A TRADE AREA ANALYSIS

FOR A

HAMILTON RESTAURANT BASED ON DELIVERY RECORDS

BY

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ABSTRACT

This study examined the trade area of a Hamilton restaurant in an attempt to determine the relevance of theoretical models in predicting trade areas based on delivery records.

Through the use of four trade area models, a comparative study was devise for 'Chicago Style Pizza' restaurant. The findings were based on delivery records. Since delivery records were used, the distance factor that is used in most models is eliminated. The models that were used were a population demand, Market Penetration Model, Intervening Opportunity Model and a Spatial Interaction Model.

The use of a Geographical Information System was used to predict surface demands for the Market Penetration Model and the Spatial Interaction Model.

It was determined that classical models of trade area analysis had only a slight relevance in delimitating the trade areas of the store in question when compared to the actual trade area of 'Chicago Style' based on delivery records.

ACKNOWLEDGEMENTS

I would like to thank certain individuals for their help and their input into this paper. These individuals know who they are, however they deserve special recognition. To begin I would like to thank Chicago Style Pizza Shack Ltd. for the use of their tremendous data set of delivery records, without it this paper would not have been possible. As well I would like to thank Blake Poland for the use of a digitized Idrisi map of Hamilton, as well as Ric Hamilton for his technical advice and help and to everyone who has help me through this paper. Finally, I would like to make special thanks to Dr. Steven Reader for his advice, support, patients and hours of work in producing this paper.

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1. INTRODUCTION

As competition in retailing intensifies with lower levels of population increases and stagnating growth in real incomes, so the need to accurately assess and forecast markets has come so the fore; Geographers are natural contributors in responding to this need since as Huff stated, as far back as 1963, "the potential market demand for the products or services of a prospective retail firm or of agglomeration of an urban area, is a geographical delineation of the region containing the probable customers for such goods...is called a retail trade area" (Huff, 1963, p.81).

As stated by Jones and Simmons in their recent text on retail location theory, "During the last two decades Canadian households have become much more diverse"...with household compositions that include... "the single parent, the single person and the two-income households" (Jones and Simmons, 1987, p.89). One result of the changing demographic nature of the population is that the structure of this population has changed. Since, a majority of this group has little time and would prefer not to expend time on cooking meals for themselves, the food services industry has responded to the growth in this demand. All of these groups have combined to increased the demands on the service sector.

This has led to the food service industry to consider that the demand of an area is extremely important in deciding where they will locate, who is their target market, and finally, where is their target market. It is obvious that any area or city has seen a rapid growth in the food services industry, through a visual examination of any commercial zone, the cluster of fast food restaurants and many small specialty restaurants is evident.

Therefore, with the growth in specific demand needs the food services sectors has now realized that an important part of their business has to do with where they are located in relation to their competitors, their patrons, as well as many other factors.

This purpose of this study is to examine the field of retail location theory though the use of empirical evidence from a Hamilton restaurant to determine how useful trade area models are in predicting the market area of a particular firm.

The difference with this study, in comparison to previous studies, is that the empirical data that will be used is from delivery records, which present certain anomalies to the study. Firstly, the customers are not travelling to the service, but the service is coming to them. This takes away the distance factor to a certain extent, which was the bases of most of the previous

studies within this field. Distance may have be a factor effecting demand through the perceived environment that a individual has or knowledge of competitors as well as a brand names (ie: Pizza Pizza) of a product. In addition, besides the relative attractiveness of actual product there are no other beneficial characteristic that can be included in this study to add to actual patronage, such as, the store size which cannot be considered as a factor for this study.

2. APPROACHES TO TRADE AREA ANALYSIS: A REVIEW OF THE LITERATURE

The bases of most approaches within the field of trade area analysis is the concept of the 'spatial demand curve'. This assumes that distance is the only factor that effects the demand of an area. Therefore, as the distance increases from a particular firm the demand will decrease, this is know as the 'distance decay model'. In this case there are no other factors that would effect the demand, except the actual distance.

Another procedures that was proposed in attempting to examine markets of a particular firm is known as 'Thiessen Polygons', which is a "geometric procedure for delimiting theoretical trade areas for a network of similar activities in space" (Jones, 1987). The procedure is base on the idea that a particular retail outlet will capture all the customers within a defined area (a polygon) in direct relationship to competitors that are in same area with same or similar product. These polygons are created by finding the location of all competitors that surround a store, then finding the midpoint of this distance. Once this midpoint is found a perpendicular line is drawn to the next midpoint until a polygon is formed. Since this

paper is examining delivery records, the 'Thiessin Polygons' method is irrelevant.

The first modelling approach to trade area delimitation was introduced by William J. Reilly and dates back to the 1930's. Reilly proposed a 'Gravity Model' which examined the relative pulling power of two competing cities (Huff, 1963 p.81). The model examined the effects of population and distance between two market centers in determining consumer flows to either canter. The 'Gravity Model' is formulated as:

$$Ga/Gb = (Pa/Pb) \times (Db/Da)^2$$

Ga = proportion of trade from intermediate city that is attracted to A
Gb = proportion of trade from intermediate city that is attracted to B
Pa = population of centre A
Pb = population of centre B
Da = distance from intermediate centre to centre A
Db = distance from intermediate centre to centre B

This model gives the percentage of population that would travel from an intermediate location to the centres in question. (Huff, 1963 p.82). In 1947 The Curtis Publishing Company adapted Reilly's model to determine a break point or point of equilibrium between two centers (Huff, 1963 p.82). The break point was defined as the point at which consumers would travel to either centre with equal probability, and was calculated from:

$$Bp = Dab / (1 + [\{\text{square root}\} Pa/Pb])$$

Bp = break point between centre A and B in distance from B
Dab= distance separating the two centers
Pa = population of centre A
Pb = population of centre B

(Huff 1963 p.82)

Huff (1963) noted that Reilly's Breaking-Point formulation was widely used to estimate trading areas of proposed shopping centers (Huff 1963 p.83) where store size (square feet floor space) would be substituted for population, and where the distance term becomes the distance between store locations.

Huff (1963) expanded on these earlier models by including two more variables that he felt were important in delimitating trade areas. The first variable was the number of items that a centre offers to the customers and the second was the travel time between the retail centre and the consumer (Huff, 1963 p.86). Huff stated that the greater the number of items offered, the more likely that a customer would use that centre. He quantified this by using the square footage of the store to be the determinate of products offered. Travel time was determined by different values for the distance coefficient for different products. The Huff model was stated as:

$$P(Cij) = (Sij / Tij) / [\{Sum\}(Sij / Tij^{a})]$$

P(Cij) = probability of consumer i going two centre j
Sj = square footage of centre j

Tij = travel time from consumer i to centre j

a = parameter which reflects the travel time on various types to products

(Huff, 1963 p.86)

Once these values have been calculated for different points or consumer locations, "a series of zonal probability contours radiating away from the centre" can be demand representing the probability of a customer going to a particular store at various distances (Huff, 1963 p.87). Obviously the Huff model could also be used to find the break point between two competing centers, in the same manner as Rielly's model.(Huff, 1964 p.37).

In 1965 Lakshmanan and Hansen proposed an expanded model based on Huff's model (1963) to account for problems that existed in Huff's model. Their model attempted to find the expected level of sales that would occur from one specific area using population and average expenditures. The factor that they combined to Huff's model was the attractiveness of a particular centre. As well, Lakshmanan and Hansen estimated parameters to numerically quantify the different consumer sensitivities to attractiveness and distance. The Ladshmanan and Hansen model has the form:

$$Sij\ (\ a\ ,\ n\ ) = \frac{ei \times Pi \times Aj^{a} \times Dij^{n}}{Sum(Aj \times Dij^{n})}$$

Sij - level of sales based on estimates from consumer surveys
ei - household expenditures form location i
Pi - population from location i
Aj - attractiveness of location j
Dij - distance from location j to consumer i
a - parameter of the comsumer's sensitivity to attractiveness
n - parameter of the consumer's sensitivity to distance

(Lakshmanan and Hansen, 1965)

The methods above have become standard tools for predicting trade areas for particular firms. However, as stated in the introduction the actual location of the customer is very important part of retail location theory.

As market analysis realized, the customer must be considered as an important part of the analysis as well as other factor such as competitors. In contrast to the theoretical models, many authors have examined trade areas from the 'applied' side of the market.

One of these authors was Stouffer (1940) who present a model that incorporated competitors in the same trade market (ie: all super markets) to determine the flow of customers by including distances between competing firms to derive his Intervening Opportunity Model. Stouffer argued that "the number of trips from an origin to a destination zone is directly proportional to the number of opportunities in the destination zone

and inversely proportional to the number of intervening opportunities" (Haggett, 1977, p.33). Therefore, distance was included by assuming that customers would travel to the closest centre and thus flows could be calculated. The formula that Stouffer presented is:

$$Tij = (E^{-} - Dj) - (E^{} Dj)$$

Tij = the flows between area i and j
Dj = the distance at area j
n = number of intervening opportunities up to and inclusive of j
n-1 = number of intervening opportunities up to, but exclusive of j

In contrast to the formal models summarized above, William Applebaum in 1966 presented ideas on how to determine store trade areas and market penetration and potential sales. The technique that Applebaum used was to obtain the location of customers through sample surveys and map these customers to find the areas of customer concentration, a technique known as 'customer spotting' (Applebaum, 1966 p.127).

Through the use of the 'customer spotting' technique, areas of customer concentration areas (ie:area demands) are determined. By using data defined areas, where population data is available, such as census tracts or postal code zones, areas can be weighted to adjust for population densities. Once the actual demand is found, based on spotted customers and population density primary and secondary trade areas can

be delimitated. This is obtained through first ranking the demand surface for each area. The primary area includes the area that accounts for 60 % of customers, the secondary accounts for 25 % of the customers. This enables the retailer to predict area(s) that could be expected to generate the most sales for that particular retail outlet (Applebaum, 1966 p.128).

Cohen and Applebaum (1960) stated that their "major considerations in evaluating store site...[is]...the need for analyzing more methodically and scientifically proposed store locations" (Cohen, 1960 p.1). As well , they state that there are many variables that have to be examined in determining a store location. The first of these variables is accessability, in which the main emphasis is on how easily the centre is reached. This is in the context of the transit networks (private or public) to the centre and the entrance to the parking lot. As well the times at which business peaks, such as weekends or nights or is the business spread evenly over time with relation to the amount of traffic that occurs at these times (Cohen, 1960 p.5). In addition, the population characteristics have a bearing on the sale of a particular firm. They discuss aspects such as the population density and disposable income which can be determined through census data. These variables can be use to weight the

potential markets for particular areas.

Gautschi (1981) evaluated the model as presented by Huff(1963). Gautschi states that " the most serious specification error from the application of the original Huff model to retail centre patronage is that the travel time parameter has an inflated absolute value" (Gautschi, 1981 p.172). Gautschi suggest some variables that should be included in the model, such as: aspects of the retail centre, variety of merchandise, parking facilities, prices, hours open and store congestion. In addition, Gautschi divided the travel time into various aspects, such as the mode of transport, private vs public transport, cost and safety (Gautschi, 1981 p.167).

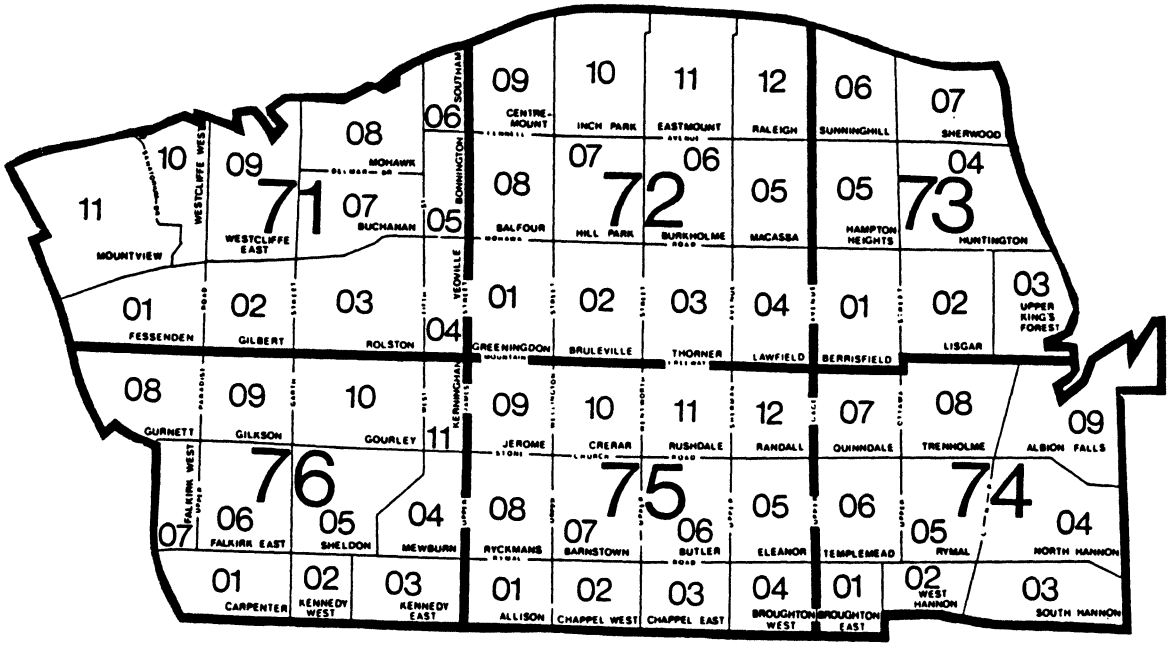
Through this evaluation of previous studies in the field of retail location analysis it can be clearly seen that most theories base analysis on the customer traveling to the firm (ie:distance). Therefore, distance plays an important part in analyzing trade areas for particular firms or areas. This examination has allowed the reader to examine the various studies that have been conducted within this field. In addition, the reader will also be able to contrast the difference between previous studies and this study.

3. METHODOLOGY AREA BASED DEFINITION FOR A DELIVERY BASED RESTAURANT

3.2 THE STUDY AREA

The area that was examined is located on the Niagara Escarpment in Hamilton. It is bounded by the Escarpment in the North and the East, and Hamilton's city limits in the West. The Southern boundary is Highway 53, which is also know as Rymal Road. Within this area there are 52 districts that divide the mountain into neighborhoods. These neighborhoods are bounded by main roads that run generally East to West

MAP 1.1



and North to South. A division of these neighborhoods can be seen below, with their corresponding numeric definition (eg. 72.04, 74.09). The restaurant that is being studied is located on Hamilton's mountain, therefore these neighborhoods are the bases of the study area.

3.2 SOURCES OF DATA AND METHODS OF COLLECTION

This study focussed on analyzing the trade area of one particular restaurant which specializes in delivered foods; the 'Chicago Style Pizza' restaurant is located at 534 Upper Sherman Ave. This restaurant has a broad delivery area that covers the entire "mountain" area within Hamilton's city boundaries and a small area downtown. Since delivers in the downtown area only represent about 8% of the total number of deliveries, analysis was constrained to the "mountain area". The location of the restaurant changed over the period to which the data collected referred, with its first location at the corner of Upper Wellington and Queensdale and its present location is at the corner of Upper Sherman and Brucedale. This move was about two city blocks to the East. The main source of data was delivery records for the years 1982 - 1988.

A sample and their records were taken from each year to give a good representation of the delivery area.

There were a total of 4346 deliveries sampled, with the years 1982 to 1988 having 568, 618, 469, 661, 605, 743, 682 delivery samples respectively.The sample was taken based on two weeks taken from each of April to September and October to March periods. This was further sampled by taking only four days from each week, with Friday and Saturday grouped together and Tuesday and Wednesday grouped together to represent the busy and slow days, respectively. Each day was then divided again with busy (before 8:00 pm.) and slow (after 8:00 pm.) times to attempt to discover a relationship between these times.

Population values were obtained from the a publication of Selected Characteristics for User-defined Area, 1986 Census, by the Planning and Development Department, Hamilton-Wentworth Region.

The final data that was needed was the location of competitors within the previously mentioned delivery boundaries. Since Chicago Style Pizza Shack delivers pizza as well as dinners, competitors were considered as any restaurant that was located within the boundaries and was delivering any Italian food, pizza or dinners. The location of the competitors were obtained from telephone directories between the years 1981 to 1989.

3.3 MODELS FOR CREATING DEMAND SURFACES ACROSS 52 NEIGHBORHOODS

Through the use of four separate models, the surface demand will be determine for the analysis area in an attempt to make an comparative analysis. These demands will be determined across the all of the 52 neighborhoods, to determine the trade areas of the Chicago Style restaurant.

Due to the enormous size of the data set, this portion of the analysis only used data for the years 1983 and 1986. The reason for choosing these years was that in 1984 the restaurant relocated, therefore these years would show a change in demand, due to the change in location. To obtain values the years between census' years (1983 was needed for the analysis), values for the neighborhoods had to be aggregated back by first obtaining the growth rate for census division that contained the neighborhoods that were being studied.In addition the models that have been used were modified to suit the situation and constraints that were present due to lack of information such as population values for every year, customer locations for competitor, actual opening dates of new competitors, ect.

The first type of neighborhood demand is based on the actual population. This assumes that demand is distributed evenly across the entire area and the only factor that would affect this demand is the actual size of the population and distance has no effect. This

value was found by finding the proportion of the total population that is contained in each neighborhood contains.

The second category will deal with is the manner in which the actual deliveries were manipulated so that a market penetration could be conducted. Since population varies across each neighborhood these variation had to be weighted in for the analysis. Therefore, the number of deliveries in each neighborhood were weighted by dividing the number of deliveries by the population values in the neighborhood. The demand values by actual deliveries were then converted to proportions of the total for all of the neighborhood for each year. Hence, the market penetration was obtained.

The third demand related estimation was derived form the Intervening Opportunity Model that was discussed earlier in this paper. This model is calculated by the number of intervening opportunities, or competitors that are within the same distance such as the distance from one neighborhood to Chicago Style Pizza. This produced a value that shows the expected sales (deliveries) from each neighborhood considering all possible locations that the consumer may use. Once this predicted demand value was calculated it was then multiplied by the population of each neighborhood to generate the expected demand that would come from each

neighborhood to the restaurant that was being studied.

The final demand estimation model that was used in this evaluation was a variation of the Spatial Interaction Model (SIM) presented by Lakshmanan and Hansen in 1965. This model uses distance as the main factor in calculating probabilities from one area (the neighborhood) to a specific firm or area (the restaurant). For this final section only data for 1983 was used due to the amount of time needed to undertake, the analysis bearing in mind a 17-store system. To calculate the distance determined demand for this study the Geographical Information Systems pack, Idrisi was used for the analysis.

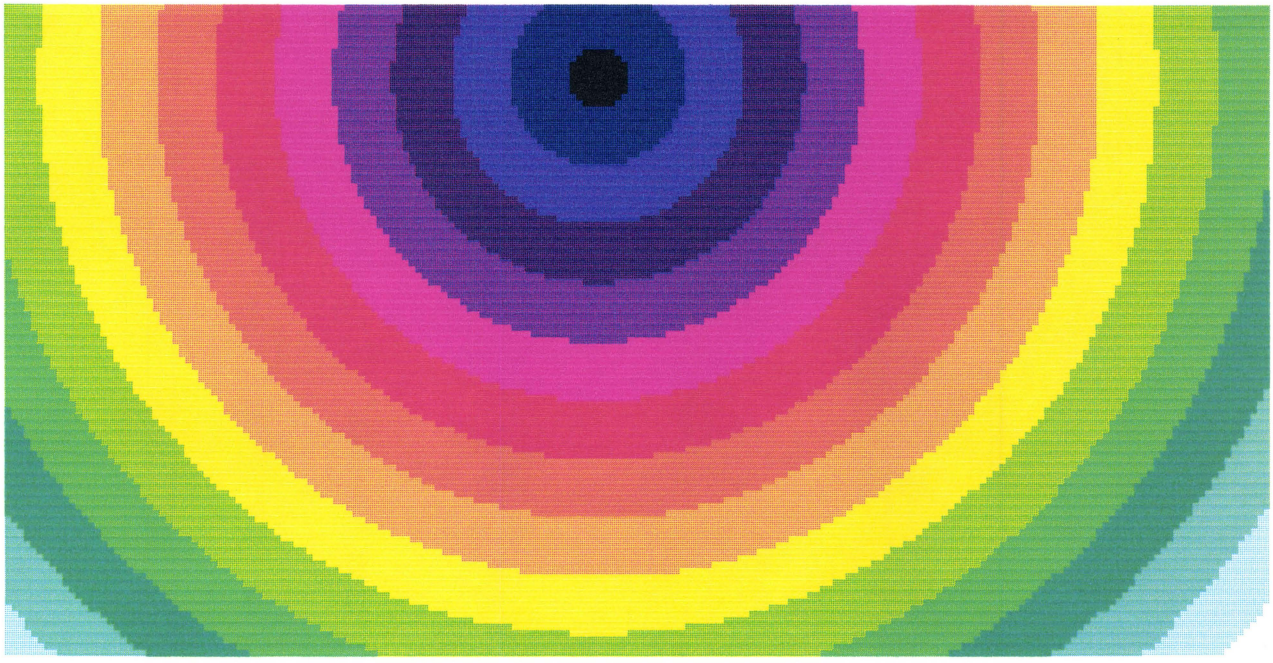
A general overview of Idrisi will be presented here to inform the reader how the system works as well as how it was used for this research. The basis of the system is that geographically defined areas that are filled with pixels (grid cells) to represent the actual area. The map used was based on 102 rows and 197 columns with an area of 40 by 40 meters represented per pixel. Therefor there were 20094 pixels on each map. Since there are a large number of pixels, accuracy for distance and area are very good. The only problem that presented itself for this study is that data on population was at the neighborhood level, since no smaller values were available at this time. As well,

five neighborhoods had to be eliminated from the study because population values of zero were found in these neighborhoods. The population density was calculated on a pixel by pixel bases by dividing the neighborhoods total population by the number of pixels in each neighborhood.

To produce a the Spatial Interaction Model all store locations were located on the map of Hamilton's mountain. Next, a distance function on Idrisi was used to calculate the distance in meters from each of the 17 restaurants to each of the 20094 pixels (example Map 1.2). These 17 distance maps were then overlaid to calculate a sum of all distances from each restaurant to each pixel. Based on the Spatial Interaction Model proposed by Lakshmanan and Hansen in 1965 where they state that the probability of a customer i going to store j is the distance from store i times the attractiveness of store j (they use store floor space as the attractiveness parameter) divided by the sum of all stores distances and attractiveness. For this analysis attractiveness was given a value of 1 to simplify the equation since the data is based on deliveries. In addition, each distance was taken to the exponent negative two because this is a typical value used in such a model.

To determine the probability of a customer (each

DISTANCE OUTPUT ON A PIXEL BASIS FOR 1 STORE



LOW HIGH

Map 1.2

PROBABILITY CONTOURS FOR "CHICAGO-STYLE" RESTAURANT

LOW HIGH

Map 13

particular pixel) going to Chicago Style, the distances from each pixel to Chicago Style was taken to the exponent -2 then divided by the sum of all distances from each of the 17 stores to each pixel. This produced a contour map of the probabilities of a customers purchasing from Chicago Style. The population density map (as discussed earlier, Map 1.4) was then multiplied by the SIM values to produce a weighted contour map of forecasted demand (see Mapl.3).

3.4 THE METHODOLOGY FOR COMPARATIVE ANALYSIS OF DIFFERENT DEMAND SURFACES VALUES

The comparative analysis of values that were calculated for neighborhood demands required manipulation so that comparison could be made at the neighborhood level. These values were calculated for store locations and customer locations for the years 1983 and 1986 since theses are the years between which store location changed.

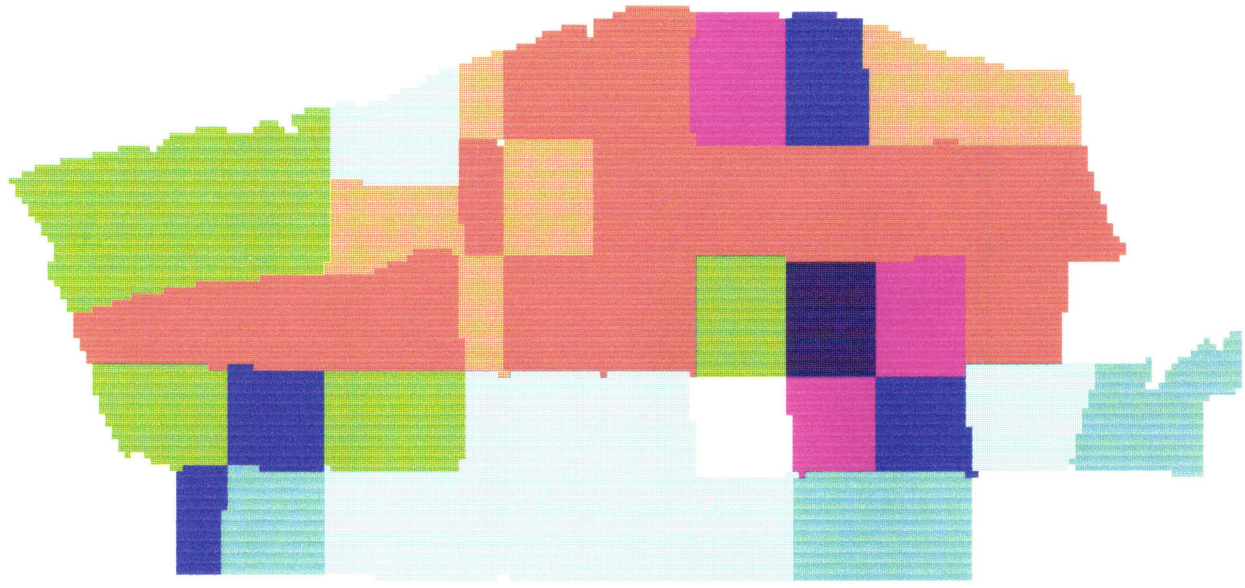
The actual demand for each neighborhood was determined by first totalling the number of deliveries in each neighborhood and then dividing by the total number of deliveries to produce a percent of the total that each neighborhood yielded. These percents were then multiplied by the percent of each population in each neighborhood so that population variations could be

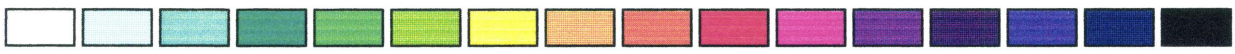
weighted into the analysis. The demand by neighborhood population was taken directly from the percent of population that each neighborhood contained. This assumes that demand is based only on the population and no other factors would effect the demand. The Intervening Opportunity Model values were also multiplied by the population demand so weight in the population in each neighborhood.

