MIAMI URBAN AREA TRANSIT STUDY

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MIAMI URBAN AREA TRANSPORTATION STUDY

TECHNICAL
REPORT
NO. 3

DEVELOPMENT OF

TRAVEL MODELS

MEL CONNER & ASSOCIATES, INC.

1968

Expressway Cost estimate

790,000,000

	Cost	Mileage (Total)	Mileage (Rural)
Ex	500,000,000 —	200	1300
Cert	290,000,000 —	1,200	37

Financial Programs

State Primary = 550
" Second = 215
785

20% = 48 M.

F.I.N.D = 1 Mill
TOLL = 132 Mill
INTERSTATE = 96 Mill

1¢ new gas tax = 116 Mill
Veh reg. fee = 13 Mill

1469 & 85

Will require legislation to break loose parts of above.

MIAMI URBAN AREA TRANSPORTATION STUDY

TECHNICAL REPORT NO. 3

DEVELOPMENT OF TRAVEL MODELS

Prepared for the

Florida State Road Department

in cooperation with the

U. S. Department of Commerce
Bureau of Public Roads

and the

Miami Urban Area Transportation Study
Technical Advisory Committee

by

Mel Conner & Associates, Inc.
Tallahassee, Florida

August, 1968

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PREFACE

This is the third of several technical reports which present the pertinent details of each major phase of the Miami Urban Area Transportation Study. These reports serve to insure that the membership of the Technical Advisory Committee and other administrative officials and interested technical persons are thoroughly familiar with the procedures and processes employed by the Florida State Road Department and its Consultant in this transportation study. This is in keeping with the prime objective of this undertaking, which is to initiate a continuing, cooperative transportation planning process.

This report discusses the development and testing of mathematical models which will be used for estimating person travel for this transportation study.

CHAPTER I

INTRODUCTION

The Miami Urban Area Transportation Study has developed a series of mathematical expressions or models which will, as closely as possible, (1) estimate the quantity of person trips generated by each internal traffic analysis zone, and (2) distribute these person trips between pairs of internal zones to build an internal origin-destination table. Person trips are defined for this study as one-way travel in an auto, bus, truck or taxi from one point to another for a particular purpose by a person over four years of age. In developing these mathematical expressions the origin-destination survey data, travel time data, and land use and social-economic data were used.

In a subsequent technical report dealing with the modal split model development, the method of estimating the portion of person trips made by transit, by auto drivers, or by other modes of travel, will be described.

Trip Generation

Trip generation is defined as trip production or trip attraction. While the gravity model technique discussed in the previous paragraphs will be used to distribute future internal person trips on the basis of productions and attractions, trip generation equations were developed to estimate these future person trip productions and attractions, by trip purpose, for each traffic analysis zone.

A step-wise multiple linear regression analysis technique was used in the development of the trip generation equations (or models). The general form of the equations which were developed is:

$$Y = b_o + b_1 X_1 + b_2 X_2 + \ldots + b_n X_n$$

where: Y = estimate of trips produced (or attracted) by zone (Dependent variable)

$X_1, X_2, \ldots X$ = land use or socio-economic factors tested (independent variables)

$b_o, b_1, \ldots b_n$ = coefficients determined from the analysis

This technique produced a series of multiple linear regression equations which were computed in a step-wise manner. At each step one variable was added to the regression equation. The variable added was the one which had highest partial correlation with the independent variable, in comparison with

variables which had already been added (i.e., it was the variable that made the greatest improvement in "goodness of fit"). The resulting coefficients are values which give the best fit of the equation, with respect to the specific variables it included. In the step-wise procedure a variable may have been indicated to be significant in any early stage and thus have entered the regression equation, but if, after other variables were added to the equation, this initial variable proved insignificant, it was removed. Therefore, only significant variables are included in the final regression equations.

Trip Distribution

The development of trip distribution models is an important and complex phase of the transportation planning process. These models provide the transportation planner with a method of estimating zonal trip interchanges for alternate plans of both land use and transportation facilities. These zonal trip interchanges constitute a basic part of the travel information necessary for transportation planning. In the Miami Urban Area Transportation Study, trip distribution will be accomplished through utilization of a methodology popularly referred to as "the gravity model." As the name implies, this type of model adapts the gravitational concept (as advanced by Newton in 1686) to the problem of distributing traffic throughout an urban area. In essence, the gravity model says that trip interchange between zones is directly proportional to the relative attraction of each of the zones in terms of trips generated and is inversely proportional to some function of the spatial separation between the zones. Mathematically, the gravity model is stated as follows:

$$T_{ij} = P_i \frac{A_j F_{ij} K_{ij}}{\sum_{j=1}^{n} A_j F_{ij} K_{ij}}$$

where: T_{ij} = trips produced in zone i and attracted to zone j.

P_i = trips produced by zone i.

A_j = trips attracted by zone j.

F_{ij} = empirically derived travel time factor which expresses the average area-wide effect of spatial separation on trip interchanges between zones which are t_{ij} apart. This factor approximates $\frac{1}{tn}$ where n would vary according to the value of t, and where t is the travel time between zones.

K_{ij} = a specific zone-to-zone adjustment factor to allow for the incorporation of the effect on travel patterns of factors not otherwise accounted for in the gravity model formulation

The gravity model distributes trips from production zone to attraction zone; therefore, it is necessary to define "production" and "attraction" as it is used in this discussion. To demonstrate the production and attraction definition, it is first necessary to classify all trips as either home based or non-home based. Home based trips always have one end at the residence of the tripmaker, while non-home based trips have neither end at the residence of the tripmaker.

By definition, home based trips are always produced by the zone of residence of the tripmaker, whether the trip begins or ends in that zone, and are always considered as attracted at the non-home end of the trip. Non-home based trips, as well as truck and taxi vehicle trips, are always produced by the zone of origin and attracted by the zone of destination.

External trips (those with at least one end outside the internal study area) will be estimated and distributed for the future by a growth factoring method which will be discussed in Technical Report No. 5.

Travel Model Development

Chapters IV and V will cover the development of the trip generation and trip distribution models for the Miami Urban Area Transportation Study, and will explain how the coefficients for these models were established empirically from existing survey data. The actual models developed for use in this study are not theoretical equations, but were tested to show that they are sufficiently stable and reliable for use in predicting 1985 travel.

It should be noted that subsequent use of these models is first in generation of trip ends and then in the distribution of these trip ends to determine the number of trips between each pair of zones. The distribution, or gravity, model is based upon travel data obtained in the home interview origin and destination study. The generation equations require, in addition to the travel data, various planning data. In this particular study these planning data were not immediately available; therefore, work progressed on the distribution model first. In any later updating or re-analysis of the transportation system, the technical personnel involved should consider the data available and the related time schedule when planning the model development work.

CHAPTER II

NETWORK PREPARATION

In order that the principal street system could be mathematically described so that mechanical calculating equipment and electronic computers could be used to analyze the system, a link-node (or network) map was prepared for the 1964 Miami urban area. This network, described initially on standard business machine cards and later on magnetic computer tape, was utilized to compute travel times between pairs of zones; an important factor in the development of gravity models. It was also used for the assignment of the factored origin-destination vehicle trip survey data to the principal street system, enabling a reliability test of the gravity models to be made by comparing gravity model assigned vehicle trips with the trip data obtained in the surveys described in Technical Report No. 1

Preparing the Network

The principal street map (Figure 2, Technical Report No. 2) and internal zone map (Figure 2, Technical Report No. 1) were used in the preparation of the network map describing the existing (1964) street system used for the initial assignment of synthesized 1964 traffic. In preparing, or numerically coding, this network, it was assumed that all trips generated by a zone originate from a single point in the zone defined as a centroid. Centroids were established for each traffic analysis zone. The centroid or point of loading for each zone is located at the approximate center of gravity of all trip ends within each zone, rather than at the geometrical center of the zone. For a completely residential zone, the center of trip ends was taken as the approximate center of gravity of the zone's population. In zones of mixed land use, such as residential and commercial, the location of the centroid was determined, to a large extent, by judgment and knowledge of the area.

The centroid of each zone, located by the method described above, was marked by a heavy dot on a copy of the zone map. There is one centroid for each traffic analysis zone and one for each external interview station (Figure 4, Technical Report No. 1). These centroids were numbered with the same numbers as those assigned to the traffic analysis zone map (in consecutive unbroken sequence) and, continuing in this sequence, the external interview stations were similarly numbered (Table I, Technical Report No. 2). The centroids and their corresponding numbers were transferred to the street map by overlaying the principal street map to the zone map.

The local streets were not included on the principal street map, but were simulated on the traffic assignment network map by hypothetical connections between zone centroids and adjacent network links. These hypothetical

links were drawn as dashed lines. Zone centroids usually did not fall directly on a link of the principal street system, but if one did it was relocated nearby and connected by a link of "zero travel time." Because of computer program restrictions, a centroid can have no more than four connections to the system. A centroid was given as many connections as practicable and consistent with reality (up to four) in order that traffic assignments would be introduced onto the arterial system within the most likely segment.

After the centroids and their connections were placed on the traffic assignment network map, a small dot was placed at each intersection in the system, including the junctions of the system links and the centroid connections. These dots are called nodes, such nodes were also inserted wherever a link crossed map matchlines, which was required since the network map was drawn in four parts to allow a larger scale where desired for clarity.

Numbering the Nodes

The network centroids and nodes were numbered in a manner acceptable for computer analysis work. Traffic assignment computer programs required that centroids be assigned the lowest range of node numbers in unbroken sequence. The remaining nodes (intersections) of the highway network were numbered beginning at 1000, but not in an unbroken sequence (not required for any programs). This was done so that groups of link-node numbers could be confined to specific areas on the map, and so that numbers in these groups would be available for additional nodes in these same areas when new links are added for updating the network in future system tests. As a number was assigned to a node, it was crossed out from a list of all numbers available, preventing any duplicate node numbers. This list was retained to provide a ready source of available node numbers for making corrections or additions to the network.

Table I shows the node number breakdown for the study's 1964 network:

TABLE I
Node Number Groups For 1964 Principal Street Network

Node Group	Type of Node	Node Numbers
A	Zone Centroid	1-550
B	External Station Centroids	551-577
C	Arterial Nodes	1000-3599
D	Freeway Nodes	3600-3704

Describing the Links

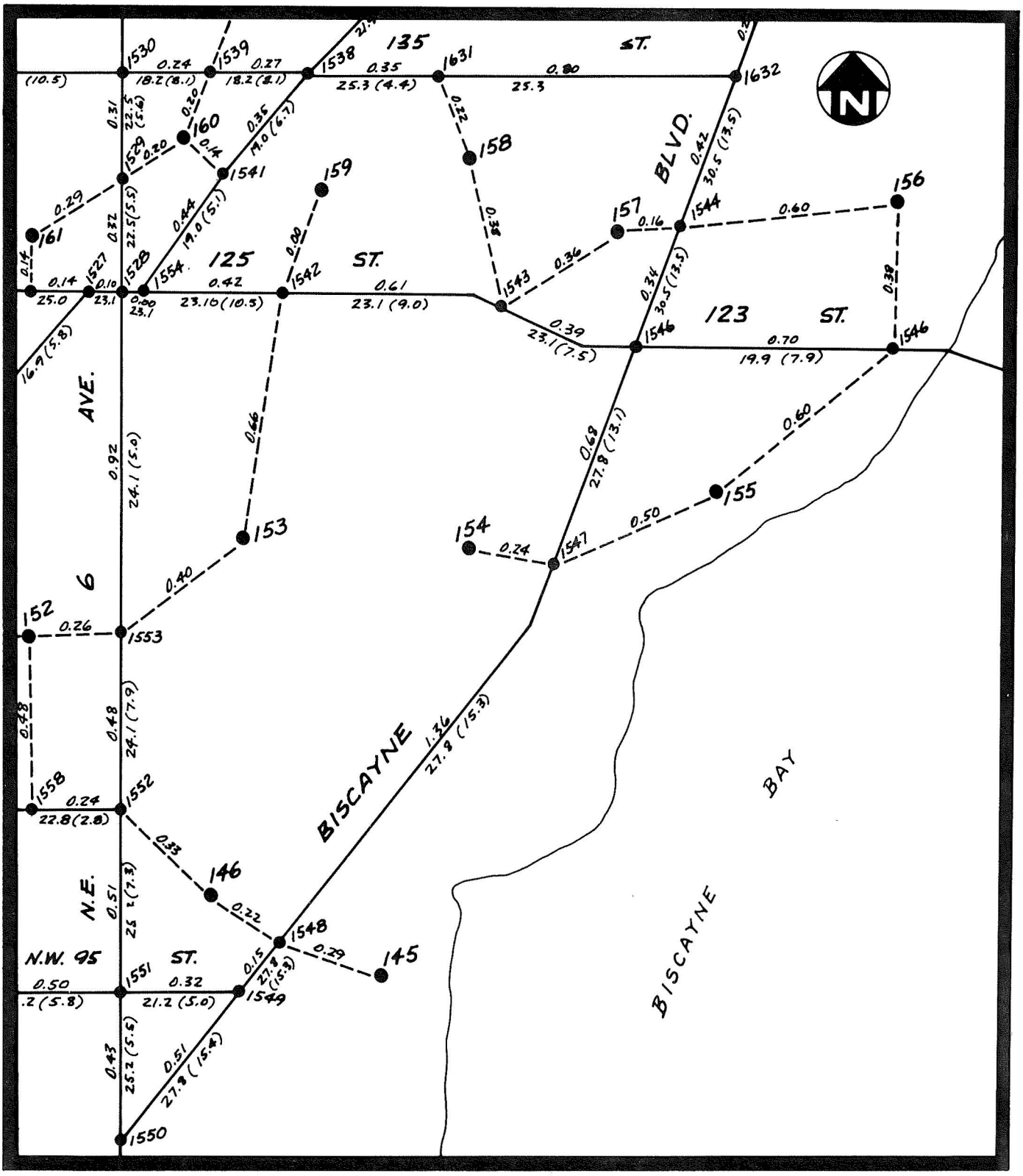
At this point, the maps, prepared on a reproducible film, showed the links (street system between two nodes), nodes, centroids, and street names of major streets as a means of identifying the location of the links. Reproducible masters were made from these films, so that the films could be filed and used as the base for all future networks to be prepared. The new masters were employed in the system development work.

On the new masters, each link was defined by two parameters -- the link distance and the observed average travel speed. Also shown on each link was the 1964 winter season average daily traffic volume, as determined by the counts described in Technical Reports No. 1 and No. 2. These parameter data were also obtained in the speed and delay study described in Technical Report No. 1. In the first report it was mentioned that travel times between control points were obtained from a minimum of nine one-way trips (six during peak hours, three during off-peak hours) in a test car, while distances between these control points were determined to the nearest 1/100 mile.

To obtain a single average time as a parameter for a network link, off-peak travel times were weighted at twice the peak travel time and then averaged, as suggested in the Bureau of Public Roads' Traffic Assignment Manual, 1964. These averaged times were then converted to speeds and assigned to all links between the control points (centroids and nodes) for which they were calculated. Distances in hundredths of a mile were assigned to each link using as a control for scaled map measurements between nodes the distances between control points obtained in the speed and delay survey. These distances were assigned to all links on the system, including connections to centroids. Travel time on each link was limited to a maximum of 6.30 minutes due to desirable computer program restrictions. Any link that exceeded this time was divided into two or more smaller links by the insertion of additional nodes.

The assignment of the link traffic counts* (to the nearest 100 vehicles) completed the preparation of the data for the network description map (link node map). Figure 1 is a portion of the 1964 Miami Urban Area Transportation Study link node map, exemplifying Network 1, which will be among the documents filed with the Florida State Road Department. Note that for each link the distance is written above the link, and the speed and traffic volume (in parenthesis) is written below the link.

* A one-way volume or one-half of the two-way volume was recorded to facilitate the coding of data for subsequent computer processing.



PORTION OF
1964 PRINCIPAL STREET NETWORK

MIAMI URBAN AREA TRANSPORTATION STUDY — MEL CONNER & ASSOCIATES, INC.

FIGURE 1

Coding and Editing the Network

After the network maps were completed, the data were transferred to network coding forms (Figure 2). Each line on this coding form represents one 80-column standard business machine card and permits the coding of two links, if the links represent two-way streets. In the case of two-direction links, both directions of travel were coded in one card, using columns 20-30 and 35-45 (Figure 2) to indicate the direction of the links.

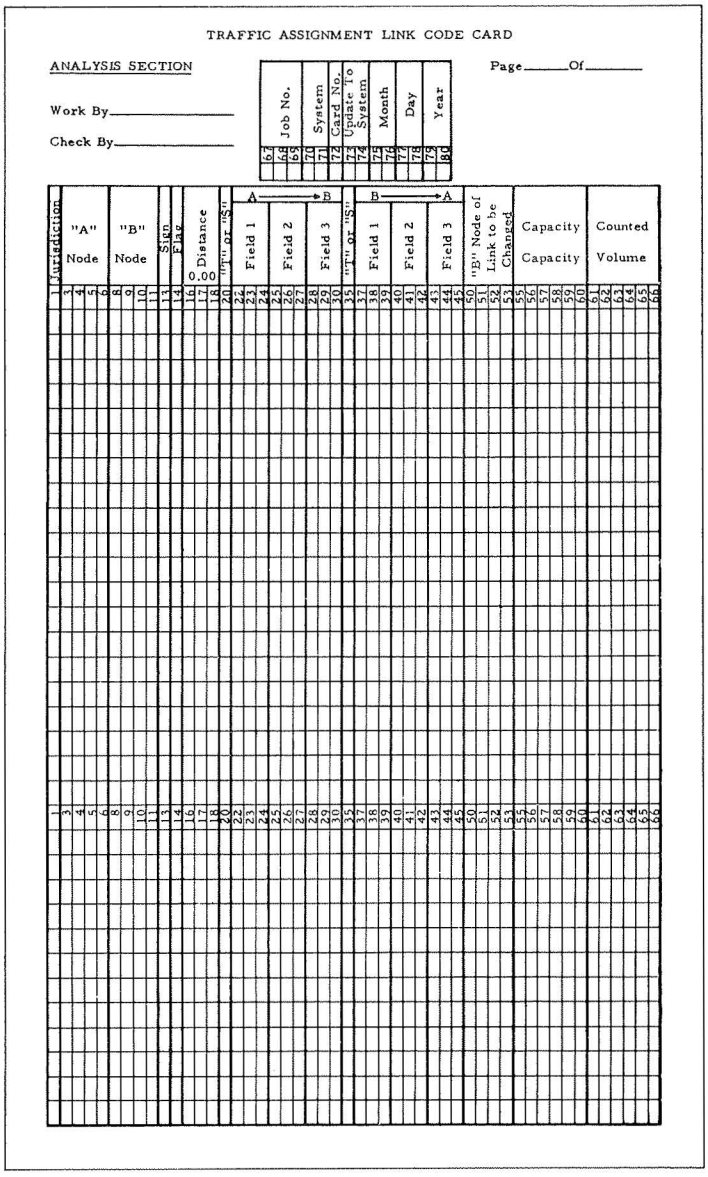


FIGURE 2

The column 20-30 field shows the link in the Node A to Node B direction, and the column 35-45 field was used for coding the link in the reverse direction. For a one-way link, the second field was not used. The network coding form (Figure 2) is discussed in detail in the Bureau of Public Roads' Traffic Assignment Manual, 1964.

After the network link data were coded and key punched on standard business machine cards, an edit was performed to help eliminate any errors made during the preparation or coding of the network. A computer program which examines the link data cards and performs several checks was used for this edit. To prepare for this edit, a listing of all centroid and intersection node numbers was coded along with the number of one-way and the number of two-way link connections to it. The edit program checked this list against the coded network link cards, as well as checking speeds, times and distances for their proper range. All errors found by the edit program and printed out by a computer printer were located and corrected. This routine was repeated until all major errors in the network link cards were found and corrected.

In addition to editing the completed network, certain other computer programs were used to test it for accuracy and completeness. An important test was the formatting and plotting of "trees". Using a special program, the computer prints out the links used for the shortest travel time path (based on driving time) through the network from selected zone centroids to all other zone centroids, and lists all links. These "trees", or paths to selected centroids, were traced on a print of the completed network and checked for logical routing. After trees were traced, the remaining links were checked against a printed listing to make sure all were listed and that no undesired links were present.

After analyzing the selected trees a driving time contour map was prepared from the Miami central business district tree (Figure 3).

Determining Total Travel Time

Spatial separation between zones (as required for the gravity model trip distribution) appears to be more realistically reflected by total travel times than by driving times (as coded on the network links). The zone-to-zone travel time is the sum of the driving time between zone centroids and the terminal times within the origin and destination zones. Therefore, it was necessary to develop a measure of each zone's terminal time and to combine it with the information on driving time, thereby establishing total time separation between zones.

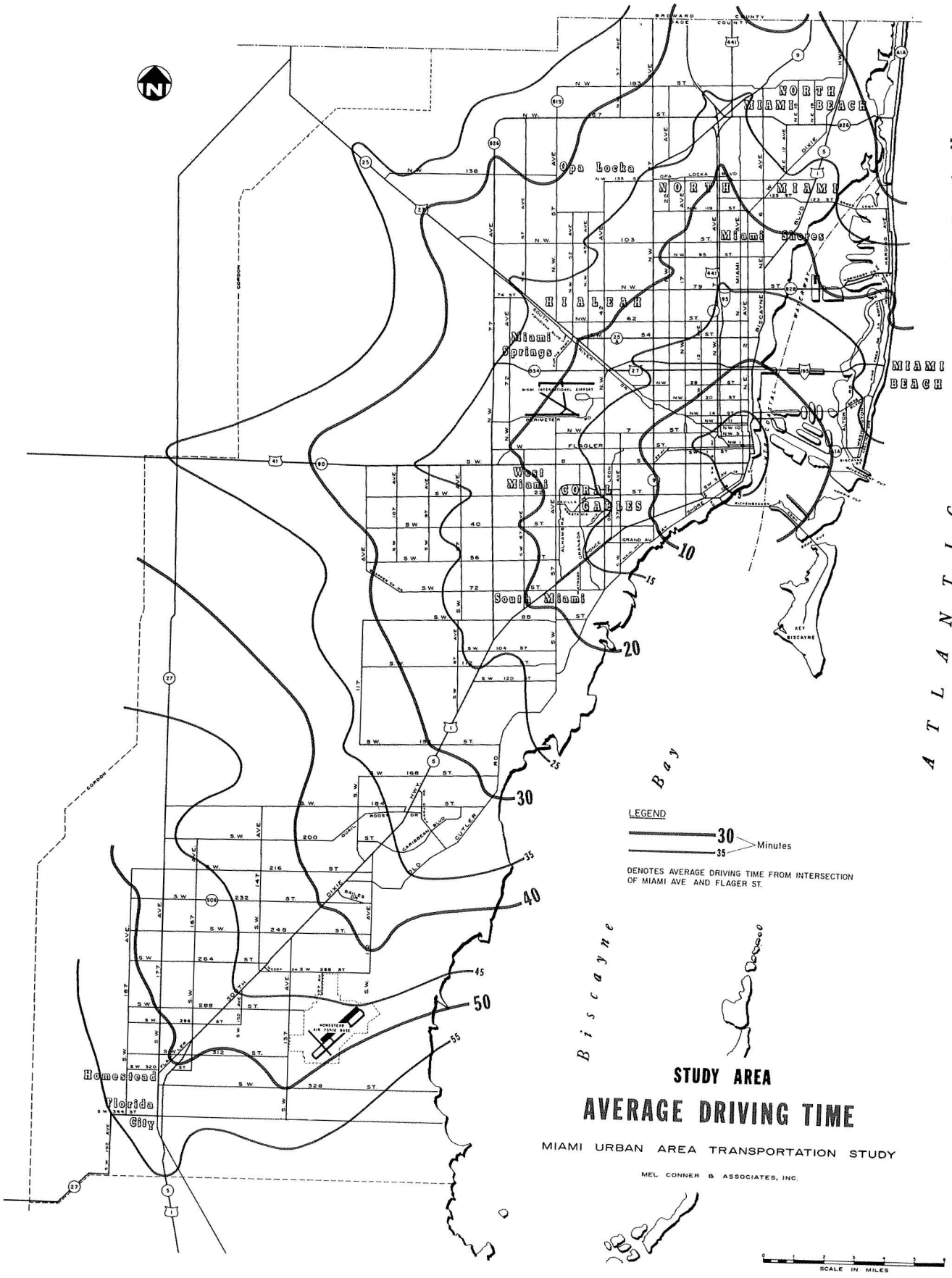

N
BROWARD COUNTY
DADE COUNTY
NORTH MIAMI BEACH
Opa Locka
NORTH MIAMI
Miami Shores
HIALEAH
Miami Springs
MIAMI BEACH
West Miami
CORAL GABLES
South Miami
KEY BISCAYNE
Homestead
Florida City
HOMESTEAD AIR FORCE BASE
Biscayne Bay
ATLANTIC OCEAN
10
15
20
25
30
35
40
45
50
55
LEGEND
30
35
Minutes
DENOTES AVERAGE DRIVING TIME FROM INTERSECTION OF MIAMI AVE AND FLAGER ST.
STUDY AREA
AVERAGE DRIVING TIME
MIAMI URBAN AREA TRANSPORTATION STUDY
MEL CONNER & ASSOCIATES, INC.
SCALE IN MILES

FIGURE 3

Terminal times were estimated for each zone considering the following factors:

1. The time spent in walking from a trip origin (store, home, office, etc.) to the parking place.

2. The time spent in getting from the parking place to the street system at the origin end of the trip.

3. The time spent looking for a parking place at the destination of a trip.

4. The time spent walking from a parking place to the actual destination of a trip such as a store, home or an office.

Since measures of terminal time were not made in the field and since there are no absolute rules for estimating terminal times, judgment, based upon a knowledge of the area, was used to develop estimates. The terminal times used in this study ranged from one minute (generally in residential areas) to eight minutes (in some areas of the Miami CBD). The terminal time used for each zone is shown in Appendix A.

