior on the Toronto Urban Fringe." Ontario Geography #10, 1976, p. 4-14.

Martin, L. R. G., and Matthews, D. L. "Recent Land Market Activity on the Toronto Rural-Urban Fringe." Urban Forum, June-July, 1977A, p. 18-25.

Martin, L. R. G. "Land Dealer and Land Developer Behavior on the Rural-Urban Fringe of Toronto" in Essays on Canadian Urban Process and Form, p. 283-376. Edited by L. H. Russwurm, R. E. Preston and L. R. G. Martin. Department of Geography, University of Waterloo, 1977B.

Meek, J. J. An Econometric Model of the Ontario Rural Land Market. Unpublished M.Sc. Thesis, University of Guelph, Guelph, 1968.

Mitchie, G. H. and Found, W. C. "Rural Estates in the Toronto Region." Ontario Geography #10, 1976, p. 15-26.

Murray, Wm. G. Farm Appraisal and Valuation. Iowa: Iowa State University Press, 1969.

Nie, N. H., Hull, C. H., Jenkins, J. G., Steinbrenner, K. and Bent, D. H. Statistical Package for the Social Sciences. 2nd Edition. Toronto: McGraw Hill, 1975.

Nowland, D. M. Fundamentals of Residential Land Price Determination. Department of Political Economy, Research Paper No. 101, Centre for Urban and Community Services, University of Toronto, October 1978.

Ontario, Countryside Planning; A Pilot Study of Huron County, 1976. Toronto: J. F. MacLaren Ltd., Consultants, Local Policy Planning Branch, Ontario Ministry of Housing and County of Huron, 1976.

Patterson, H. L. "Ontario's Disappearing Agricultural Land." Agricultural Institute Review, March/April, 1968, p. 7-10.

Pearson, N. The Effect of Urbanization on Agricultural Land. University of Guelph, Publication #65, The Centre for Resources Development, June, 1972.

Pearson, N. Agriculture and Land Planning. Ottawa: Canada Department of Agriculture, Research Branch, January 1973.

Punter, J. V. The Impact of Exurban Development on Land and Landscape in the Toronto-Centred Region (1954-1971). Ottawa: Policy Planning Division, Central Mortgage and Housing Corporation, 1974.

Putnam, R. G. "Changes in Rural Land Use Patterns on the Central Lake Ontario Plain." Canadian Geographer, Vol. 6, 1962, p. 60-68.

Randich, M. T. "Land Value Changes in an Area Undergoing Urbanization." Land Economics, Vol. 46, 1970, p. 32-40.

Rodd, R. S. "Urban Field of Influence on Agricultural Land-Use Patterns." Notes on Agriculture, University of Guelph, Vol. Vlll, No. 2, 1972A.

Rodd, R.S. "Rural Land Planning: Issues and Principles." Notes on Agriculture, University of Guelph, Vol. Vlll, No. 2, July 1972B.

Rodd, R. S. "A Remarkable Change in the Rural Land Market." Notes on Agriculture, University of Guelph, Vol. X, No. 2, April 1974, p. 21-23.

Rodd, R. S. Use and Non-Use of Rural Land. Draft Report, University of Guelph, 1975.

Rodd, R. S. "The Use and Abuse of Rural Land." Urban Forum, Vol. 2, 3, 1976, p. 5-12.

Rodd, R. S. "The Crisis of Agricultural Land in the Ontario Countryside." in Readings in Canadian Geography, p. 180-190. Edited by R. M. Irving. Toronto: Holt, Rinehart, Winston, 1977.

Russwurm, L. H. "Expanding Urbanization and Selected Agricultural Elements: Case Study, South Western Ontario Area, 1941-61." Land Economics, Vol. 43, 1967, p. 101-107.

Russwurm, L. H. Development of an Urban Corridor System, Toronto to Stratford Area, 1941-1966. Toronto: Queen's Printer, Regional Development, Branch Paper No. 3, 1970.

Russwurm, L. H. "Urban Fringe and Urban Shadow in the Waterloo-South Eastern Wellington County Area Land Space Matrix." in The Waterloo County Area, Selected Geographical Studies, p. 98-111. Edited by A. G. MacLellan. Geography Department, University of Waterloo, 1971.

Russwurm, L. H. The Urban Fringe in Canada: Problems, Research Needs, Policy Implications. M.S.U.A. Ottawa, 1973.

Russwurm, L. H. "The Urban Fringe as a Regional Environment" in Essays on Canadian Urban Processes and Form. p. 175-280. Edited by L. H. Russwurm, R. E. Preston and L. R. G. Martin. Department of Geography, University of Waterloo, 1977A.

Russwurm, L. H. "Urban Fringe Problems in Canada." Readings in Canadian Geography, p. 72-88. Edited by R. M. Irving. Toronto: Holt, Reinhart, Winston, 1977B.

Sargent, F. O. The Rural Land Market. University of Guelph, Guelph, 1962.

Schmid, A. A. Rural to Urban Land Conversion - The Economics of Non-Marginal Change. Department of Agricultural Economics, Pub. No. AE 69/3,) University of Guelph, 1969.

Snedecor, G. W. Statistical Methods Applied to Experiments in Agriculture and Biology. 6th Edition. Iowa, U.S.A.: Iowa State College Press, 1946.

Snedecor, G. W., and Cochran, Wm. G. Statistical Methods. Iowa, U.S.A.: Iowa State University Press, 1967.

Sokal, R. R. "Statistical Methods in Systematics." Biological Reviews of the Cambridge Philosophical Society, Vol. 40, 1965, p. 337-390.

Thomson, Wm. Agricultural Land Versus Urban Expansion. Unpublished Staff Report, The Regional Municipality of Waterloo, June, 1976.

Turner, D. M. An Approach to Land Values. London: Wm. Clowes & Sons Ltd., 1977.

Wagner, C. Rural Retreats, Urban Investment in Rural Land for Residential Purposes. Department of Urban and Regional Development, Australian Government Pub. Service, Canberra, 1975.

VanVuuren, W. Problems of Change in Rural Land Use in Southern Ontario. Centre for Resources Development. Pub. No. 58, University of Guelph, March, 1972A.

VanVuuren, W. "Agricultural Land Values." Planning for Agriculture in Southern Ontario. Centre for Resources Development, Arda Report No. 7, University of Guelph, September, 1972B.

VanVuuren, W. Distribution of Gains and Losses Resulting from Planning Legislation. School of Agricultural Economics, Pub. AE 76/8, CRD No. 76, University of Guelph, 1976.

Wehrwein, G. S. "The Rural-Urban Fringe." Economic Geography, 18, 1942, p. 217-228.