Since these demand values had a very different range, the logarithmic function was used on each demand value so that comparison could be made between the neighborhood. Each of these demand values were then plotted onto graphs to show if there was a positive or negative relationship between these values and how strong of a relationship existed. In addition, correlation were calculated between the demand values. The correlation coefficient, which measures the relationship between two separate values, a value of 1 shows a perfect positive relationship and a value of -1 shows a perfect negative relationship.

Through the use of the Idrisi system the Market Penetration Model was used. The Market Penetration Model is based on the location of 'spotted customers' that use a particular firm. Market Penetration as stated by Jones and Simons is the "proportion of customers within a given neighborhood who deal with the store" (Jones and Simons, 1987, p.309). This

POPULATION DENSITY BY NEIGHBORHOOD





LOW HIGH

proportions that were used in this study were the top 60% of the total neighborhood demand values was considered as the primary trade area and the secondary trade area is based on the next 25% demand.

To produce the Market Penetration map the total number of deliveries in each neighborhood were divided by the population density in each pixel (see Map 1.4). Since population density was by pixel and total deliveries were by neighborhood, an average of each pixel's demand was calculated within each neighborhood. The final step was to rank this values in descending order and find the top 60% of the total demand by Market Penetration from each neighborhood and the next 25% demand formulate the primary and secondary trade areas (see Map 1.5).

The second primary and secondary map that was produced was on the Idrisi system represents the demand surface based on the Spatial Interaction Model values. As stated earlier SIM values were calculated from distances to Chicago Style over the total distances of the 17 store system as well as the population density for each pixel. This creates an very accurate demand based on distances and competitors locations. To produce an neighborhood by neighborhood probability demand value, averages for each pixel in each

neighborhood was determined. Once again these probability values were ranked and the top 60% formed the primary area and the next 25% formed the secondary area (see Map 1.7).

These two maps were produced so that a comparison of the theoretical and the actual market areas could be made to assess the relevance of theoretical models in formulating market trade areas in comparison to actual demand.

The final maps that were produced through the GIS system, plotted the actual location of each spotted customer over the primary and secondary maps discussed earlier. The spotted customers were divided into intervals of 1 KM radiating out from Chicago Style. The distance was determined through the SIM distance values for each pixel. These rings were overlaid on the Market Penetration Map (Map 1.6), the Spatial Interaction Model Map (Map 1.8) of primary and secondary areas, and finally the contour map of SIM values (Map 1.3). This allows for the spotted customers, their actual location, to be compared to the maps of theoretical and actual trade areas.

4.4. RESULTS OF FINDINGS ON TRADE AREAS FOR CHICAGO STYLE

The various models that have been used in this paper have produced some very significant results that

will contribute to the field of retail location theory. Since this study area is small and well defined and the data used to produce the findings are very extensive, the results that were produced through delivery records suggest that trade area analysis method need to be redefined when examining delivery records. Through a comparative analysis, actual findings from the restaurants have been analyzed so that comparison can be made between models of trade area analysis and actual result.

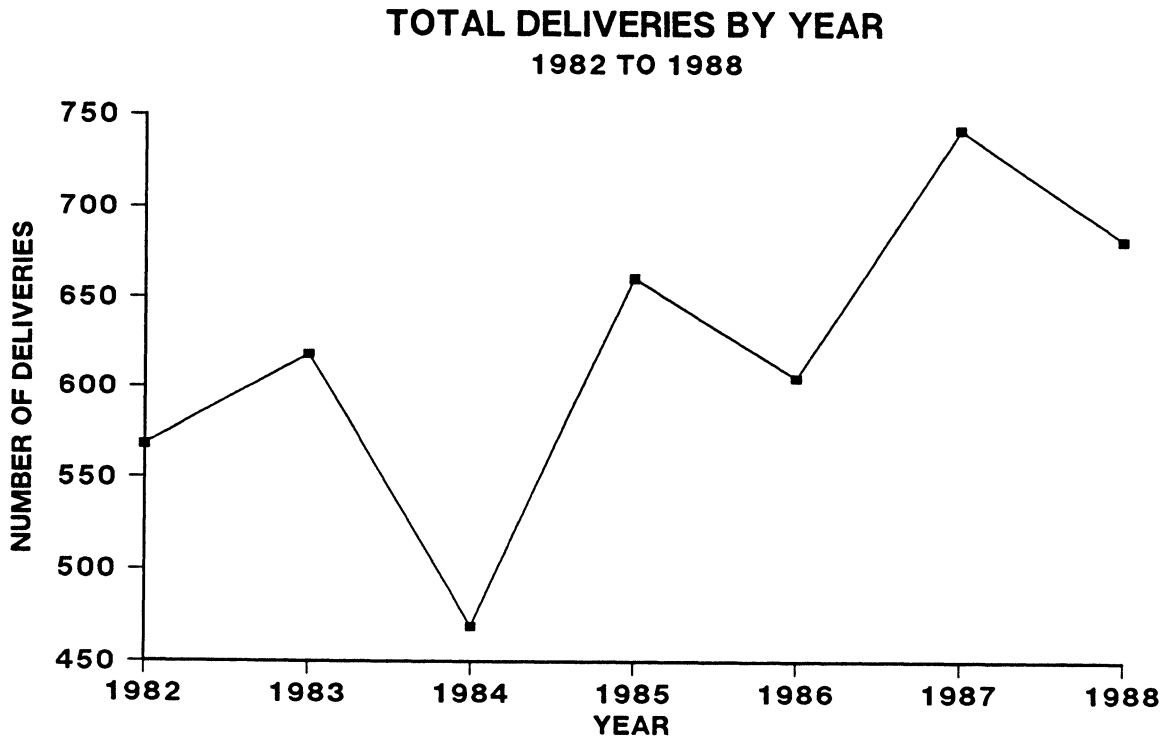
4. FINDINGS BASED ON DELIVERIES AND MODEL DEMANDS

The first section of this chapter will present some general findings on what has occurred in terms of the demand and number of competitors for Chicago Style Pizza. In general terms the number of deliveries has increased since 1982, although this trend has not been completely smooth with different years showing increases and decreases (see Graph 1). In addition the number of competitor has increased significantly, which could be due to the changing nature of the retail market in the service industry.

In examining Graph 1.1 on the total number of deliveries it is obvious that in 1984 there was a rapid decline in the number of deliveries, while there was an

increase in 1983. This decline can be attributed to the relocation of the restaurant and the sequential short term loss of customer demand, due to numerous reasons such as many of the customer did not know that the restaurant had relocated. In 1983 the increase may be attributed to the decline in the number of competitors

GRAPH 1.1



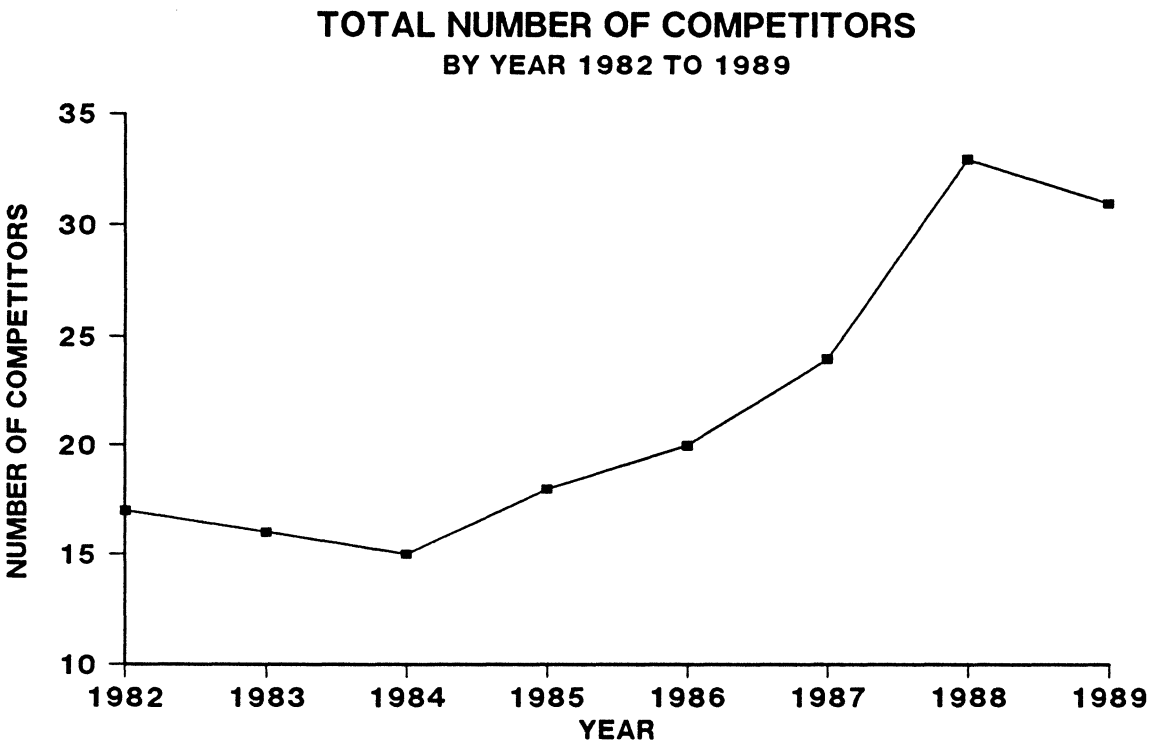
on the mountain as can be seen on Graph 1.2. Between the years of 1987 and 1988 the total number of deliveries declined drastically and this could be due to an increase in the number of competitors in the order of 35.8% between the two years. These are some of the general trends that have been found for demand and number of competitors over the years 1981 to 1989.

In examining the maps of spotted customers from the delivery records, it was found that there was little variation in the distribution of 'spotted customers'. Since this is only based on the location of the actual customers and population density are not included, it is difficult to draw any concrete conclusion through a simple visual observation. In the next section, the detail examination of actual demand versa the theoretical demand by the Intervening Opportunity Model, as well as the demand by neighborhood population will be examined.

The demand by each neighborhood has been has been determined by three separate methods. The first being the actual demand based on delivery records as discussed earlier. The seconds is the demand based by population of each neighborhoods and the final one is the demand calculated from the Intervening Opportunity Model. It should be conveyed now that values of zero

found on the graphs are due to either a zero population

GRAPH 1.2

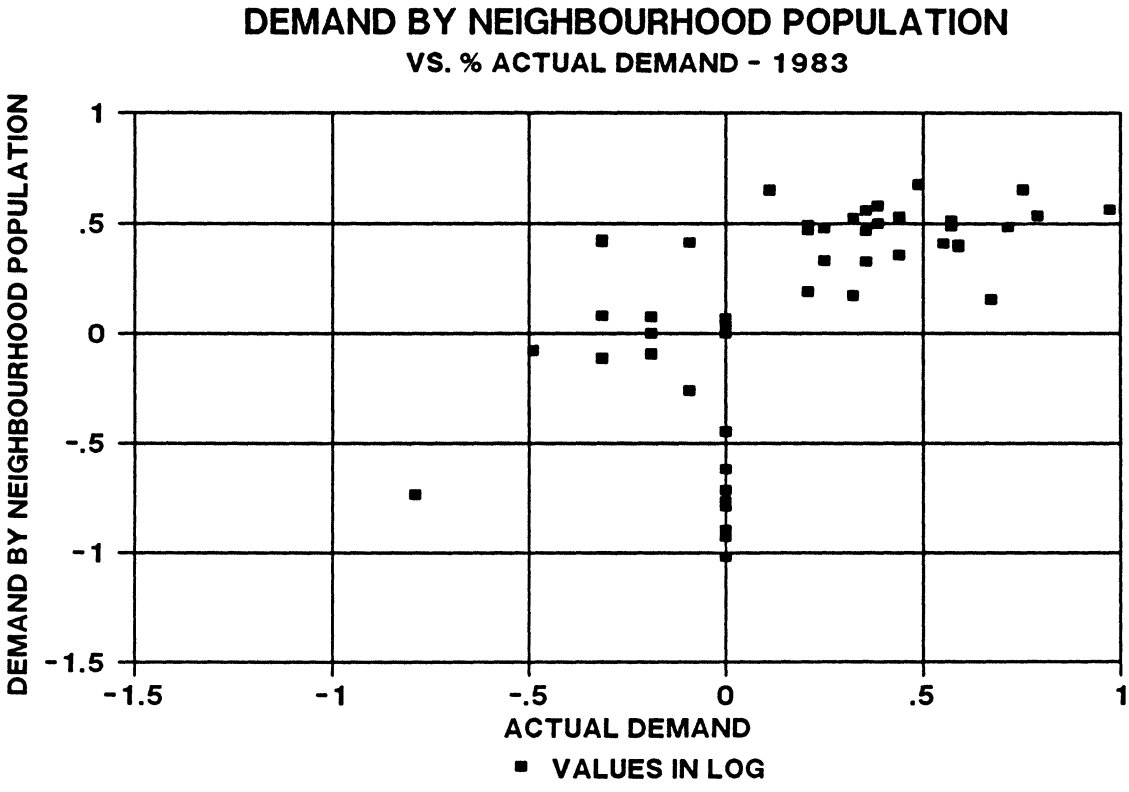


found on the graphs are due to either a zero population in the neighborhood, or there were no deliveries to that area that year.

The first comparative analysis will examine the relationship between the actual demand and the demand based on neighborhood population for the year 1983. Through a correlation coefficient, it was found that the

there was a value of 0.699, which shows a fairly strong positive relationship. This is the results that would be expected, since areas with larger populations would order more just by the higher probability that is associated with larger populations. Through an

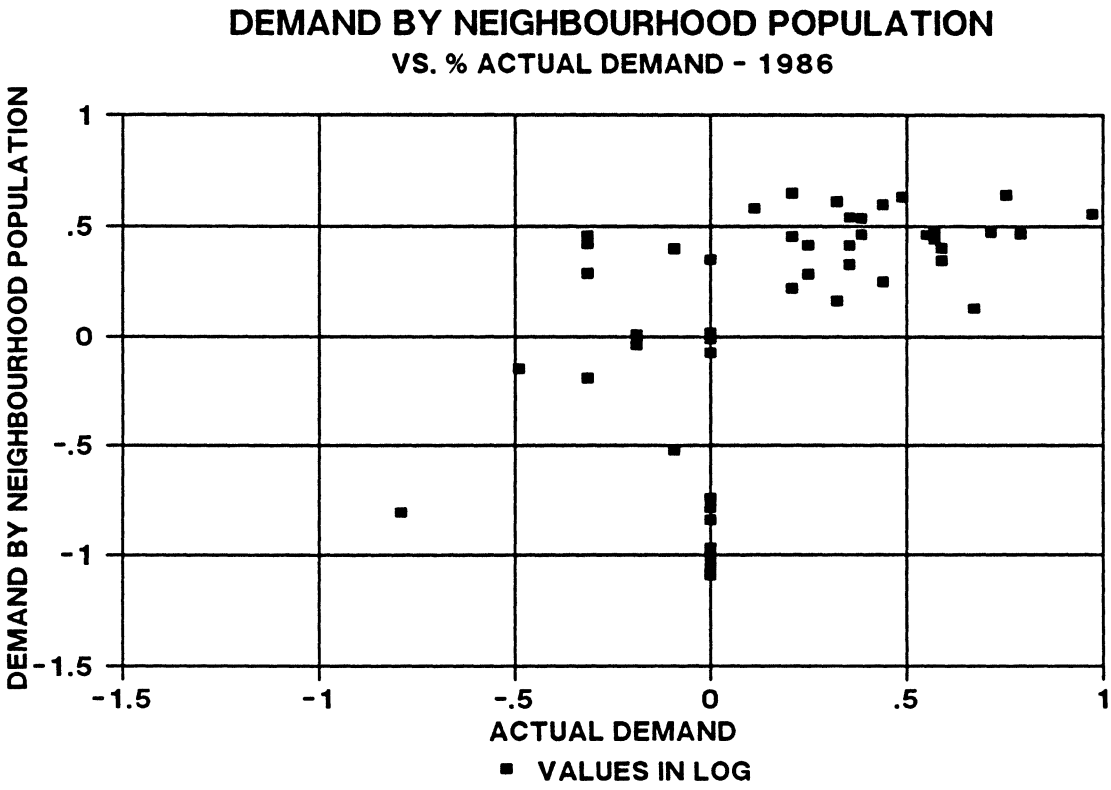
GRAPH 2.1



examination of the graphed logarithmic demand, (Graph 2.1) the values show a clear positive relationship with a 45 degree slope to the right. This also supports the findings of the correlation coefficient.

These demand values were also determined for the 1986 population and delivery records. The correlation

GRAPH 2.2



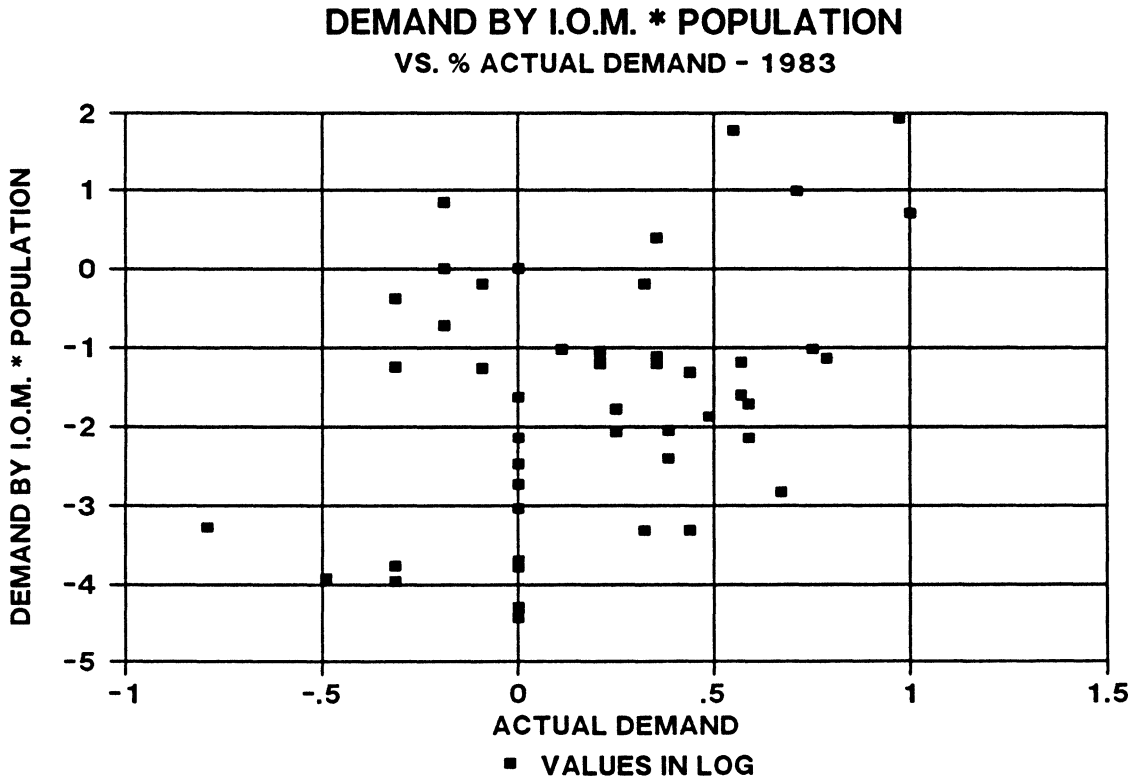
for this year was found to be 0.653 which is very close to the values in 1983. However, when the graph of the variables is examined it is clear that through a visual inspection the values seem to be clustered closer together and with less of the sporadic distribution. Once again this is the type of relationship that would be expected.

The second comparative analysis, compares the actual demand and the demand forecasts by the Intervening Opportunity Model. This model is based on the location of the neighborhoods and the number of intervening competitors between the neighborhood and Chicago Style, as well as the location of the neighborhood's populations as described in chapter 3.2.

The 1983 I.O.M. and actual demand values produced a correlation of 0.478, which suggest a positive relationship, however not as strong as was found for actual demand and the demand by population. The comparative results are discovered through examining the graph for these values, were the points appear to show little relationship. This is due to the scatter dispersion of the values suggesting that the Intervening Opportunity Model (IOM) predicted demand does not defined an realistic trade area. This can be contributed to the concentration of competitors in two

specific areas, see Appendix A for the location of competitors in 1983. There is a concentration of competitors found on the West and East mountain along Upper James and the Upper Gage, Fennell area. This would skew these values, since the customers in these areas would be expected to be patrons of stores that intervenes between them and 'Chicago Style'. However,

GRAPH 2.3



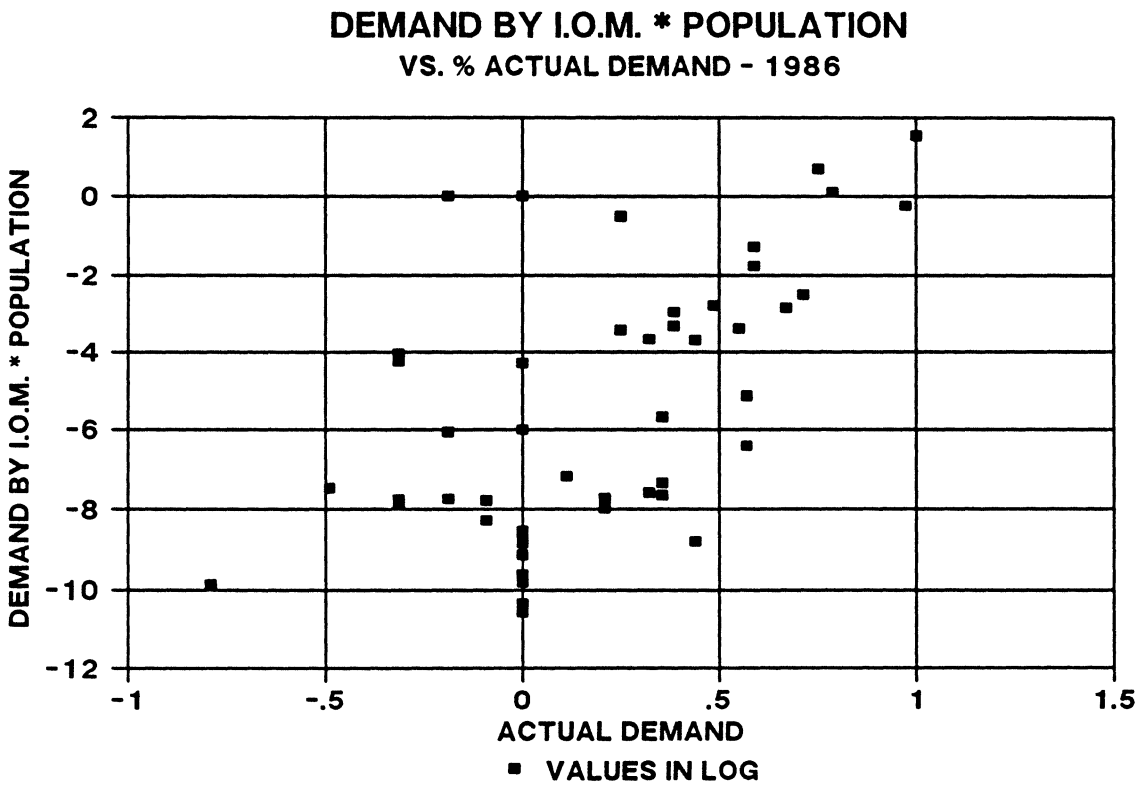
from the maps on the 1983 spotted deliveries (Appendix B) it is obvious that Chicago Style Pizza does receive customers from these neighborhood.

The Intervening Opportunity Model for 1986 does create a demand that is more closely related to the actual demand. The correlation value increases from 0.478 in 1983 to a value of 0.539 in 1986. The corresponding graph, Graph 2.4, supports this finding, since the points are concentrated to a greater extent than those from 1983. The graph shows a positive relationship with the points extending to the along a 45 degree angle from the X and Y axis. A reason for this may be due to the competitor's locations have a more even distribution across the mountain. Hence, causing the I.O.M. demand values to have a closer relationship to the actual demand.

This section has shown the relationship between two predicted demands and the actual demand that was found through the 'customer spotting'. It has concluded that the population demand by neighborhood does relate to the actual demand. However, through the use of the Intervening Opportunity Model demand was predicted, but this predicted demand does not display a strong relationship in comparison to demand by population. The next section of will continue the analysis by examining

the findings

GRAPH 2.4



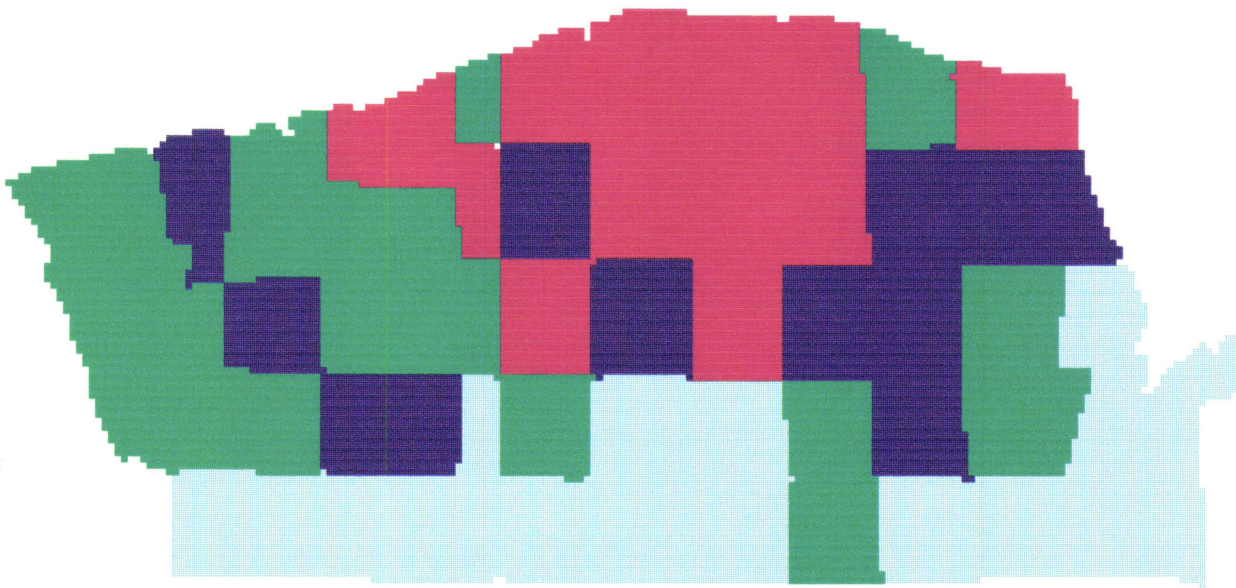
demand. However, through the use of the Intervening Opportunity Model demand was predicted, but this predicted demand does not display a strong relationship in comparison to demand by population. The next section of will continue the analysis by examining the findings

that were produced by the Idrisi Geographical Information System for Market Penetration by actual demand and the predicted demand through the S.I.M..