The travel times discussed thus far do not yield any measure of time for trips that remain entirely within a particular zone. This time is called intrazonal driving time and was derived separately. To arrive at an estimate of intrazonal driving time the average speeds on streets within each zone were used in conjunction with the distances from the centroid to each zonal boundary. The intrazonal driving time was, by this method, calculated for each zone by dividing street distances by the speed on the facility. Intrazonal travel times used for the Miami urban area ranged from one minute to five minutes, and are shown in Appendix A.

Total travel time for any trip thus becomes the driving time plus the terminal time at the origin, plus the terminal time at the destination for zone-to-zone movements, or, for intrazonal trips, the intrazonal travel time plus two times the terminal time (one for each end of a trip). Therefore, the minimum travel time for the shortest possible trip was three minutes for intrazonal trips, since the minimum terminal and travel times are one minute each. Total travel times were used in developing the Miami Urban Area Transportation Study gravity models described in Chapter V of this report.

CHAPTER III

TRAVEL DATA PREPARATION

In Technical Report No. 2 the preparation of origin-destination trip data was discussed in relation to preparing 1964 trip tables. Additional processing of these data was necessary before development of the trip distribution or the trip generation models could proceed. This Chapter will discuss (1) linking of trip records, and (2) selecting trip records.

Linking Trip Records

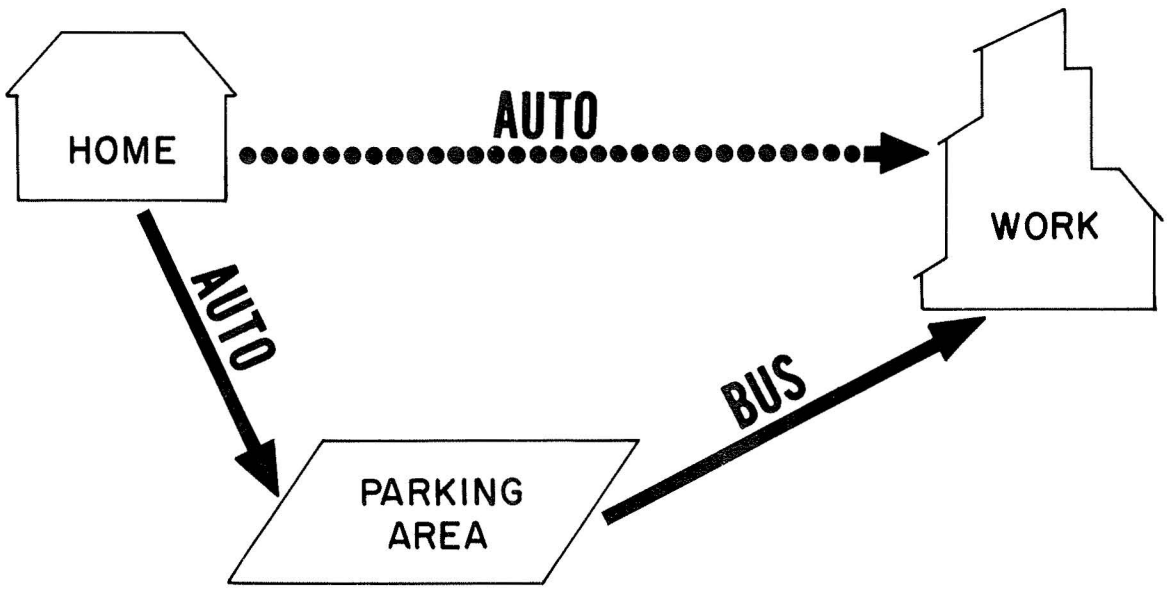
Because of the standard origin-destination survey definition of a trip, many journeys made by a trip maker are represented by two or more trip records, even though only one journey is involved. In the O-D survey, one trip ended and another began (except at the end of the 24-hour survey period, per discussion in Technical Report No. 1) every time a person changed his mode of travel, or an auto driver stopped to pick up or let off a passenger, or when the tripmaker reached his ultimate destination. If each of these "trips" were analyzed separately, the relationship between the actual starting point, the ultimate destination and the purpose of the trip would be lost. Consequently, trips with a purpose "to" or purpose "from" of either "change mode of travel" or "serve passenger" were "linked" so that the relationship between the purpose and the ultimate destination of the trip was preserved.

The mode of each linked trip was determined according to the following priority listing: (1) auto driver; (2) auto passenger; (3) transit. Examples of trips which were linked are shown in Figure 4.

The top part of Figure 4 illustrates an auto driver driving his car from home to a fringe-area parking lot, where he boarded a bus and rode to work. In the origin-destination survey this journey was recorded as two separate trips. The first trip was recorded as "auto driver" trip from "home" to "change mode of travel". The second trip was recorded as a "transit passenger" trip from "change mode of travel" to "work". Since the ultimate purpose of this journey was to get from home to work, these two trips were linked into one trip covering the entire journey, as an auto driver trip. This type of trip linking was deemed desirable because in Miami autos provide the only significant travel mode. In cities where transit travel is significant, however, it is desirable to link such a trip as a transit passenger trip.

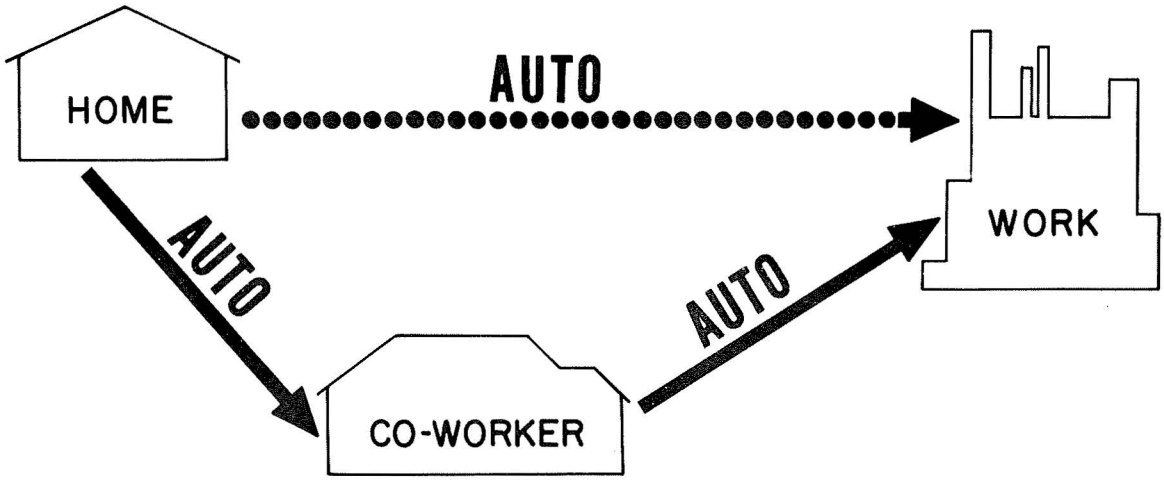
The lower part of Figure 4 illustrates a person driving his car from his home to the home of a co-worker, then both proceeding to work. In this case the auto driver's journey was recorded in the origin-destination survey as two separate auto driver trips, the first one from "home" to "serve passenger"

Examples of Trip Linking



LINKING CHANGE MODE OF TRAVEL

LINKING SERVE PASSENGER



LEGEND:
RECORDED TRIP
LINKED TRIP

MIAMI URBAN AREA TRANSPORTATION STUDY
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FIGURE 4

and the second one from "serve passenger" to "work". Since the auto driver's ultimate purpose was to get to work, these two trips records were, for analysis purposes, "linked" into one which covered the entire journey. In this case, the auto driver's "linked" trip became a home-to-work trip by automobile and was analyzed as such. The co-worker's trip from home to work as an auto passenger remained unchanged.

There were additional cases in the recording of trips which had to be handled during the trip linking process. The first of these occurred when a wife drove her husband to work and then returned home. These two trips were originally coded as "home" to "serve passenger" and "serve passenger" to "home". The "linked" card for these trips would show an invalid "home" to "home" trip for the wife, if the above procedures were followed. Instead, the "serve passenger" code for the trip purpose was changed to "personal business". It also is incorrect to show a passenger in a vehicle making a trip for the purpose of "serve passenger". Trips by passengers in autos where the driver was serving a passenger were changed to "personal business", while "serve passenger" to "serve passenger" trips by auto passengers were dropped.

Another case that required special treatment during trip linking procedures occurred when one trip was recorded with a purpose of "change mode of travel", such as a trip to an airline terminal, where the tripmaker boarded a plane and did not return to the study area. The one trip record was used as the "linked" trip record after "change mode of travel" code was changed to "personal business" code.

The trip linking process resulted in a decrease in the absolute number of "trips" recorded as taking place in the urban area, as well as the vehicle (or person) miles that would be traveled on urban streets. Only those person trip records which had both ends of the trip inside the study area were involved in the trip linking process. The results of the trip linking process are shown in Table II.

The input to the trip linking process (92,435 sample trips), when factored, represent 2,670,795 person trips, as is shown in Table B-2(7) of the supplement to Technical Report No. 2. The output (88,734 sample trips), when factored, represents 2,557,151 person trips, as shown in Table C-1 of the same publication, indicating a reduction of 113,644 person trips due to trip linking; approximately four percent of the total original person trips.

TABLE II

TRIP LINKING PROCESS

Input Records (No. 2 Records, Int.-Int.)	92,435
Linked Records	5,676
Adjusted Records	5,968
Duplicate Records	13
Excluded Records	850
Output Records	88,734

These classifications of records are defined as follows:

Input Records -- Actual number of sample trips (before factoring).

Linked Records -- Those records indicating an intermediate stop (coded as "serve passenger", "change mode of travel", "transit passenger"); i.e., "home" to "serve passenger" plus "serve passenger" to "work" becomes "home" to "work".

Adjusted Records -- Records where linking of auto driver trips produced a "home" to "home" situation; e.g., a wife taking her husband to work and returning home. This was adjusted to read "home" to "personal business".

Duplicate Records -- Those records which, due to coding errors, had duplicate sample numbers, person numbers and trip numbers.

Excluded Records -- Those records which, after trip linking, revealed an impossible situation; e.g., an auto passenger making "serve passenger" to "serve passenger" trips. These records were dropped from the analysis.

Output Records -- The number of input records minus the duplicates and excluded records and one-half of the linked records.

A more complete definition of these categories may be found in Chapter 4 of the Bureau of Public Roads' publication, Calibrating and Testing a Gravity Model for Any Sized Urban Area.

After the trip linking was completed, all trips contained a primary purpose suitable for model development.

Selecting Trip Records

Up to this point, all the information collected in the travel pattern inventory has been processed through the editing phase (Technical Report No. 2) and, in the case of the internal survey data, the trip linking phase.

Internal person trips (i.e., those with both ends of the trip within the study area) were selected from the home interview, truck interview and taxi interview survey trip records and were used in calibrating the gravity models. Trips from the home interview survey which had one end outside the internal study area were not selected for use in developing models, but were used for comparisons of trips at the cordon line, as discussed in Technical Report No. 2.

External vehicle trips (those with one end inside the study area and one end external) and "through" trips (those with both ends outside the study area) were selected from the roadside interview survey. These trips, which will be expanded by a growth-factor technique to be described in Technical Report No. 5, were not used in developing the gravity models.

CHAPTER IV

TRIP GENERATION REGRESSION ANALYSIS

The gravity models described in the next Chapter were developed as tools to synthetically distribute person trips according to patterns of travel found to exist in the Miami urban area. These models will also be used to synthetically distribute future person trips, which can then be mathematically processed so as to reflect vehicular trips and travel by public bus. Since the principal input for these gravity models are trip productions and trip attractions by traffic zone, a means of estimating future trip productions and attractions was developed.

To make these estimates of future trip ends, trip generation (attraction and production) equations were developed by multiple regression analysis, where certain known land use and socio-economic data were related to trip production and trip attraction, as determined from the origin-destination survey. All multiple regression computations were accomplished through the use of a computer program, designated BMD02R Step-Wise Regression, developed by the Health Sciences computing facility at the University of California at Los Angeles.

The first regression run included all zones and as many independent variables as were available which could be logically associated with the dependent variables.

Testing for possible correlation, the following zonal independent variables were used in the equations listed in Table III.

1. Population
2. Dwelling Units
3. Automobiles
4. Industrial Employment
5. Commercial Employment
6. Other Employment
7. Total Employment
8. Agriculture & Fishing Employment
9. Mining Employment
10. Construction Employment
11. Manufacturing Employment
12. Transportation, Utilities & Communications Employment
13. Wholesale, Retail, Financial & Real Estate Employment
14. Personal Services Employment
15. Amusement & Recreation Employment
16. Professional Services Employment
17. Government Employment
18. Net Residential Acres
19. Net Non-Residential Acres
20. Income
21. Population: 5-15 Years of Age
22. Hotel-Motel Units
23. Retail Sales
24. Resident Labor Force
25. Manufacturing Floor Area
26. Building Materials & Hardware Employment
27. General Merchandise Employment
28. Food Employment
29. Auto Dealers & Service Station Employment
30. Apparel & Accessories Employment

31. Furniture & Home Furnishings Employment
32. Eating & Drinking Employment
33. Miscellaneous Retail Store Employment
34. Total Retail Employment
35. Open Space
36. Grade 1-9 School Enrollment
37. Grade 10-12, College and Other School Enrollment
38. Sales Space Area
39. Parking Space Area

The equations developed with all the data shown above provided a starting point for final variable selection and for investigation of zones where the equation failed to predict a value close to that found in the survey.

As the analysis progressed, independent variable data pertaining to the Homestead Air Force Base zone were omitted because of the special characteristics and probable future change of land use in that zone. Later, 83 zones having predominantly rural characteristics were also eliminated from the analysis in order to have the final equations reflect only urban trip generation characteristics. Inspection of the equations and the equation values indicated that geographical stratification of the variables within an equation need not be tested. However, a separate equation for shopping trip attractions was derived for zones in which shopping centers were located.

Zero intercepts were forced on a trial basis in all equations in order to simplify the equations and improve their ability to forecast trips. Determination was then made of the percent difference between the dependent variable mean and the zero intercept equation solution, using the means of the selected independent variables. If this difference exceeded five percent for a particular equation, the equation was rerun with the intercept calculated. The only negative constant or intercept, obtained in taxi productions and attractions, was found to be insignificant and was subsequently dropped from the equations. All equations were developed for person trips.

Table IV gives the final trip generation equations, and the following paragraphs discuss the individual equations.

Home Based Work Trip Production

In this equation each member of the resident labor force produces approximately one and a half home based work trips. Since a logical relationship exists between home based work trip productions and resident labor force and since the coefficient is not unreasonable in terms of values found in other studies, this equation is the result of a valid correlation. No special investigation was required for this equation.

Home Based Shopping Trip Production

The shopping production equation was developed with autos and dwelling units as independent variables. The autos in the equation represent, to some extent, the wealth associated with shopping trips, while the dwelling units will help predict the shopping trips from dense residential areas where automobile ownership might be slightly below the average for the study area.

TABLE III

INDEPENDENT VARIABLES TESTED FOR TRIP GENERATION EQUATIONS

TRIP PURPOSE	VARIABLE NUMBER																																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
Work Productions	x	x	x															x		x				x															
Shopping Productions	x	x	x		x													x		x		x		x															
Social-Recreation Productions	x	x	x		x													x		x		x		x															
School Productions	x	x	x															x		x	x	x		x															
Miscellaneous Productions	x	x	x		x													x		x	x			x															
Work Attractions	x						x												x				x															
General Shopping Attractions																			x				x		x	x	x	x	x	x	x	x	x					
Shopping Center Attractions																										x	x							x				x	x
Social-Recreation Attractions	x														x							x				x	x		x			x	x	x	x			
School Attractions																																				x	x		
Miscellaneous Attractions				x	x								x	x	x		x																						
Non-Home Based Productions or Attractions		x			x	x												x					x			x	x	x	x	x	x	x	x	x				
Truck Production or Attractions	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x		x	x		x													
Taxi Production or Attractions	x		x				x											x		x		x	x															

TABLE IV

TABLE OF REGRESSION EQUATIONS

Home-Based Trip Production		Number of Cases	Mean of Dependent Variable	Standard Error of Estimate	Multiple Regression Coefficient
Work	= +1.51592 (Resident Labor Force)	466	1071.8	209.8	.99
Shopping	= +1.05694 (Autos) +0.15161 (Dwelling Units)	466	954.5	444.9	.94
Social-Recreation	= +1.05553 (Autos) +0.94028 (Hotel-Motel Units)	466	941.5	514.2	.94
School	= +0.59639 (Autos)	466	511.2	342.1	.88
Miscellaneous	= +1.22731 (Autos) +0.63507 (Hotel-Motel Units)	466	1054.6	508.7	.95
Home-Based Trip Attraction					
Work	= +1.15657 (Total Employment)	466	1060.2	218.7	.99
General Shopping	= +5.34718 (General Merchandise Employment) +7.17457 (Food Store Employment) +2.72164 (Total Retail Employment)	405	652.3	755.6	.87

TABLE IV (Continued)

		Number of Cases	Mean of Dependent Variable	Standard Error of Estimate	Multiple Regression Coefficient
Shopping Center	= +936.46276 + 8.83640 (General Merchandise Employment) + 9.97531 (Food Store Employment) + 1.84467 (Parking Area)	61	3008.6	1539.4	.90
Social-Recreation	= +313.02517 + 0.12125 (Population) + 0.31940 (Commercial Employment) + 6.48293 (Amusement & Recreation Employment) + 0.41152 (Hotel-Motel Units)	451	845.9	539.7	.71
School	= + 0.78897 (Grades 1-9 Enrollment) + 0.93520 (Grades 10-College & Other Enrollment)	194	860.0	929.1	.89
Miscellaneous	= +305.78010 + 0.40157 (Total Employment) + 8.20322 (Eating and Drinking Employment)	466	1054.1	747.2	.79
Nonhome-Based Trip Attractions or Productions					
Person	= +133.64201 + 0.16273 (Total Home-Based Trip Attraction)	466	834.9	394.2	.88

TABLE IV (Continued)

		Number of Cases	Mean of Dependent Variable	Standard Error of Estimate	Multiple Regression Coefficient
Taxi	= + 0.02823 (Total Employment) + 0.04067 (Hotel-Motel Units)	466	26.9	48.4	.76
Truck	= + 93.36358 + 0.11745 (Autos) + 0.16255 (Total Employment)	466	337.4	195.9	.73
Control					
Total Trip Production	= + 6.66493 (Autos)	466	5386.4	1568.0	.98
Total Nonhome-Based Trip Generation	= + 1.05939 (Autos)	466	852.8	461.1	.93

Home Based Social-Recreation Trip Production

This equation has as its independent variables both automobiles and hotel-motel units. The logic of the automobile relationship rests with its correlation with people and wealth and social recreation trip production. The logic of the hotel-motel relationship rests with the social-recreation oriented tourist population and tourist areas.

Home Based School Trip Production

School trip productions, not including walking trips, were found to be related to the number of automobiles owned in an area. Many other logical independent variables were tested, (with and without autos), but no reliable generation equation could be developed with them.

Home Based Miscellaneous Trip Production

This category contains personal business, eat meal, and medical-dental trips. Investigation revealed that stratification of this equation would not improve overall results. The automobile relationship again is related to the people and wealth it represents, and the hotel-motel unit relationship results from tourist travel for eat meal and personal business purposes.

Home Based Work Trip Attraction

With total employment as an independent variable this equation had a multiple regression coefficient of .99, but the equation produced some variation in downtown zones and outlying zones where the origin and destination information fell outside the 95 percent confidence level for the calculated equation. In an attempt to improve the equation, both a geographical stratification and the categorization of the independent variable into various types of employment were tried; however, neither of these approaches produced any noticeable improvement in the equation fit.

Home Based General Shopping Trip Attraction

Initial attempts to develop an equation for shopping trip attractions revealed extreme variations between equation solutions and observed data in zones where shopping centers exist and in other areas where shopping takes place. Geographical stratification, such as an equation for the Central Business District and an equation for the beach area, did not prove feasible because of further variation within these geographical strata. The final solution was the separation of shopping trip attractions into those attracted to shopping centers (see definition of shopping center in the next paragraph) and all other shopping trips. This particular equation for general shopping trip attractions relates general merchandise (e.g., department store) employment, food store employment, and total retail employment to the general category of shopping trip attraction.

Home Based Shopping Center Trip Attraction

Investigation of the first shopping trip attraction equation residuals* revealed

* Residual: Difference between observed trips and those predicted by the regression equation.

that separation of shopping centers from other shopping areas would be necessary. A shopping center was defined as being under single ownership, having more than 10,000 square feet of floor area and having off-street parking. General merchandise and food store employment and parking space (area) relationships are considered to have a logical relationship with trip attraction. A zero intercept could not be used in this equation because the zero intercept equation solution differed from the mean by 35 percent. The large intercept (30 percent of the mean) results basically from relationships which are unmeasured, but probably results in part from the size limitation in shopping centers as defined. However, because of the overall increase in shopping trip attraction reliability, a large intercept is considered acceptable in this case.

Home Based Social-Recreation Attraction

Stratification of social-recreation trips by various types of land area (beaches, golf courses, parks, etc.) was investigated but it was found that the extreme variation in attraction rates for similar land uses made this impractical and unreliable on a zonal basis. The final equation developed contains four variables related to social-recreation attractions and is applicable for all zones within the study area.

Home Based School Trip Attraction

Originally, the school attraction equation was run with all zones. Inspection of the residuals led to a check and minor revision in the enrollment data and indicated that the data should be re-cast into (1) the first ten grades, and (2) all other enrollment, in order to coincide with driving ages. The equation was then re-computed, using only those zones which contained schools. The resulting equation had an intercept of 344 school trips per zone and over-estimated trips for zones containing three grade schools. The final equation was computed with a zero intercept, even though the difference between the equation solution and the dependent variable mean was 10.8 percent.

Home Based Miscellaneous Trip Attraction

Investigation revealed that stratification by land use of data for this equation would not result in improvement, because of the diversity of land use to which personal business trips are attracted. In the equation, the magnitude of the coefficients of the "total employment" and "eating and drinking employment" independent variables reflects the fact that the miscellaneous category is predominantly composed of personal business and eat meal trips. The large intercept suggests that a large number of personal business and eat meal trips are attracted to residential land use, although a measure of residential land use did not enter the equation.

Non-Home Based Trip Productions or Attractions

Non-Home Based trip equations were first computed separately for productions and attractions, using independent variables from the planning data. These two equations were very similar and were combined in the third computation. The combined equation was dropped because of low correlation of the independent and dependent variables. A new equation was then calculated using as the independent variable the number of non-home ends of home based trips (total home based attractions). A good relationship was found and is based on the supportable assumption that non-home based trips are produced and attracted by the same land uses which attract home based trips. The final equation includes total home based attractions as the independent variable. A later paragraph discusses the method of controlling this equation.

Taxi Trip Production or Attraction

This equation was originally developed for separate attractions and productions in order to investigate the need for stratification and as a check on the reliability of the basic data. A single equation for attractions or productions was developed in later calculations because there was little difference between the original separate equations. Theoretically, productions and attractions for any zone for this type of trip are equal on the average day. Inspection of the equation residuals revealed considerable variation which is attricuted to the small number of taxi trip observations and to the lack of significance in all available independent variables. A small negative intercept in the equation was dropped in a subsequent re-calculation. The independent variables, employment and hotel-motel units, are especially fitted to the Miami area since a considerable amount of taxi travel occurs between the Miami Beach hotel area and other recreational, shopping and business areas.