Through the use of the GIS system maps have been produced that define the trade area for the actual demand based on Market Penetration, as well as the demand by a Spatial Interaction Model using the 1983 data values. These values were then used to produce market penetration maps for the primary and secondary trade areas of the restaurant. As stated earlier in the paper the primary is the top 60% of the customers and the secondary trade area is the next 25%.

The first map that was produced was a market penetration based on the number of spotted customers and the population density of each neighborhood. From this map it was found that the primary trade area consisted of twelve of the neighborhoods and the secondary trade area was comprised of ten neighborhoods. The areas that are not included in the primary and secondary zones are the last 15% of the market area. The primary trade area is concentrated in the central mountain area where the study store is located. The secondary trade area is found on the East mountain as well as three neighborhoods on the West mountain and two that are bounded by the primary trade area (Map 1.5) on the central mountain.

PRIMARY/SECONDARY TRADE AREAS FROM MKT PENETRATION

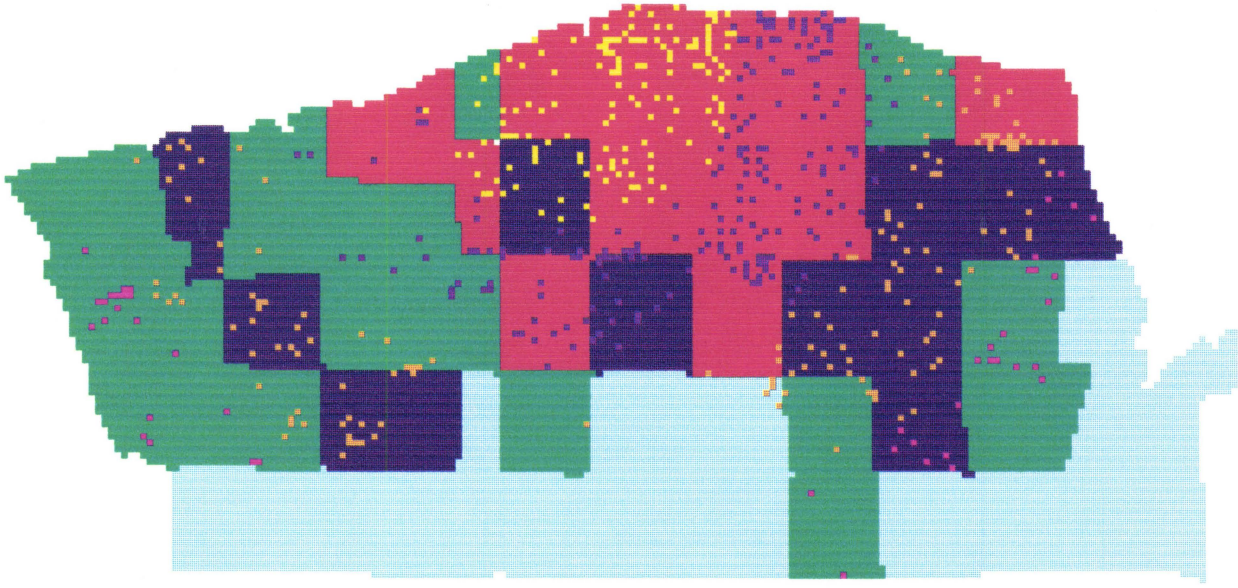


PRIMARY

SECONDARY

Map 15

DELIV'S BY 1KM INTERVALS ON MKT PENETN. TRADE AREAS



PRIMARY

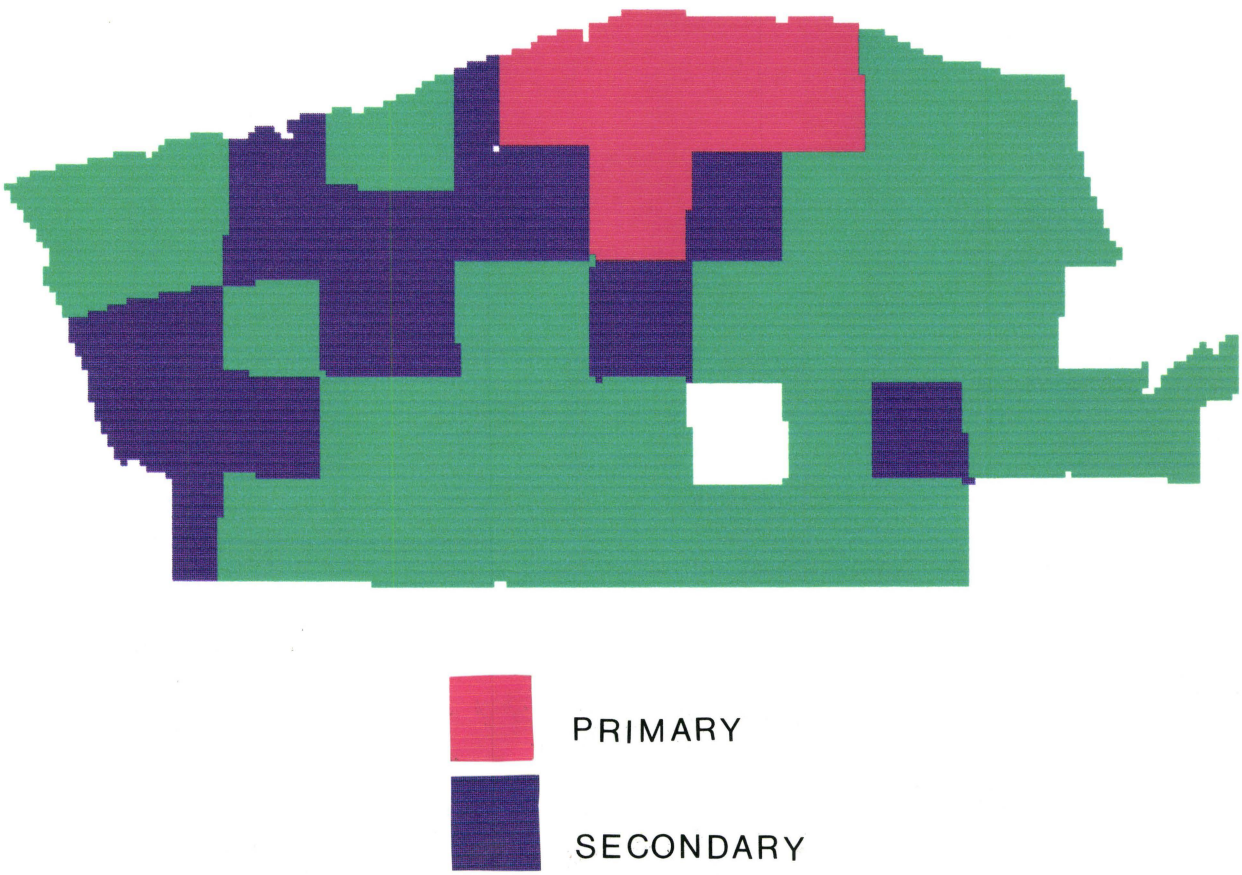
SECONDARY

Map 15

The actual spotted customers are plotted onto study store is located. The secondary trade area is this map to display the actual number of deliveries in each neighborhood. These are plotted at 1KM zones radiating out from the restaurant in question. The primary area that is located at the edge of the escapement on the West mountain has only about five deliveries. The reason for it being included is that the area has a very small population density, since the Hamilton Psychiatric Hospital is located here and since the workers order deliveries it falls within the primary trade area (see Map 1.6). In addition, the border of neighborhoods show concentration of spotted customers because of apartment buildings located in these areas. This map of market penetration and spotted customers gives a clear representation of the restaurants trade area.

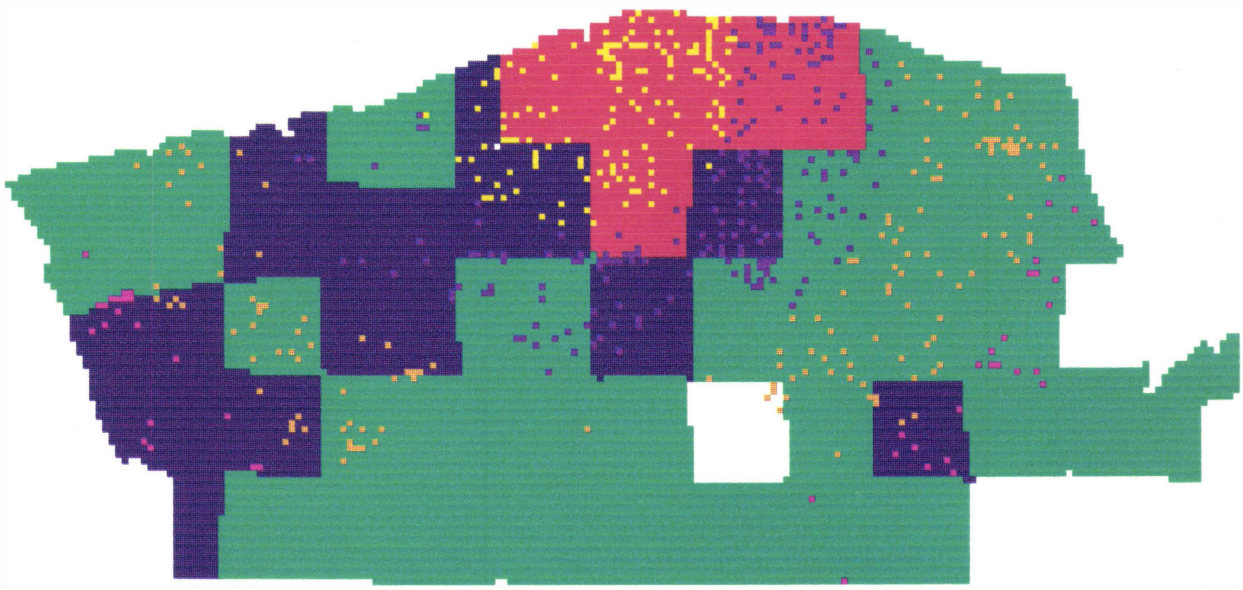
The second trade area that was produced was the primary and secondary trade area based on the values from the Spatial Interaction Model and the population density by pixel. As stated before, the S.I.M. provides probabilities for each pixel (customer) using the study location rather than the sixteen other locations with population density weighted into the model. These values provide a contour map of distance rings from the restaurant, Chicago Style's can be examined on Map 1.3.

PRIMARY AND SECONDARY TRADE AREAS FORCAST BY S.I.M.



Map 7

DELIVERIES BY 1KM INTERVALS ON S.I.M. TRADE AREAS



PRIMARY

SECONDARY

These values were averaged to be used for each neighborhood and the primary and secondary trade areas were delimitated. The primary trade area is located in five neighborhoods on the North central mountain and the secondary trade area is located in 12 neighborhoods. These areas are located in general on the West mountain with one found on the South East mountain. This anomaly can be attributed to the high population density of the area, due the number of townhouse complexes in this neighborhood. As well the secondary trade area on the West mountain bordering the city limits can also be attributed to high population densities (Map 1.4).

Once the spotted customers have been plotted onto this map a comparative analysis is possible. Map 1.8 displays this area and through inspection the differences in the theoretical trade area and the actual trade area can be distinguish. The primary trade area does have a high number of spotted customers, however on the East mountain a very different picture is shown. The East mountain show that based on the S.I.M. there should be very little demand from this area, but spotted customers show a high concentration of customers.

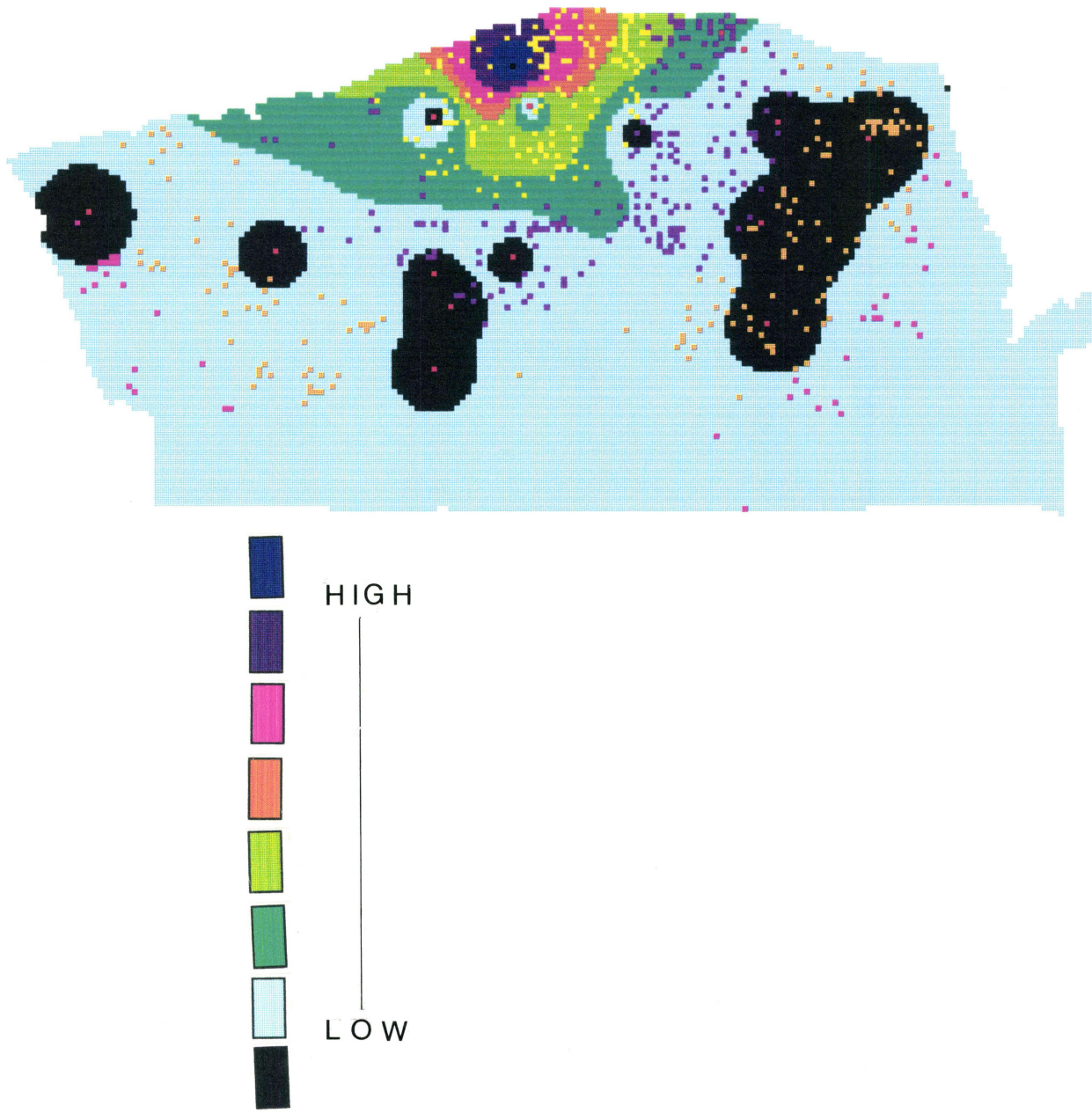
The delimitated trade area based on the Spatial Interaction Model produces probabilities that are distinctively different from those found by the actual

demand based on spotted customers.

The final demand based map (Map 1.5) is the actual pixel values from the S.I.M. and population density. The contours are directly related to the distance from Chicago Style and the location of competitors. As you move away from the restaurant the values decrease, with the lowest values found in pixels surrounding the competitors.

The spotted customer intervals were then placed onto the contour map (Map 1.3) to compare the spotted customers and the probability values of the S.I.M.. The main finding from this map is that distance is not the only factor affecting customer patronage. Therefore if an attractiveness feature was included in the model it may have produced probabilities that were closer to the real demand. The areas that show the highest deviation from the model are found on the East mountain. From Map 1.3, the black area has a very low probability, however there is a high number of spotted customers in this area, which contradicts the model. Therefore, the Spatial Interaction Model may not be appropriate in delimitating trade areas based on distances and competitors locations without including an attractiveness factor that incorporates the fact that the customers do not have to travel to the store location.

DELIVERIES BY 1KM INTERVALS ON S.I.M. PROBABILITIES



5. CONCLUSION

Through the use of a trade area analysis of a Hamilton restaurant, the relative importance of theoretical models in delimitating trade areas have been examined. This study was based on actual delivery records from Chicago Styles Pizza to produce what a factual trade area would be. Since the trade area is based on deliveries and all previous studies have not used this type of data, this paper has importance relevance to the study of retail location theory within the geographical discipline.

There were four separate methods used to delimitate probable trade areas. The first used in this analysis was based on population density with no other factors used to determine the trade area. The second was the demand based on actual deliveries. The third was the Intervening Opportunity Model, that produced probabilities of customer using the study store that is based on the distances from each neighborhood, as well as the number of competitors that are found between the neighborhood and the store that is being examined. The final model that was used was the Spatial Interaction Model that was computed through a Geographical Information System that examined the distance of all customers to all stores to create a probability of a

customer patronizing the store that is being studied. These models were then compared to the actual findings to evaluate their relevance in determining trade areas.

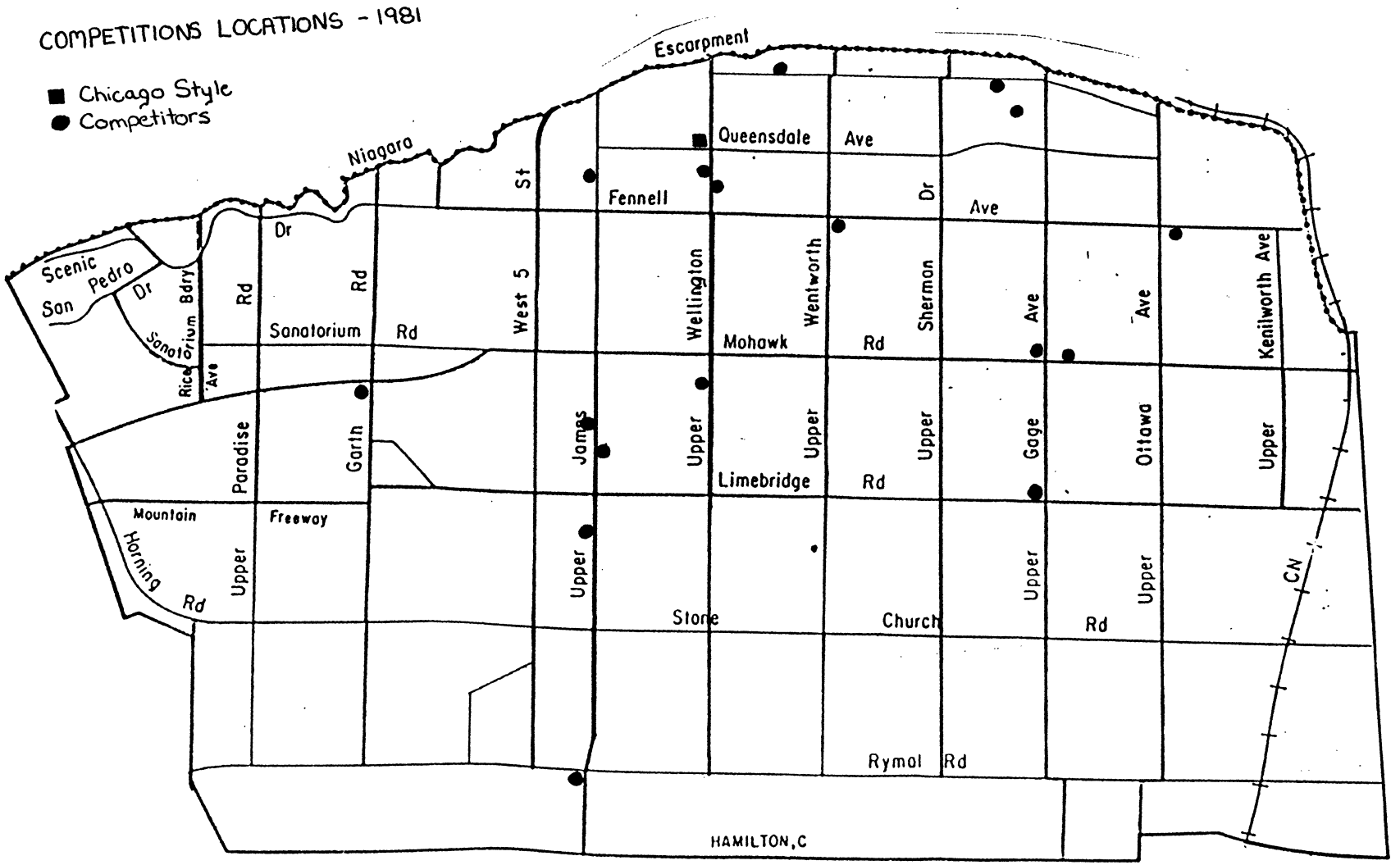
Through the comparative analysis it was found that the predictability of the Intervening Opportunity Model and the Spatial Interaction Model did not coincide with the actual findings. However, the model based only upon population appears to have the highest significance in relationship to the actual trade area. One factor that must be considered is that the Spatial Interaction Model needs to be modified to incorporate that the actual demand is based on deliveries, which reduces the dependance on distance.

In conclusion, this study was based upon a extremely large data set, and to incorporated all of the data would be unrealistic. Therefore, through further analysis and the use of models that are independent of distance, new findings could be concluded that would create models of trade area analysis that incorporated that the actual data is delivery records. As well through the use of Geographical Information Systems, further analysis could be performed as well as the changes in trade areas overtime. This study has formulated some very interesting results and since it incorporated a new variable (deliveries) into the research field of retail location theory, its

significance is highly important.

APPENDIX A:

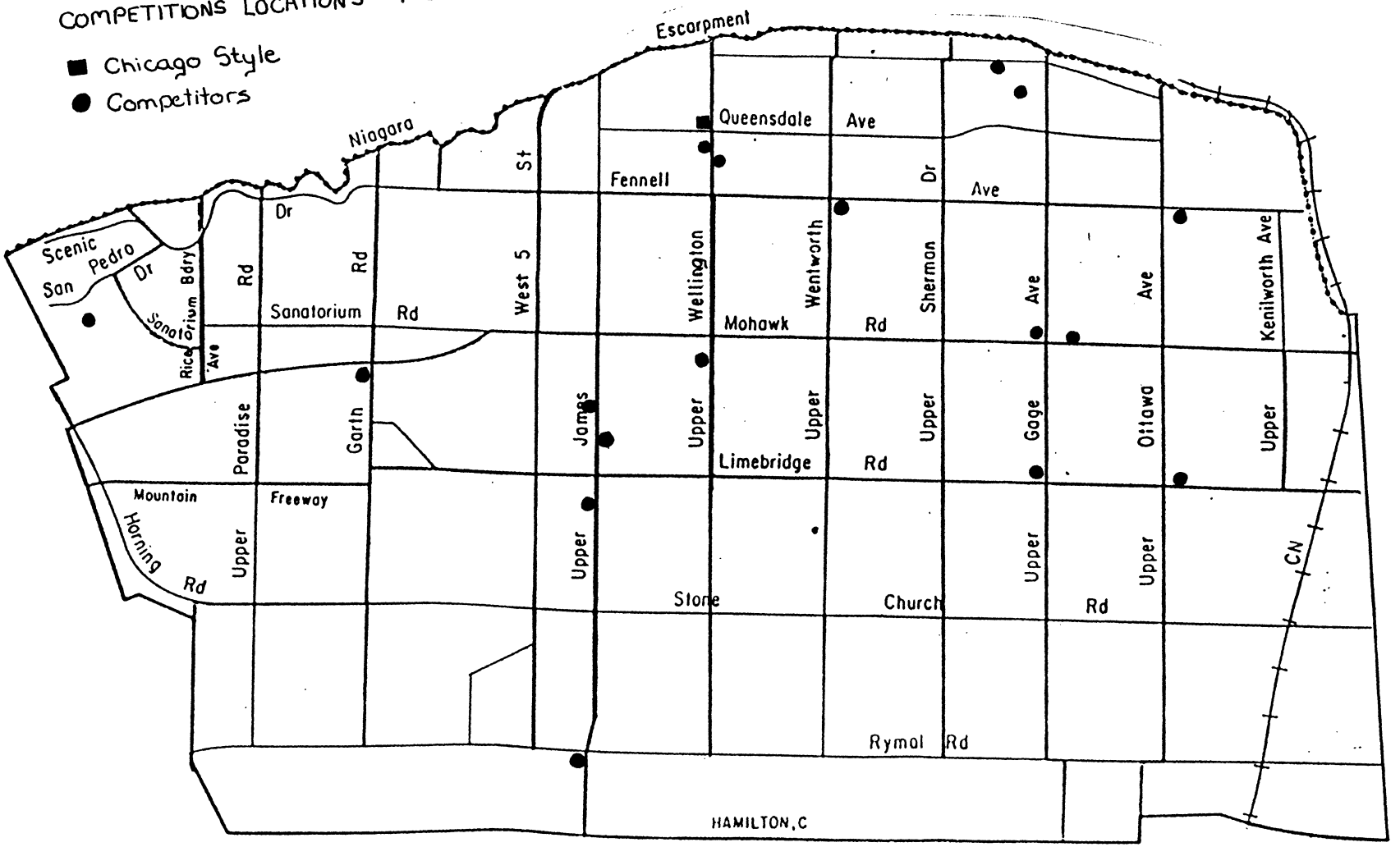
MAPS OF COMPETITORS LOCATIONS 1981 TO 1989


COMPETITIONS LOCATIONS - 1981
Chicago Style
Competitors
Escarpment
Niagara
Queensdale
Ave
Fennell
Dr
Ave
St
Scenic
San Pedro
Dr
Sanatorium Bdry
Rd
Dr
Sanatorium
Rd
West 5
Wellington
Mohawk
Wentworth
Rd
Sherman
Ave
Ave
Kenilworth Ave
Rice
Ave
Paradise
Garth
James
Upper
Limebridge
Upper
Rd
Upper
Gage
Ottawa
Upper
Mountain
Freeway
Horning
Rd
Upper
Upper
Stone
Church
Upper
Rd
Upper
CN
Rymal
Rd
HAMILTON, C