Truck Trip Production or Attraction

For truck trip estimating, equations were also originally developed separately for attractions and productions, but were later combined because of their similarity. Theoretically, productions and attractions for any zone should balance on the average day. The independent variable, construction employment (which was significant in the original equation), was dropped because of concern that it cannot be reliably forecasted. Autos and total employment are logically related to truck trips and reflect trips to and from residential and non-residential zones. The autos in the equation relate to the truck trip ends at residential areas in relation to wealth and development, while total employment relates to the areas where trucks are based and where business deliveries are made.

Non-Home Based Trip Generation Control

This equation was developed to control the total number of non-home based trip productions or attractions estimated by the non-home based production or attraction equation. It relates the total number of such trips to characteristics of the total trip making population. The total number of automobiles was found to be the only significant variable related to the total number of non-home based trips. This equation is used for control on a study area wide basis only.

Total Home Based Person Trip Control

This equation was used to provide control for the total number of person trips made by residents of the study area. While it would be desirable to have the total control responsive to more than one tripmaker characteristice, the number of autos was the only significant independent variable found. This equation is also used for control on a study area wide basis only.

After the regression analyses were performed using the significant independent variables, residuals were reviewed and it was found that, generally, the equations "fit" all areas. The principal exceptions were zones with pari-mutual establishments and other special recreational areas, such as "Interama" and public beach areas. Future trips for these zones were estimated by using attendance forecasts supplied by the area planners rather than by using the trip generation equations. These zones were removed from consideration, along with the rural zones, in final equation development.

Table IV contains statistics related to each of the trip generation equations and they are helpful in making judgments with regard to equation reliability. While attention should be given to the statistics in this Table, attention should also be given to Appendix B which shows the results of the preliminary regression calculation plotted by graph and step.

CHAPTER V

DISTRIBUTION MODEL CALIBRATION

The theory and concept of the gravity model was briefly discussed in Chapter I. This Chapter deals with calibrating the gravity models and testing their ability to simulate traffic patterns in the Miami urban area. The IBM 7094 Computer and standard Bureau of Public Roads' programs, as described in the Bureau's Calibrating and Testing A Gravity Model For Any Size Urban Area, were used.

Building Trip Tables

The number of trips produced and the number of trips attracted by each zone in the study area are two of the required inputs to the gravity model formula. These values, as defined in Chapter I, were used throughout the entire gravity model calibration process and were taken directly from the origin-destination survey data. A trip table was built using an electronic computer which examined and summarized each survey trip (IBM trip card on magnetic tape multiplied by the trip factor) and determined the zone of production and the zone of attraction which had been recorded for each trip. All trips were divided into two broad categories, home based and non-home based (where home based trips had either end at the residence of the tripmaker and non-home based trips had neither end at the home).

For the home based category of trips, the computer treated the home end of the trip as the production end and the non-home end of the trip as the attraction end, while for non-home based trips the origin end was always the zone of production and the destination zone was always the attraction end. At the same time the computer determined the zone of production and the zone of attraction for a trip record, it also classified the trip into specific categories of trip purpose by travel mode. Gravity models were developed for each of the following trip purpose and travel mode categories:

1. Home based work person trips.
2. Home based shopping person trips.
3. Home based social-recreation person trips.
4. Home based school person trips.

5. Home based miscellaneous purposes person trips.*

6. Non-home based person trips.

7. Truck trips.

8. Taxi trips.

After these preliminary steps were completed, the movements between each zone of production and each zone of attraction were summarized according to the above trip purposes. Additionally, all the trips produced and attracted by each traffic zone were summarized according to these same trip purpose categories.

These data were next used for the trip summary data processing. The actual output from the trip summary data processing was in two parts: first, a printed summary of zonal trip production and trip attraction values for each trip purpose and gravity model category was obtained; second, a table (on magnetic computer tape) of zonal trip interchange (production or attraction) was obtained for each purpose. Appendix C contains a summary table of trip productions and attractions by purpose and by zone for the Miami Urban Area Transportation Study internal trip origin-destination surveys. This appendix is in two parts:

1. Trips for the purpose of work, shop, social-recreation and school.

2. Trips for the purposes of miscellaneous, non-home based, truck and taxi.

Determining Trip Length Frequency Characteristics

The next step in the gravity model calibration process was to obtain a trip length frequency distribution of the origin-destination trip data, by one-minute travel time increments, for each general trip purpose. The table of zone-to-zone movements for each trip purpose and the travel times on the principal street network, along with the terminal times and intrazonal times, were used to calculate the trip length frequency distribution.

The computer determined the trip length frequency distributions as follows:

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* The miscellaneous trip category includes trips for purposes: eat meal, medical-dental, and personal business.

by accumulating the number of trips between each pair of zones according to the total travel time between the zones (and repeating this process for all possible zone pairs); the number and percentage of total trips in each travel time increment was obtained for each trip purpose or travel mode category. An example of a trip length distribution summary is shown in Table V and all trip length distribution summaries will be included in the documents to be filed with the Department at the completion of this base study.

TABLE V
1964 TRIP LENGTH DISTRIBUTION EXAMPLE

	Home Based Work Person Trips		
Trip Length (Minutes)	Trips	Percent of Total	Accumulated Percentage
0	0	0	0
1	0	0	0
2	0	0	0
3	2,147	0.426	0.426
4	4,303	0.854	1.280
5	5,703	1.132	2.412
6	11,201	2.224	4.636
- - -	- - -	- - -	- - -
44	0	0.009	99.993
45	45	0.009	100.002

Total trips for this purpose	503,737
Total person hours of travel	161,168
Average trip length, this purpose	19.20 minutes

From Table V it can be observed that no trips were of "lengths" shorter than three minutes. This results from the minimum of one minute used for both terminal times and the one minute minimum value used for intrazonal times (Chapter II). These data, obtained from the origin-destination survey, were later compared to the trip length distributions obtained from gravity model equations. These comparisons will be discussed in a later section of this Chapter.

Developing Travel Time Factors

A part of the process of calibrating gravity model equations for a particular urban area involves a series of trials and adjustments of the travel time factors (friction or "F" factors) employed in making the gravity model trip distribution reasonably approximate the trip distribution found in the O&D survey. A set of "F" factors was developed for each of the trip purpose and travel mode categories. The "F" factors used in the Fort Lauderdale-

Hollywood Urban Area Transportation Study were used as a starting point for the first trial in calibrating gravity models for the Miami Urban Area Transportation Study since it was felt that this procedure would require fewer trials to arrive at the final "F" factors and is recommended in the Bureau of Public Roads' gravity model manual.

With the initial set of travel time factors selected for each trip purpose and travel mode category, the computer was used to calculate trip zone-to-zone interchange estimates to compare with survey data. The input for the gravity model program used by the computer consisted of the following data:

1. Zonal trip production and attraction values (i.e., the number of trip ends) by trip purpose and travel mode categories.

2. A trip length frequency distribution, by one minute travel time increments, of trip interchanged estimated by the gravity model formula.

3. A table of comparisons between the trips attracted to each zone by the gravity model and the trips attracted to each zone as determined from the origin-destination survey trip data.

Using these output data, the travel time factors were adjusted by an iterative procedure. To facilitate the calculations for this adjustment, a special form (Figure 5) was used to record the information. The actual adjustment was made for each one minute travel time increment by multiplying the travel time factor used previously by the ratio of the O&D survey trip percentage to the gravity model trip percentage.

The adjusted "F" factors were determined for each one minute increment of trip length by the following formula:

$$F_{adj} = F_{used} \times \frac{OD\%}{GM\%}$$

where: F_{adj} = travel time factor to be used, for one minute travel time increment, in the next gravity model trial.

F_{used} = travel time factor used for the one minute travel time increment in the gravity model trial being analyzed.

OD% = percentage of origin-destination (actual) trips for each one minute increment of trip length.

GM% = percentage of trips in the trial being analyzed estimated by the gravity model for each one minute increment of trip length.

MEL CONNER AND ASSOCIATES, INC.
Friction Factor Determination - Gravity Model Calibration
_____ Metropolitan Area Transportation Study _____ Trips (Purpose _____)
Job No. _____. Date _____. Sheet ___ of ___.

(1)	Travel time (2)	% Trips actual (3)	Friction factor #1 (4)	% Trips est. #1 (5)	Adjusted friction factor (6)	Friction factor #2 (7)	% Trips est. #2 (8)	Adjusted friction factor (9)	Friction factor #3 (10)	% Trips est. #3 (11)	Adjusted friction factor (12)

FIGURE 5

These calculations resulted in adjusted travel time factors for each one minute increment of travel time.

The adjusted travel time factors were then plotted against their respective travel time increments on logarithmic graph paper for each trip purpose and travel mode category. A line of best fit was drawn as smoothly as possible, since smooth curves can be approximately defined in a mathematical expression that is not too complex. After the curves of best fit had been drawn, a new set of travel time factors was selected by reading values from the smooth curves. The new set of travel time factors was then used in the next trial of the calibration of the gravity models. Zonal trip production values, trip attraction values and minimum travel times between all zones remained the same for the second calibration trial. Taking the output from the second "F" factor trial, the same adjustment procedures were followed.

This trial and adjustment of travel time factors was repeated until there was little or no change between the last adjusted factors and the factors from the preceding trial. Satisfactory adjustments were based on the criteria that (1) the O&D and gravity model curves should be relatively close when compared visually, and (2) the difference between average trip lengths should be within $\pm$ 3 percent.

Three such calibrations or adjustments were required to adjust the travel time factors for the Miami Urban Area Transportation Study. The final travel time factor curves for all trip purpose and travel mode gravity models are shown in Figure 6, while the actual final travel time factors are shown in Appendix D.

Developing Additional Adjustment Factors

There are factors other than travel time which can affect patterns of urban travel -- for example, topographical barriers (such as rivers or large open spaces) or possibly various social and economic conditions unique to a particular community. The effect of these conditions is indicated when zone-to-zone trip interchanges developed by calibrated gravity model formulae do not compare favorably with zone-to-zone trip interchanges found in the actual O&D survey. When these conditions are encountered and there are logical reasons for expecting them to influence travel patterns, it is desirable to develop special zone-to-zone adjustment factors (K factors).

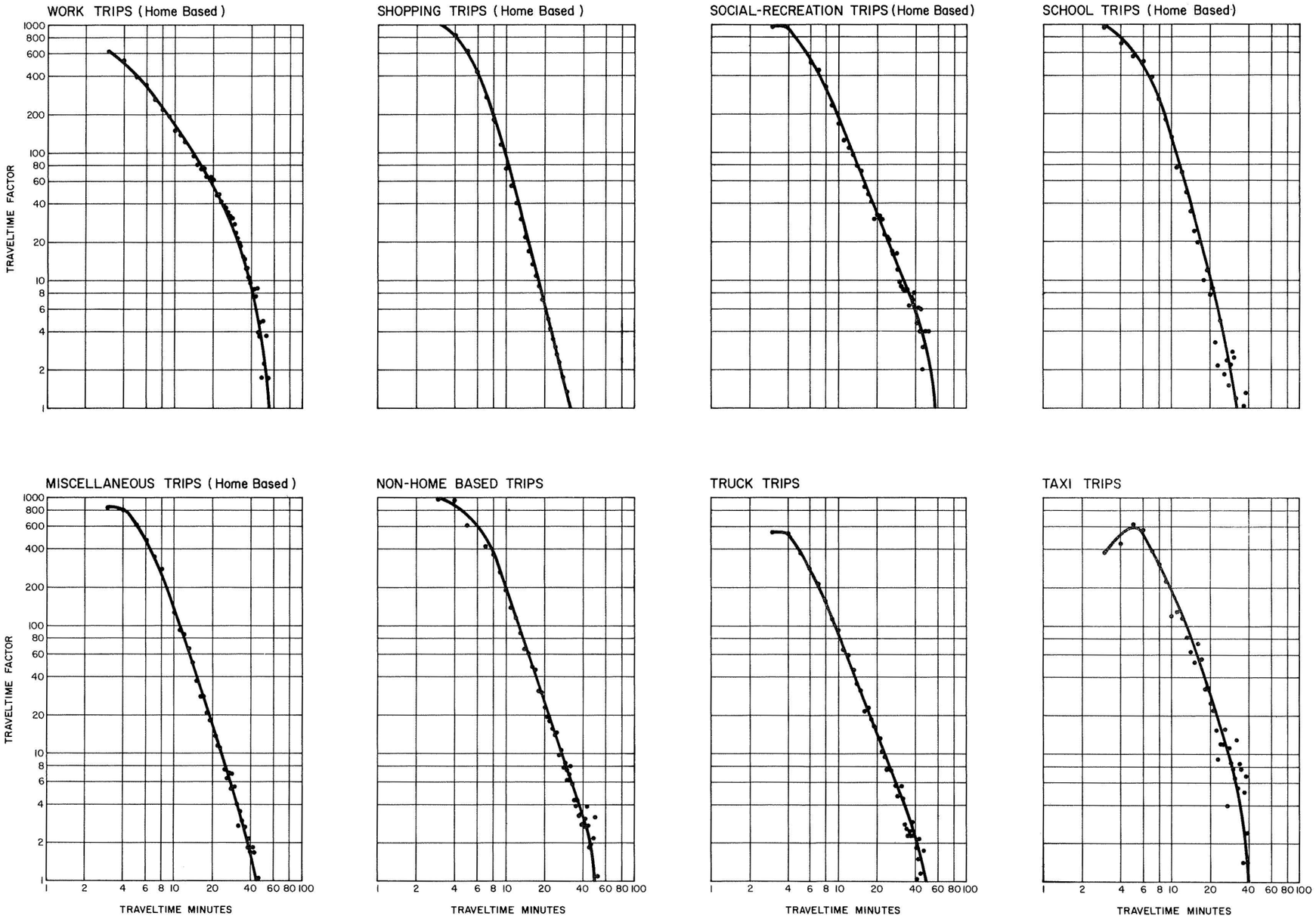
Comparisons of the zone-to-zone movements, as predicted by the calibrated gravity model for this study, with the zone-to-zone movements, as determined by the origin and destination survey, revealed that several areas in the Miami urban area would require K factors. K factors were found to be needed for trip interchanges to and from the zones in the Miami Beach area and are probably needed because this area is separated from the mainland by Biscayne Bay and because it is a recreation and tourist center. Other areas, such as the Miami central business district, required K factors because they serve a unique function in the community.

The major areas where K factors were required are shown in Figure 7. This figure also illustrates the areas where the gravity models considerably over or under distributed trips before adjustment factors were applied.

Special adjustment factors were calculated by trip purpose category (work and non-work) so that an acceptable statistical comparison would result between trips distributed by the gravity model and the trip distribution found in the field survey. During testing of 1985 transportation systems the K factors used will be those that can logically be applied for the future. The use of K factors in developing the 1985 transportation plans will be discussed in the technical report covering the testing of future highway systems.

After investigation determined that K factors were needed, first K factors were developed using the following formula:

TRAVELTIME FACTORS



NOTE: TRIPS REFER TO INTERNAL PERSON TRAVEL

FIGURE 6

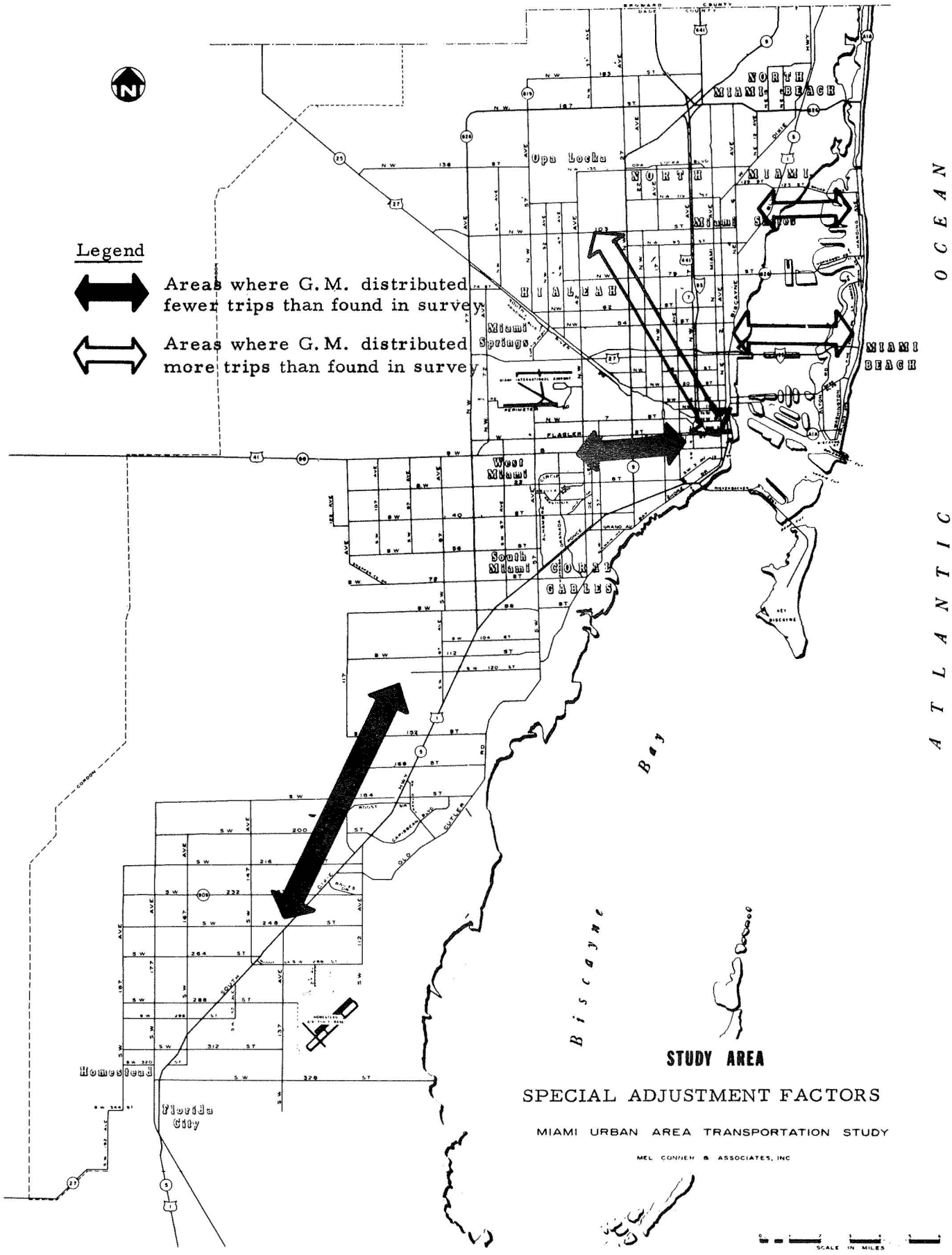

Legend
Areas where G.M. distributed fewer trips than found in survey
Areas where G.M. distributed more trips than found in survey
NORTH MIAMI BEACH
Opa Locka
NORTH MIAMI
HIALEAH
Miami Springs
MIAMI BEACH
West Miami
South Miami
CORAL GABLES
Homestead
Florida City
Biscayne Bay
ATLANTIC OCEAN
STUDY AREA
SPECIAL ADJUSTMENT FACTORS
MIAMI URBAN AREA TRANSPORTATION STUDY
MEL CONNER & ASSOCIATES, INC
SCALE IN MILES

FIGURE 7

$$K_{ij} = R_{ij} \frac{1 - X_i}{1 - X_i R_{ij}}$$

where: K_{ij} = adjustment factor to be applied to movements between zone i and zone j.

R_{ij} = ratio of origin-destination survey results to the gravity model results for the movement between zone i and zone j.

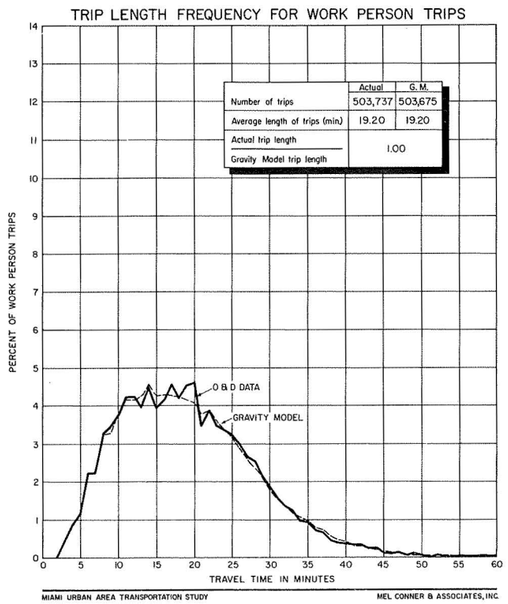
X_i = ratio of OD trips from zone i to zone j to total OD trips leaving zone i.

Results of the first K factor trial indicated that the above formula still did not produce a gravity model trip distribution that compared favorably with the O&D trip distribution. Additional adjustment of the K factors was required. However, in order to attain more sensitive factors, subsequent K factors were developed as the ratio of origin-destination survey results to the gravity model results for the movement between a particular pair of zones. Most of the final K factors which are shown in Appendix D-2, were in the range of 0.80 to 1.20. Although most adjustments were applied to inter-district travel some were found necessary for intra-district movements. The latter were related to the same area characteristics which dictated the need for inter-district factors.

Analytical Test of the Gravity Models

It has been shown in the preceeding paragraphs that, by using the gravity models and existing trip productions and attractions, a synthetic trip distribution pattern can be produced which will provide a reasonable approximation of existing conditions. As an analytical test of the gravity models, the final trip length frequency results of the model were compared with the origin-destination survey data. Trip length frequency curves for each trip purpose and travel mode category were plotted for both actual origin-destination data and the calibrated gravity model data (Figure 8). These curves were plotted for each trip purpose using the percent of total trips versus the travel time in minutes.

Also shown with these trip length frequency curves are the number of trips for each purpose, the average trip length, and the comparison of the average trip length as determined by the gravity model and the origin-destination survey. For the total of all person trips the origin-destination data indicated an average trip length of 15.0 minutes and the gravity model results in a 15.2 minute average trip length; a difference of less than two percent.



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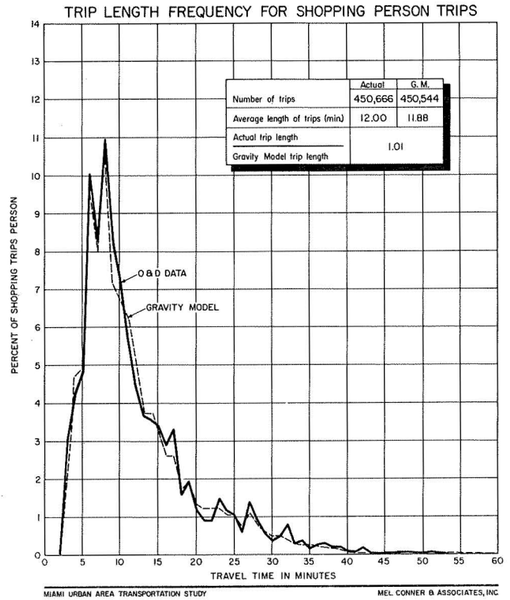

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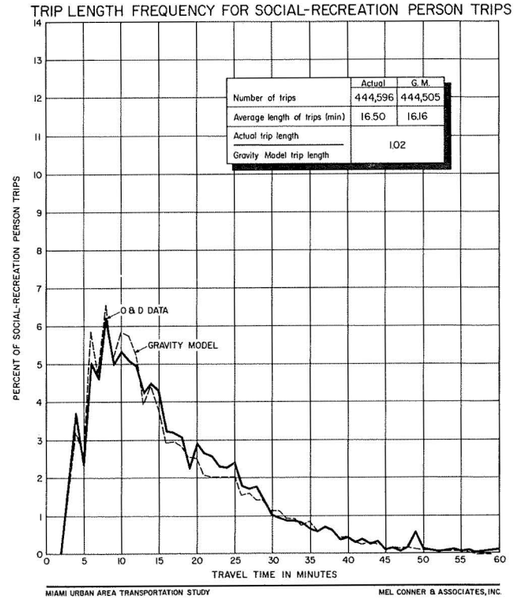

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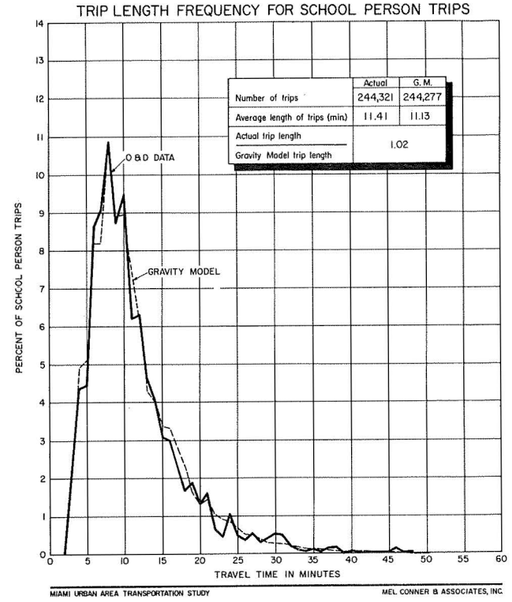

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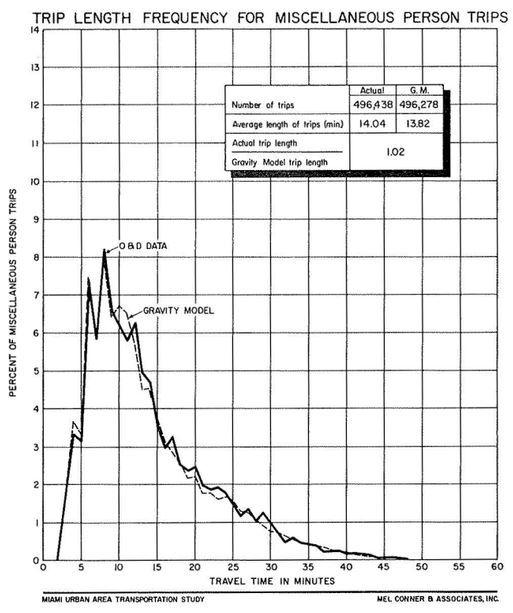

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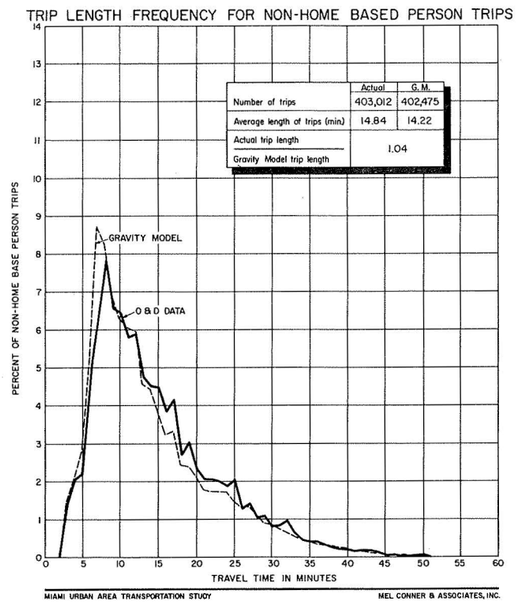

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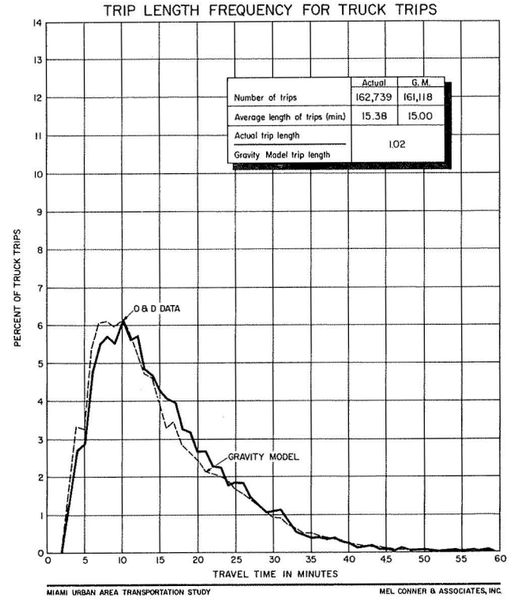
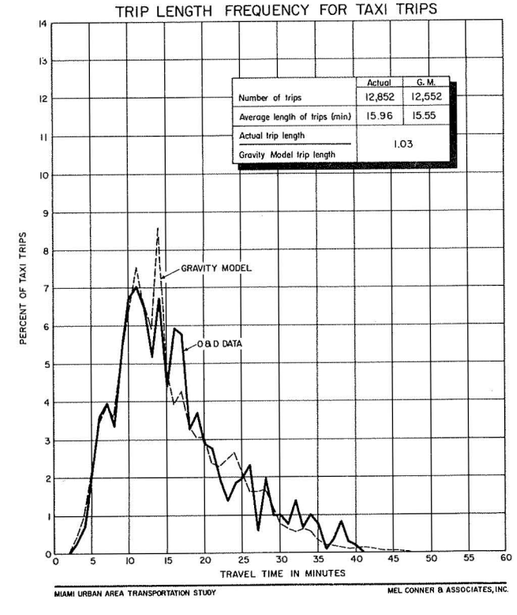


(g)



(h)

FIGURE 8

Another check of the gravity models was made by assigning O&D trips and gravity model trips to a special analysis network. This special network was composed of straight-line connections between zone centroids. Because of its appearance, this network is often referred to as a "spider web" network (Figure 9) and it is coded in the same manner as the principal street network described in Chapter II, except that a constant speed of 60 miles per hour was coded for all links.

The spider network was loaded with origin-destination survey person trips and with person trips distributed by the adjusted gravity model (with K factors). Although the traffic assigned to this fictitious network does not represent traffic volumes on actual sections of roadway, it does allow comparisons of area-to-area traffic movements. The spider network in Figure 9 is shown with both traffic assignments, where the figure above each link is an O-D traffic movement, while below each link the gravity model traffic estimate is shown. East-west and north-south screenlines have been drawn to compare area-to-area traffic movements and it should be noted that these comparisons are very good, except in outlying areas which are presently rural in character, but which are expected to be urban in the future.

Comparisons of both the trip length distribution and the trip movement for internal trips indicated that the gravity models had been calibrated to the desired accuracy.

Statistical Comparison

The programs which the computer used to produce the traffic assignments to the spider network separated the link volumes into 16 groups. For each of these volume groups, the difference between the origin-destination survey and the gravity model movements were tabulated. Table VI shows statistical data of the differences between the gravity model and the origin-destination survey movements within the 8,000 to 9,999 volume group. A similar table was developed for all volume groups and these will be included in the documents to be on file with the Department at the completion of this base study. The "root mean square (RMS) error" was calculated for each of the 16 volume groups, using the following statistical equation:

$$\text{RMS Error} = \pm\sqrt{\frac{\Sigma\,(\text{Differences})^2}{\text{No. of movements in volume group}}}$$

A percentage of the root mean square error was then calculated for each group with the following equation:

$$\text{Percent RMS Error} = \frac{\text{RMS Error}}{\text{Volume Group Mean}} \times 100\%$$

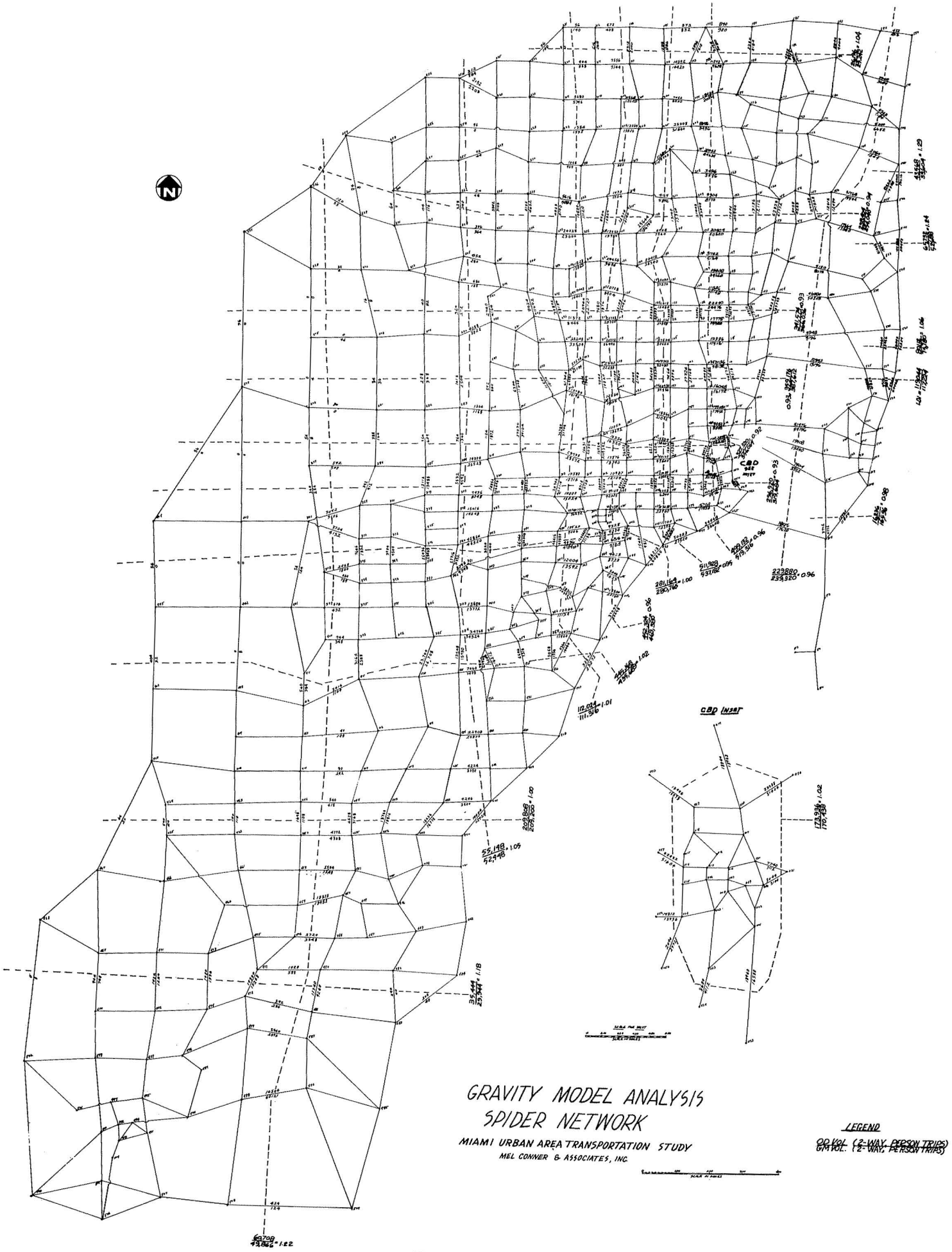

N
CBD INSET
GRAVITY MODEL ANALYSIS
SPIDER NETWORK
MIAMI URBAN AREA TRANSPORTATION STUDY
MEL CONNER & ASSOCIATES, INC.
LEGEND
OD VOL (2-WAY PERSON TRIPS)
GM VOL. (2-WAY PERSON TRIPS)

FIGURE 9

In the actual statistical comparisons and calculations, all person trips were divided into two categories -- work and non-work. This was done first, because of the very large amount of data involved, and second, because the average length of person work trips was 19.2 minutes as found in the origin-destination information, while the average trip length for all person trips was 15.0 minutes as found in the origin-destination data. Table VII shows the results of these calculations for each volume group and for the work trips and non-work trips. The data from Table VII were then plotted on logarithmic paper (see Figure 10) and the resulting curves compared with the accuracy level expected from the origin-destination data for a five percent sample at the 95 percent level of confidence. This expected accuracy level was developed and recommended by the Bureau of Public Roads in their gravity model manual, Calibrating and Testing a Gravity Model for any Size Urban Area.

Since these models demonstrated an accuracy (at each volume level) equivalent to the accuracy of the survey data, the calibration was considered complete.

TABLE VI
1964 MIAMI URBAN AREA TRIP COMPARISON
BETWEEN ORIGIN-DESTINATION AND GRAVITY MODEL

Volume Group 8000 to 9999

Mean Difference	-1,249
Standard Deviation	926
Sum of Squares	307,112,176
Total O-D Trips	1,130,716
Total G.M. Trips	1,165,200

TABLE VII
PERCENT ROOT-MEAN-SQUARE ERROR FOR ALL VOLUME GROUPS
MIAMI URBAN AREA GRAVITY MODEL

Work Trips

Volume Group	Volume Group Mean	Number of Movements	Percent RMS Error
0- 399	200	487	37
400- 999	700	380	21
1,000- 1,999	1,500	392	18

TABLE VII (Continued)
PERCENT ROOT-MEAN-SQUARE ERROR FOR ALL VOLUME GROUPS
MIAMI URBAN AREA GRAVITY MODEL

Work Trips

Volume Group	Volume Group Mean	Number of Movements	Percent RMS Error
2,000- 2,999	2,500	244	16
3,000- 3,999	3,500	123	14
4,000- 4,999	4,500	93	15
5,000- 5,999	5,500	68	14
6,000- 7,999	7,000	77	13
8,000- 9,999	9,000	33	11
10,000-12,500	11,250	22	7
12,500-14,999	13,750	17	7
15,000-19,999	17,500	7	5

Non-Work Trips

0- 399	200	323	57
400- 999	700	141	42
1,000- 1,999	1,500	204	29
2,000- 2,999	2,500	165	24
3,000- 3,999	3,500	180	22
4,000- 4,999	4,500	169	17
5,000- 5,999	5,500	138	20
6,000- 7,999	7,000	232	19
8,000- 9,999	9,000	127	17
10,000-12,499	11,250	111	16
12,500-14,999	13,750	79	14
15,000-19,999	17,500	82	14
20,000-24,999	22,500	30	11
25,000-29,999	27,500	18	7
30,000-49,999	40,000	10	8

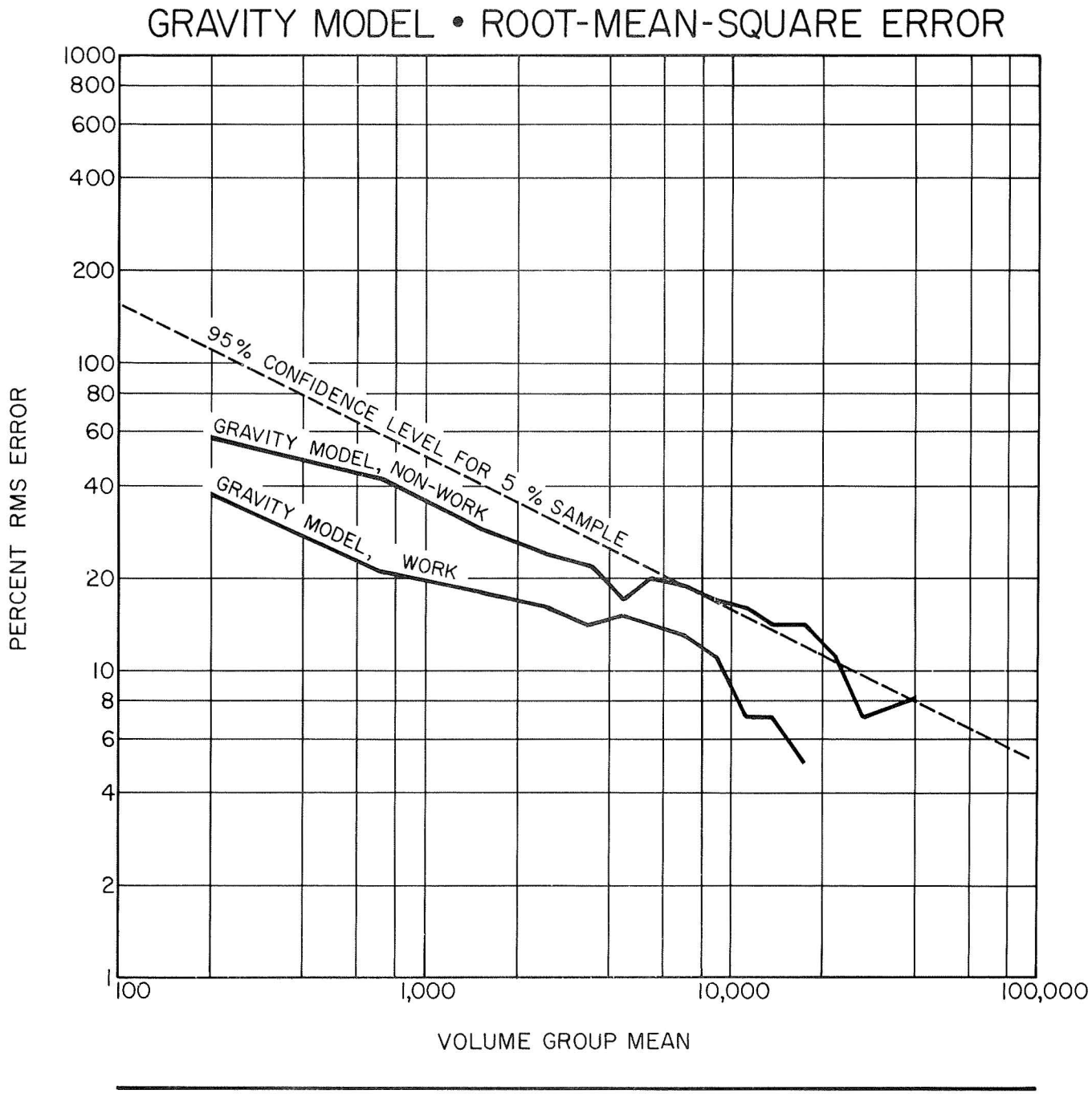

GRAVITY MODEL • ROOT-MEAN-SQUARE ERROR
PERCENT RMS ERROR
1000
800
600
400
200
100
80
60
40
20
10
8
6
4
2
1
95% CONFIDENCE LEVEL FOR 5 % SAMPLE
GRAVITY MODEL, NON-WORK
GRAVITY MODEL, WORK
100
1,000
10,000
100,000
VOLUME GROUP MEAN
MIAMI URBAN AREA TRANSPORTATION STUDY
MEL CONNER & ASSOCIATES, INC.

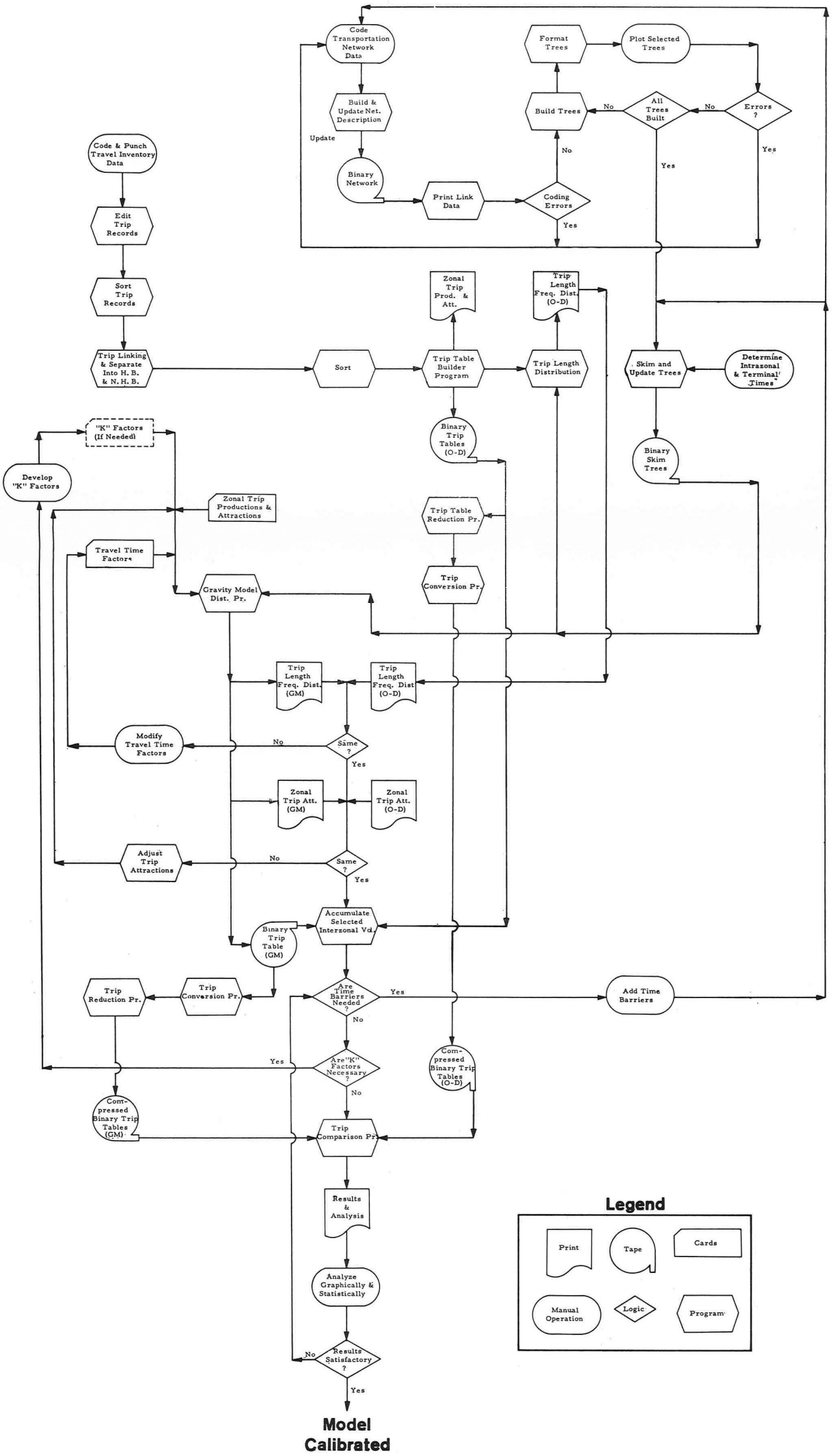
FIGURE 10

CHAPTER VI

SUMMARY

This technical report has outlined the basic steps followed in developing mathematical models which represent the person-trip generation and the person-trip distribution characteristics of the Miami urban area. Figure 11 graphically presents the basic steps which were used in developing the gravity models.

The next technical report will cover the development of modal split models which will be used to estimate that portion of travel which is likely to be accomplished by transit and by automobile. A fifth technical report will cover the use made of the trip generation equations in estimating 1985 trips, based on the estimates of population growth, land use and socio-economic changes in the urban area provided by the Metropolitan Dade County Planning Department.



GRAPHIC PRESENTATION
OF
MODEL DEVELOPMENT PROCESS

MIAMI URBAN AREA TRANSPORTATION STUDY

MEL CONNER & ASSOCIATES, INC.