COMPETITIONS LOCATIONS - 1982

■ Chicago Style

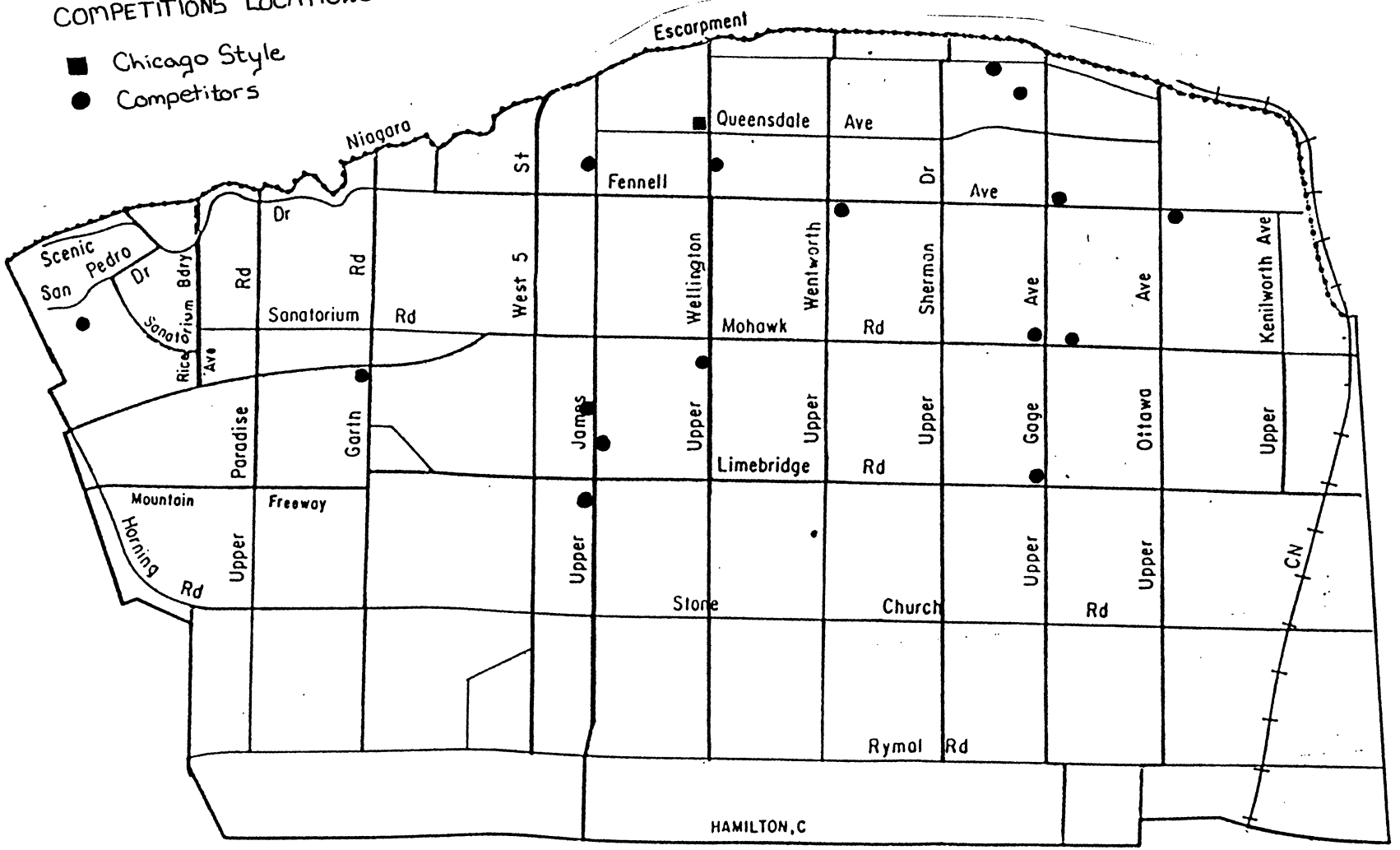
● Competitors

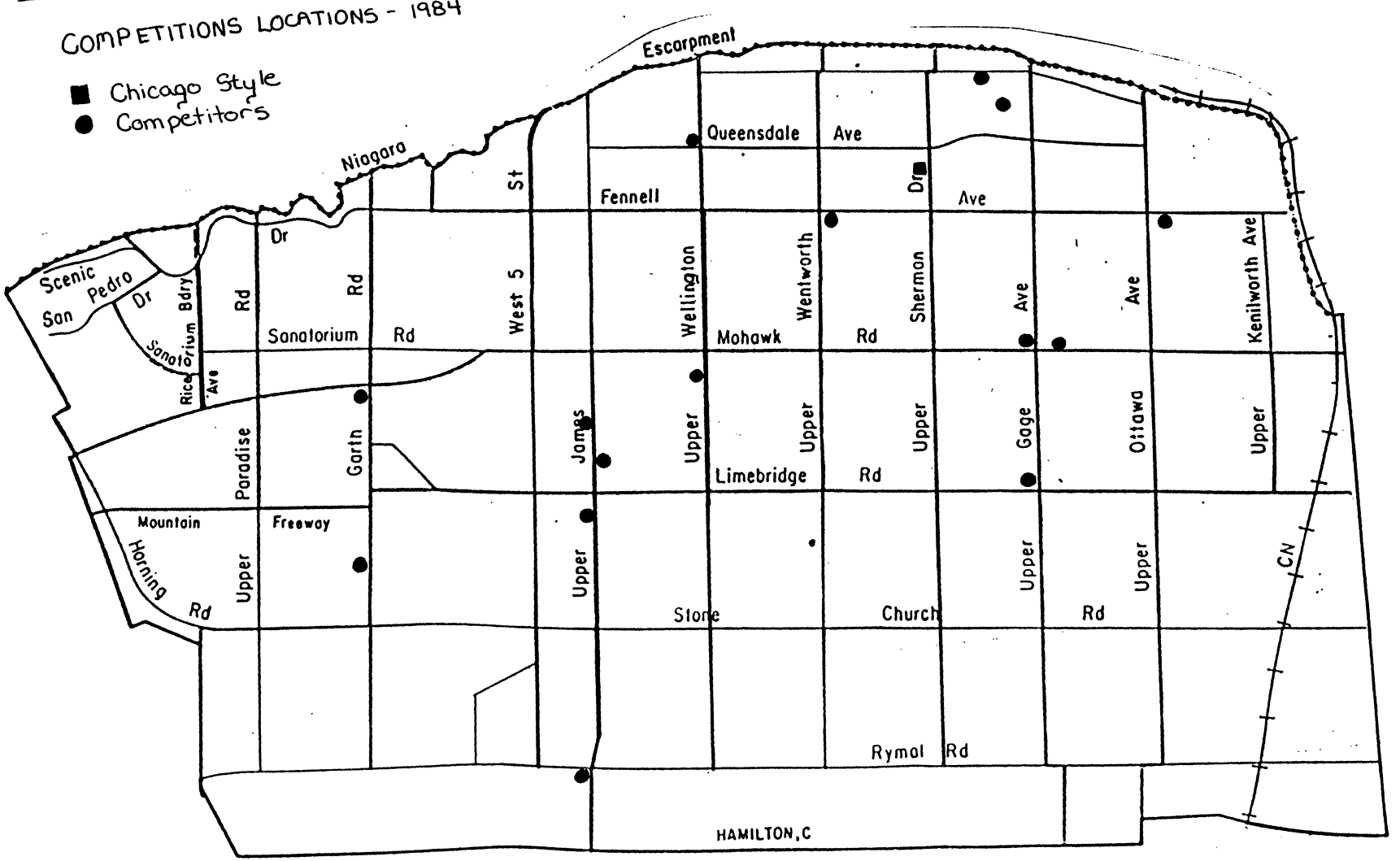


COMPETITIONS LOCATIONS - 1983

■ Chicago Style

● Competitors

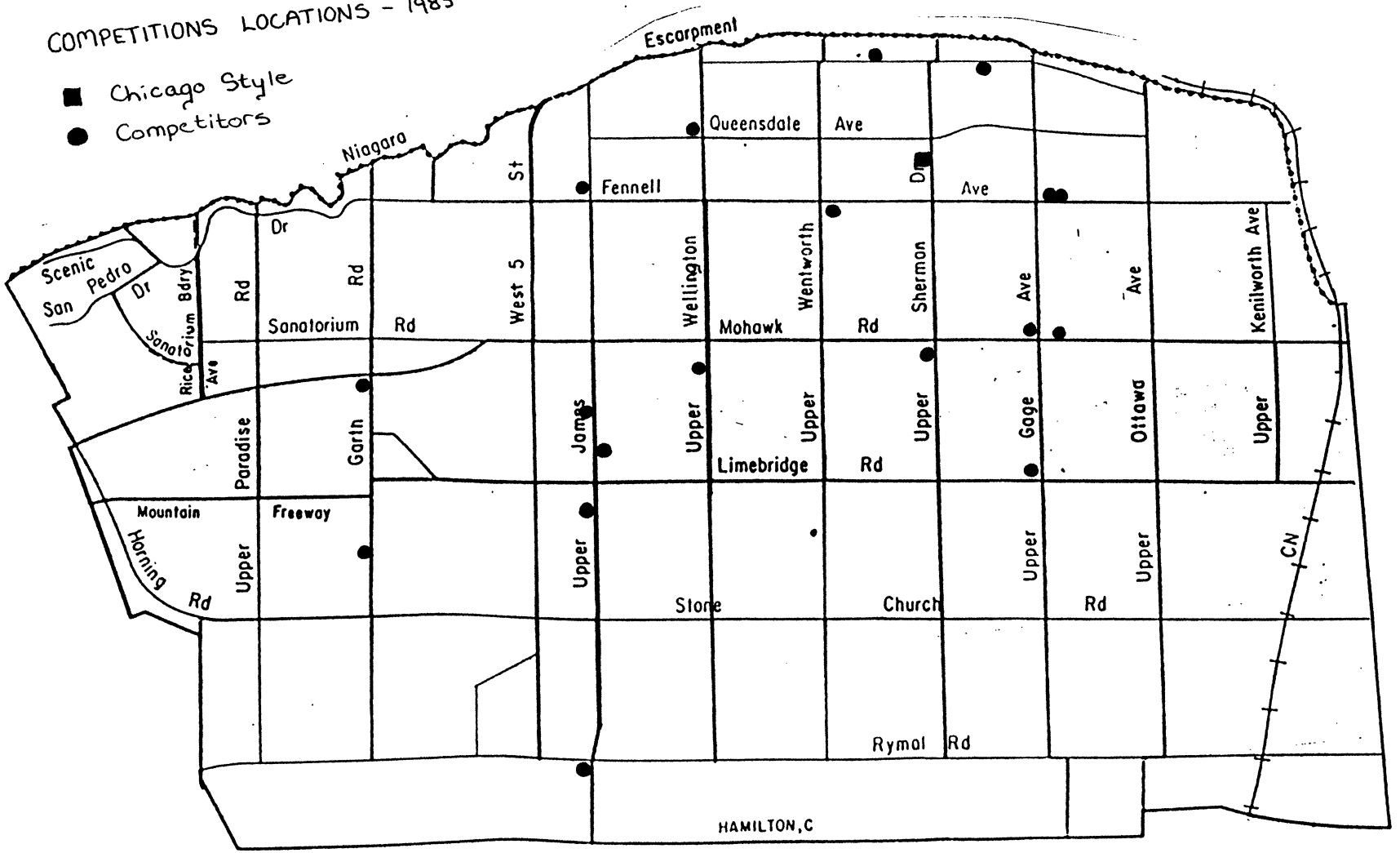


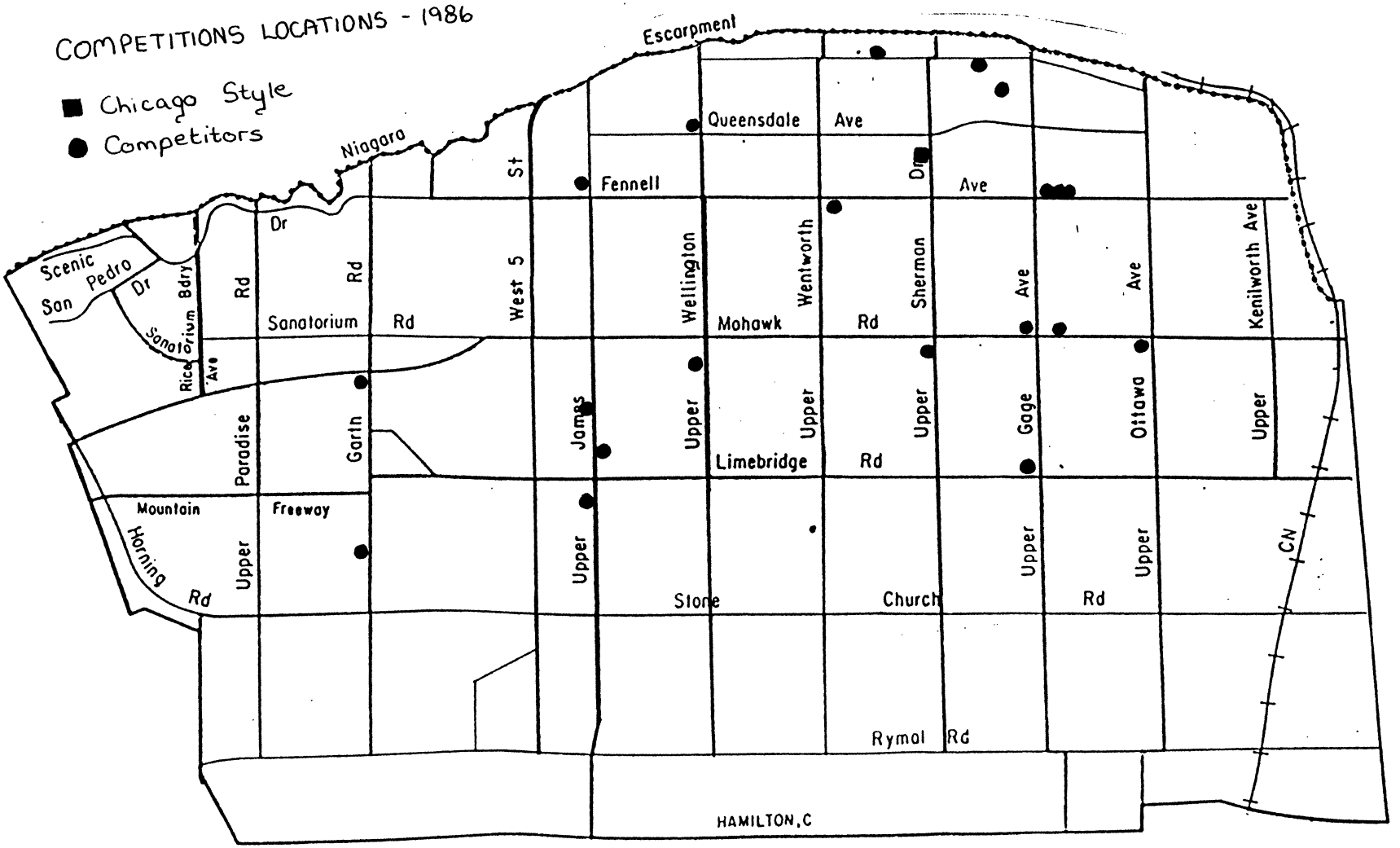

COMPETITIONS LOCATIONS - 1984
Chicago Style
Competitors
Escarpment
Niagara
St
Queensdale
Ave
Fennell
Dr
Ave
Scenic
San Pedro
Dr
Sanatorium Bdry
Rice
Ave
Rd
Dr
Sanatorium
Rd
West 5
Wellington
Wentworth
Mohawk
Rd
Sherman
Ave
Ave
Kenilworth Ave
Paradise
Garth
James
Upper
Upper
Limebridge
Rd
Upper
Gage
Ottawa
Upper
Mountain
Freeway
Horning
Rd
Upper
Upper
Stone
Church
Upper
Upper
Rd
CN
Rymal
Rd
HAMILTON, C

COMPETITIONS LOCATIONS - 1985

■ Chicago Style

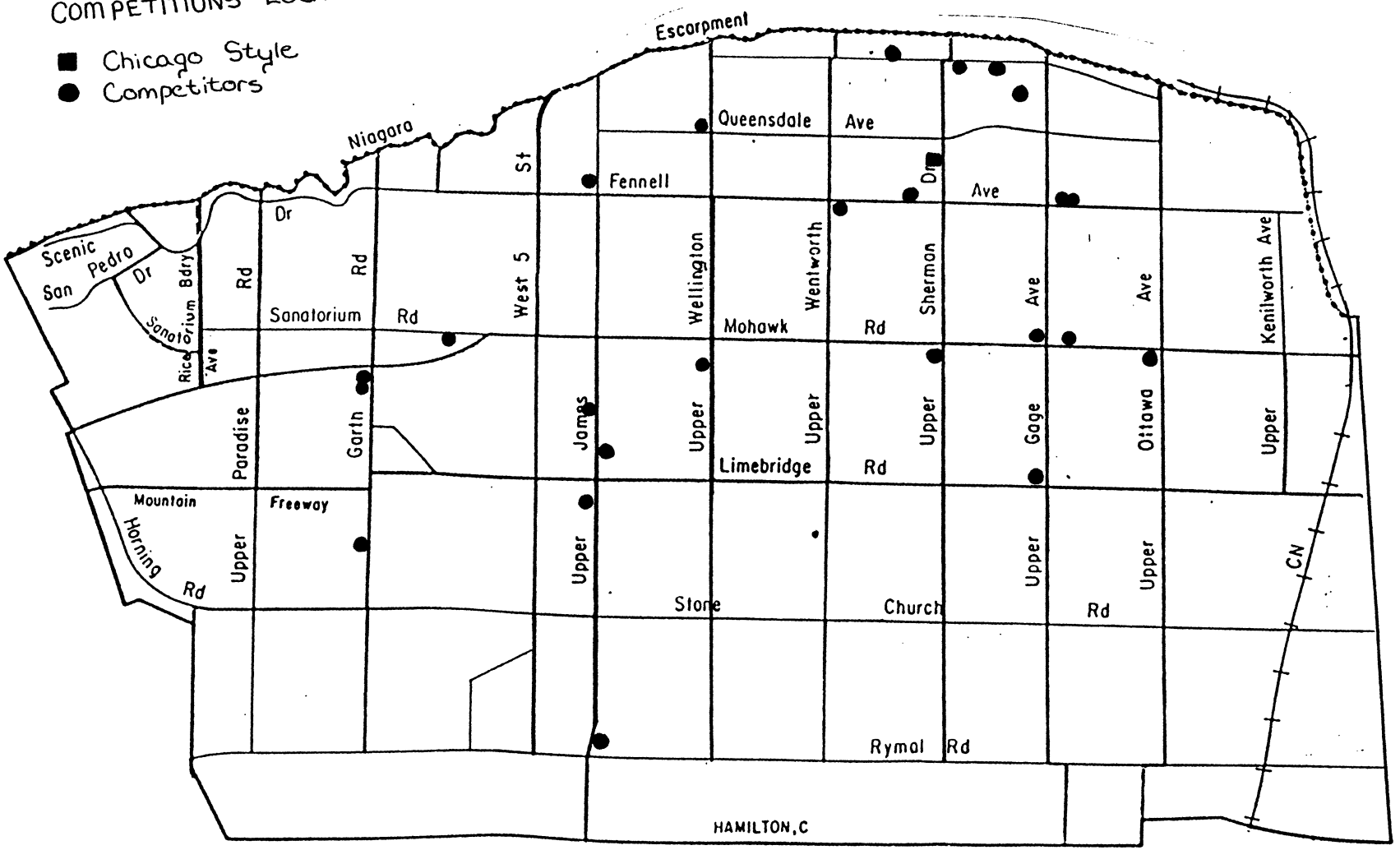
● Competitors




COMPETITIONS LOCATIONS - 1986
Chicago Style
Competitors
Escarpment
Niagara
St
Fennell
Queensdale
Ave
Dr
Ave
Scenic
San Pedro
Dr
Sanatorium Bdry
Rd
Dr
Rd
Sanatorium
Rd
West 5
Wellington
Wentworth
Mohawk
Rd
Sherman
Ave
Ave
Kenilworth Ave
Rice
Ave
Paradise
Garth
James
Upper
Upper
Limebridge
Rd
Upper
Gage
Ottawa
Upper
Mountain
Freeway
Horning
Rd
Upper
Upper
Stone
Church
Upper
Upper
Rd
CN
Rymal
Rd
HAMILTON, C

COMPETITIONS LOCATIONS - 1987

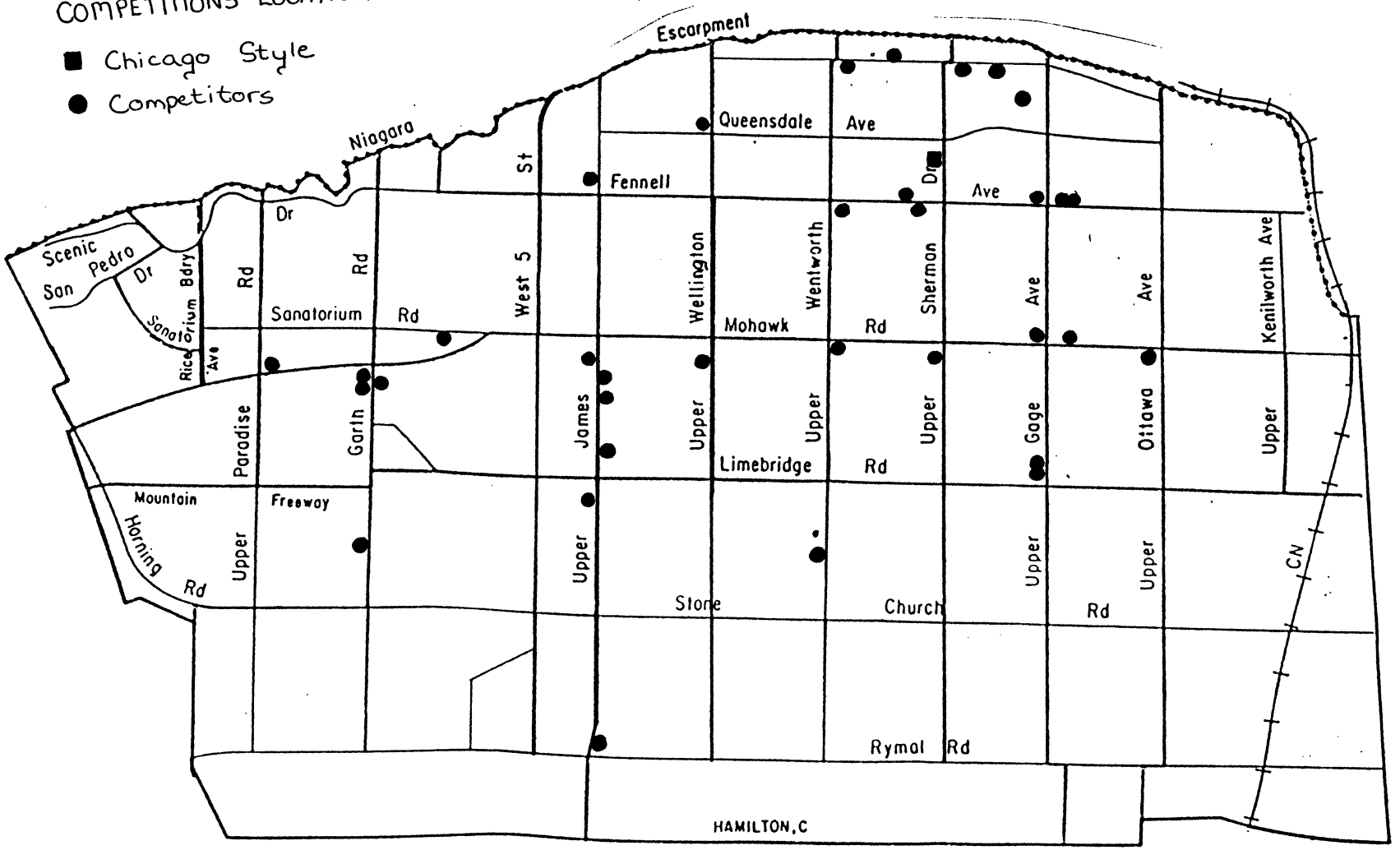
■ Chicago Style
● Competitors



COMPETITIONS LOCATIONS - 1988

■ Chicago Style

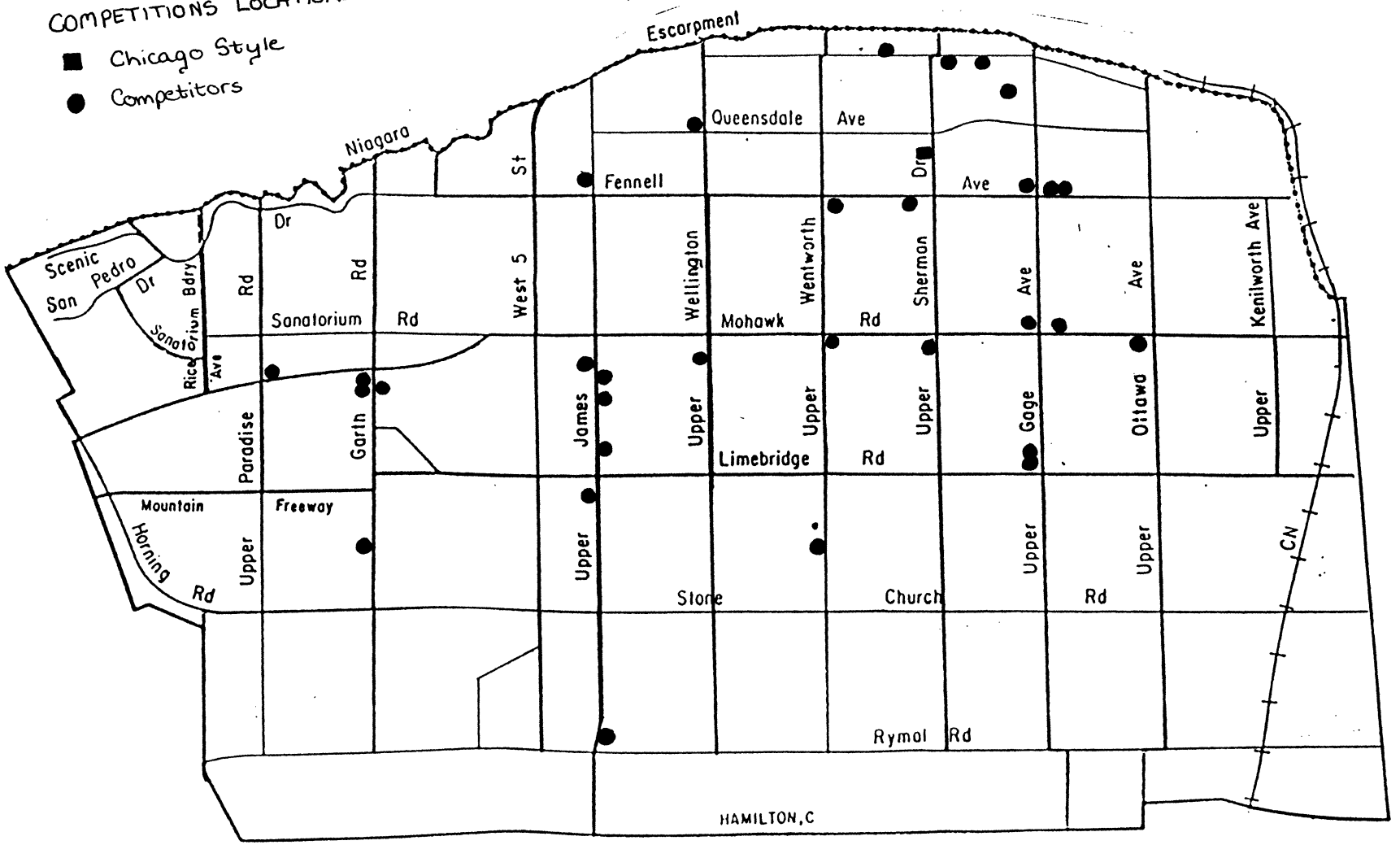
● Competitors



COMPETITIONS LOCATIONS - 1989

■ Chicago Style

● Competitors



APPENDIX B:

MAPS OF SPOTTED CUSTOMERS FOR THE YEARS 1982 TO 1988

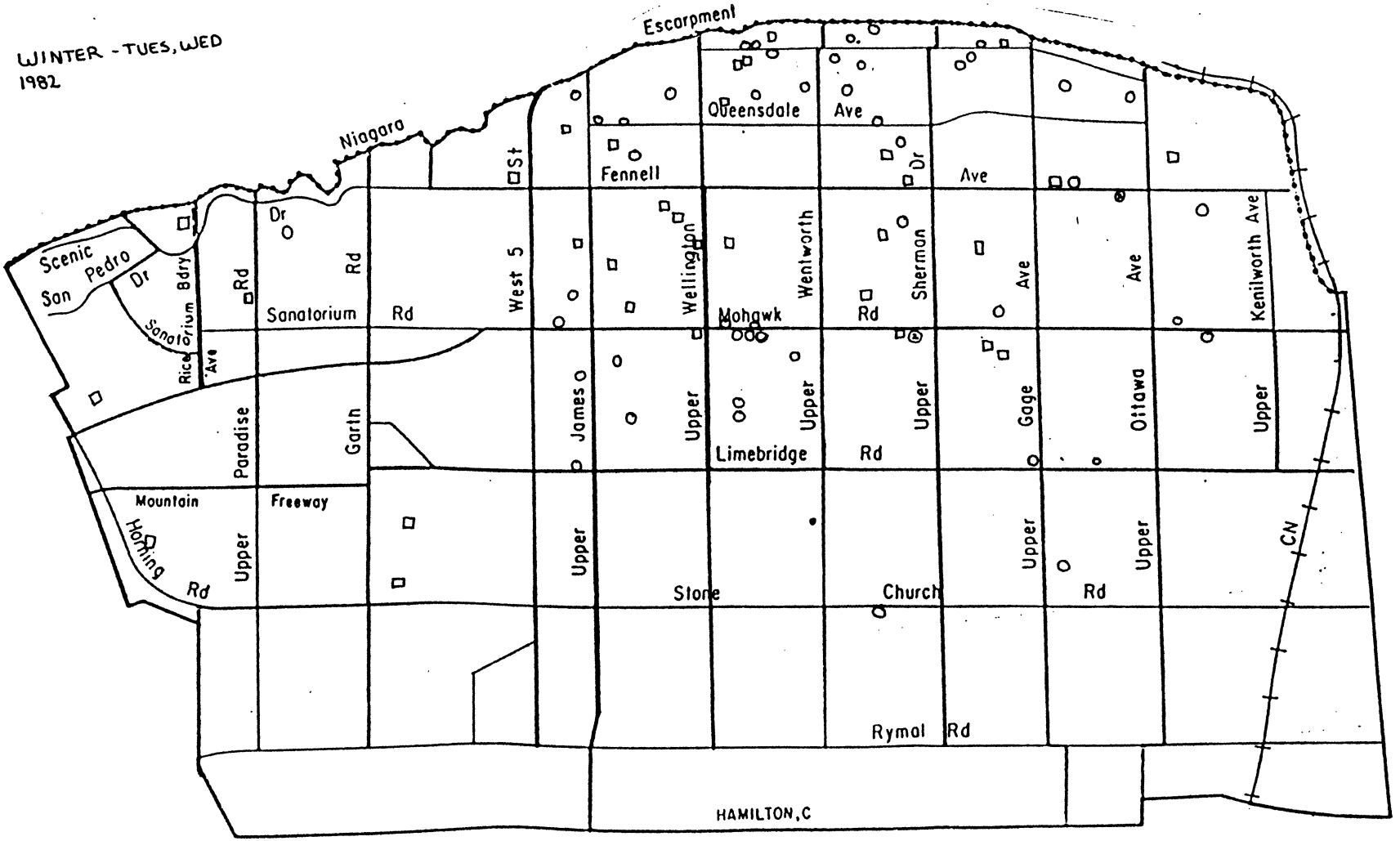
LEGEND FOR MAPS OF APPENDIX B

○ Represents deliveries before 8:00 PM

□ Represents deliveries after 8:00 PM

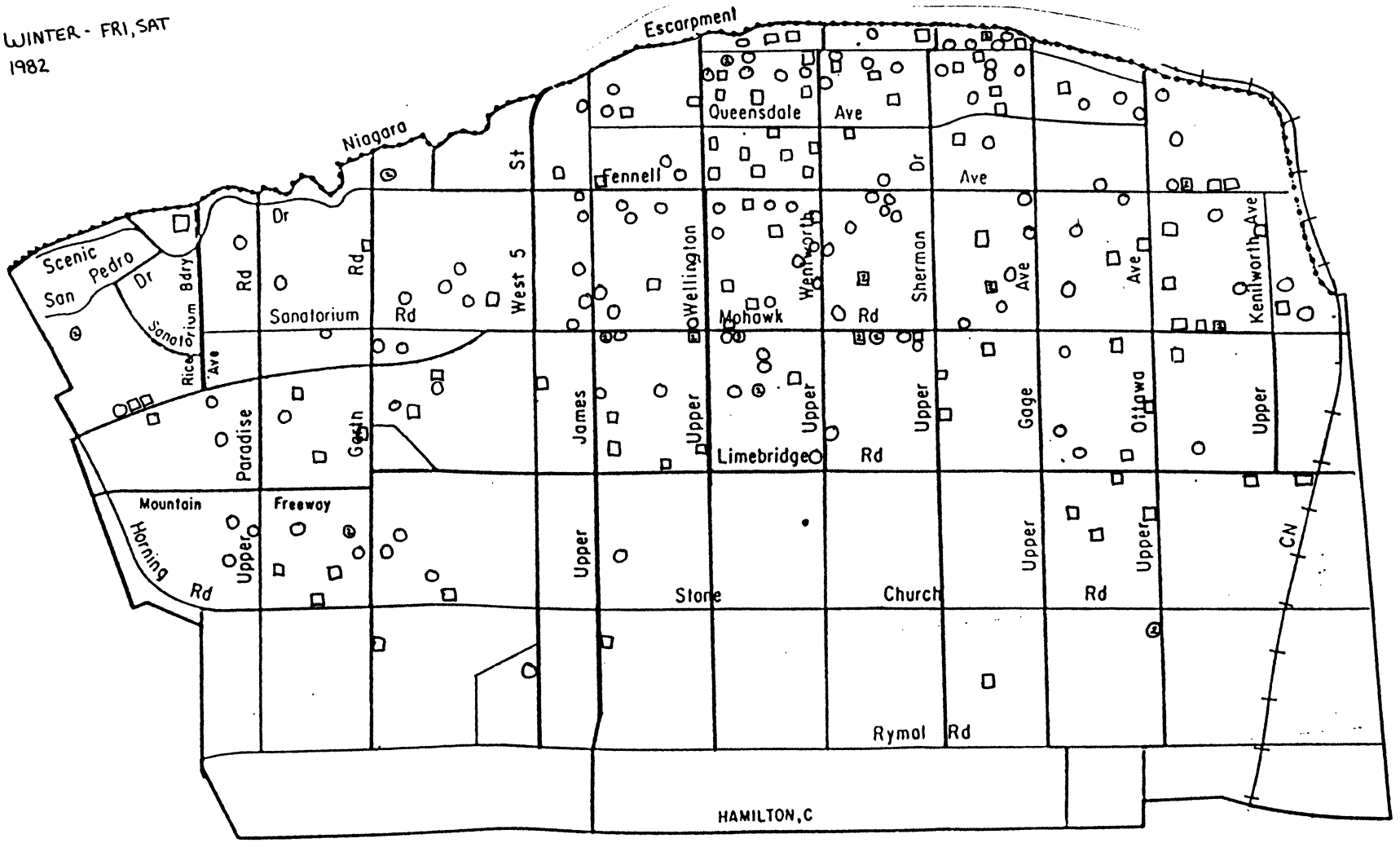
* note: values within points represent multiply deliveries