FIGURE 11

APPENDICES

APPENDIX A

TERMINAL TIMES / INTRAZONAL TIMES

APPENDIX A

TERMINAL TIMES/INTRAZONAL TIMES

1964 Miami Urban Area Transportation Study
Network Terminal and Intrazonal Times in Minutes

Zone Number	Terminal Time	Intrazonal Time	Zone Number	Terminal Time	Intrazonal Time
1	6	1	38	1	1
2	3	1	39	1	1
3	4	1	40	1	2
4	4	1	41	1	1
5	4	1	42	2	1
6	6	1	43	1	1
7	6	1	44	3	2
8	6	1	45	4	1
9	6	1	46	2	2
10	8	1	47	3	1
11	8	1	48	1	2
12	6	1	49	1	1
13	6	1	50	3	1
14	8	1	51	2	1
15	6	1	52	3	1
16	6	1	53	3	1
17	6	1	54	1	1
18	3	1	55	1	1
19	3	1	56	2	1
20	4	1	57	2	1
21	5	1	58	2	1
22	1	2	59	2	1
23	3	1	60	2	2
24	2	1	61	2	2
25	1	1	62	2	1
26	2	1	63	2	1
27	2	1	64	3	1
28	1	1	65	2	1
29	1	1	66	1	1
30	1	1	67	2	1
31	1	1	68	2	1
32	1	1	69	1	2
33	2	1	70	3	1
34	2	1	71	2	1
35	2	1	72	2	1
36	2	1	73	2	1
37	1	1	74	2	1

TERMINAL TIMES/INTRAZONAL TIMES
(Cont'd)

Zone Number	Terminal Time	Intrazonal Time	Zone Number	Terminal Time	Intrazonal Time
75	2	1	112	2	1
76	2	1	113	2	2
77	2	1	114	1	1
78	2	1	115	1	1
79	3	1	116	1	1
80	3	1	117	2	1
81	3	1	118	2	1
82	3	2	119	2	1
83	3	1	120	3	1
84	3	1	121	2	2
85	5	1	122	2	1
86	3	1	123	2	1
87	2	1	124	2	1
88	3	1	125	3	2
89	2	1	126	3	1
90	3	1	127	3	1
91	5	1	128	2	1
92	1	1	129	2	1
93	2	1	130	2	1
94	2	1	131	2	1
95	1	1	132	1	1
96	2	2	133	1	1
97	2	1	134	1	1
98	3	1	135	2	1
99	2	1	136	1	1
100	2	1	137	1	1
101	2	1	138	2	1
102	2	1	139	2	1
103	2	1	140	2	1
104	2	2	141	6	1
105	2	1	142	6	1
106	2	1	143	3	1
107	2	1	144	2	1
108	3	1	145	1	2
109	3	1	146	1	1
110	2	1	147	2	1
111	2	1	148	1	1

TERMINAL TIMES/INTRAZONAL TIMES
(Cont'd)

Zone Number	Terminal Time	Intrazonal Time	Zone Number	Terminal Time	Intrazonal Time
149	1	1	186	1	2
150	1	1	187	1	2
151	1	2	188	1	2
152	2	1	189	1	1
153	1	1	190	1	1
154	1	1	191	1	1
155	1	2	192	2	1
156	1	2	193	1	1
157	1	1	194	1	2
158	1	1	195	1	1
159	2	1	196	1	2
160	2	1	197	1	2
161	2	1	198	1	2
162	1	2	199	1	2
163	1	1	200	1	2
164	1	1	201	1	1
165	1	1	202	2	1
166	1	1	203	1	1
167	1	1	204	1	1
168	2	2	205	1	2
169	1	2	206	1	2
170	1	2	207	1	2
171	2	1	208	2	2
172	1	2	209	2	2
173	3	1	210	1	1
174	1	2	211	1	1
175	1	2	212	1	1
176	1	2	213	1	2
177	1	2	214	1	1
178	1	2	215	1	1
179	1	2	216	1	2
180	2	2	217	1	2
181	1	2	218	1	2
182	1	2	219	1	2
183	1	2	220	1	2
184	2	2	221	1	2
185	1	2	222	1	1

TERMINAL TIMES/INTRAZONAL TIMES
(Cont'd)

Zone Number	Terminal Time	Intrazonal Time	Zone Number	Terminal Time	Intrazonal Time
223	1	2	260	1	2
224	1	2	261	1	2
225	1	1	262	1	2
226	1	1	263	1	2
227	1	1	264	1	2
228	1	1	265	1	1
229	1	2	266	1	3
230	1	1	267	1	3
231	1	2	268	1	3
232	1	2	269	1	2
233	1	2	270	1	2
234	1	2	271	2	2
235	1	2	272	1	2
236	2	2	273	1	2
237	1	1	274	1	5
238	1	1	275	1	3
239	3	1	276	1	3
240	3	1	277	1	3
241	1	1	278	1	3
242	1	1	279	1	2
243	1	1	280	1	2
244	2	1	281	1	2
245	1	1	282	1	2
246	1	1	283	1	2
247	1	2	284	1	2
248	1	1	285	1	2
249	4	1	286	1	2
250	1	1	287	1	1
251	3	1	288	1	1
252	1	2	289	1	1
253	1	2	290	1	2
254	1	1	291	1	2
255	1	1	292	3	2
256	1	1	293	2	2
257	1	1	294	3	2
258	1	2	295	4	2
259	1	2	296	1	2

TERMINAL TIMES/INTRAZONAL TIMES
(Cont'd)

Zone Number	Terminal Time	Intrazonal Time	Zone Number	Terminal Time	Intrazonal Time
297	1	1	334	1	1
298	1	1	335	1	2
299	2	2	336	1	1
300	3	1	337	1	1
301	3	1	338	1	1
302	3	1	339	1	1
303	1	1	340	1	2
304	1	2	341	1	1
305	2	2	342	1	1
306	3	2	343	1	1
307	6	2	344	1	1
308	2	2	345	1	1
309	1	1	346	1	1
310	1	1	347	1	1
311	2	1	348	1	1
312	2	1	349	1	1
313	2	1	350	1	1
314	2	1	351	1	2
315	1	2	352	1	1
316	2	1	353	4	2
317	1	2	354	2	1
318	2	1	355	4	1
319	1	1	356	3	1
320	2	1	357	1	1
321	2	1	358	1	1
322	3	1	359	1	1
323	3	1	360	1	1
324	3	1	361	1	1
325	3	1	362	1	1
326	3	1	363	1	2
327	3	1	364	1	1
328	2	1	365	1	1
329	1	1	366	1	1
330	1	1	367	1	1
331	1	1	368	1	2
332	1	1	369	1	2
333	2	1	370	1	2

TERMINAL TIMES/INTRAZONAL TIMES
(Cont'd)

Zone Number	Terminal Time	Intrazonal Time	Zone Number	Terminal Time	Intrazonal Time
371	1	2	408	1	2
372	1	2	409	1	2
373	1	1	410	1	2
374	1	1	411	1	2
375	1	1	412	1	2
376	1	1	413	1	2
377	1	1	414	1	2
378	1	1	415	1	2
379	1	1	416	1	2
380	1	1	417	1	2
381	4	1	418	1	2
382	1	2	419	1	2
383	1	2	420	1	3
384	1	1	421	1	2
385	1	1	422	3	1
386	1	2	423	1	1
387	1	1	424	1	2
388	1	1	425	1	2
389	1	1	426	1	2
390	1	1	427	3	2
391	1	1	428	2	2
392	1	2	429	1	2
393	1	1	430	1	2
394	1	1	431	1	2
395	1	2	432	1	2
396	1	1	433	1	2
397	1	3	434	1	2
398	1	2	435	1	2
399	1	2	436	1	2
400	1	2	437	1	2
401	1	2	438	1	2
402	1	3	439	1	2
403	1	3	440	1	2
404	1	3	441	1	2
405	1	3	442	1	2
406	1	3	443	1	2
407	1	3	444	1	2

TERMINAL TIMES/INTRAZONAL TIMES
(Cont'd)

Zone Number	Terminal Time	Intrazonal Time	Zone Number	Terminal Time	Intrazonal Time
445	1	2	482	1	3
446	1	2	483	1	3
447	1	2	484	1	2
448	1	2	485	1	4
449	1	1	486	4	3
450	1	1	487	1	1
451	1	2	488	1	3
452	1	2	489	1	2
453	1	2	490	1	2
454	1	2	491	1	2
455	1	2	492	3	1
456	1	2	493	2	1
457	1	2	494	3	1
458	1	2	495	1	2
459	1	2	496	1	2
460	1	2	497	1	2
461	1	1	498	1	2
462	1	2	499	1	2
463	1	2	500	1	2
464	1	2	501	1	2
465	1	2	502	1	5
466	1	2	503	1	4
467	1	2	504	1	2
468	1	3	505	1	2
469	1	2	506	1	2
470	1	2	507	1	3
471	1	2	508	1	3
472	1	2	509	1	5
473	1	2	510	1	2
474	1	2	511	1	1
475	1	1	512	1	2
476	1	2	513	4	2
477	1	2	514	3	2
478	1	1	515	1	1
479	1	2	516	1	1
480	1	2	517	4	2
481	1	3	518	4	1

TERMINAL TIMES/INTRAZONAL TIMES
(Cont'd)

Zone Number	Terminal Time	Intrazonal Time
519	4	1
520	4	1
521	4	1
522	4	1
523	1	1
524	4	1
525	4	1
526	4	1
527	5	1
528	8	1
529	5	1
530	1	1
531	3	2
532	4	2
533	4	1
534	2	1
535	2	1
536	2	2
537	4	2
538	4	3
539	1	1
540	1	1
541	1	2
542	1	2
543	1	2
544	4	2
545	1	2
546	3	1
547	5	2
548	4	1
549	2	2
550	2	2
551	0	0
552	0	0
553	0	0
554	0	0
555	0	0
556	0	0
557	0	0
558	0	0
559	0	0
560	0	0
561	0	0
562	0	0
563	0	0
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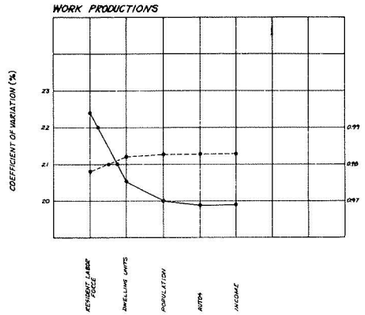
565	0	0
567	0	0
568	0	0
569	0	0
570	0	0
571	0	0
572	0	0
573	0	0
574	0	0
575	0	0
576	0	0
577	0	0

APPENDIX B

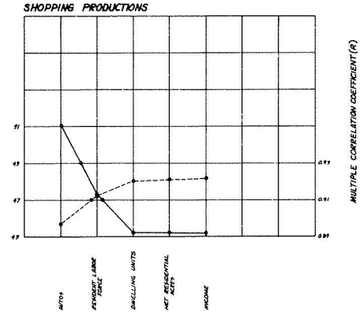
TRIP GENERATION VARIABLE SELECTION

EVALUATION OF MULTIPLE REGRESSION - TRIAL #1

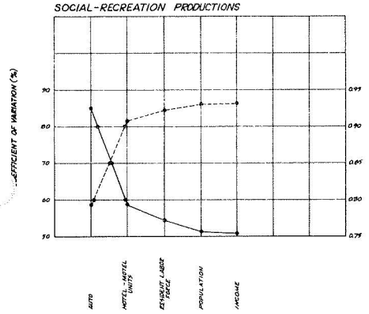
WORK PRODUCTIONS



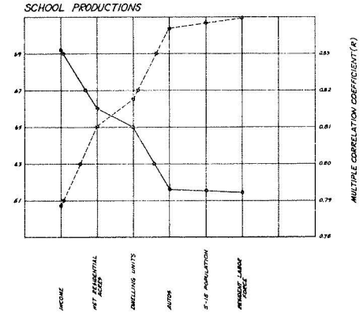
SHOPPING PRODUCTIONS



SOCIAL-RECREATION PRODUCTIONS

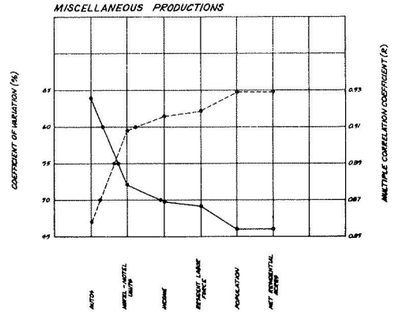


SCHOOL PRODUCTIONS



INDEPENDENT VARIABLES ENTERED INTO EQUATION

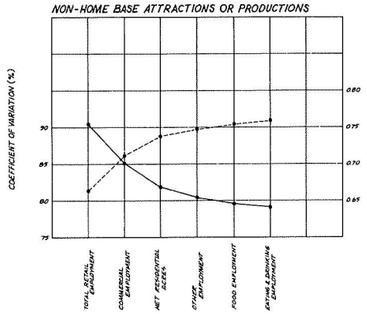
MISCELLANEOUS PRODUCTIONS



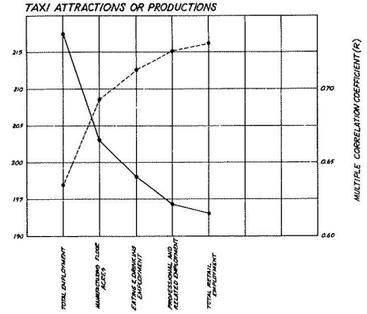
INDEPENDENT VARIABLES ENTERED INTO EQUATION

EVALUATION OF MULTIPLE REGRESSION - TRIAL #1

NON-HOME BASE ATTRACTIONS OR PRODUCTIONS

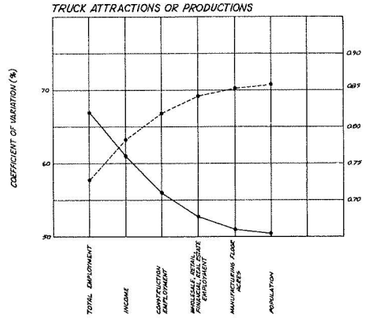


TAXI ATTRACTIONS OR PRODUCTIONS



INDEPENDENT VARIABLES ENTERED INTO EQUATION

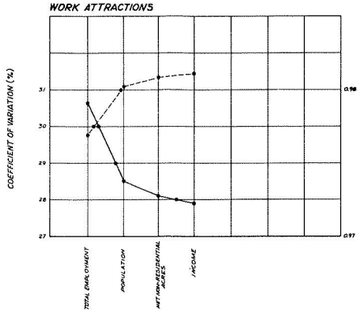
TRUCK ATTRACTIONS OR PRODUCTIONS



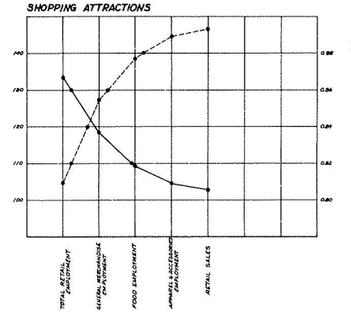
INDEPENDENT VARIABLES ENTERED INTO EQUATION

EVALUATION OF MULTIPLE REGRESSION - TRIAL #1

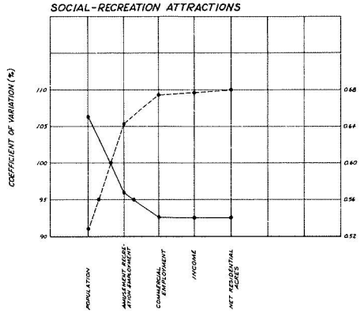
WORK ATTRACTIONS



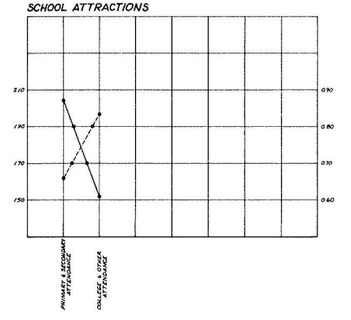
SHOPPING ATTRACTIONS



SOCIAL-RECREATION ATTRACTIONS

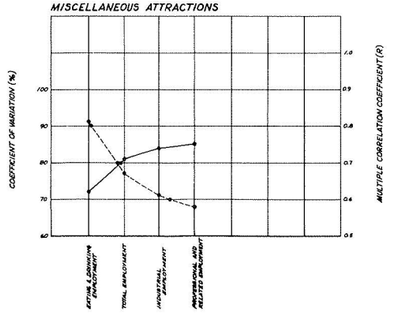


SCHOOL ATTRACTIONS



INDEPENDENT VARIABLES ENTERED INTO EQUATION

MISCELLANEOUS ATTRACTIONS



INDEPENDENT VARIABLES ENTERED INTO EQUATION

APPENDIX C

1964 TRIP PRODUCTIONS AND ATTRACTIONS

APPENDIX C

1964 TRIP PRODUCTIONS AND ATTRACTIONS

Zone No.	Dist. No.	Person Trip Productions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
001	001	163	108	323	0	215	600	123	81
002	001	0	0	0	0	0	53	55	0
003	001	29	215	54	108	592	464	205	0
004	001	0	0	0	0	0	81	110	23
005	001	0	0	0	0	0	485	110	35
006	001	0	0	0	0	0	1796	27	46
007	001	41	0	54	0	0	356	69	23
008	001	0	0	108	0	108	397	27	0
009	001	0	0	0	0	0	730	178	23
010	001	0	0	0	0	0	692	110	46
011	001	122	323	1399	0	0	1416	370	426
012	001	0	0	0	0	0	1242	178	0
013	001	0	0	0	0	0	600	96	161
014	001	0	0	0	0	0	1607	137	0
015	001	0	0	0	0	0	89	96	12
016	001	0	0	0	0	0	1210	164	23
017	001	163	377	484	0	108	934	329	58
018	001	82	108	108	0	0	1072	370	46
019	001	119	0	0	0	0	137	233	12
020	001	163	0	484	613	527	405	219	23
021	001	0	0	0	0	0	1587	247	23
022	002	625	339	280	270	189	240	178	23
023	002	181	108	183	0	0	689	329	46
024	002	336	599	621	162	1084	516	247	23
025	002	200	302	151	0	339	111	206	12
026	002	304	259	399	0	217	157	27	12
027	002	660	626	795	617	524	531	123	23
028	002	2199	1750	1100	970	936	542	438	69
029	002	1458	514	257	698	972	994	357	12
030	002	1365	465	1052	393	671	545	220	58
031	002	1179	1134	1023	990	1619	740	178	23
032	002	1004	764	958	449	1564	541	260	23
033	002	998	1682	1004	570	1316	277	96	46
034	002	1160	882	697	759	1365	843	123	23
035	002	1509	1475	1411	408	817	3523	260	12
036	002	1031	785	1099	345	1225	1133	219	23

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Productions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
037	002	1125	538	877	425	906	823	219	12
038	002	1548	1376	566	509	1216	976	206	35
039	002	710	962	905	651	453	507	302	0
040	002	1201	1252	978	497	912	783	124	23
041	002	1862	1440	1044	778	1813	666	247	58
042	002	2041	1553	1993	1836	2285	1757	425	46
043	002	2123	1671	1473	1063	1495	898	384	0
044	002	3693	1116	1075	547	1469	1662	753	47
045	002	1286	400	114	29	582	998	343	0
046	002	836	377	809	200	689	396	261	0
047	002	129	29	355	0	124	1375	164	0
048	002	2024	1686	1713	486	1610	943	315	12
049	002	833	993	486	686	1316	903	274	23
050	003	43	0	0	0	0	123	192	0
051	003	2638	1939	2951	1262	2855	1066	575	92
052	003	48	108	258	0	215	597	438	35
053	003	253	215	538	75	278	742	343	12
054	003	711	276	466	138	108	625	247	0
055	003	291	289	363	63	211	195	342	35
056	004	3301	1050	2384	1123	2913	1774	507	69
057	004	2921	1564	1566	1069	2511	1624	590	92
058	004	2562	1871	1302	1453	1419	1010	493	23
059	004	780	229	487	240	349	2329	439	0
060	004	2294	2474	1982	1116	2282	1245	589	35
061	004	2621	2697	1614	1161	1865	1403	521	12
062	004	1127	878	1149	292	1438	944	288	0
063	004	1499	1362	758	758	1380	709	301	23
064	004	2192	966	1737	946	2195	1355	328	116
065	004	1945	603	1277	1031	1578	1391	384	92
066	004	846	687	713	343	1082	583	260	23
067	004	886	607	502	686	973	712	466	0
068	004	1655	1421	1887	1133	1587	859	246	0
069	004	2705	3045	2639	1798	2233	686	206	0
070	005	4548	318	576	0	1466	930	534	311
071	005	3569	300	264	338	881	394	137	81
072	005	3749	273	186	113	415	214	110	58

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Productions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
073	005	3707	343	108	0	583	658	315	70
074	005	3158	132	210	104	426	556	863	104
075	005	563	114	228	228	228	1291	1356	23
076	005	2727	1147	1876	1370	1919	1875	1535	81
077	005	1179	1019	545	179	1476	531	219	58
078	005	675	346	1217	107	641	1055	465	46
079	005	1272	532	1098	262	843	3758	2055	150
080	005	0	0	0	0	0	320	219	46
081	005	0	0	0	0	0	999	370	81
082	005	872	407	894	39	396	2907	274	92
083	005	2392	1714	1336	1378	2389	1313	370	115
084	006	1937	1106	710	534	1820	1245	890	127
085	006	1632	250	465	148	553	2162	672	185
086	006	748	0	491	416	297	2732	1905	242
087	006	2073	964	731	681	849	887	658	23
088	006	1673	1418	571	597	884	1881	836	23
089	006	757	416	464	0	624	749	1370	12
090	006	580	384	236	328	296	714	466	35
091	006	159	210	248	0	172	2078	233	12
092	006	1448	765	1267	472	1697	1264	945	12
093	006	2082	1219	1254	732	2004	1810	383	46
094	006	1690	1289	820	818	762	812	877	12
095	006	1155	864	466	825	1223	660	644	12
096	006	1997	1779	1236	871	2013	1167	1438	23
097	006	424	474	250	251	501	2364	1083	12
098	007	1149	324	216	332	450	1103	1562	0
099	007	2161	492	433	666	1032	261	411	23
100	007	2467	543	420	120	914	400	535	35
101	007	2911	638	928	812	1073	189	370	46
102	007	2412	635	375	58	1439	618	233	46
103	007	2866	1438	517	403	1124	1529	384	46
104	007	6655	839	996	692	2593	2873	754	81
105	007	1812	329	344	545	574	411	219	23
106	007	1190	362	201	29	725	326	274	0
107	007	918	491	325	222	388	509	260	12
108	007	42	0	0	0	55	448	1151	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Productions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
109	007	0	0	0	0	0	1285	1343	12
110	007	1049	184	246	307	430	500	671	0
111	007	556	56	395	56	197	698	548	12
112	007	2787	561	471	56	1213	89	137	104
113	007	5339	1060	1306	233	1581	1921	987	104
114	008	1067	1312	937	557	901	815	521	0
115	008	1780	1030	1192	471	1559	931	384	46
116	008	2615	1371	1243	956	1405	583	753	46
117	008	2496	1912	1495	769	1938	1904	617	58
118	008	1912	1372	1144	504	1317	721	712	69
119	008	2135	3226	1977	915	1615	1044	1069	35
120	008	984	981	1329	311	949	725	507	23
121	008	1346	1061	1220	846	1423	307	301	0
122	009	2491	736	288	334	1166	1029	712	92
123	009	850	273	57	115	287	395	178	0
124	009	0	0	0	0	0	263	274	0
125	009	1953	1521	994	818	1091	4071	1041	0
126	009	1575	1418	2474	667	1418	470	151	12
127	009	317	389	306	0	612	29	69	0
128	009	450	1112	417	167	612	1414	82	35
129	009	2253	1006	883	601	1946	608	219	0
130	009	1369	986	568	718	1405	1068	206	12
131	009	2120	1661	1696	707	1802	343	370	46
132	009	1177	830	1058	276	852	1001	329	0
133	009	863	347	550	897	723	445	301	35
134	009	838	1270	779	519	1127	226	274	0
135	009	2096	1322	1724	634	1183	1976	685	35
136	009	1474	2114	1748	568	1577	674	178	0
137	009	1291	626	1146	471	768	1065	411	23
138	009	1660	1853	1388	1280	1757	1321	671	69
139	010	769	900	831	117	469	531	219	0
140	010	734	506	88	59	88	493	494	0
141	010	805	893	719	166	960	690	288	35
142	010	547	518	539	254	679	2461	370	0
143	010	60	157	0	39	196	2590	192	58
144	010	989	2254	1492	688	2182	1633	685	23