WINTER - TUES, WED
1982



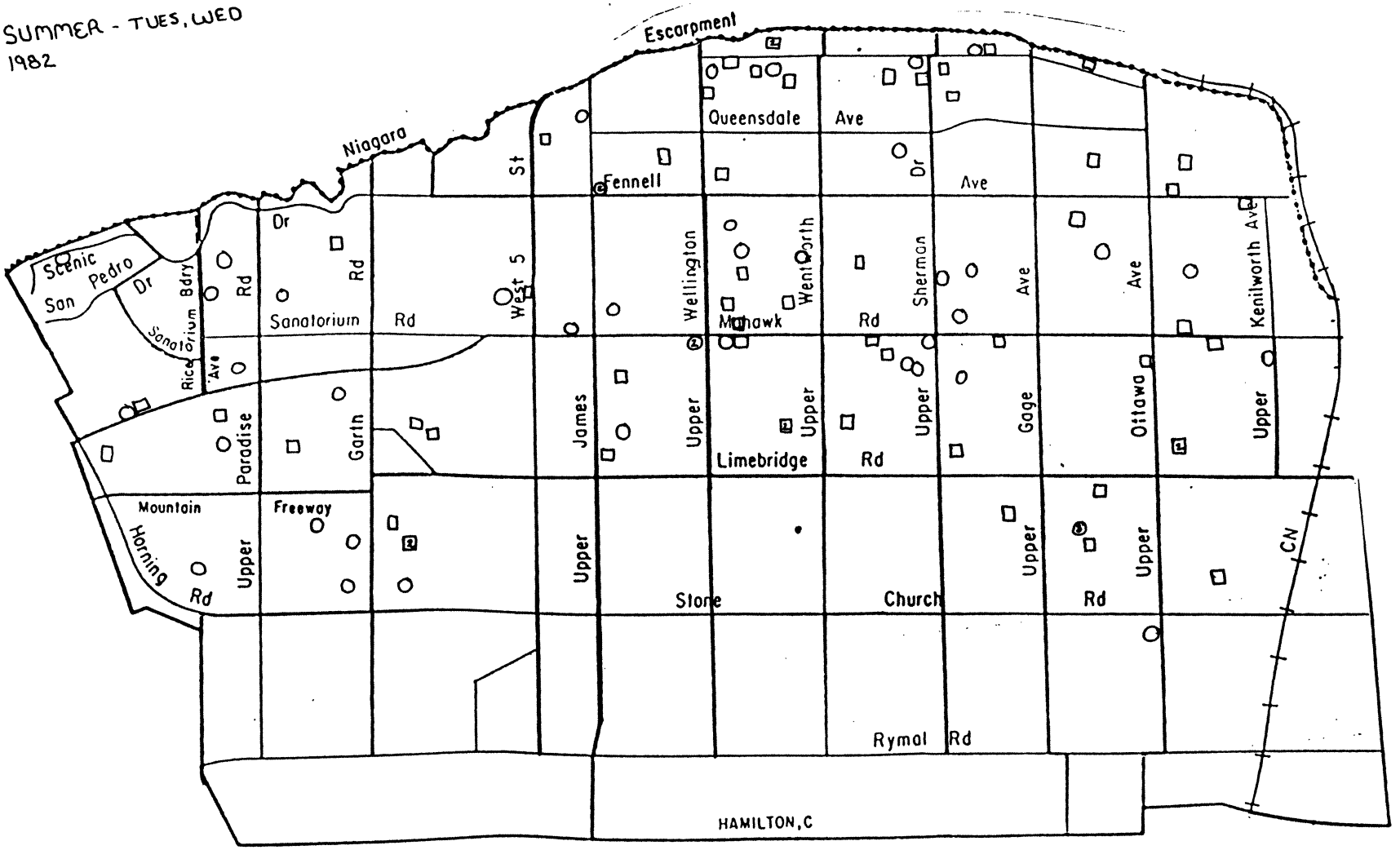
MAP 1

WINTER - FRI, SAT
1982



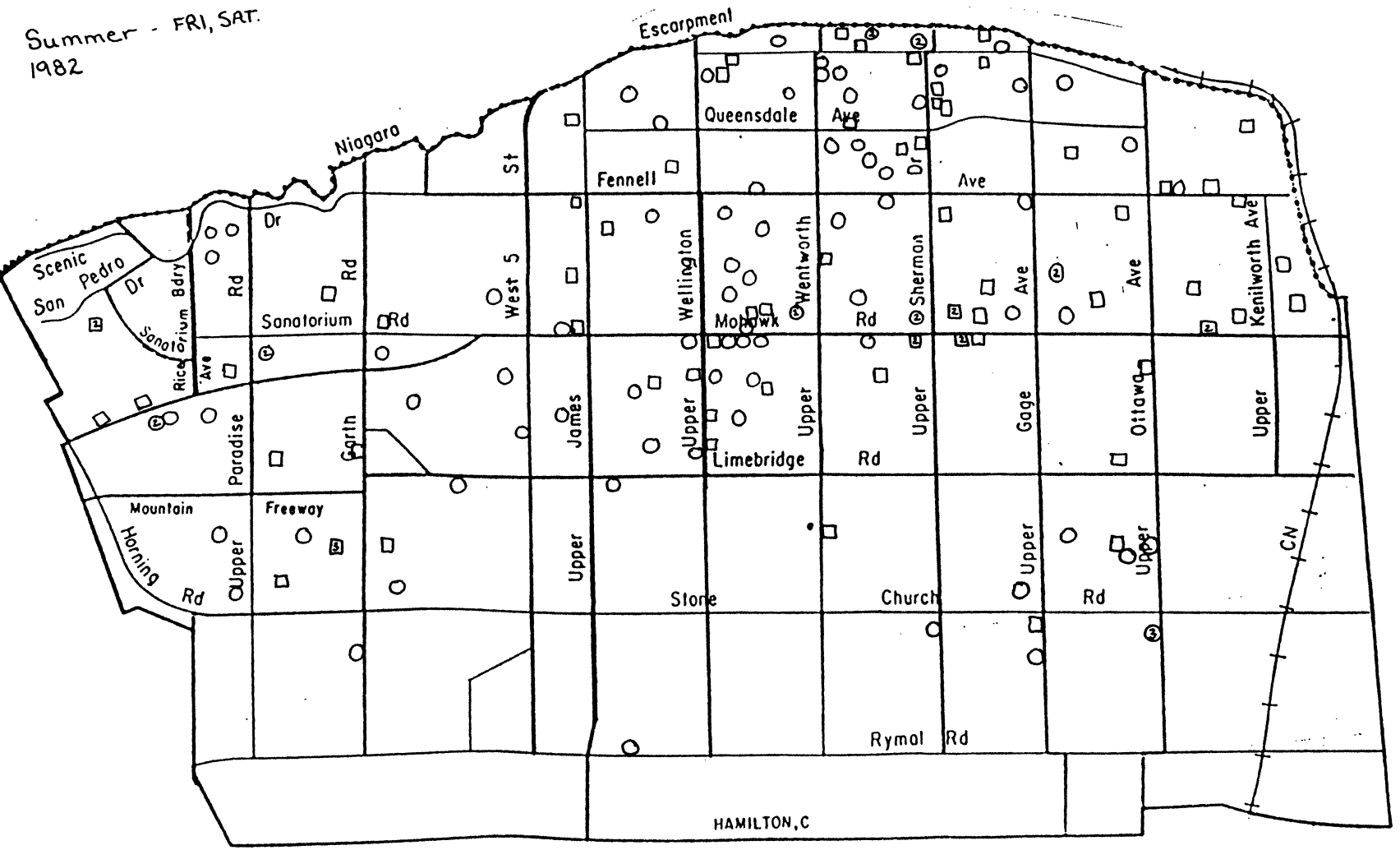
MAP 2

SUMMER - TUES, WED
1982



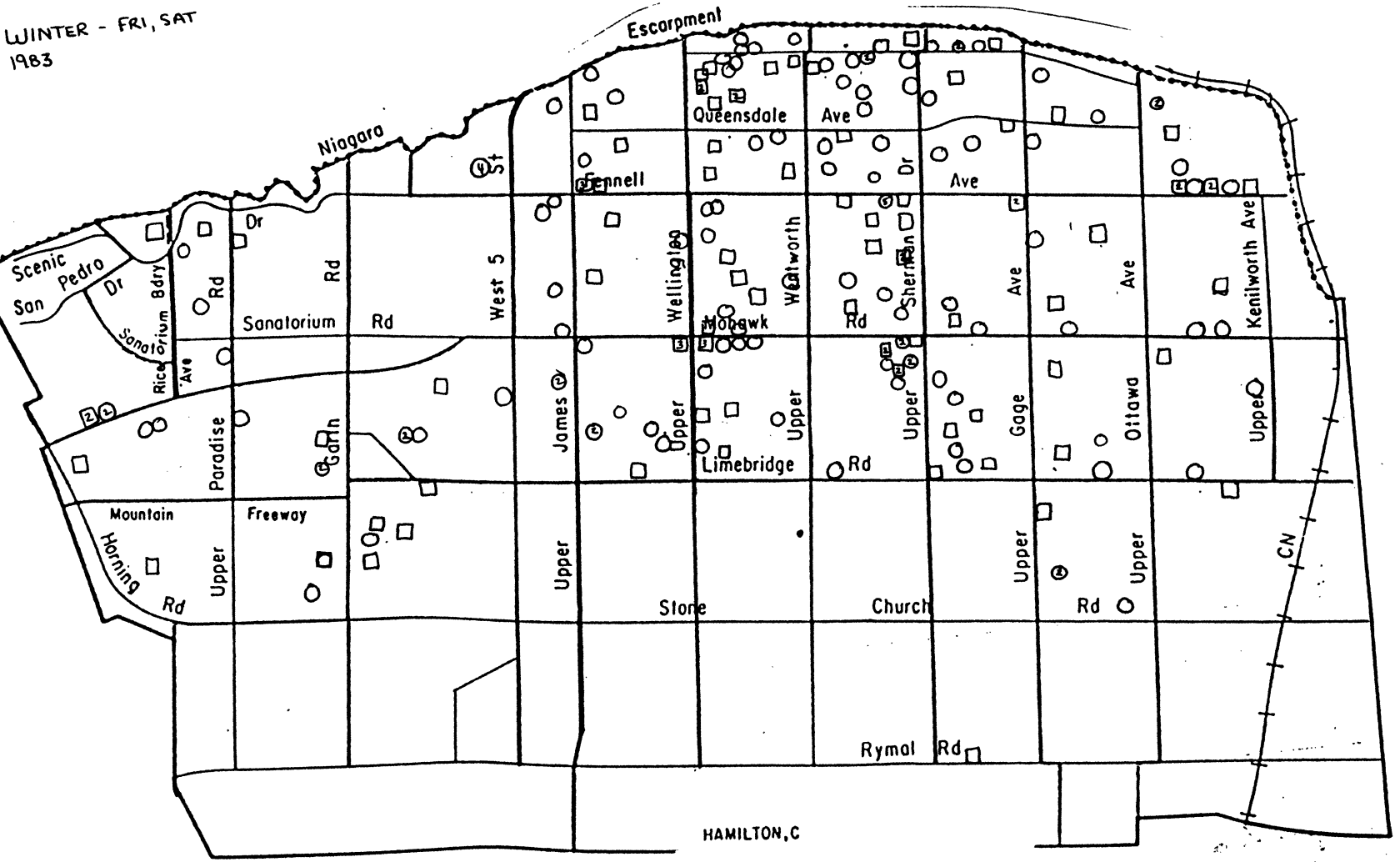
MAP 3

Summer - FRI, SAT.
1982



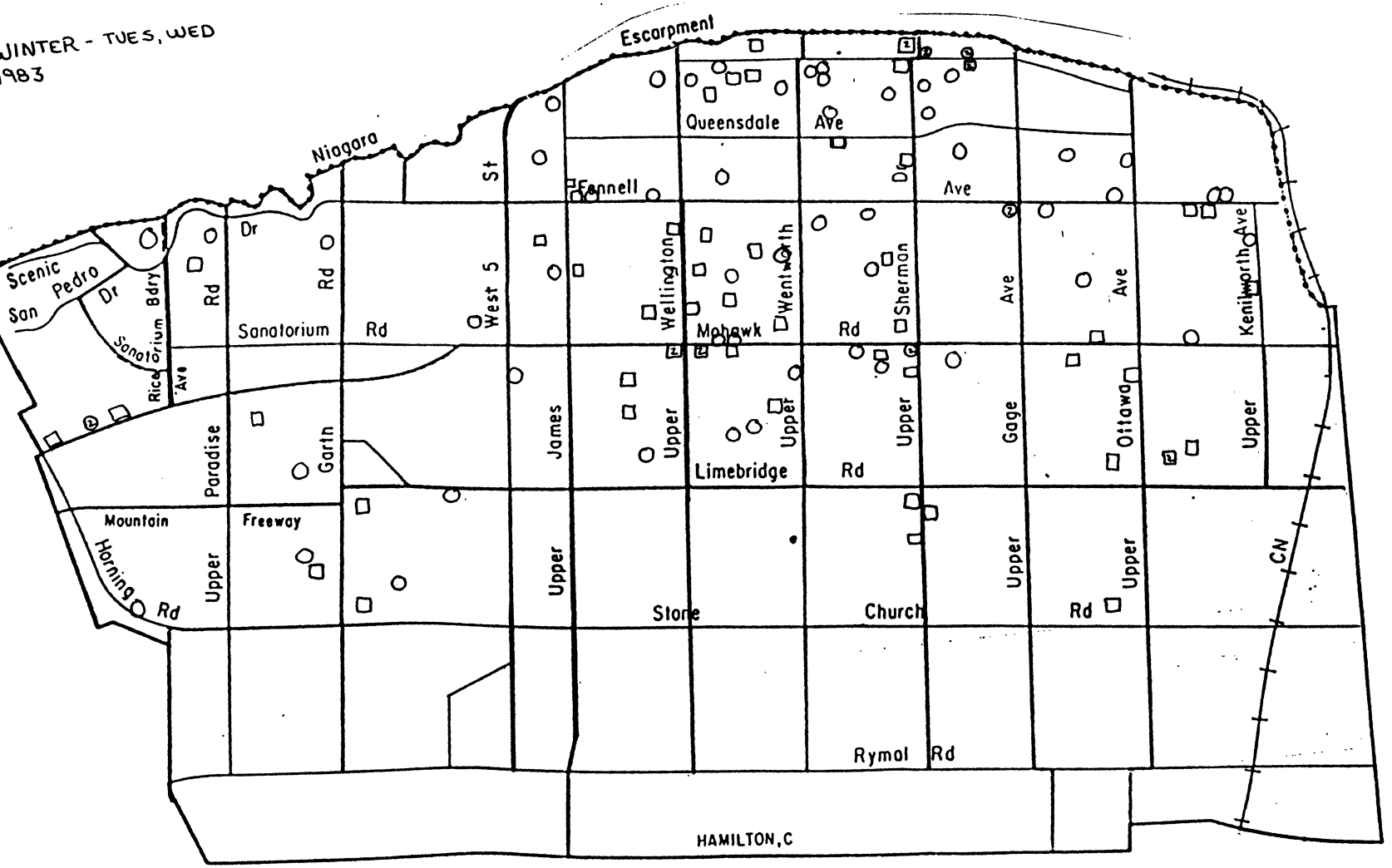
map 4

WINTER - FRI, SAT
1983



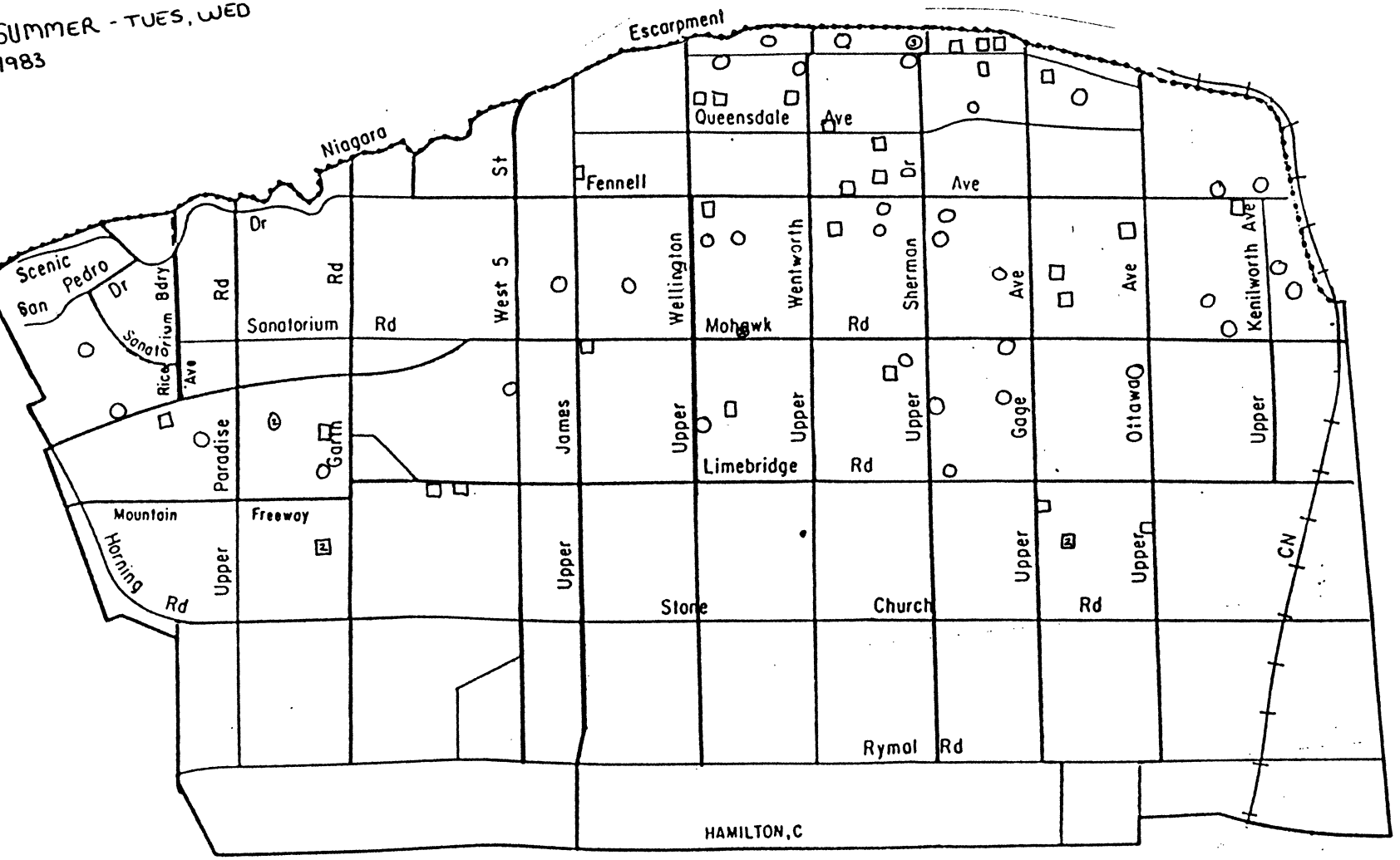
Map 6

WINTER - TUES, WED
1983



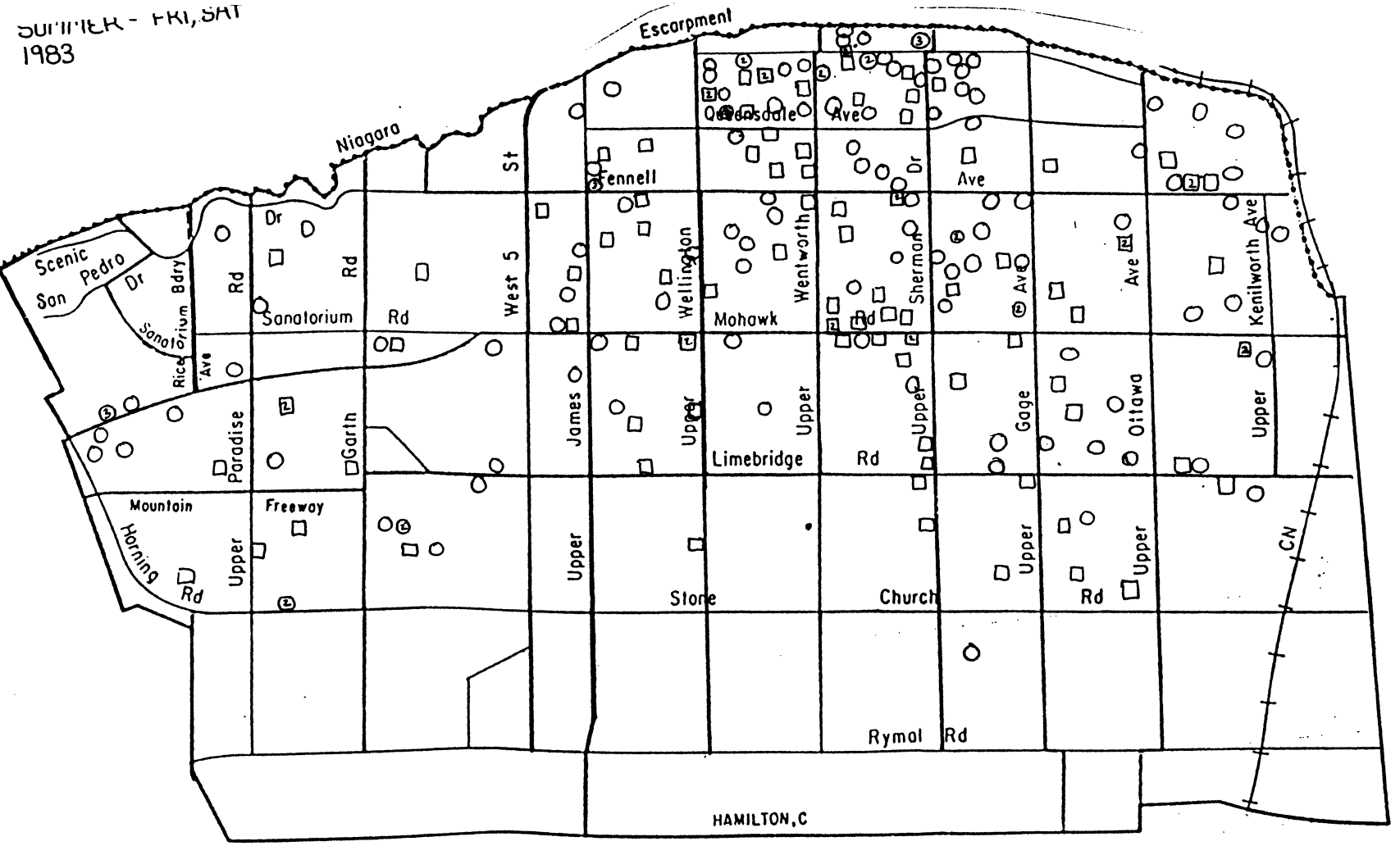
MAPS

SUMMER - TUES, WED
1983



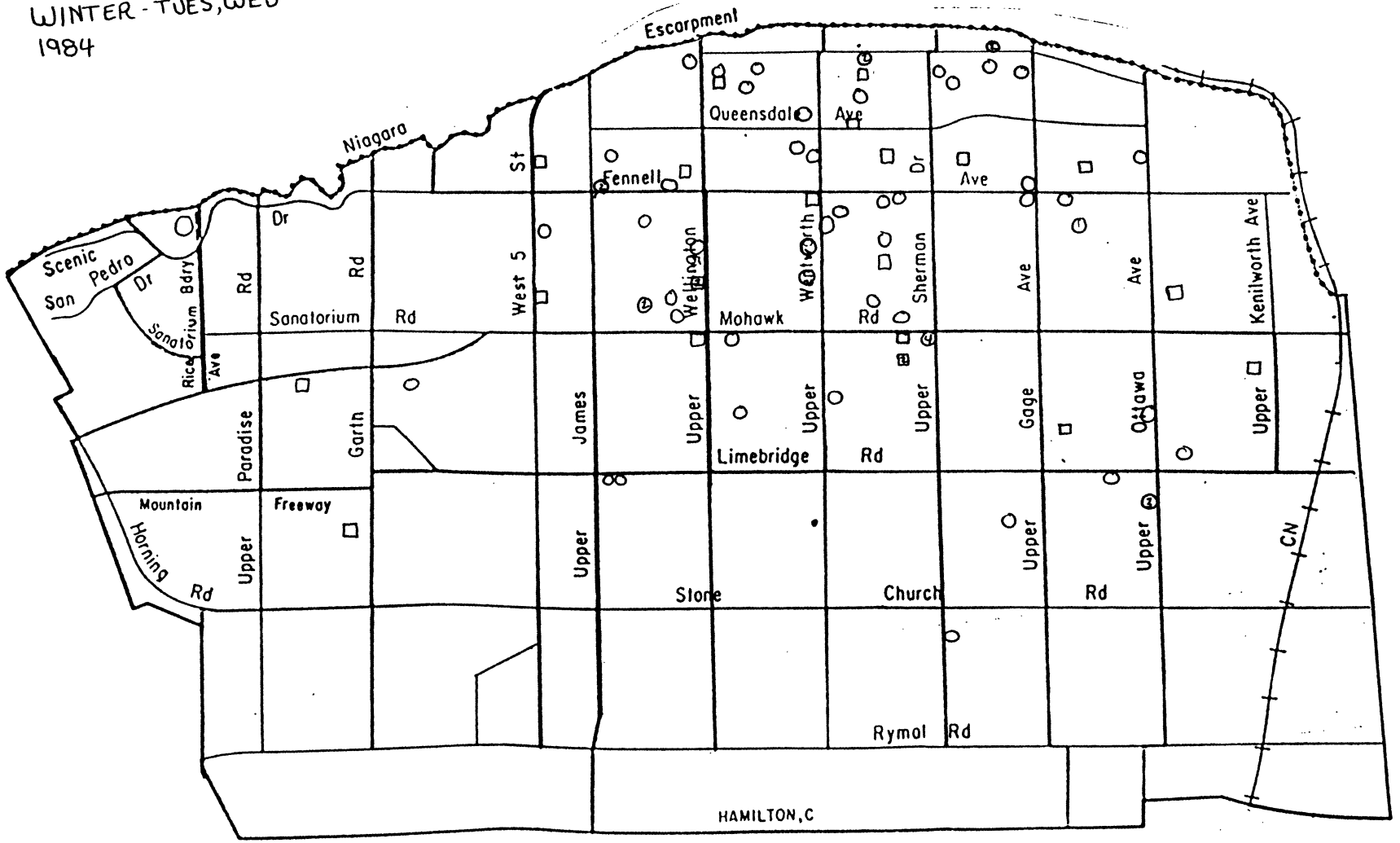
MAP 7

SUMMER - FRI, SAT
1983



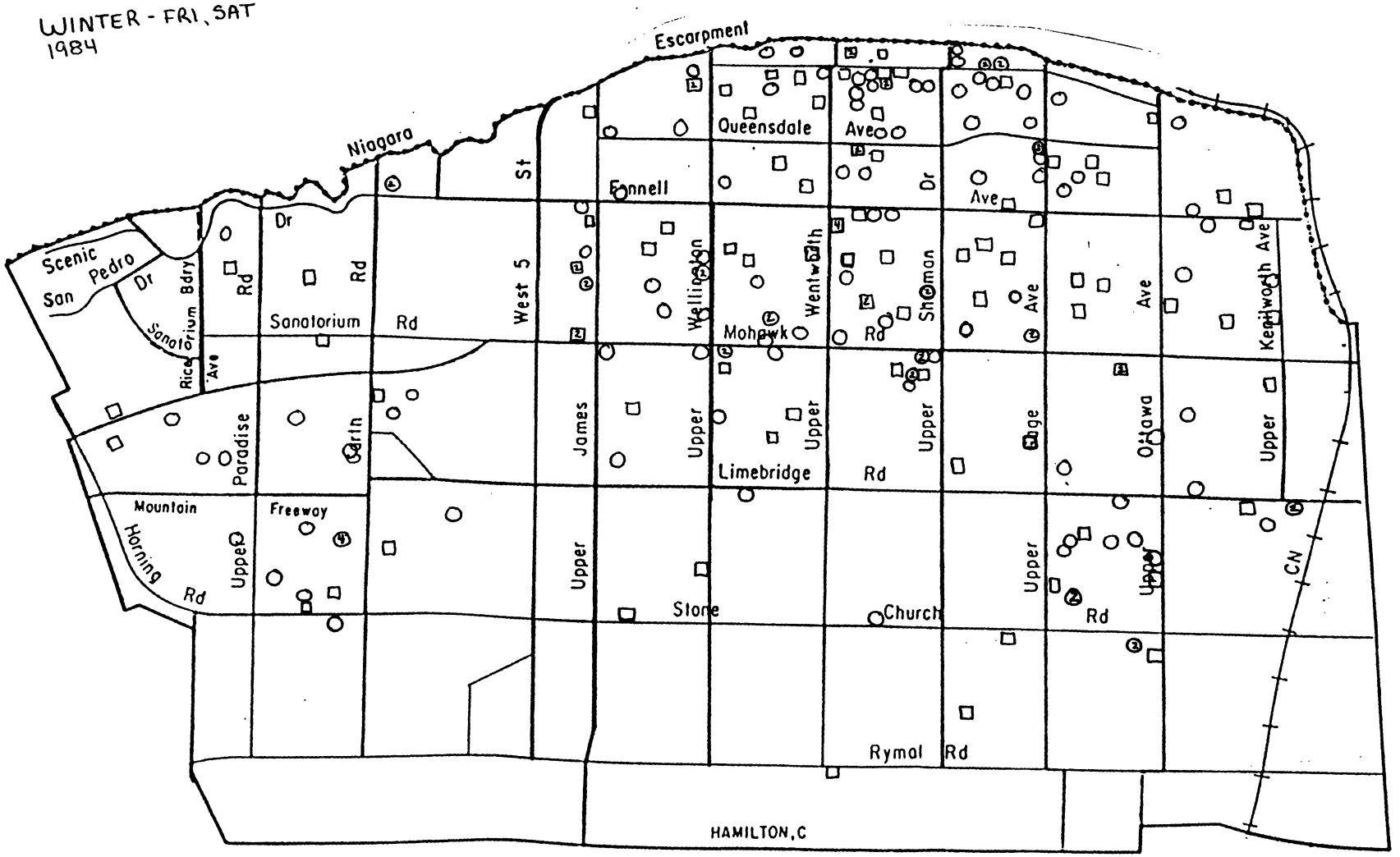
MAP 8

WINTER - TUES, WED
1984



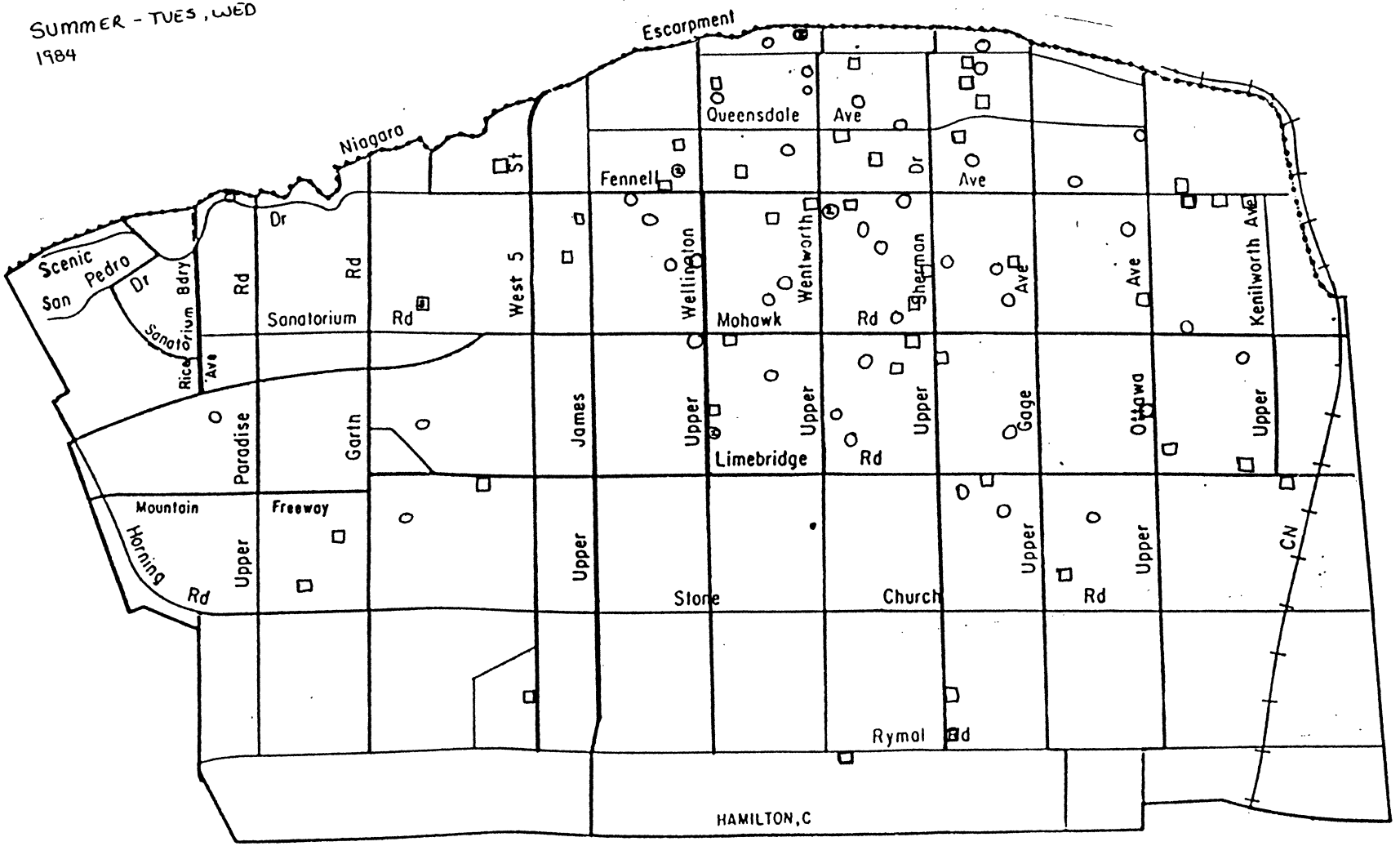
Map 9

WINTER - FRI, SAT