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Productions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
145	010	1781	2856	3400	1390	4021	519	452	58
146	010	359	242	167	159	318	657	329	12
147	010	876	1271	260	838	1553	1664	274	23
148	010	1296	912	974	699	1296	314	55	12
149	010	1281	1018	437	407	786	174	41	0
150	010	372	492	463	347	694	1667	356	81
151	010	2478	3295	2165	1849	3194	815	370	12
152	010	1733	1007	1192	616	642	880	370	23
153	010	1101	1817	1199	1101	1736	282	220	12
154	010	1250	1440	1380	609	1718	355	384	24
155	010	352	994	736	0	632	1418	384	58
156	011	1490	2110	2348	896	2453	1977	452	81
157	011	554	284	151	0	166	1310	384	23
158	011	907	1563	191	368	1393	343	302	23
159	011	1271	1055	491	307	751	3295	424	47
160	011	218	290	0	0	106	1416	151	0
161	011	635	767	811	335	1082	748	219	0
162	011	3867	3312	2719	1417	3245	885	315	0
163	011	1343	783	1280	437	873	93	123	12
164	011	1145	949	949	502	726	356	83	0
165	011	1092	1333	1447	574	1515	667	165	0
166	011	2155	2382	1636	1062	2440	1837	315	0
167	011	712	746	803	517	373	195	123	0
168	011	1546	1005	879	402	1367	600	520	0
169	011	0	0	0	0	0	181	123	0
170	011	44	180	116	173	29	0	41	0
171	012	86	0	0	75	113	860	287	0
172	012	1736	2207	1235	832	1170	1824	479	0
173	012	0	0	0	0	0	4534	466	23
174	012	2708	2335	1973	1307	3558	1500	863	0
175	012	2206	1851	1797	1417	3050	831	644	12
176	012	1915	2127	2367	1235	1920	1098	507	0
177	012	2835	3893	2640	2785	3502	1392	411	0
178	013	142	125	0	0	0	24	178	0
179	013	2124	3039	1338	642	2061	1227	219	0
180	013	1332	3251	2038	611	2269	852	535	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Productions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
181	013	153	430	0	231	0	371	411	0
182	013	1615	2285	1008	1982	1814	653	439	23
183	013	732	677	600	797	314	63	137	0
184	013	0	0	0	0	0	29	82	0
185	014	996	558	670	279	865	177	247	0
186	014	855	2064	1507	754	1312	373	178	0
187	014	64	56	0	112	0	176	206	0
188	014	843	1172	527	528	615	374	507	0
189	014	0	0	0	0	0	344	260	0
190	014	565	558	251	558	614	318	246	0
191	014	1515	1770	1269	1210	1594	823	411	0
192	014	1434	2066	1416	1475	1180	899	110	0
193	014	470	856	620	266	974	187	69	0
194	014	858	1003	236	797	354	175	164	0
195	015	246	30	30	295	118	103	178	0
196	015	875	715	514	86	343	166	247	0
197	015	615	29	743	372	801	356	164	0
198	015	2001	2567	826	1534	2331	965	82	0
199	015	2204	2149	1814	1563	1870	340	233	0
200	015	912	1228	1144	474	698	520	288	12
201	015	1058	1553	908	586	1143	748	178	0
202	015	1857	1817	879	1231	820	281	123	12
203	016	0	0	0	0	0	79	41	0
204	016	1395	1599	1932	1057	1927	512	83	0
205	016	3542	601	400	57	975	349	233	0
206	016	0	0	0	0	0	271	411	0
207	016	2645	1632	1463	1152	1128	688	411	0
208	016	665	912	736	179	208	501	452	23
209	016	3736	3498	4242	1575	2635	2270	973	70
210	016	2551	2320	2552	1566	2784	745	178	0
211	016	1663	406	1081	0	642	79	138	12
212	016	1321	568	425	158	583	603	589	23
213	016	3651	2437	3003	2556	3052	561	521	81
214	016	188	30	239	239	179	200	69	0
215	016	0	0	0	0	0	0	0	12
216	017	0	0	0	0	0	0	41	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Productions							
		Work	Shop*	Soc-Rec	School	Misc.	NHB	Truck	Taxi
217	017	1851	2174	1773	1229	1573	508	110	0
218	017	3131	2174	1744	1744	1716	1185	493	0
219	017	1562	2374	1201	1344	1001	375	178	12
220	017	0	0	0	0	0	0	27	0
221	017	0	0	0	0	0	0	0	0
222	017	0	0	0	0	0	0	0	0
223	017	0	0	0	0	0	0	0	0
224	017	0	0	0	0	0	21	0	0
225	017	0	0	0	0	0	28	96	0
226	018	0	0	0	0	0	0	14	0
227	018	474	569	596	271	352	87	55	0
228	018	0	75	0	0	0	0	41	0
229	018	0	0	0	0	0	107	69	0
230	018	239	201	57	57	57	21	69	0
231	018	0	0	0	0	0	50	123	12
232	018	0	0	0	0	0	29	137	12
233	018	781	286	163	572	715	171	397	0
234	018	564	630	343	572	572	292	233	0
235	019	1879	1668	858	1201	1630	431	370	0
236	019	4370	5092	3015	2919	4457	2779	1041	12
237	019	2684	3036	4041	2204	4371	1595	370	12
238	019	2921	2437	1552	1147	2600	387	260	0
239	019	124	0	244	81	81	362	206	0
240	019	1092	1193	1436	407	948	777	466	0
241	019	1468	905	1262	466	975	521	178	0
242	019	1806	1736	932	411	1794	1217	384	12
243	019	2017	1613	1163	428	1958	596	164	23
244	019	1747	1615	1318	1184	1345	2177	315	12
245	019	0	0	0	0	0	29	41	0
246	019	1477	983	759	1152	742	49	82	12
247	019	2405	949	969	647	1658	1158	713	0
248	019	1113	298	735	228	817	796	521	35
249	019	0	0	0	0	0	351	69	0
250	019	1477	1764	1925	807	1434	972	233	0
251	019	1219	1929	889	962	893	1641	794	0
252	020	0	0	0	0	0	0	0	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Productions							
		Work	Shop*	Soc-Rec*	School	Misc.	NHB	Truck	Taxi
253	020	750	178	534	743	178	22	110	0
254	020	0	0	0	0	0	0	0	0
255	020	0	0	0	0	0	22	14	0
256	020	0	0	0	0	0	0	0	0
257	020	0	0	0	0	0	0	0	0
258	020	0	0	0	0	0	0	0	0
259	020	0	0	0	0	0	0	0	0
260	021	0	0	0	0	0	0	0	0
261	021	0	0	0	0	0	0	0	0
262	021	0	0	0	0	0	28	14	0
263	021	0	0	0	0	0	21	0	0
264	021	0	59	0	0	0	72	14	0
265	021	0	0	0	0	0	76	69	0
266	022	45	0	0	59	0	0	14	0
267	022	0	0	0	0	0	0	0	0
268	022	0	0	0	0	0	0	14	0
269	023	0	0	0	0	0	106	69	0
270	023	0	0	0	0	0	0	0	0
271	023	0	0	0	0	0	0	14	0
272	023	0	0	0	0	0	42	55	0
273	023	0	0	0	0	0	23	82	0
274	024	0	0	0	0	0	29	55	0
275	024	0	0	0	0	0	0	0	0
276	024	0	0	0	0	0	0	0	0
277	024	0	89	0	119	30	73	110	0
278	025	0	0	0	0	0	0	0	0
279	025	0	0	0	0	0	190	96	12
280	025	44	0	0	0	174	104	562	0
281	026	88	116	0	0	0	0	14	0
282	026	0	0	0	0	0	0	27	0
283	026	0	0	0	0	0	0	192	0
284	026	498	725	203	261	1421	120	55	0
285	026	0	0	0	0	0	42	28	0
286	026	645	667	348	116	290	310	411	0
287	027	0	0	56	278	111	31	110	0
288	027	0	0	0	0	0	177	603	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Productions							
		Work	Shop*	Soc-Rec*	School	Misc.	NHB	Truck	Taxi
289	027	0	111	0	0	0	247	480	0
290	027	2419	1668	1924	1843	2330	351	370	0
291	027	2089	1856	1682	1305	1624	353	82	0
292	027	1151	1001	746	461	949	935	439	0
293	027	1733	1594	1117	1057	1512	1685	480	92
294	027	1442	814	740	439	1217	2189	576	219
295	028	863	997	595	416	1105	4100	740	58
296	028	3996	3281	1348	1607	3363	1293	274	35
297	028	2227	999	1483	962	1258	1317	247	12
298	028	1016	840	591	529	715	1130	151	12
299	028	1628	1089	1147	591	1787	932	151	12
300	028	1212	591	995	1026	1089	658	658	12
301	028	810	653	248	311	404	1691	329	0
302	028	1106	1193	1377	857	887	1803	479	58
303	028	635	140	300	787	281	465	425	12
304	029	0	0	0	0	0	122	178	0
305	029	0	0	0	0	0	594	288	0
306	029	0	0	0	0	0	1069	219	23
307	029	0	0	0	0	0	4049	1370	863
308	029	133	0	85	0	109	1703	1164	46
309	029	960	477	568	645	982	1988	315	12
310	029	306	418	60	0	268	457	178	184
311	029	1090	1132	783	626	813	974	110	0
312	029	407	832	603	115	520	1446	274	12
313	029	1307	666	526	336	1104	233	178	0
314	029	1340	1091	1557	115	402	272	123	12
315	029	1861	1690	1022	909	2044	847	274	0
316	029	2744	2400	1964	942	2937	1281	507	35
317	029	1871	2591	1766	755	1879	648	411	0
318	029	2113	1923	1633	1138	1362	1732	493	0
319	029	558	695	754	473	726	64	384	0
320	029	1339	1807	2549	733	762	914	233	0
321	030	2453	882	1976	377	1577	1829	356	0
322	030	57	75	0	226	0	1079	260	23
323	030	400	531	490	490	431	692	82	0
324	030	0	0	0	0	0	2116	178	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Productions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
325	030	0	0	0	0	108	2195	123	58
326	030	0	0	0	0	0	2345	151	0
327	030	0	0	0	0	0	1673	96	12
328	030	259	325	325	206	295	1876	302	0
329	030	1186	1057	956	293	553	723	219	0
330	030	2636	2896	2531	1967	2601	483	439	12
331	030	1601	1512	2538	1550	1615	559	356	0
332	030	308	880	882	871	1084	701	178	0
333	030	471	425	526	354	598	490	123	12
334	030	570	764	869	663	1058	299	123	0
335	030	1332	1752	1942	1125	2050	1497	534	46
336	030	1699	1436	1923	1111	1084	2162	315	0
337	030	2394	1283	882	656	938	842	370	0
338	030	2297	2288	1831	1487	1695	1251	260	0
339	030	1539	1764	1470	588	2029	859	191	0
340	030	3456	2316	3348	2204	2846	877	425	0
341	030	1456	1084	945	1279	1057	1048	397	0
342	030	1519	1335	834	917	1168	512	507	0
343	031	165	108	27	190	190	737	520	0
344	031	776	1041	464	247	875	331	123	0
345	031	252	222	249	443	249	62	191	0
346	031	1053	948	1176	718	1120	1308	425	0
347	031	426	626	566	626	1244	283	150	0
348	031	1788	1897	1516	869	1829	605	287	0
349	031	1078	2359	1788	1263	1347	244	219	0
350	031	1632	1815	2011	1225	1472	922	384	0
351	031	673	1132	1193	887	1989	369	110	0
352	031	289	718	398	245	245	676	178	0
353	031	358	1881	2772	1848	4554	4498	288	12
354	031	1502	744	706	329	545	1171	288	0
355	031	0	0	0	0	0	3015	630	0
356	031	622	853	736	379	1356	2359	329	0
357	031	841	813	1205	717	871	668	247	0
358	031	1355	1463	2300	657	1697	1035	219	0
359	031	515	728	817	695	1172	1024	219	0
360	031	639	918	1476	523	1540	330	206	12

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Productions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
361	031	956	1163	954	924	1311	685	123	12
362	031	448	398	640	457	398	1313	69	0
363	031	894	1088	1387	1058	1943	900	123	0
364	031	0	0	0	0	0	1437	822	12
365	031	2040	114	115	0	287	355	274	0
366	031	1074	1131	1370	923	1817	402	178	0
367	031	892	676	764	794	1470	239	192	0
368	031	0	0	0	0	0	38	137	0
369	032	0	0	0	0	0	163	69	0
370	032	288	231	169	58	258	603	370	0
371	032	720	1169	371	314	513	187	233	0
372	032	1882	1560	1185	722	2194	1257	260	0
373	032	835	827	513	86	257	313	110	0
374	032	1202	970	742	884	1254	496	164	0
375	032	591	520	607	0	520	521	69	12
376	032	1524	1272	1070	520	636	1193	370	0
377	032	1081	941	342	656	656	528	55	0
378	032	2577	941	1739	1283	1596	953	315	0
379	032	1518	1754	932	1288	1946	665	151	0
380	032	1336	1204	1069	795	1261	1460	233	0
381	033	0	0	0	0	0	310	55	0
382	033	1070	650	623	705	813	1264	274	0
383	033	585	813	677	759	650	544	164	0
384	033	231	332	471	693	693	137	123	0
385	033	172	340	0	113	85	28	233	0
386	033	443	723	334	445	751	535	233	0
387	033	1989	1445	1863	528	1835	633	219	12
388	033	1399	1362	2224	806	2391	1426	328	0
389	033	2413	1698	1751	778	1391	838	178	0
390	033	1549	1531	1362	500	1362	239	123	0
391	033	240	195	391	167	251	331	110	0
392	033	1462	1076	1811	849	991	382	206	0
393	033	2548	2133	1690	1025	1385	329	164	0
394	033	1511	1551	1163	637	1108	135	123	0
395	033	1173	1088	1116	558	1004	134	220	0
396	033	0	0	0	0	0	116	521	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Productions							
		Work	Shop*	Soc-Rec	School	Misc.	NHB	Truck	Taxi
397	034	1349	772	773	980	1723	298	96	0
398	034	180	208	0	149	59	127	41	0
399	034	90	89	119	0	208	84	82	0
400	034	45	0	0	59	119	102	27	0
401	034	0	0	0	0	0	0	14	0
402	034	0	0	0	0	0	21	14	0
403	034	0	0	0	0	0	0	14	0
404	034	0	0	0	0	0	27	0	0
405	034	0	0	0	0	0	0	137	0
406	035	0	0	0	0	0	0	0	0
407	035	0	0	0	0	0	0	0	0
408	035	0	0	0	0	0	0	0	0
409	035	0	0	0	0	0	0	0	0
410	035	0	0	0	0	0	0	0	0
411	035	0	0	0	0	0	0	0	0
412	035	0	0	0	0	0	43	27	0
413	035	0	0	0	0	0	128	0	0
414	035	0	0	0	0	0	22	521	0
415	036	43	311	170	114	170	21	82	0
416	036	172	425	283	537	283	70	55	0
417	036	3410	622	1387	311	1358	207	343	0
418	036	200	283	57	170	28	56	27	0
419	036	1269	1019	679	934	1613	727	315	0
420	036	1211	1188	820	934	1161	943	301	0
421	036	1108	1161	1188	621	1728	1558	493	0
422	037	0	0	0	0	0	2186	110	0
423	037	0	0	0	0	0	340	82	0
424	037	617	674	646	169	1058	1830	548	12
425	037	873	1096	899	927	1377	343	41	0
426	037	277	309	309	281	337	172	192	0
427	037	47	250	125	62	0	228	82	0
428	037	47	31	62	0	156	130	27	0
429	037	86	197	141	56	56	50	96	0
430	037	729	1337	873	1193	1510	79	233	0
431	037	575	562	1068	562	899	405	329	0
432	037	1018	1954	1643	656	1093	1804	383	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Productions							
		Work	Shop*	* Soc-Rec	School	Misc.	NHB	Truck	Taxi
433	037	597	1571	1047	641	1281	689	397	0
434	037	803	553	1076	495	1076	953	343	0
435	037	424	1680	733	705	1043	610	315	0
436	037	385	282	423	508	987	205	110	0
437	038	364	1156	903	902	1241	386	356	0
438	038	178	226	169	282	0	0	150	0
439	038	600	423	282	226	733	2520	494	0
440	038	107	310	0	85	56	0	55	0
441	038	274	250	250	250	167	70	110	12
442	038	0	0	0	0	0	0	14	0
443	038	21	28	0	56	56	23	27	0
444	038	1026	1085	778	612	1223	359	96	0
445	038	2277	2169	806	973	1168	670	192	0
446	038	2642	4392	1502	1918	2085	169	150	0
447	038	573	56	106	0	111	208	55	0
448	038	2145	194	113	58	405	332	137	0
449	038	0	0	0	0	0	1860	178	0
450	039	42	0	0	111	0	91	41	0
451	039	380	278	111	540	278	317	192	0
452	039	2104	311	424	981	673	564	315	0
453	039	931	1160	878	1104	1217	555	397	0
454	039	0	0	0	0	0	43	82	0
455	039	501	595	85	396	311	27	55	0
456	039	0	0	0	0	0	51	0	0
457	039	383	594	119	59	713	0	69	0
458	039	2017	1446	834	1168	890	85	151	0
459	039	337	56	139	56	250	108	69	0
460	039	84	84	0	111	28	22	27	0
461	039	42	0	0	0	0	0	14	0
462	039	0	0	0	0	0	56	164	0
463	039	0	0	0	0	0	0	27	0
464	039	0	0	0	0	0	0	14	0
465	039	0	0	0	0	0	0	110	0
466	039	63	85	56	56	85	0	82	0
467	039	0	0	0	0	0	21	69	0
468	039	0	0	0	0	0	0	27	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS

Zone No.	Dist. No.	Person Trip Productions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
469	040	171	361	136	705	169	49	82	0
470	040	364	226	254	85	254	174	41	0
471	040	188	169	0	0	28	278	192	0
472	040	64	28	56	113	56	21	96	0
473	040	107	310	85	226	56	54	14	0
474	040	214	169	91	226	85	29	41	0
475	040	161	91	273	0	30	0	220	0
476	040	851	424	121	303	378	195	151	0
477	040	299	273	0	121	121	116	82	0
478	040	46	0	430	229	114	86	137	0
479	041	1006	619	29	968	457	494	288	0
480	041	44	0	652	58	318	232	247	0
481	041	468	240	0	617	343	159	192	0
482	041	0	0	0	0	0	23	41	0
483	041	0	0	0	0	0	0	27	0
484	041	0	0	0	0	0	29	14	0
485	042	0	0	0	0	0	0	14	0
486	042	259	1980	2972	1681	2560	620	192	0
487	042	0	0	0	0	0	0	0	0
488	042	1172	937	912	1116	1810	263	233	0
489	042	365	306	417	306	612	278	110	0
490	042	694	845	759	286	429	585	164	0
491	042	291	164	218	55	164	987	466	0
492	043	758	387	439	57	629	1476	329	0
493	043	695	216	499	370	315	834	439	0
494	043	0	79	79	0	79	2548	439	0
495	044	1374	1635	1804	818	2105	823	411	0
496	044	293	220	138	413	440	195	82	0
497	044	105	110	468	258	358	163	0	0
498	044	86	113	57	57	0	64	137	0
499	044	2225	2312	1852	680	2129	725	220	0
500	044	1304	711	914	154	370	70	603	0
501	044	516	226	519	226	226	22	109	0
502	044	126	106	106	0	0	69	96	0
503	045	80	53	0	211	53	41	96	0
504	045	1478	285	171	263	446	82	69	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS

Zone No.	Dist. No.	Person Trip Productions							
		Work	Shop*	Soc-Rec*	School	Misc.	NHB	Truck	Taxi
505	045	824	958	275	602	561	586	288	0
506	045	23	184	0	60	60	0	14	0
507	046	46	150	30	150	150	23	69	0
508	046	0	0	0	0	0	0	0	0
509	046	0	0	0	0	0	79	28	0
510	047	0	0	0	0	0	0	0	0
511	047	90	646	2388	0	807	202	82	0
512	047	1045	1298	1750	1004	1180	481	192	0
513	047	0	0	0	0	0	801	151	0
514	047	0	0	0	0	0	1236	137	0
515	047	0	0	0	0	0	0	0	0
516	048	363	285	925	427	783	206	96	23
517	048	904	926	900	151	707	736	589	58
518	048	0	0	0	0	0	525	69	81
519	048	117	1072	1117	79	979	477	466	69
520	048	82	523	1679	0	710	1308	727	104
521	048	2381	3762	3567	731	3096	1091	877	127
522	048	216	757	851	415	647	576	315	12
523	048	465	580	818	499	1875	248	288	23
524	048	1083	1467	1014	630	2429	860	424	69
525	048	1232	1447	1396	604	1736	1138	343	35
526	048	264	1049	1195	108	1090	1002	671	104
527	048	392	1442	4154	0	3034	4241	657	426
528	048	831	949	1284	0	905	5149	822	173
529	048	203	159	198	0	513	622	192	35
530	048	306	798	767	620	341	1016	740	35
531	048	1267	1708	2362	685	1787	1716	822	58
532	048	693	5632	8444	240	6630	2482	1452	403
533	049	98	2686	6725	0	8145	1554	507	277
534	049	1099	905	249	510	914	790	302	35
535	049	931	675	840	540	1598	1310	315	139
536	049	728	967	1561	967	1299	852	630	23
537	049	234	4342	5700	108	4627	1186	589	81
538	050	2492	7400	7911	675	7564	4641	1493	472
539	050	1148	1476	3569	1029	4262	836	397	12
540	050	1324	2206	2354	994	3289	1566	686	12

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Productions							
		Work	Shop*	Soc-Rec*	School	Misc.	NHB	Truck	Taxi
541	050	1198	2838	4043	1014	3612	400	357	47
542	050	2540	1489	1604	1347	1739	427	384	35
543	050	585	1663	2079	624	1099	253	178	23
544	050	590	1775	3719	329	2526	1255	671	265
545	050	1478	2272	3279	1005	3134	1140	713	185
546	050	229	4892	10362	0	8243	1157	576	265
547	050	0	0	0	0	0	413	178	23
548	050	26	1598	2481	0	2124	1106	315	46
549	050	442	4848	9605	313	8753	2988	671	47
550	050	106	104	313	0	244	50	151	0

APPENDIX C

1964 TRIP PRODUCTIONS AND ATTRACTIONS

Zone No.	Dist. No.	Person Trip Attractions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
001	001	1180	0	587	0	624	681	123	92
002	001	92	0	0	0	31	28	55	0
003	001	820	57	191	67	742	638	205	0
004	001	396	0	0	0	0	59	110	23
005	001	1665	543	0	0	812	302	123	35
006	001	2891	13898	846	0	2045	2273	27	46
007	001	911	285	809	0	320	345	82	23
008	001	130	259	124	0	969	284	27	0
009	001	3105	416	153	0	1734	465	178	23
010	001	1992	54	228	111	1136	510	110	35
011	001	3178	863	1903	0	2871	1294	370	391
012	001	2724	502	354	0	2565	933	178	0
013	001	2112	1628	322	0	810	650	96	161
014	001	3241	367	183	0	2513	1405	123	0
015	001	417	344	0	206	156	146	96	12
016	001	2767	3665	1473	1060	2701	1032	178	23
017	001	2831	490	844	195	1935	1014	329	92
018	001	4311	274	138	108	2160	611	370	35
019	001	308	58	229	0	397	137	233	12
020	001	604	27	564	75	562	362	219	23
021	001	949	382	4540	0	1044	1766	260	23
022	002	343	0	497	79	498	210	164	23
023	002	1333	64	308	0	460	491	315	46
024	002	771	0	146	596	388	486	247	23
025	002	79	0	269	207	0	90	206	12
026	002	174	0	253	0	27	87	27	12
027	002	532	891	202	0	513	477	123	23
028	002	731	547	790	0	739	848	425	69
029	002	1114	58	1035	1524	1680	967	343	12
030	002	414	255	627	0	672	491	220	46
031	002	515	0	947	713	1394	684	206	12
032	002	282	414	938	278	496	870	260	23
033	002	353	27	637	0	187	577	96	46
034	002	676	429	540	0	351	871	123	23
035	002	746	11392	1014	0	781	4123	260	12
036	002	765	582	828	0	1216	1183	219	23

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Attractions							
		Work	Shop*	* Soc-Rec	School	Misc.	NHB	Truck	Taxi
037	002	348	1135	779	0	616	1135	219	12
038	002	1098	1285	740	1991	1436	853	192	35
039	002	632	1377	572	886	223	600	288	0
040	002	626	517	1274	54	837	448	137	23
041	002	421	706	897	274	1265	737	274	46
042	002	1250	1036	1230	145	2590	1338	425	46
043	002	674	378	1016	382	932	1027	384	0
044	002	1565	1856	1612	646	2498	2282	739	47
045	002	679	114	2037	379	1172	915	357	0
046	002	501	120	1139	364	704	587	261	0
047	002	2255	67	2099	0	1475	1344	164	0
048	002	630	517	656	619	489	900	329	12
049	002	1628	88	1592	1396	798	831	274	35
050	003	193	0	94	0	58	165	178	0
051	003	1368	975	1490	542	1292	1245	589	92
052	003	1121	0	298	0	485	545	425	35
053	003	1428	653	798	893	814	809	343	12
054	003	844	29	778	141	235	460	247	0
055	003	397	293	579	392	491	211	329	46
056	004	2235	935	2190	913	3026	1507	507	81
057	004	1503	531	1313	77	1876	1500	576	92
058	004	1444	2570	820	196	802	1374	465	23
059	004	1525	1099	701	6598	4158	1777	452	0
060	004	1075	854	1360	541	1816	1885	575	35
061	004	1049	1655	2821	927	1824	1850	549	12
062	004	1383	185	658	0	1273	777	274	0
063	004	1324	647	616	2485	1308	599	301	23
064	004	825	1251	1084	104	1751	1347	328	116
065	004	2465	624	831	0	1670	1408	384	104
066	004	910	172	544	0	322	322	260	23
067	004	977	1021	485	169	493	485	452	0
068	004	721	1285	867	1203	1899	889	260	0
069	004	1347	731	1227	122	421	821	206	0
070	005	1660	324	1426	0	1210	1067	521	323
071	005	684	57	232	220	345	631	151	81
072	005	410	142	147	173	360	308	110	58