1984



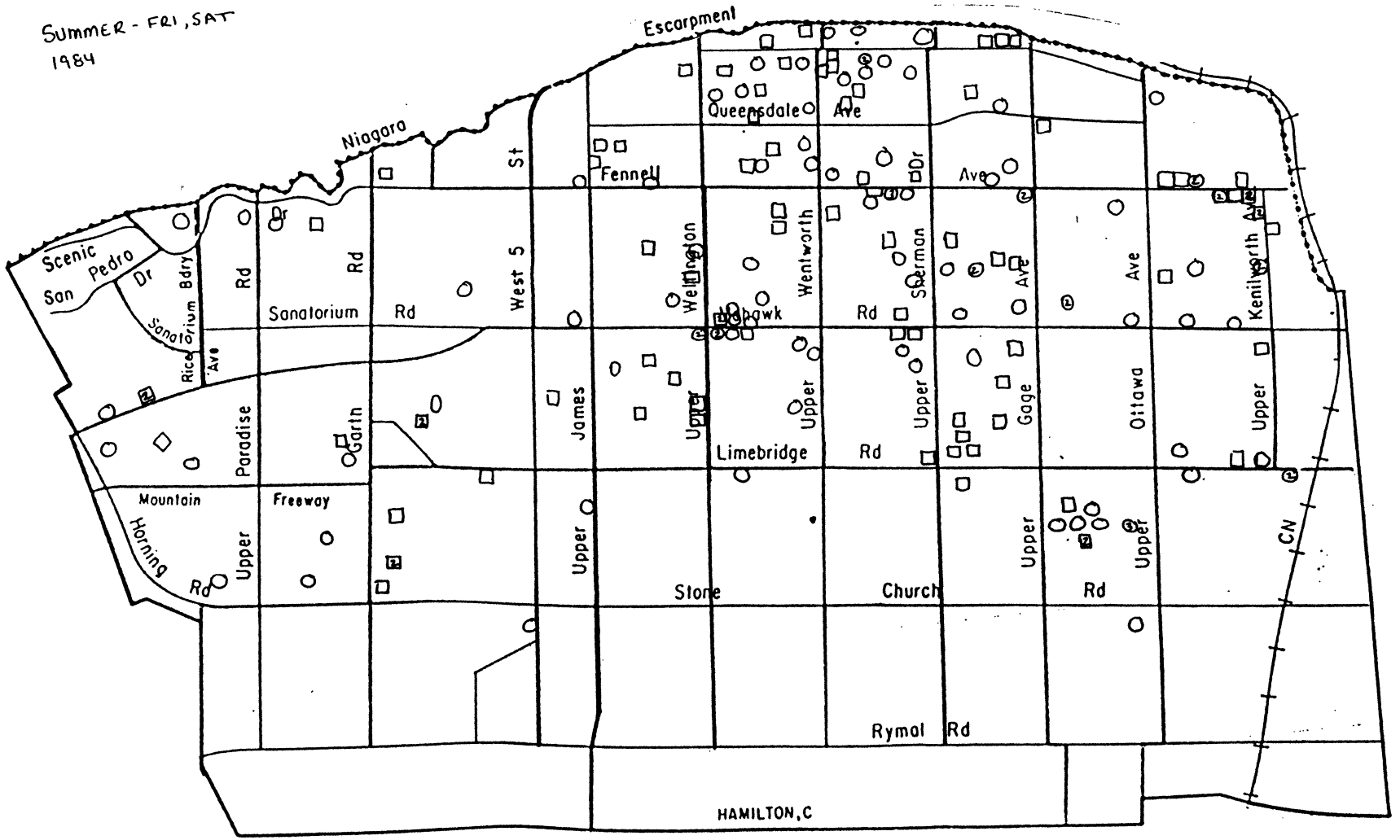
Map 10

SUMMER - TUES, WED
1984



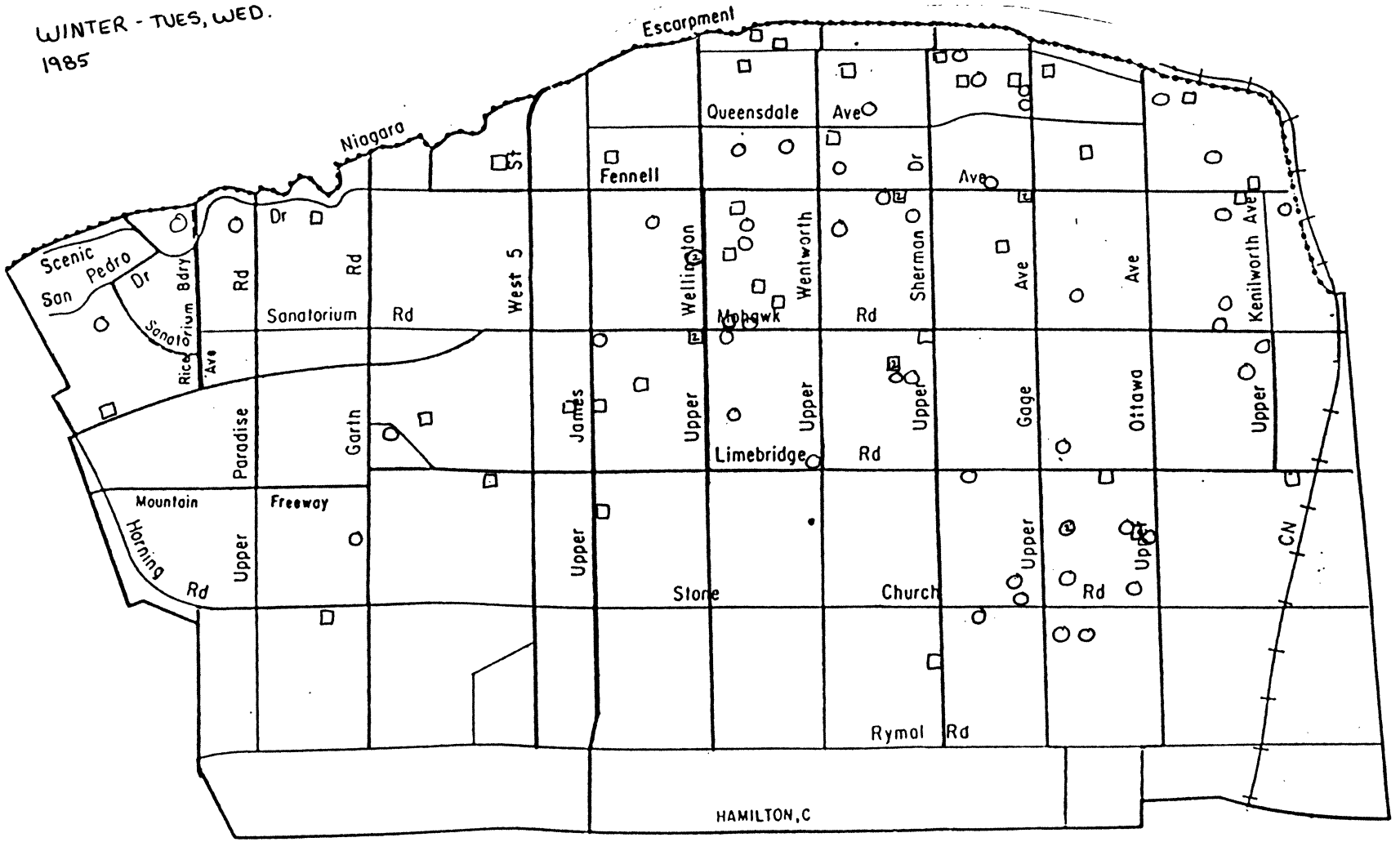
map 11

SUMMER - FRI, SAT
1984



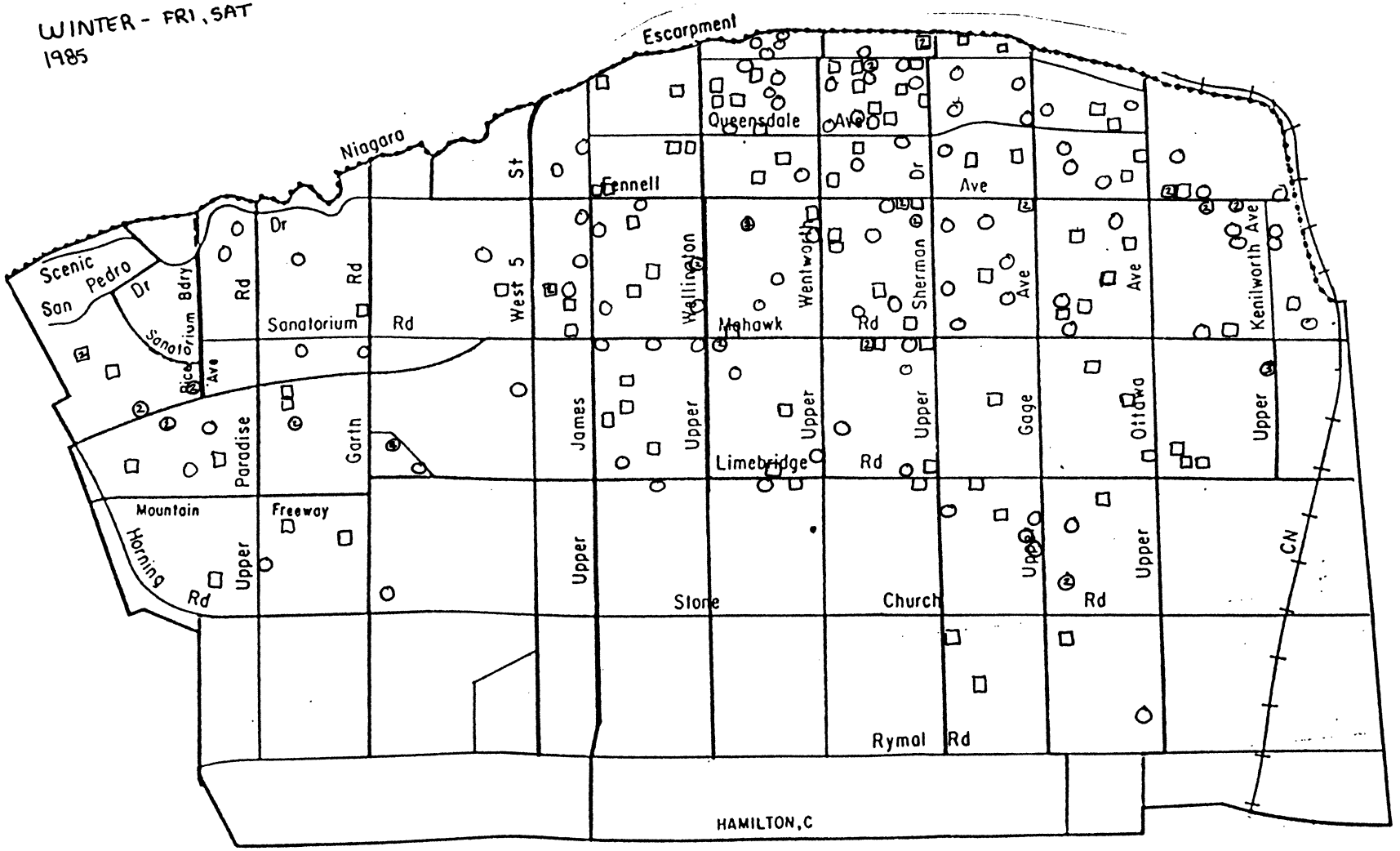
Map 12

WINTER - TUES, WED.
1985



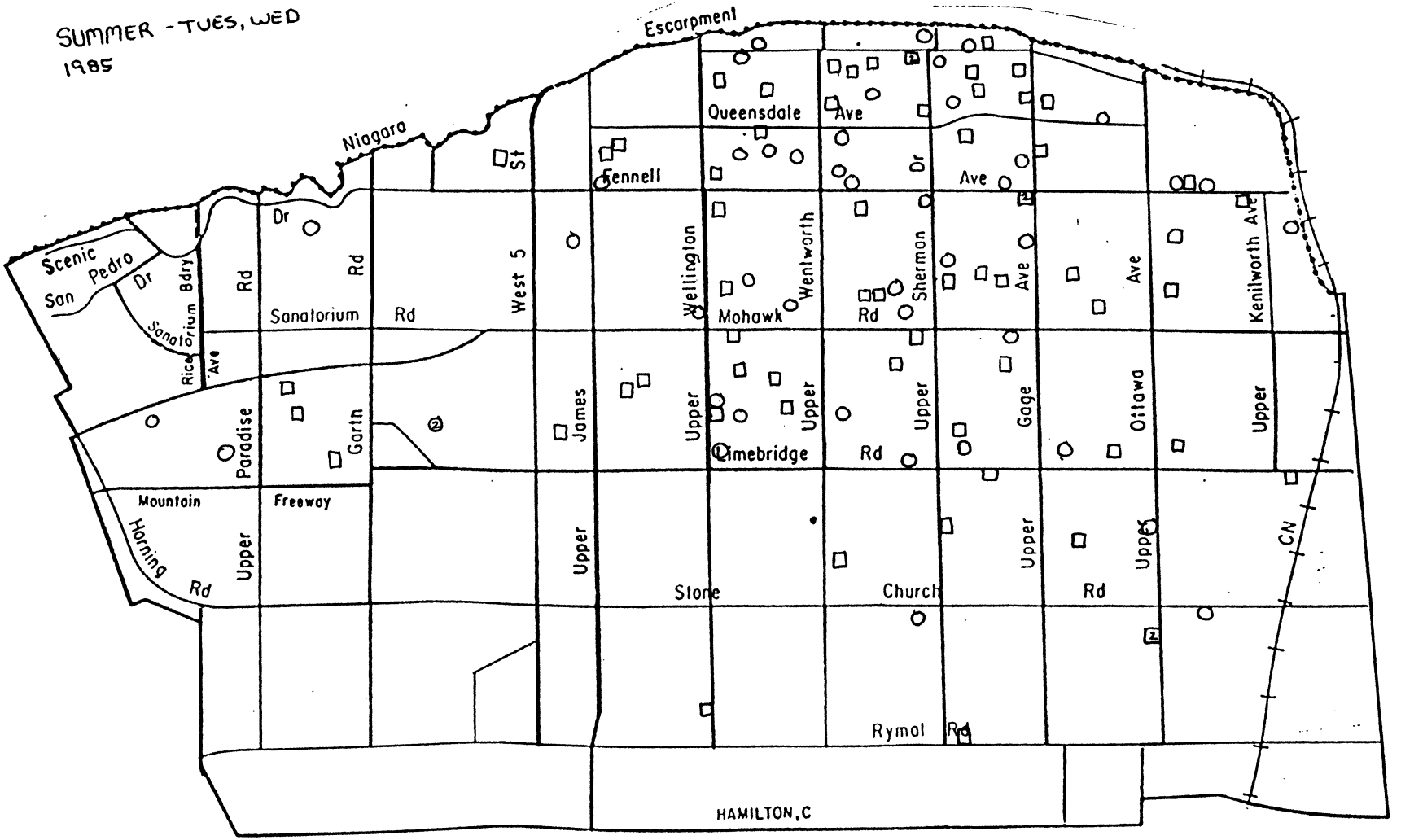
Map 13

WINTER - FRI, SAT
1985



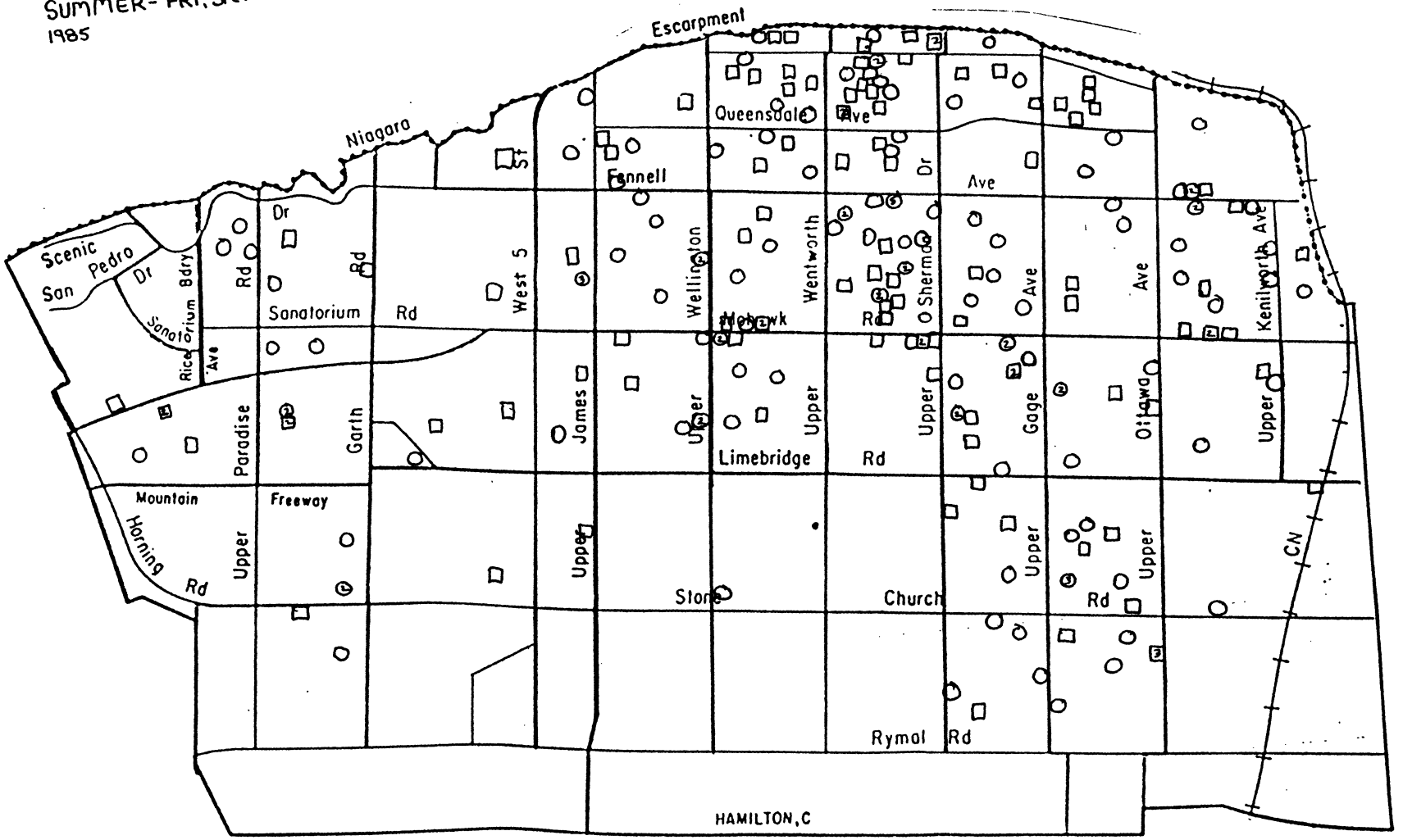
map 14

SUMMER - TUES, WED
1985



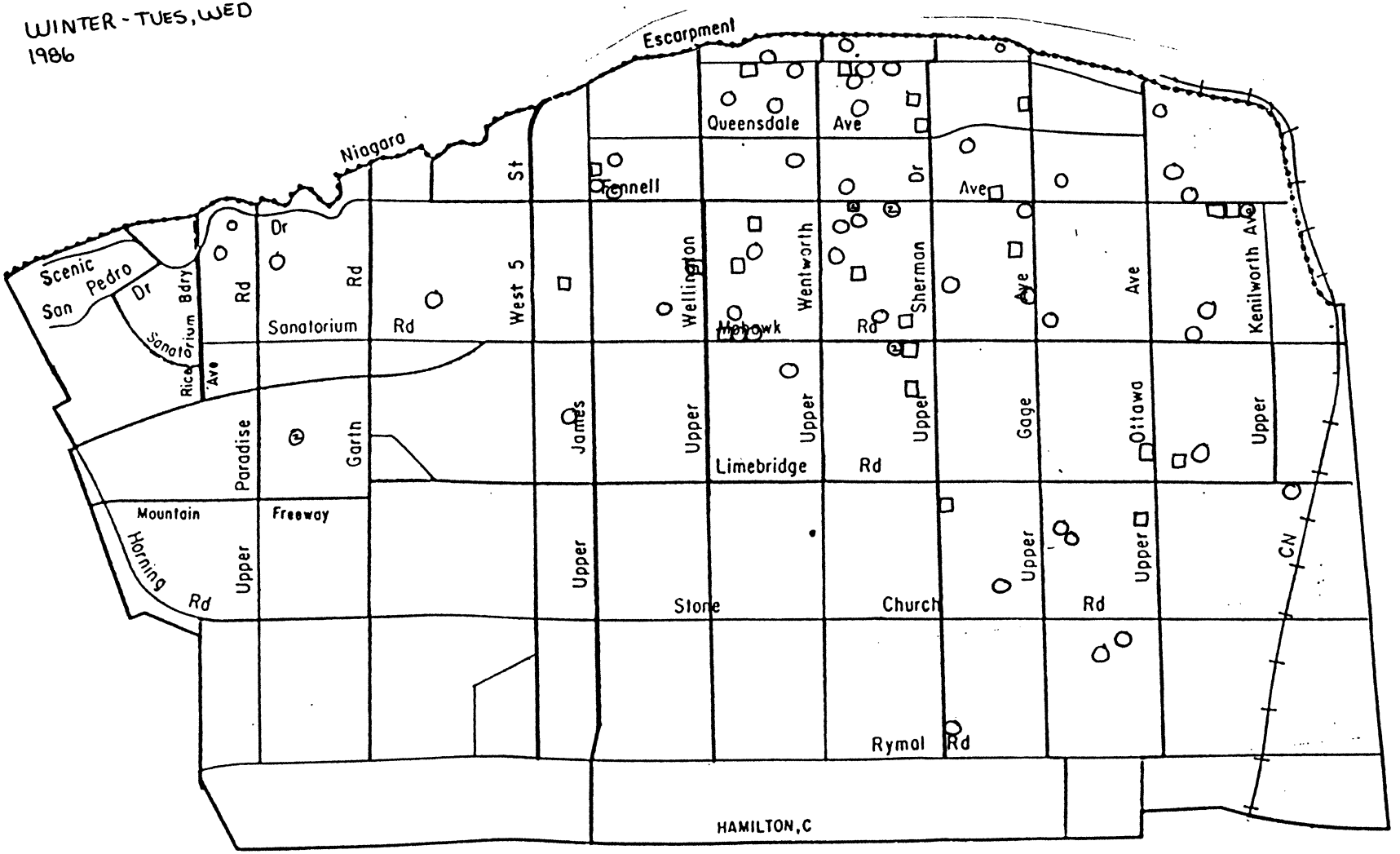
Map 15

SUMMER- FRI, SAT
1985



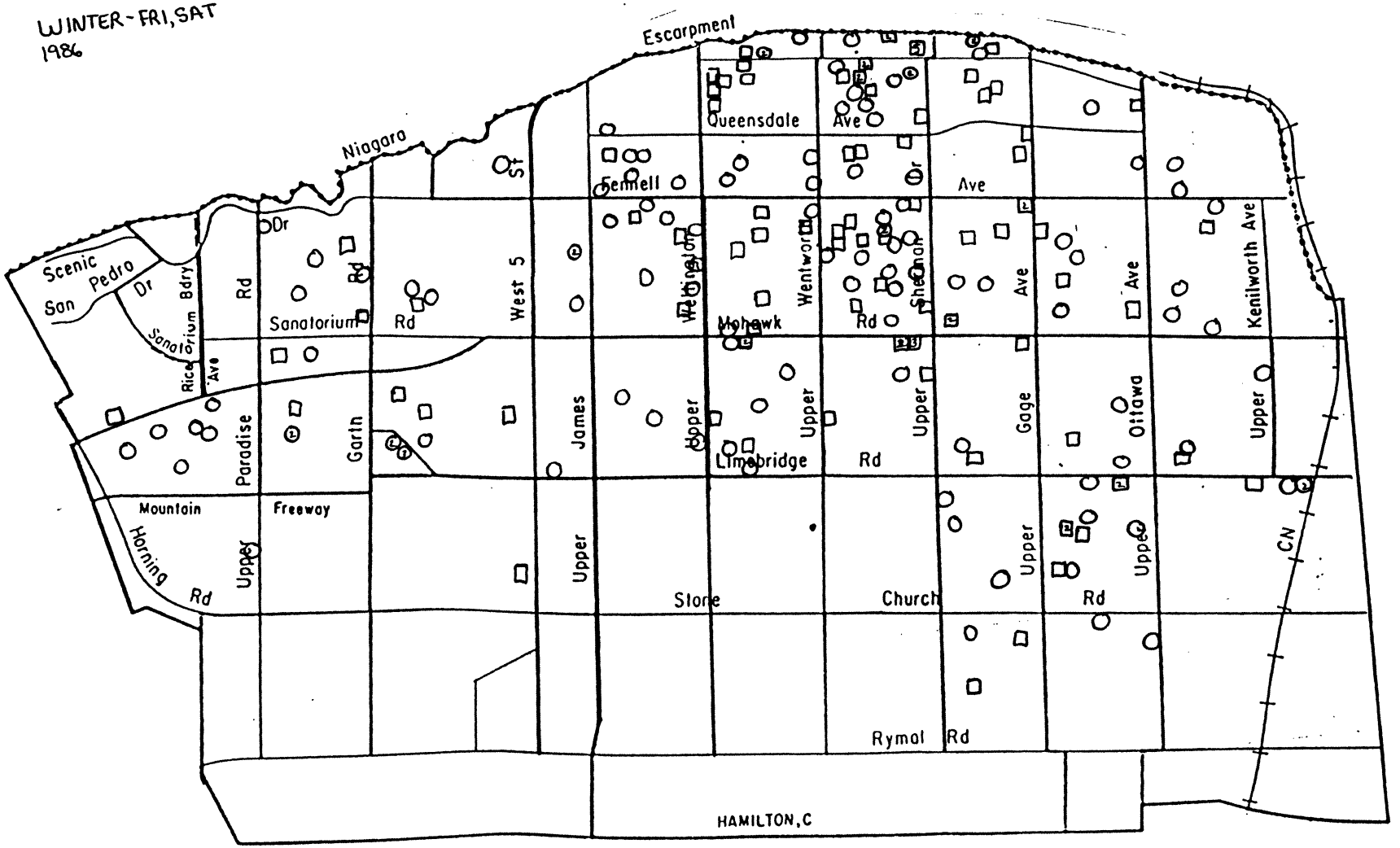
map16

WINTER - TUES, WED
1986



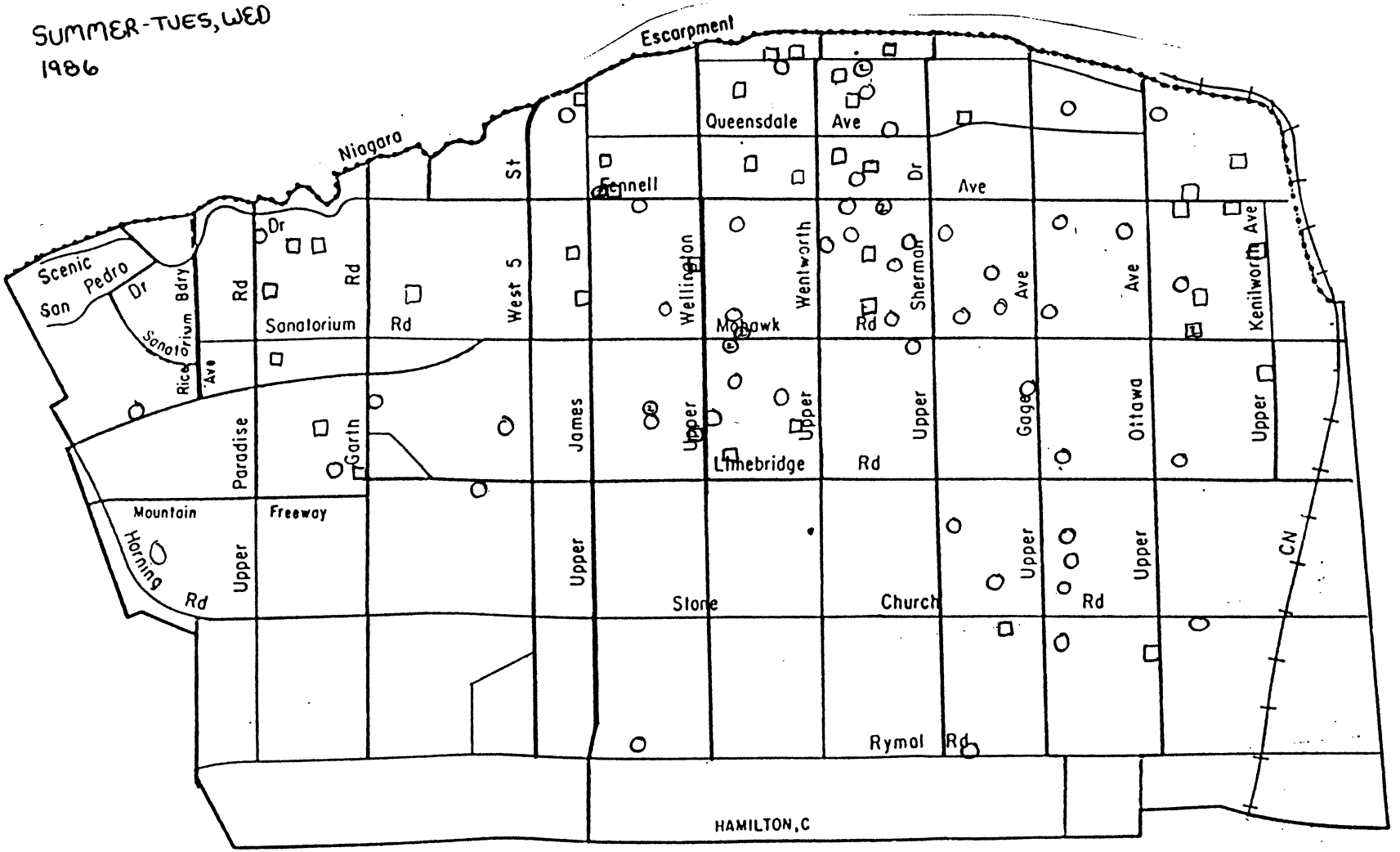
Map 17

WINTER - FRI, SAT
1986



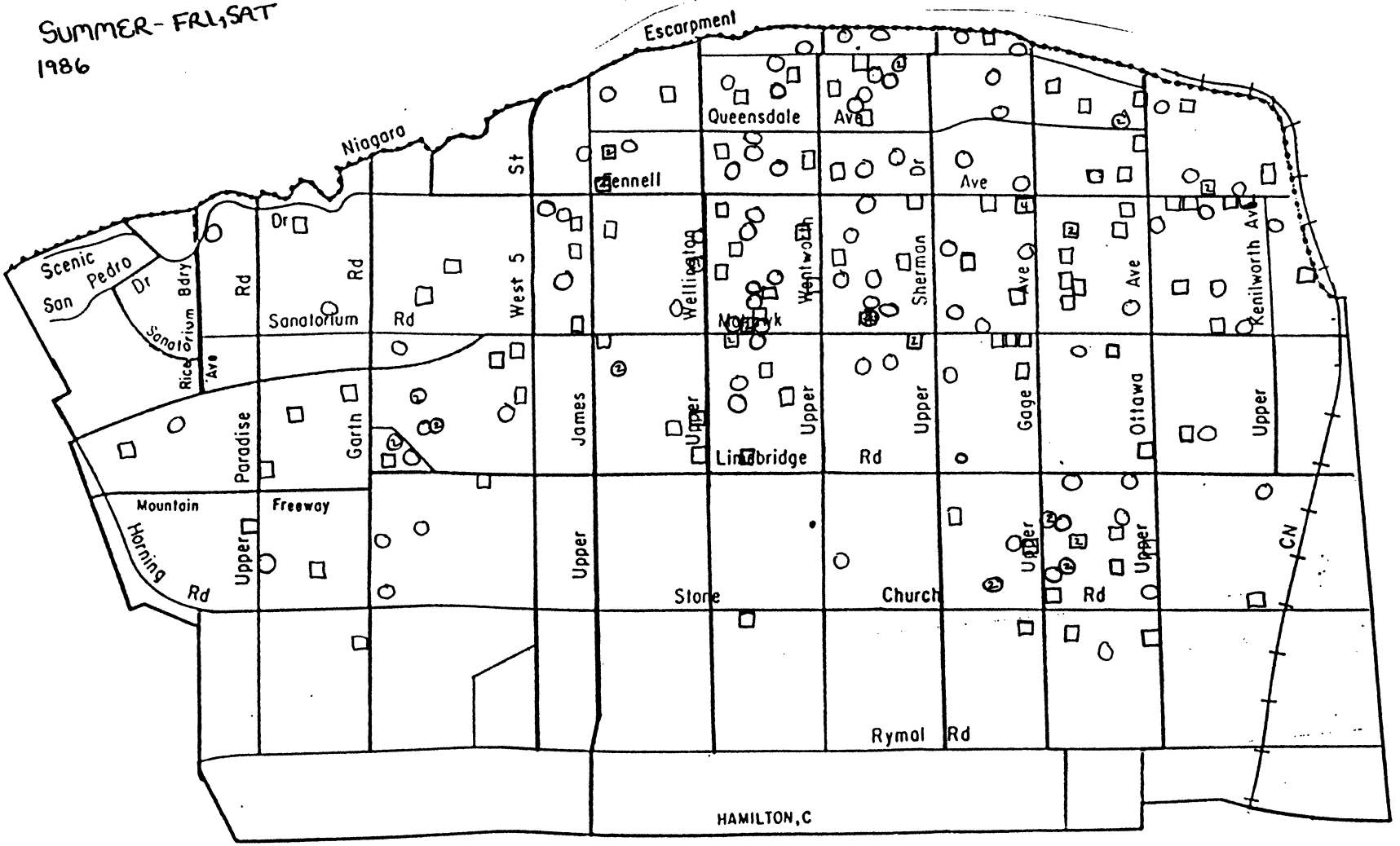
map 18

SUMMER-TUES, WED
1986