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Attractions							
		Work	Shop*	* Soc-Rec	School	Misc.	NHB	Truck	Taxi
073	005	1311	27	386	0	547	531	315	70
074	005	4617	115	373	403	1011	381	863	92
075	005	4884	487	212	0	1264	1092	1287	35
076	005	3866	706	1252	411	1054	1965	1535	81
077	005	893	181	193	0	833	477	233	58
078	005	1427	1219	599	1096	1445	961	465	46
079	005	7043	2459	936	3156	4505	3227	2082	161
080	005	1030	70	250	0	166	372	219	46
081	005	2639	0	795	0	886	1019	370	81
082	005	1168	6224	942	0	1629	2664	274	92
083	005	616	247	1559	0	1564	1125	370	115
084	006	4329	265	509	758	1335	1145	863	116
085	006	7336	175	2435	663	7334	1284	672	185
086	006	5095	1485	2452	75	2267	2379	1795	242
087	006	1425	417	785	1622	1531	707	671	23
088	006	2135	1758	793	79	2009	1636	836	23
089	006	2686	508	226	0	456	726	1329	12
090	006	2060	118	1669	0	935	623	438	46
091	006	4995	0	487	79	3655	1538	233	12
092	006	3872	580	790	1078	1774	1290	1000	12
093	006	1571	2333	1213	4176	2156	1831	370	46
094	006	1312	1230	948	0	854	738	877	12
095	006	1167	326	1067	147	775	681	644	12
096	006	3111	700	933	673	1372	1206	1424	23
097	006	3579	162	5210	75	1689	1670	1069	23
098	007	4307	264	399	79	1031	817	1521	0
099	007	859	348	437	198	323	306	411	23
100	007	1548	59	336	531	510	319	521	35
101	007	173	88	424	61	533	330	397	46
102	007	696	387	482	293	286	644	247	46
103	007	1190	2755	464	0	2047	1349	384	46
104	007	2781	8237	1220	123	2533	3780	781	81
105	007	365	114	264	0	227	264	219	23
106	007	757	794	183	56	285	469	274	0
107	007	341	495	60	58	244	467	260	12
108	007	3857	0	56	0	197	330	1192	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Attractions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
109	007	6488	996	176	0	438	1103	1288	12
110	007	1388	264	201	205	348	638	644	0
111	007	781	922	820	58	369	882	534	12
112	007	607	139	960	536	787	202	137	104
113	007	2361	1885	1540	1655	2207	1861	945	104
114	008	1742	683	692	497	588	1085	521	0
115	008	1088	231	1107	4211	974	527	411	46
116	008	1041	342	1120	343	1073	717	740	46
117	008	2372	1395	1062	1168	2008	1815	644	58
118	008	1317	1510	428	1162	1532	976	685	69
119	008	2056	96	1882	664	1002	916	1096	35
120	008	677	92	1374	0	490	571	494	23
121	008	544	184	517	115	442	420	301	0
122	009	1246	310	477	0	1420	763	712	92
123	009	408	279	143	0	346	343	178	0
124	009	1229	120	110	0	396	198	260	0
125	009	4017	10741	2686	1195	2701	3903	1041	0
126	009	507	109	1198	31	685	360	164	12
127	009	73	0	255	0	0	58	69	0
128	009	1227	396	1182	10112	613	629	82	35
129	009	723	1605	925	56	921	886	219	0
130	009	723	1942	746	365	1542	1536	220	12
131	009	221	1004	532	31	615	734	370	46
132	009	529	266	928	2756	891	697	329	12
133	009	495	234	1534	1048	741	566	288	35
134	009	385	145	657	174	463	190	288	0
135	009	721	4284	1875	1023	2151	1773	699	35
136	009	547	459	1101	0	808	669	192	0
137	009	1115	984	792	0	1246	969	411	23
138	009	1050	865	1640	0	503	1509	685	69
139	010	723	317	1123	2026	1385	529	219	0
140	010	1278	544	386	56	962	531	507	0
141	010	467	903	1168	0	381	1030	274	35
142	010	2381	2144	570	62	2512	2177	370	0
143	010	1912	3859	405	59	2627	2441	206	58
144	010	1147	856	1604	0	1522	1924	644	23

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Attractions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
145	010	451	884	1465	88	1323	663	438	58
146	010	309	293	1299	29	1125	441	356	12
147	010	1217	1408	321	59	1912	1292	274	23
148	010	302	0	472	1710	814	242	55	12
149	010	81	235	260	113	361	268	55	0
150	010	799	2378	625	94	1570	1980	370	70
151	010	511	624	872	882	521	814	370	12
152	010	546	99	1030	2454	2213	898	370	23
153	010	139	0	859	0	235	222	220	12
154	010	499	0	321	0	558	259	384	24
155	010	669	712	572	0	2115	1222	425	58
156	011	1136	1658	1511	55	4065	1853	466	69
157	011	1534	3162	1359	0	2587	1373	384	23
158	011	507	0	365	260	145	169	302	23
159	011	2285	3092	1726	151	4004	3167	397	47
160	011	759	529	979	1727	1900	764	178	0
161	011	275	1931	716	261	666	980	219	0
162	011	608	458	1781	1028	939	719	301	0
163	011	184	179	782	0	340	276	123	12
164	011	297	0	114	1387	1008	215	96	0
165	011	700	494	707	230	367	471	151	0
166	011	543	745	1304	7491	3403	1383	315	0
167	011	269	62	132	115	326	195	123	0
168	011	1125	1413	594	61	786	990	534	12
169	011	86	0	823	0	392	70	123	0
170	011	57	29	336	0	189	92	27	0
171	012	1130	1558	215	0	1014	1053	301	0
172	012	1247	820	1638	62	3322	1648	466	0
173	012	1864	21919	2561	62	3565	4607	466	23
174	012	874	3956	1093	248	1073	2490	877	0
175	012	421	317	1560	137	524	944	616	23
176	012	940	2676	769	56	1627	948	520	0
177	012	892	1380	1436	2300	2932	1670	424	0
178	013	87	0	193	67	62	24	192	0
179	013	501	189	1141	626	1357	1177	233	0
180	013	576	1360	1579	62	1251	899	549	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Attractions							
		Work	Shop*	Soc-Rec*	School	Misc.	NHB	Truck	Taxi
181	013	833	430	433	0	759	727	425	23
182	013	545	1218	968	1606	1024	475	452	0
183	013	0	0	558	0	59	57	151	0
184	013	44	0	146	0	29	58	82	0
185	014	223	252	239	28	174	178	247	0
186	014	216	435	540	112	131	354	137	0
187	014	119	380	89	0	0	197	206	0
188	014	755	350	342	1629	702	390	535	0
189	014	793	230	1407	0	834	317	247	0
190	014	363	612	510	0	747	465	246	0
191	014	21	2264	380	30	809	544	452	0
192	014	606	3379	893	4095	1681	946	110	0
193	014	253	28	58	3274	918	21	69	0
194	014	100	59	1289	0	117	270	164	0
195	015	21	0	113	0	0	70	178	0
196	015	22	0	171	173	175	201	247	0
197	015	45	402	858	550	631	271	164	0
198	015	111	3136	1218	490	751	1108	96	0
199	015	87	0	793	56	173	523	260	0
200	015	180	871	1410	1059	989	642	329	12
201	015	544	2692	1017	322	1182	881	206	0
202	015	176	205	1700	57	228	268	123	12
203	016	0	0	114	799	172	28	27	0
204	016	220	2344	548	473	694	321	83	0
205	016	683	508	300	203	610	237	233	0
206	016	1706	161	114	28	338	319	425	0
207	016	886	1479	1257	0	486	888	384	0
208	016	704	316	912	116	433	549	452	23
209	016	1611	5933	2596	534	3181	3010	973	70
210	016	268	628	950	1596	988	689	164	0
211	016	65	29	772	0	161	126	138	12
212	016	1291	1218	603	112	906	704	589	23
213	016	1330	989	1710	976	2141	789	507	70
214	016	349	0	542	1441	475	302	69	0
215	016	0	0	75	0	0	0	0	12
216	017	0	0	0	0	0	0	41	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Attractions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
217	017	427	58	1116	2788	741	180	110	0
218	017	711	4578	1046	1084	1439	1295	507	0
219	017	250	1014	721	171	453	513	192	12
220	017	84	87	117	0	0	0	14	0
221	017	0	0	0	0	0	0	0	0
222	017	43	0	0	0	29	29	0	0
223	017	0	28	0	0	0	28	0	0
224	017	43	0	172	0	59	21	0	0
225	017	0	0	738	0	0	57	110	0
226	018	41	58	0	0	28	0	14	0
227	018	0	0	145	0	135	57	55	0
228	018	216	0	111	0	0	0	41	0
229	018	290	0	548	0	83	177	69	0
230	018	41	29	55	0	56	45	69	0
231	018	324	0	54	56	86	111	123	12
232	018	0	114	0	0	57	56	137	12
233	018	43	114	269	544	484	114	397	0
234	018	186	1225	314	54	54	347	233	0
235	019	517	0	798	84	195	367	370	0
236	019	1738	4118	2739	1908	5223	3727	1055	12
237	019	592	1767	1466	442	1326	1863	343	0
238	019	229	611	1025	220	819	529	246	0
239	019	597	222	81	0	274	174	206	0
240	019	1859	437	700	0	545	941	480	0
241	019	209	781	1149	564	1119	501	192	0
242	019	921	2353	871	8644	2506	1384	384	12
243	019	435	195	1765	1747	1136	544	164	23
244	019	1374	9994	2166	864	2551	2929	329	12
245	019	82	0	171	0	0	51	41	0
246	019	127	0	192	0	56	341	82	12
247	019	2169	476	1468	2152	1599	1370	699	0
248	019	2582	255	482	27	852	688	494	46
249	019	532	29	1269	0	246	289	69	0
250	019	1162	196	962	258	1888	630	233	0
251	019	4836	1394	762	0	1033	1506	849	0
252	020	0	0	0	0	0	0	0	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Attractions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
253	020	21	0	59	0	59	44	110	0
254	020	0	0	0	0	0	0	0	0
255	020	0	0	0	0	0	0	14	0
256	020	0	0	0	0	0	0	0	0
257	020	0	0	0	0	0	0	0	0
258	020	82	0	0	0	0	0	0	0
259	020	0	0	0	0	0	0	0	0
260	021	0	0	0	0	0	0	0	0
261	021	0	0	0	0	0	0	0	0
262	021	0	0	56	0	0	22	14	0
263	021	43	59	0	0	0	0	0	0
264	021	121	220	0	0	0	49	14	0
265	021	42	28	0	0	0	42	69	0
266	022	0	0	0	0	0	0	14	0
267	022	0	0	0	0	0	0	0	0
268	022	0	0	0	0	0	0	14	0
269	023	46	0	0	0	38	67	69	0
270	023	0	0	0	0	0	0	0	0
271	023	44	0	0	0	0	0	14	0
272	023	170	0	0	0	0	21	55	0
273	023	0	0	0	0	0	23	96	0
274	024	0	0	0	0	0	0	55	0
275	024	0	0	0	0	0	0	0	0
276	024	0	0	0	0	0	0	0	0
277	024	64	0	58	0	230	21	110	0
278	025	0	0	0	0	0	0	0	0
279	025	1095	0	654	0	0	73	96	12
280	025	539	62	38	0	79	89	562	0
281	026	353	0	0	0	56	0	14	0
282	026	0	53	0	0	31	0	27	0
283	026	100	0	0	0	0	0	192	0
284	026	44	0	55	527	337	111	69	0
285	926	30	0	55	0	0	42	28	0
286	026	194	231	570	1057	140	247	411	0
287	027	42	0	0	0	93	62	110	0
288	027	742	87	27	0	113	202	603	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Attractions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
289	027	987	0	28	0	161	219	466	0
290	027	216	260	390	0	206	462	370	12
291	027	255	145	738	309	258	318	82	0
292	027	688	1405	966	578	1471	1232	452	0
293	027	1178	1259	2379	523	1743	1553	493	92
294	027	2306	1572	740	2567	2890	2597	576	219
295	028	2326	2386	1848	1248	4665	3754	740	35
296	028	650	838	1193	0	1674	1283	274	35
297	028	725	1745	880	28	568	1142	233	12
298	028	739	815	1839	1357	1779	1377	137	12
299	028	789	197	449	0	877	667	151	12
300	028	1956	237	171	0	627	733	658	12
301	028	1963	1879	649	0	831	1404	329	0
302	028	2305	2398	166	0	932	1725	493	58
303	028	2648	55	140	0	229	548	438	12
304	029	65	0	107	0	0	44	178	0
305	029	5764	0	552	0	383	307	274	0
306	029	10319	0	370	57	1377	641	233	23
307	029	13322	0	3317	0	9130	2905	1329	920
308	029	3712	202	663	271	982	1509	1178	46
309	029	1020	7596	1826	85	1117	2441	315	12
310	029	667	60	1074	0	348	641	178	81
311	029	431	1097	463	0	443	648	110	0
312	029	594	393	1125	0	731	1191	274	12
313	029	428	757	539	2594	1352	364	178	0
314	029	106	112	347	0	287	407	123	12
315	029	535	249	1639	278	813	1029	261	0
316	029	605	1718	708	27	1797	1427	521	35
317	029	699	2119	1086	171	681	1113	425	0
318	029	842	1349	1250	242	1568	1556	493	0
319	029	489	201	483	29	58	218	384	0
320	029	608	968	1082	0	936	884	233	0
321	030	1443	340	2235	413	1313	1593	356	0
322	030	1209	1127	1235	0	1231	1155	288	23
323	030	573	238	239	1656	817	567	55	0
324	030	2669	1454	305	28	3150	1656	178	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Attractions							
		Work	Shop*	Soc-Rec	School	Misc.	NHB	Truck	Taxi
325	030	1368	2626	811	0	2664	2035	110	58
326	030	1808	3341	770	86	1581	2210	151	0
327	030	1068	909	488	149	2148	1616	110	12
328	030	2027	963	502	399	1737	1593	288	0
329	030	540	281	505	0	408	736	219	0
330	030	463	0	539	0	227	566	439	12
331	030	399	169	1071	27	710	751	356	0
332	030	631	162	832	58	1067	686	178	0
333	030	355	0	660	0	1003	339	123	12
334	030	114	0	587	115	86	294	123	0
335	030	2245	654	3510	2515	1848	1368	534	46
336	030	1249	5487	1176	753	2564	1925	315	0
337	030	615	318	949	483	925	657	343	0
338	030	618	957	889	28	833	1210	260	0
339	030	272	320	819	2124	1101	456	205	0
340	030	900	225	1123	195	723	823	425	0
341	030	707	2524	447	0	756	1567	411	0
342	030	490	337	2119	110	1132	523	507	0
343	031	1377	198	318	0	501	557	507	0
344	031	69	56	225	0	171	493	123	0
345	031	0	57	350	0	115	0	178	0
346	031	1384	341	967	1074	1662	1097	425	12
347	031	329	86	666	0	369	214	164	0
348	031	531	61	818	2714	1110	625	287	0
349	031	192	732	860	60	384	306	206	0
350	031	538	4628	984	826	1261	1670	370	0
351	031	660	0	892	183	306	250	123	0
352	031	289	183	483	126	696	807	178	0
353	031	3836	88	2514	10452	2111	3686	261	12
354	031	914	2765	1279	0	1423	1503	288	0
355	031	1608	3313	687	89	4766	3843	603	0
356	031	920	1902	1180	146	4332	3016	302	0
357	031	224	552	463	142	1032	571	233	0
358	031	195	1519	2281	1033	1033	1036	219	0
359	031	710	1523	499	0	1422	1268	219	0
360	031	253	0	777	1394	618	383	192	12

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Attractions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
361	031	421	1267	261	0	395	608	123	12
362	031	765	333	979	2306	2096	1167	69	0
363	031	551	0	1043	6397	1525	659	123	0
364	031	3258	355	804	0	1060	1247	822	12
365	031	766	116	415	370	317	354	261	0
366	031	114	0	192	0	230	144	164	0
367	031	265	75	299	0	278	420	192	0
368	031	86	0	334	0	56	154	137	0
369	032	43	28	86	79	82	49	69	0
370	032	342	2848	593	57	589	726	370	0
371	032	22	0	696	0	223	248	233	0
372	032	344	3101	739	566	879	1287	246	0
373	032	128	114	564	1725	683	22	110	0
374	032	371	2494	647	56	327	1176	123	0
375	032	350	649	796	3003	1424	484	82	12
376	032	554	840	1955	169	1599	1410	384	0
377	032	286	0	685	454	508	304	55	0
378	032	478	3914	1103	57	979	1518	356	0
379	032	606	1355	529	806	564	900	151	0
380	032	479	2171	1349	333	1620	1100	233	0
381	033	570	0	200	0	251	209	41	0
382	033	446	642	534	382	834	1001	288	0
383	033	240	220	1257	121	342	745	178	0
384	033	0	28	138	0	55	220	123	0
385	033	22	57	90	0	0	85	233	0
386	033	585	137	860	1128	762	447	233	0
387	033	874	862	899	6106	1043	569	219	0
388	033	468	2065	1178	113	1246	1595	328	0
389	033	489	1064	1261	2218	1095	787	178	0
390	033	22	0	394	388	707	213	123	0
391	033	22	418	260	197	193	262	110	0
392	033	214	256	535	167	276	296	219	0
393	033	198	195	1350	58	334	531	164	0
394	033	205	167	289	199	140	83	123	0
395	033	45	0	603	0	224	250	206	0
396	033	736	0	177	0	524	0	521	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Attractions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
397	034	42	0	363	59	232	420	96	0
398	034	43	0	961	56	28	180	41	0
399	034	0	0	112	0	87	56	82	0
400	034	0	113	176	0	0	72	55	0
401	034	42	0	0	0	0	0	14	0
402	034	0	0	0	0	0	21	14	0
403	034	0	0	0	0	0	0	14	0
404	034	0	0	0	0	0	27	0	0
405	034	127	0	0	0	0	0	137	0
406	035	46	0	0	0	0	0	0	0
407	035	0	0	0	0	0	0	0	0
408	035	0	0	0	0	116	0	0	0
409	035	0	0	538	0	0	0	0	0
410	035	0	0	0	0	0	0	0	0
411	035	0	0	0	0	28	0	0	0
412	035	87	0	0	0	0	43	27	0
413	035	0	0	753	0	0	21	0	0
414	035	185	0	0	0	0	22	507	0
415	036	0	111	59	113	0	80	82	0
416	036	88	0	28	85	57	49	41	0
417	036	433	113	789	603	726	157	343	0
418	036	0	86	291	56	0	102	27	0
419	036	552	142	1123	784	704	616	301	0
420	036	1674	54	1885	588	1578	798	301	0
421	036	751	2776	861	366	1408	1656	507	0
422	037	892	8692	601	0	422	2783	110	0
423	037	282	0	83	0	178	176	82	0
424	037	1344	560	338	0	2322	1762	548	12
425	037	267	0	567	693	419	234	41	0
426	037	131	0	342	197	499	44	206	0
427	037	187	0	2168	0	113	248	69	0
428	037	103	28	61	0	0	54	27	0
429	037	186	0	1064	0	0	119	96	0
430	037	22	0	199	0	230	72	233	0
431	037	64	0	1034	0	28	557	329	0
432	037	1428	4848	1991	4030	2146	2077	397	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Attractions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
433	037	511	0	525	2328	1260	437	397	0
434	037	550	2379	507	58	966	1163	357	0
435	037	550	96	1704	1024	482	563	301	0
436	037	150	0	141	235	462	162	110	0
437	038	173	284	331	0	629	425	356	0
438	038	128	0	83	0	0	77	150	0
439	038	1580	4353	862	981	2367	2658	466	0
440	038	44	0	0	28	0	0	55	0
441	038	190	56	280	0	195	21	96	12
442	038	0	118	0	0	0	0	14	0
443	038	86	111	0	0	0	44	27	0
444	038	214	168	308	28	148	302	110	0
445	038	504	55	839	2401	1147	531	178	0
446	038	290	0	528	334	820	302	150	0
447	038	92	30	29	0	0	305	55	0
448	038	768	222	175	1500	370	234	164	0
449	038	1064	7728	1613	56	605	1879	165	0
450	039	63	85	0	0	28	118	41	0
451	039	274	839	56	227	503	380	206	0
452	039	1051	484	591	0	997	669	288	0
453	039	365	143	655	0	285	442	383	0
454	039	93	0	170	0	0	43	82	0
455	039	82	57	0	140	83	21	69	0
456	039	457	0	59	57	142	59	0	0
457	039	0	0	58	0	203	30	69	0
458	039	121	28	330	250	306	28	151	0
459	039	526	30	653	0	169	28	69	0
460	039	100	121	0	0	0	22	27	0
461	039	0	0	0	0	0	0	27	0
462	039	79	0	56	0	0	0	151	0
463	039	0	0	0	0	0	0	14	0
464	039	86	0	0	0	57	0	14	0
465	039	43	0	0	0	0	0	82	0
466	039	0	0	56	0	0	0	82	0
467	039	44	0	0	0	0	21	69	0
468	039	0	0	0	0	0	0	27	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Attractions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
469	040	83	0	0	28	0	49	82	0
470	040	0	0	264	0	29	50	55	0
471	040	197	108	83	2139	61	131	192	0
472	040	291	0	132	0	56	43	96	0
473	040	0	84	277	56	0	136	27	0
474	040	47	121	319	0	27	56	41	0
475	040	0	0	0	0	0	0	220	0
476	040	243	171	208	0	243	184	137	0
477	040	159	54	121	0	84	123	82	0
478	040	124	110	0	0	54	86	137	0
479	041	1169	290	203	0	715	544	302	0
480	041	594	95	293	116	106	228	260	0
481	041	423	180	310	274	539	102	178	0
482	041	152	0	233	0	0	23	55	0
483	041	22	0	0	0	0	0	27	0
484	041	0	0	124	0	0	29	0	0
485	042	119	0	169	0	0	0	27	0
486	042	5363	1443	1316	172	2551	618	219	0
487	042	0	137	69	0	137	0	0	0
488	042	272	203	263	687	408	71	247	0
489	042	376	958	119	0	307	762	137	0
490	042	604	311	318	0	125	739	151	0
491	042	916	225	888	194	1318	945	452	0
492	043	682	1323	925	1335	1921	1300	302	0
493	043	676	497	683	0	590	594	452	0
494	043	1095	4404	730	0	1874	2354	439	0
495	044	360	800	2024	0	1094	1100	411	0
496	044	281	110	113	2784	841	251	82	0
497	044	65	0	179	1812	415	86	0	0
498	044	43	0	0	114	113	64	137	0
499	044	932	34	1031	369	722	773	233	0
500	044	175	89	377	75	119	78	575	0
501	044	47	0	57	0	57	22	137	0
502	044	43	0	106	0	216	42	110	0
503	045	40	0	123	31	123	41	96	0
504	045	185	114	305	0	86	51	69	0

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Attractions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
505	045	1087	28	140	296	628	555	288	0
506	045	53	28	62	0	108	28	14	0
507	046	80	90	28	0	28	0	55	0
508	046	0	0	0	0	61	0	0	0
509	046	21	0	434	0	0	48	28	0
510	047	0	0	0	0	0	0	0	0
511	047	551	0	654	0	145	307	82	0
512	047	486	1575	2689	30	1455	386	192	0
513	047	480	0	4659	0	69	789	137	0
514	047	711	0	4270	0	146	910	137	0
515	047	0	0	0	0	0	0	0	0
516	048	263	0	579	0	0	212	96	23
517	048	2174	38	336	189	444	519	589	58
518	048	711	0	4715	0	112	839	69	92
519	048	994	28	810	0	580	513	466	69
520	048	2106	2722	2657	0	2848	1730	740	104
521	048	1046	683	1660	0	79	843	863	127
522	048	784	1032	1029	91	335	1377	315	12
523	048	540	0	1109	0	132	292	274	23
524	048	1384	38	858	0	685	653	438	81
525	048	1199	561	1864	1844	1497	906	329	35
526	048	1084	1085	3558	249	2067	1147	685	104
527	048	4254	3615	3650	0	3755	3713	671	414
528	048	5809	15198	3025	119	6566	5065	808	173
529	048	755	892	2791	0	752	949	206	35
530	048	2431	205	1010	0	346	1059	726	35
531	048	1949	3495	3261	5077	1747	1940	822	69
532	048	5056	116	6119	0	9050	2863	1480	414
533	049	4499	254	6765	0	1672	2255	548	288
534	049	941	1045	546	618	978	552	329	35
535	049	3186	303	1579	2485	3340	1092	315	139
536	049	1824	0	2509	0	1860	608	630	23
537	049	3518	0	3781	0	1323	1215	589	93
538	050	5161	5003	11153	341	7822	4775	1507	460
539	050	845	739	889	0	1461	592	411	12
540	050	2087	485	3174	1131	3602	1717	672	12