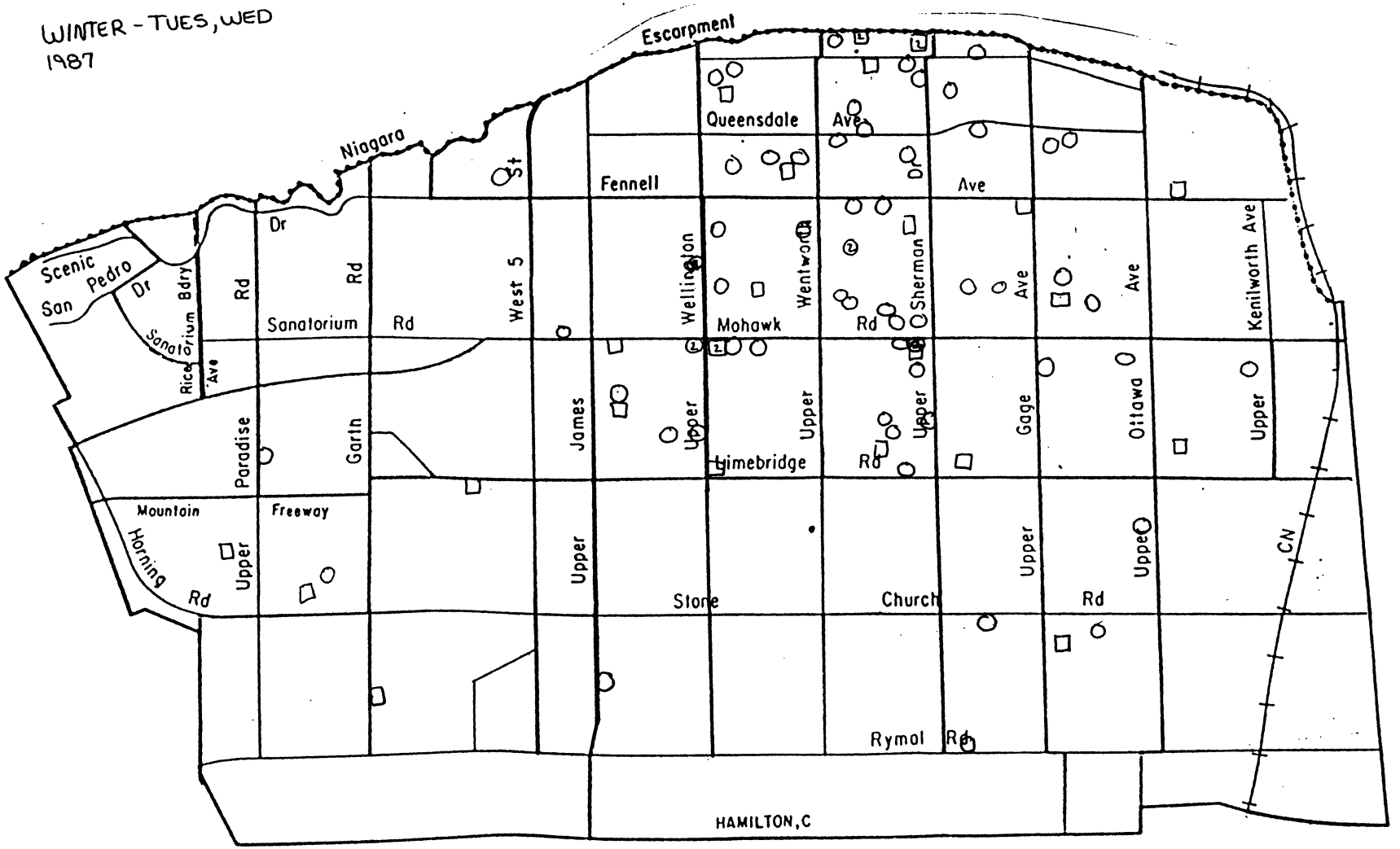
map 19

SUMMER - FRI, SAT
1986



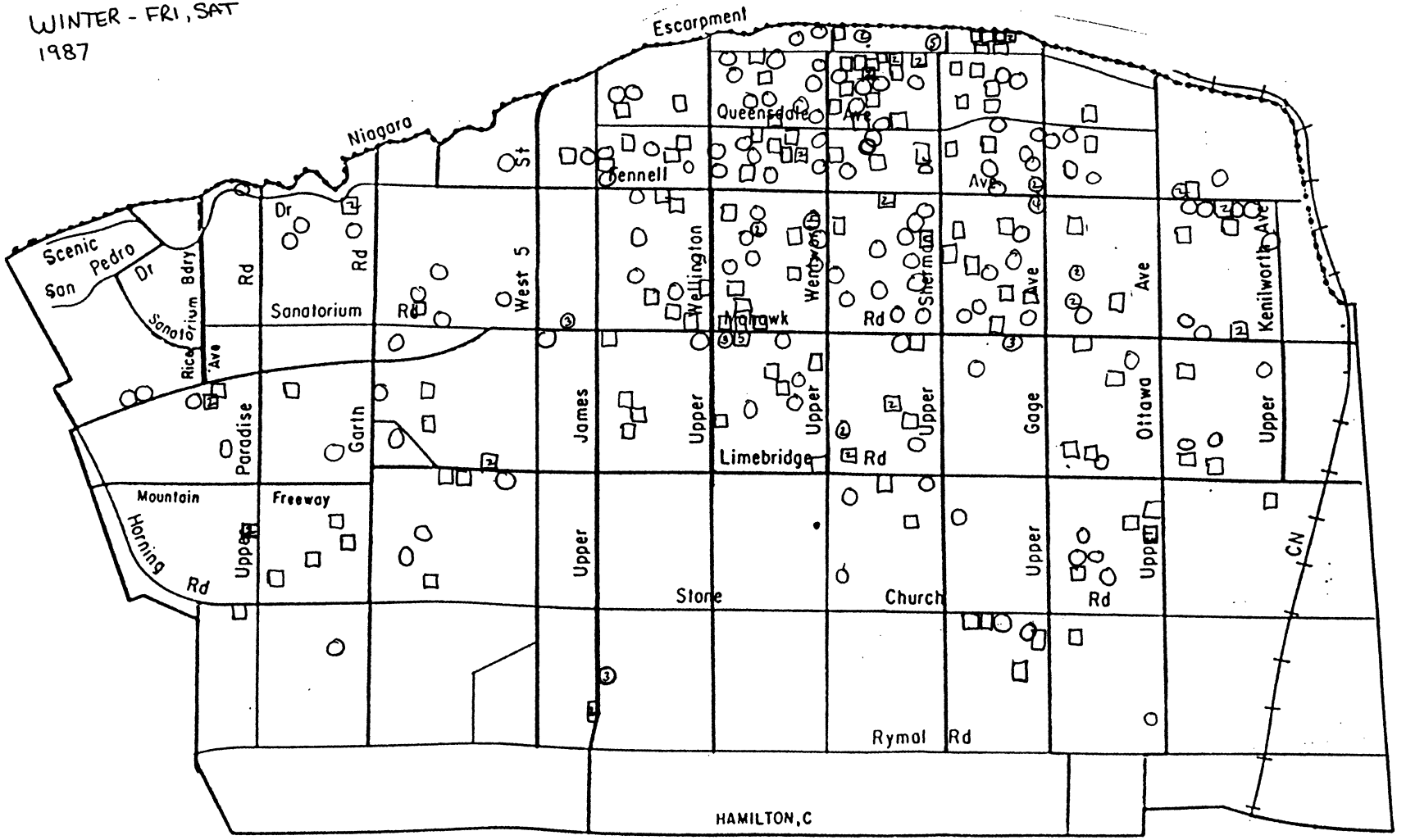
Map 20

WINTER - TUES, WED
1987



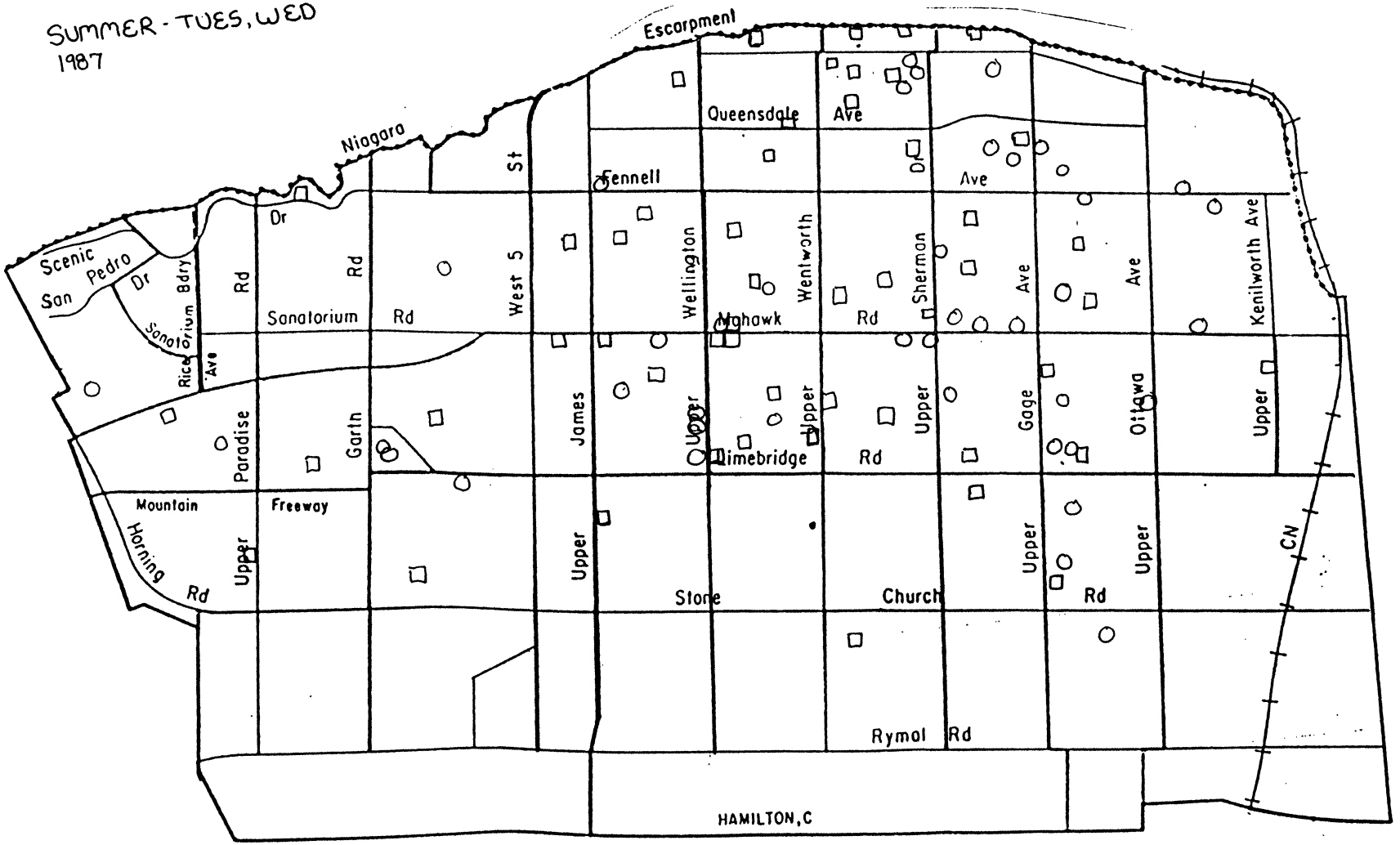
Map 21

WINTER - FRI, SAT
1987



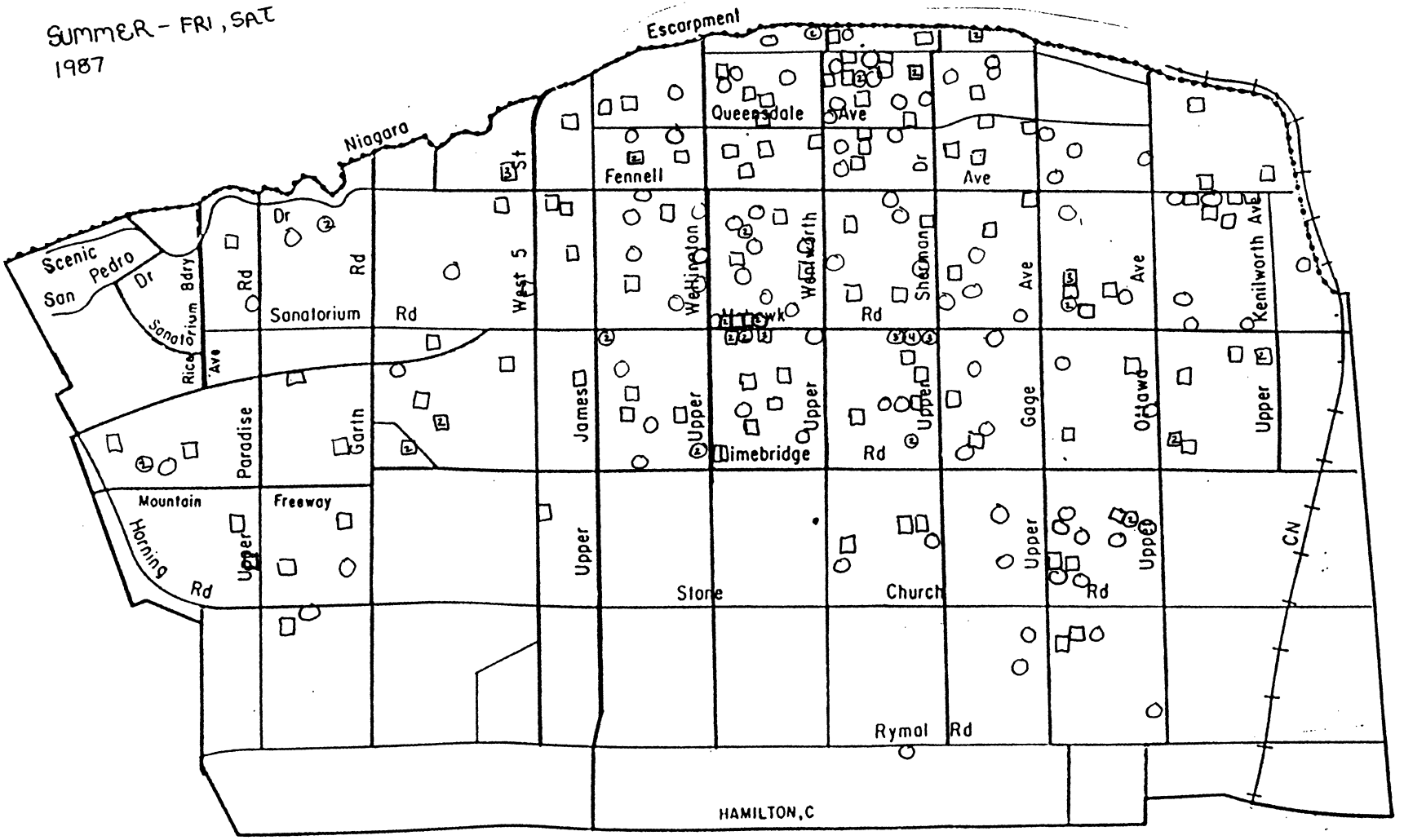
Map 22

SUMMER - TUES, WED
1987



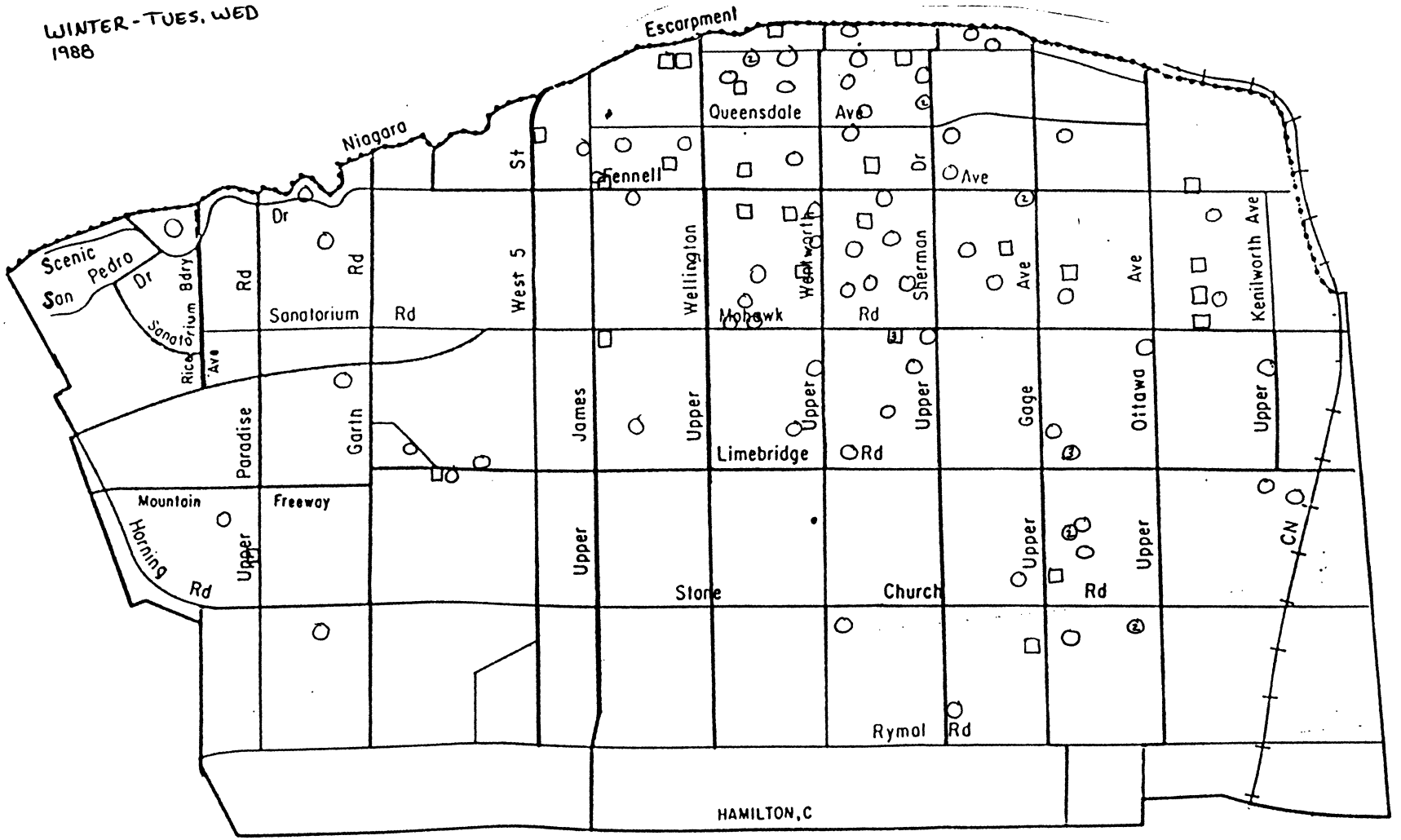
map 23

SUMMER - FRI, SAT
1987



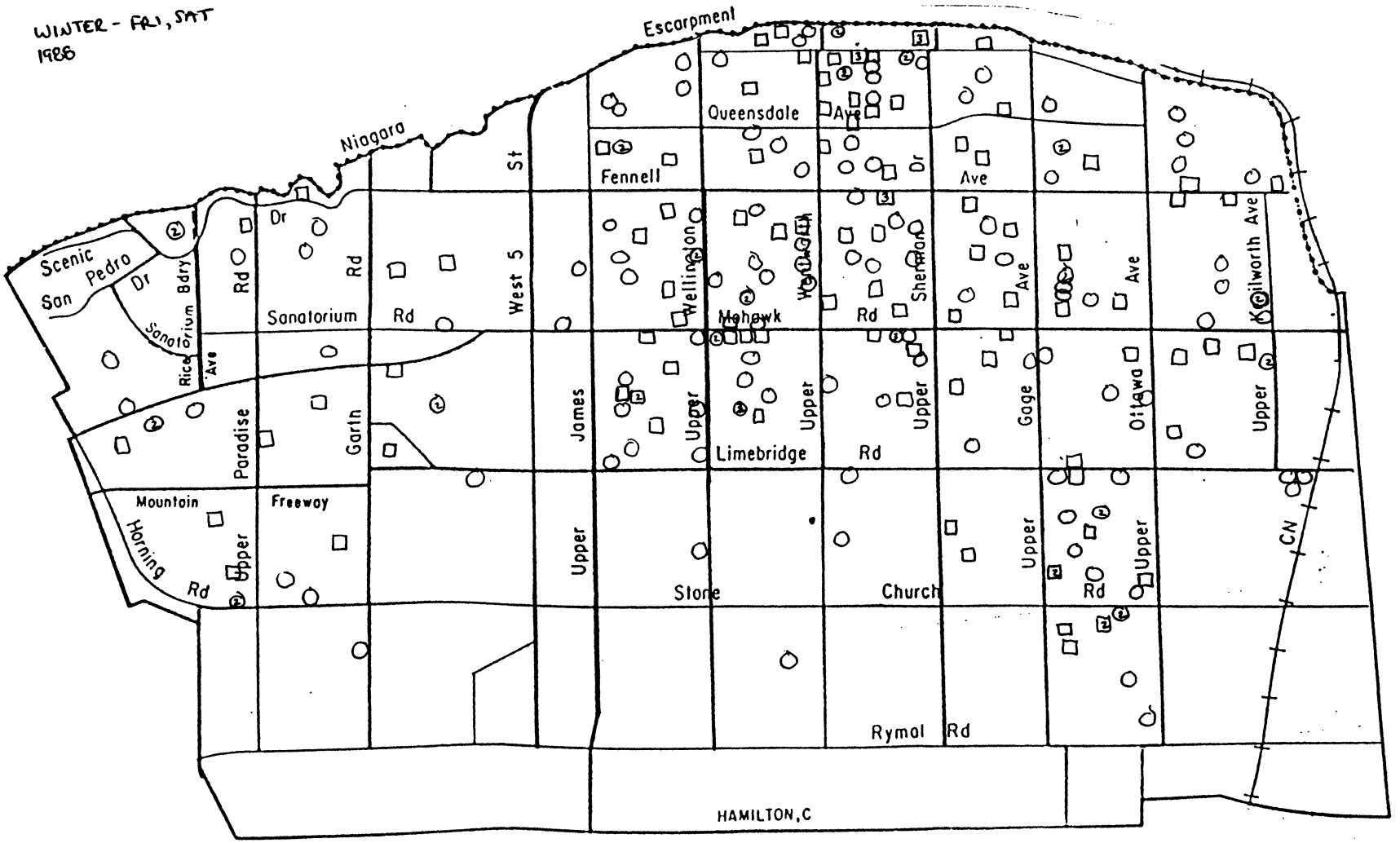
map24

WINTER - TUES, WED
1988



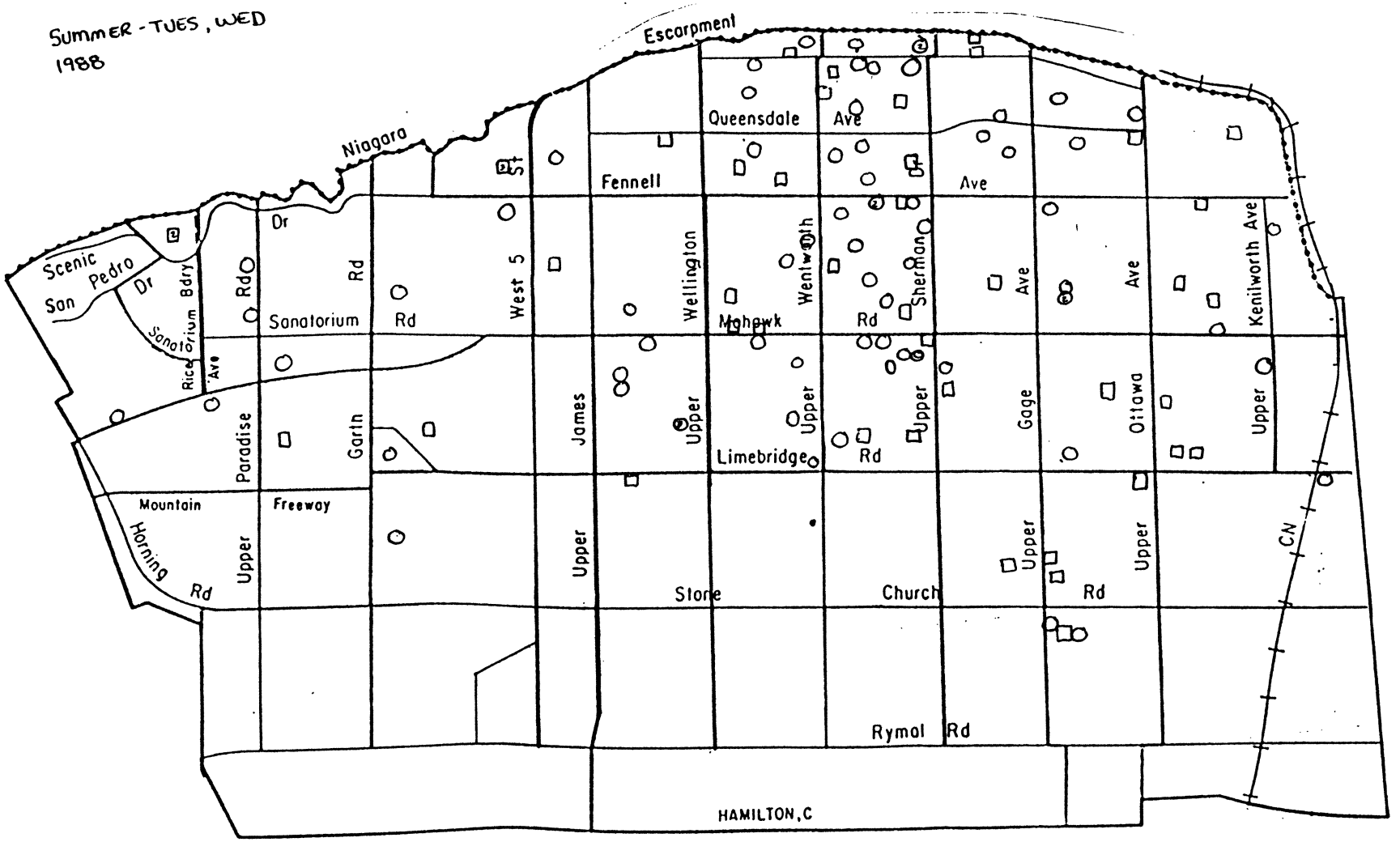
map 25

WINTER - FRI, SAT
1986



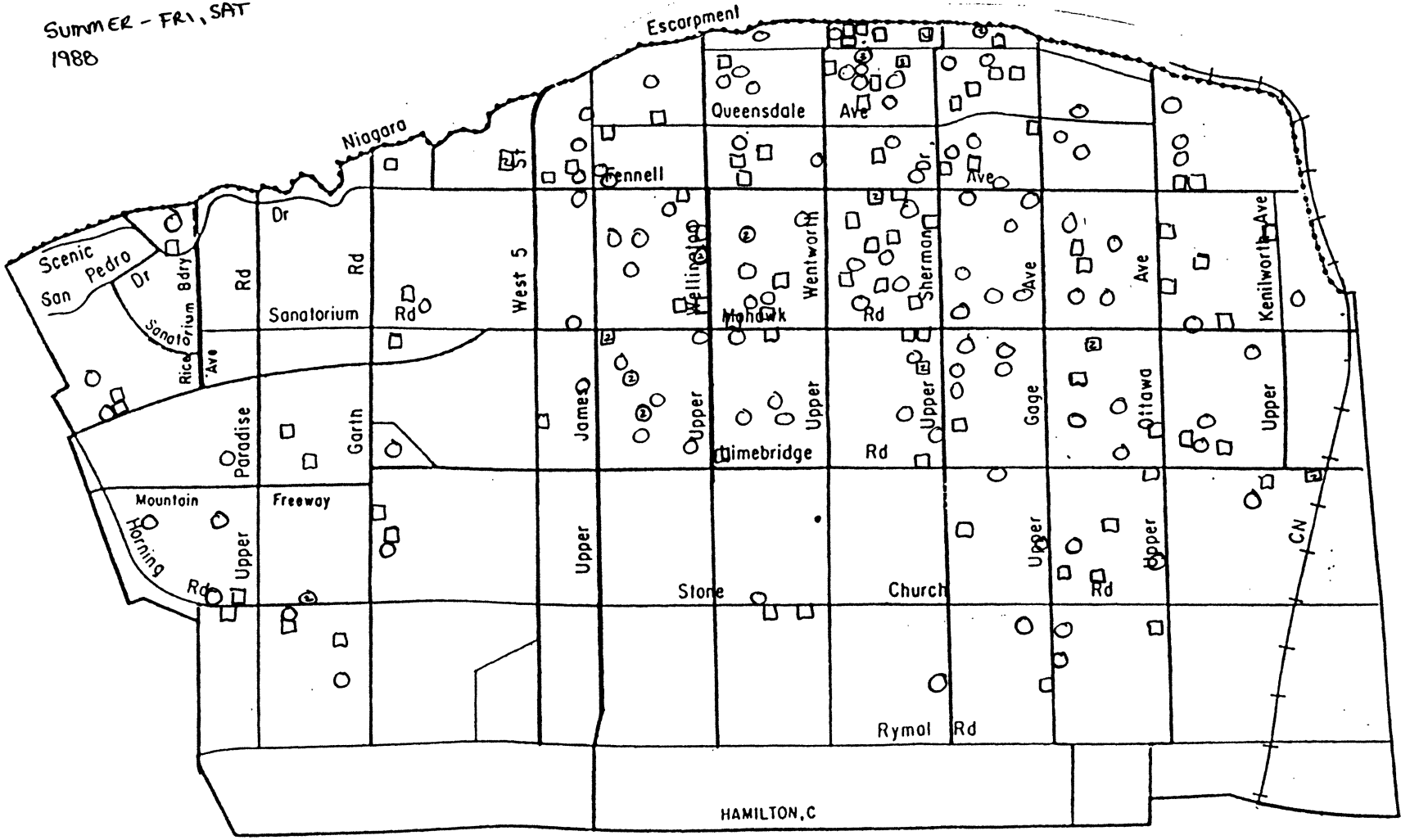
map 26

SUMMER - TUES, WED
1988



map27

SUMMER - FRI, SAT
1988



Map 28

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