1964 TRIP PRODUCTIONS AND ATTRACTIONS
(Cont'd)

Zone No.	Dist. No.	Person Trip Attractions							
		Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
541	050	868	1878	1402	0	2083	632	357	47
542	050	379	0	526	75	39	239	384	35
543	050	458	0	1068	59	87	434	178	23
544	050	1940	4793	2031	134	2229	1335	671	254
545	050	2290	375	1951	540	2629	1243	699	173
546	050	2169	253	2434	0	1395	1413	562	265
547	050	439	0	5910	0	1299	219	178	23
548	050	940	108	1561	0	1166	1234	302	46
549	050	2533	2480	5268	0	8494	2415	671	47
550	050	169	0	308	0	0	280	151	0

APPENDIX D

GRAVITY MODEL TRAVEL TIME FACTORS

APPENDIX D

GRAVITY MODEL TRAVEL TIME FACTORS

Time Interval	Travel Time Factors							
	Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
1	99999	99999	99999	99999	99999	99999	99999	99999
2	99999	99999	99999	99999	99999	99999	99999	99999
3	63000	99999	99999	96000	84000	99999	54000	38000
4	53000	82000	96000	77000	82000	87000	53000	52000
5	42000	62000	70000	61000	62000	72000	37000	60000
6	33000	43000	55000	48000	46000	60000	28000	52000
7	27000	27000	43000	35000	33000	58000	21000	39000
8	22000	18000	33000	25000	25800	37000	15500	30000
9	19000	11500	24000	18000	18700	27000	11200	24000
10	16000	7500	18500	12500	13800	19000	8700	19000
11	14200	5500	14500	9200	10600	15000	6600	15000
12	12300	4000	11500	6800	8200	12000	5400	12000
13	11100	3000	9500	5100	6500	9000	4400	9600
14	9800	2200	8000	3800	5100	7100	3600	7800
15	9000	1700	6700	3100	4100	5800	3000	6500
16	8000	1350	5600	2500	3400	4800	2500	5400
17	7200	1100	4900	1900	2700	4000	2200	4500
18	6600	900	4200	1500	2300	3400	1850	3800
19	6000	710	3700	1200	1900	2900	1600	3200
20	5500	600	3200	980	1700	2500	1400	2800
21	5000	500	2900	780	1400	2100	1250	2400
22	4600	420	2600	640	1200	1850	1100	2100
23	4200	350	2300	530	1050	1650	980	1800
24	3800	300	2050	430	950	1450	870	1550
25	3500	265	1850	360	820	1250	800	1400

GRAVITY MODEL TRAVEL TIME FACTORS
(Cont'd)

Time Interval	Travel Time Factors							
	Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
26	3200	230	1650	300	720	1150	750	1250
27	3000	200	1550	250	650	1050	660	1100
28	2700	175	1400	210	560	920	600	960
29	2500	150	1300	180	500	830	540	860
30	2250	135	1200	155	460	750	500	760
31	2100	115	1100	130	410	700	460	650
32	1900	100	1000	115	370	630	420	570
33	1750	85	950	100	330	580	390	500
34	1600	75	860	86	300	520	350	410
35	1450	71	800	70	270	480	330	340
36	1300	62	750	60	250	430	300	270
37	1200	57	700	46	230	400	280	210
38	1100	50	650	38	200	370	260	150
39	1000	45	600	31	180	340	240	110
40	900	40	550	27	170	320	220	90
41	800	29	500	24	155	300	195	70
42	730	20	450	20	135	280	170	50
43	670	11	420	16	115	260	160	45
44	600	5	400	12	105	240	150	30
45	540	2	370	9	70	210	135	30
46	480	0	350	0	52	190	120	20
47	400	0	330	0	40	170	110	10
48	380	0	300	0	30	150	100	1
49	340	0	270	0	23	100	90	1
50	290	0	230	0	17	70	80	1

GRAVITY MODEL TRAVEL TIME FACTORS
(Cont'd)

Time Interval	Travel Time Factors							
	Work	Shop	Soc-Rec	School	Misc.	NHB	Truck	Taxi
51	240	0	200	0	14	60	70	1
52	200	0	170	0	10	40	60	1
53	160	0	155	0	1	30	50	1
54	130	0	140	0	1	20	42	1
55	100	0	125	0	1	15	35	1
56	85	0	100	0	1	10	30	1
57	70	0	1	0	1	10	25	1
58	65	0	1	0	1	1	20	1
59	60	0	1	0	1	1	15	1
60	50	0	1	0	1	1	10	1
61	40	0	1	0	1	1	7	1
62	30	0	1	0	1	1	5	1
63	20	0	1	0	1	1	2	1
64	10	0	1	0	1	1	0	1
65	1	0	1	0	1	1	0	1
66	1	0	1	0	1	1	0	1
67	1	0	1	0	1	1	0	1
68	1	0	1	0	1	1	0	1
69	1	0	1	0	1	1	0	1
70	1	0	1	0	1	1	0	1

APPENDIX D-2

SPECIAL ADJUSTMENT (K) FACTORS

APPENDIX D-2

ZONE RANGE O/D	WORK	NON WORK
001021001021	0	055
001021022049	124	096
001021050055	0	096
001021056069	109	131
001021070083	053	097
001021084097	106	120
001021098113	050	121
001021114121	175	125
001021122138	084	066
001021139155	168	121
001021156170	0	066
001021203215	105	069
001021235251	104	063
001021295303	0	093
001021304320	185	177
001021321342	127	159
001021343368	102	110
001021369380	0	144
001021381396	161	091
001021422436	0	118
001021510515	0	070
001021516532	088	117
001021533537	0	074
001021536550	0	107
022049001021	124	096
022049022049	105	107
022049050055	121	099
022049056069	090	095
022049070083	088	109
022049084097	080	099
022049098113	082	077
022049114121	0	158
022049122138	128	110
022049139155	0	117
022049235251	084	079
022049287294	0	045
022049295303	0	053
022049304320	089	101
022049321342	114	097
022049343368	108	082
022049369380	212	191
022049381396	158	131
022049415421	0	168
022049422436	0	093
022049437449	0	155
022049510515	0	102
022049516532	082	088
022049533537	0	099
022049538550	0	123
050055001021	0	096
050055022049	121	099
050055050055	0	081
050055056069	0	121
050055070083	116	077
050055084097	0	128
050055304320	0	185
050055321342	0	136
050055516532	0	118
056069001021	109	131
056069022049	090	095
056069050055	0	121
056069056069	105	115
056069070083	100	126
056069084097	087	104
056069098113	096	081
056069114121	128	098
056069122138	133	112
056069139155	0	052
056069156170	0	065
056069203215	0	068
056069235251	158	065
056069287294	0	069
056069295303	105	047
056069304320	110	120
056069321342	095	073
056069343368	104	078
056069369380	0	116
056069381396	0	082
084097381396	120	104
084097516532	072	053
084097533537	0	042
084097538550	072	065
098113001021	050	121
098113022049	082	077
098113056069	096	081
098113070083	122	127
098113084097	078	102
098113098113	124	180
098113114121	084	106
098113122138	086	089
098113139155	084	044
098113156170	067	053
098113171177	0	104
098113203215	121	104
098113235251	106	058
098113287294	075	060
098113295303	090	066
098113304320	082	062
098113321342	088	060
098113343368	115	092
098113516532	149	046
098113533537	109	035
098113538550	132	021
114121001021	175	125
114121022049	0	158
114121056069	128	098
114121070083	100	105
114121084097	105	078
114121098113	084	106
114121114121	128	128
114121122138	068	087
114121139155	133	117
114121156170	0	081
114121171177	0	080
114121203215	0	087
114121235251	0	090
114121287294	0	156
114121295303	0	099
114121304320	072	074
114121321342	0	067
114121516532	075	049
114121533537	0	041
114121538550	084	072
122138001021	084	066
122138022049	128	110
122138056069	133	112
122138070083	079	062
122138084097	115	115
122138098113	086	089
122138114121	068	087
122138122138	175	142
122138139155	101	106
122138156170	101	072
122138171177	0	079
122138178184	0	096
122138185194	0	088
122138195202	0	096
122138203215	134	098
122138216225	0	100
122138235251	061	064
122138287294	0	079
056069422436	0	046
056069510515	0	035
056069516532	059	053
056069533537	167	074
056069538550	0	061
070083001021	053	097
070083022049	093	109
070083050055	116	077
070083056069	100	126
070083070083	064	107
070083084097	098	127
070083098113	122	127
070083114121	100	105
070083122138	079	062
070083139155	109	089
070083156170	083	094
070083171177	0	162
070083203215	076	060
070083235251	125	068
070083287294	0	055
070083295303	087	067
070083304320	087	110
070083321342	116	091
070083343368	103	115
070083516532	171	074
070083533537	112	060
070083538550	202	140
084097001021	106	120
084097022049	080	099
084097050055	0	128
084097056069	087	104
084097070083	098	127
084097084097	126	114
084097098113	178	102
084097114121	105	078
084097122138	115	115
084097139155	072	076
084097156170	052	064
084097171177	0	068
084097185194	0	086
084097195202	207	125
084097203215	146	092
084097235251	108	127
084097287294	091	101
084097295303	110	062
084097304320	104	106
084097321342	094	066
084097343368	103	129
084097369380	0	082
122138295303	098	086
122138304320	081	074
122138321342	0	121
122138343368	0	085
122138516532	072	043
122138533537	0	019
122138538550	065	031
139141001021	168	121
139141022049	0	117
139141056069	0	052
139141070083	109	089
139141084097	072	076
139141098113	094	044
139141114121	133	117
139141122138	101	106
139141139155	132	136
139141156170	141	099
139141171177	0	102
139141178184	0	094
139141185194	0	052
139141195202	0	023
139141203215	109	070
139141235251	055	034
139141287294	0	050
139141295303	0	053
139141304320	084	085

139141321342	0	090
139141343368	0	076
139141516532	038	079
139141533537	0	070
139141538550	097	075
142142001021	053	097
142142022049	089	109
142142050055	116	077
142142056069	100	126
142142070083	064	107
142142084097	098	127
142142098113	122	127
142142114121	100	105
142142122138	019	062
142142139155	109	089
142142156170	083	094
142142171177	0	162
142142203215	076	060
142142235251	125	068
142142287294	0	055
142142295303	087	067
142142304320	087	110
142142321342	116	091
142142343368	103	115
142142516532	171	074
142142533537	112	060
142142538550	202	140
143155001021	168	121
143155022049	0	117
143155056069	0	052
143155070083	109	089
143155084097	072	076
143155098113	094	044
143155114121	133	117
143155122138	101	106
143155139155	132	136
143155156170	141	099
143155171177	0	102
143155178184	0	094
143155185194	0	052
143155195202	0	023
143155203215	109	070
143155235251	055	034
143155287294	0	050
143155295303	0	053
143155304320	084	085
143155321342	0	090
143155343368	0	076
143155516532	038	079
143155533537	0	070
143155538550	097	075
156170001021	0	066
156170056069	0	065
156170070083	083	094
156170084097	052	064
156170098113	067	053
156170114121	0	081
156170122138	101	072
156170139155	141	099
156170156170	154	133
156170171177	129	102
156170178184	0	082
156170185194	0	071
156170195202	0	054
156170203215	131	131
156170235251	059	045
156170304320	0	098
156170516532	082	063
156170533537	0	037
156170538550	091	054
171177070083	0	162
171177084097	0	068
171177098113	0	104
171177114121	0	080
171177122138	0	079
171177139155	0	102
171177156170	129	102
171177171177	152	113
171177178184	0	120
171177185194	0	072
171177195202	0	076
171177203215	069	055
171177216225	0	028
171177235251	0	086
171177516532	161	151
171177538550	124	070
178184122138	0	096
178184139155	0	094
178184156170	0	082
178184171177	0	120
178184178184	165	126
178184185194	0	073
178184195202	0	066
178184203215	0	054
178184538550	0	097
185194084097	0	086
321342304320	106	083
321342321342	115	125
321342343368	127	100
321342369380	082	090
321342381396	127	104
321342415421	0	078
321342422436	0	106
321342437449	0	106
321342510515	0	094
321342516532	072	068
321342533537	0	055
321342538550	0	057
343344001021	102	110
343344022049	108	082
343344056069	104	078
343344070083	103	115
343344084097	103	129
343344098113	115	092
343344122138	0	085
343344139155	0	076
343344235251	048	044
343344287294	0	038
343344295303	0	058
343344304320	084	057
343344321342	127	100
343344343368	103	116
343344369380	132	068
343344381396	116	092
343344415421	015	124
343344422436	161	084
343344437449	117	098
343344450468	0	117
343344510515	0	123
343344516532	0	077
343344538550	0	128
345345369380	0	101
345345381396	0	080
346368001021	102	110
346368022049	109	082
346368056069	104	078
346368070083	103	115
346368084097	103	129
346368098113	115	092
346368122138	0	085
346368139155	0	076
346368235251	048	044
346368287294	0	038
346368295303	0	058
346368304320	084	057
346368321342	127	100
346368343368	103	116
346368369380	132	068
346368381396	116	092
346368415421	015	124
346368422436	161	084
346368437449	117	098
346368450468	0	117
346368510515	0	123
346368516532	0	077
346368538550	0	128
369380001021	0	114
369380022049	212	191
369380056069	0	116
369380084097	0	082
369380235251	0	033
369380281286	0	029
369380287294	0	018
369380304320	057	078
369380321342	082	090
369380343368	132	068
369380369380	137	128
369380381396	128	112
369380397405	0	101
369380415421	0	080
369380422436	0	048
381396001021	161	091
381396022049	158	131
381396056069	0	082
381396084097	120	104
381396235251	0	055
381396287294	0	024
381396304320	095	081
381396321342	127	104
381396343368	116	092
381396369380	128	112
381396381396	075	113
381396397405	0	080
381396415421	0	106
381396422436	0	071
381396437449	0	078
397405369380	0	101
397405381396	0	080
415421022049	0	168
415421321342	0	078
415421343368	075	124
415421369380	0	080
415421381396	0	106
415421415421	127	102
415421422436	0	094
415421437449	0	094
415421450468	0	149
422436001021	0	118
422436022049	0	093
422436056069	0	046
422436235251	0	063
422436304320	0	077
422436321342	0	106
422436343368	1161	084
422436369380	0	048
422436381396	0	071
422436415421	0	094
422436422436	126	130
422436437449	0	120
422436450468	0	103
422436485491	0	142
422436538550	0	445
437449022049	0	155
437449321342	0	106
437449343368	117	098
437449381396	0	078
437449415421	0	094
437449422436	0	120
437449437449	126	095
437449450468	104	087
437449469478	0	076
437449479484	0	066
437449485491	107	183
437449492494	0	257

437449495502	0	116
450468343368	0	117
450468415421	0	149
450468422436	0	103
450468437449	104	087
450468450468	076	109
450468469478	0	075
450468485491	0	157
469469343368	0	117
469469415421	0	149
469469422436	0	103
469469437449	104	087
469469450468	076	109
469469469478	0	075
469469485491	0	157
470478437449	0	076
470478450468	0	075
470478469478	0	104
470478479484	0	106
470478485491	0	101
470478495502	0	102
479484437449	0	066
479484469478	0	106
479484479484	0	082
479484485491	0	137
479484492494	0	240
479484495502	0	142
485491422436	0	142
485491437449	107	183
485491450468	0	157
485491469478	0	101
485491479484	0	137
185194122138	0	088
185194139155	0	052
185194156170	0	071
185194171177	0	072
185194178184	0	073
185194185194	180	135
185194195202	0	153
185194203215	0	046
185194216225	0	117
185194235251	0	044
185194516532	0	126
185194538550	0	047
195202084097	207	125
195202122138	0	096
195202139155	0	023
195202156170	0	054
195202171177	0	076
195202178184	0	066
195202185194	0	153
195202195202	0	125
195202203215	0	068
195202216225	0	119
195202235251	0	027
195202538550	0	078

203215001021	105	069
203215056069	0	068
203215070083	076	060
203215084097	146	092
203215098113	121	104
203215114121	0	087
203215122138	144	098
203215139155	109	070
203215156170	131	131
203215171177	069	055
203215178184	0	054
203215185194	0	046
203215195202	0	086
203215203215	106	157
203215162225	0	131
203215235251	084	042
203215295303	0	076
203215304320	114	066
203215516532	065	027
203215538550	092	022
216225122138	0	100
216225171177	0	028
216225185194	0	117
216225195202	0	119
216225203215	0	131
216225216225	0	110
216225235251	0	071
226234226234	0	212
226234235251	0	120
235251001021	104	063
235251022049	084	079
235251056069	158	065
235251070083	125	068
235251084097	108	127
235251098113	106	058
235251114121	0	090
235251122138	061	064
235251139155	055	034
235251156170	059	045
235251171177	084	086
235251185194	0	044
235251195202	0	027
235251203215	0	042
235251216225	0	071
235251226234	0	120
235251235251	132	130
235251287294	094	075
235251295303	156	136
235251304320	151	082
235251321342	044	057
235251343368	046	044
235251369380	0	033
235251381396	0	055
235251422436	0	063
235251516532	052	033
235251533537	0	010

235251538550	055	025
281286281286	0	315
281286304320	0	154
281286321342	0	059
281286369380	0	029
287294022049	0	045
287294056069	0	069
287294070083	0	055
287294084097	091	101
287294098113	075	060
287294114121	0	156
287294122138	0	079
287294139155	0	050
287294235251	094	075
287294287294	356	240
287294295303	108	091
287294304320	196	076
287294321342	0	022
287294343368	0	038
287294369380	0	018
287294381396	0	024
287294516532	0	018
287294538550	0	083
295303001021	0	093
295303022049	0	053
295303056069	105	047
295303070083	087	067
295303084097	110	062
295303098113	090	066
295303114121	0	099
295303122138	098	086
295303139155	0	053
295303203215	0	076
295303235251	156	136
295303287294	108	091
295303295303	170	153
295303304320	119	082
295303321342	067	038
295303343368	0	058
295303516532	0	027
295303538550	0	014
304320001021	185	177
304320022049	089	101
304320050055	0	185
304320056069	110	120
304320070083	087	110
304320084097	104	106
304320098113	092	062
304320114121	072	074
304320122138	081	074
304320139155	084	085
304320156170	0	098
304320203215	114	066
304320235251	151	082
304320281286	0	154
304320287294	196	076

304320295303	119	082
304320304320	096	124
304320321342	106	083
304320343368	084	057
304320369380	067	078
304320381396	095	081
304320422436	0	077
304320516532	038	095
304320533537	0	140
304320538550	0	142
321342001021	127	159
321342022049	114	097
321342050055	0	136
321342056069	095	073
321342070083	116	091
321342084097	094	066
321342098113	088	060
321342114121	0	067
321342122138	0	121
321342139155	0	090
321342235251	044	057
321342281286	0	059
321342287294	0	022
321342295303	067	038
485491485491	094	084
485491492494	0	106
485491495502	113	098
485491503506	0	053
492494437449	0	257
492494479484	0	240
492494485491	0	106
492494492494	0	083
492494495502	127	093
492494503506	0	085
495502437449	0	116
495502469478	0	102
495502479484	0	142
495502485491	113	098
495502492494	127	093
495502495502	077	105
495502503506	0	112
503506485491	0	053
503506492494	0	085
503506495502	0	112
503506503506	218	103
510515001021	0	070
510515022049	0	102
510515056059	0	035
510515321342	0	094
510515343368	0	123
510515510515	0	105
510515516532	0	118
510515538550	0	727
516532001021	088	117
516532022049	082	088
516532050055	0	118

516532056069	059	053
516532070083	171	074
516532084097	072	053
516532098113	149	046
516532114121	075	049
516532122138	072	043
516532139155	038	079
516532156170	090	063
516532171177	141	151
516532185194	0	126
516532203215	065	027
516532235251	052	033
516532287294	0	018
516532295303	0	027
516532304320	038	095
516532321342	072	068
516532343368	0	077
516532510515	0	118
516532516532	136	106
516532533537	111	131
516532538550	188	280
533537001021	0	074
533537022049	0	099
533537056069	167	074
533537070083	112	060
533537084097	0	042
533537098113	109	035
533537114121	0	041
533537122138	0	019
533537139155	0	070
533537156170	0	037
533537235251	0	010
533537304320	0	140
533537321342	0	055
533537516532	111	131
533537533537	168	081
533537538550	139	203
538550001021	0	107
538550022049	0	123
538550056069	0	061
538550070083	202	140
538550084097	072	065
538550098113	132	021
538550114121	084	072
538550122138	063	031
538550139155	097	075
538550156170	091	054
538550171177	124	070
538550178194	0	097
538550185194	0	047
538550195202	0	078
538550203215	092	022
538550235251	055	025
538550287294	0	083
538550295303	0	014
538550304320	0	142
538550321342	0	057
538550343368	0	128
538550422436	0	445
538550510515	0	727
538550516532	184	280
538550533537	139	203
538550538550	109	091

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MIAMI URBAN AREA TRANSPORTATION STUDY

TECHNICAL REPORT NO. 4

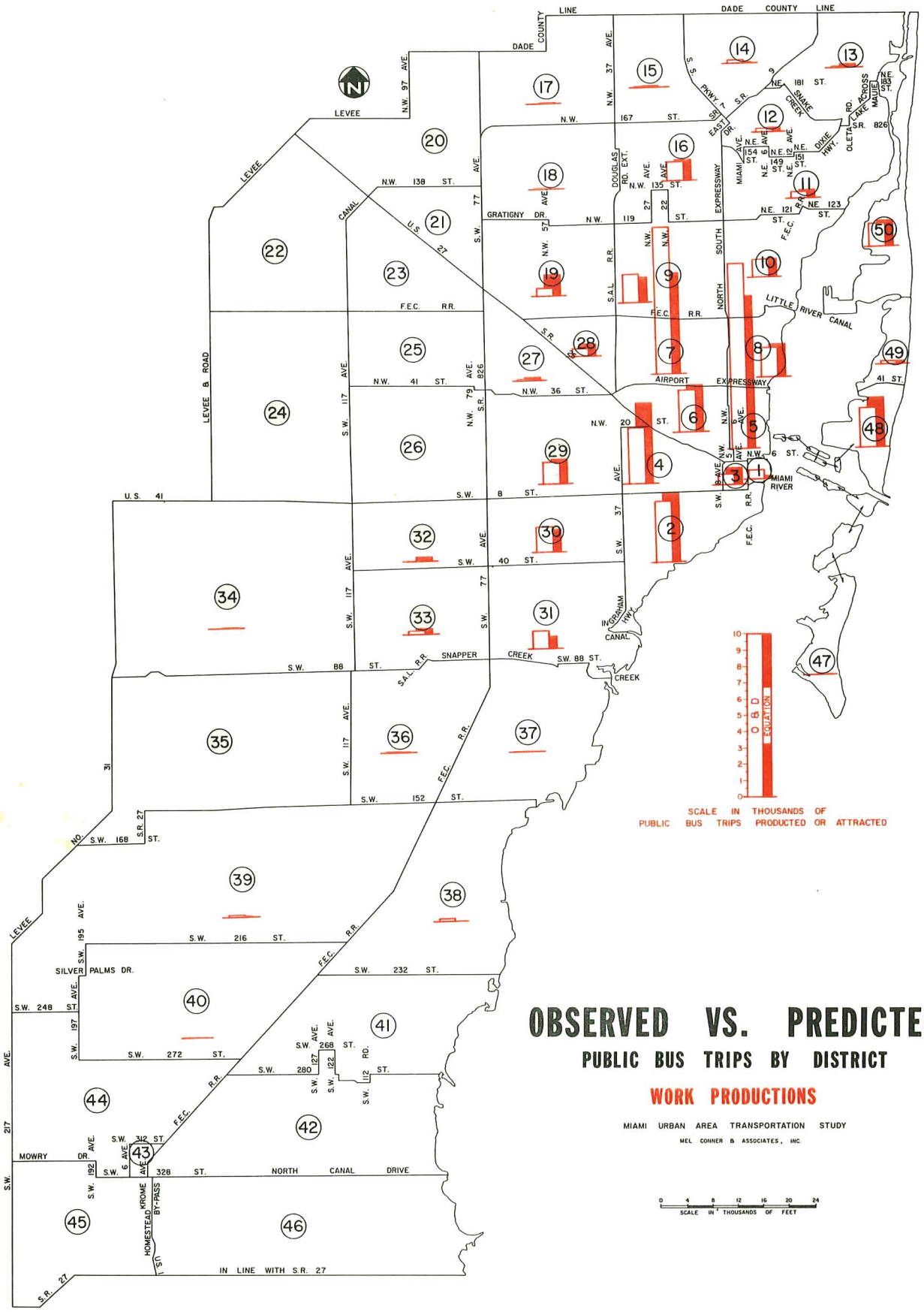
DEVELOPMENT AND TESTING OF MODAL SPLIT MODELS

FLORIDA STATE ROAD DEPARTMENT

AND

MEL CONNER & ASSOCIATES, INC.

1968



OBSERVED VS. PREDICTED

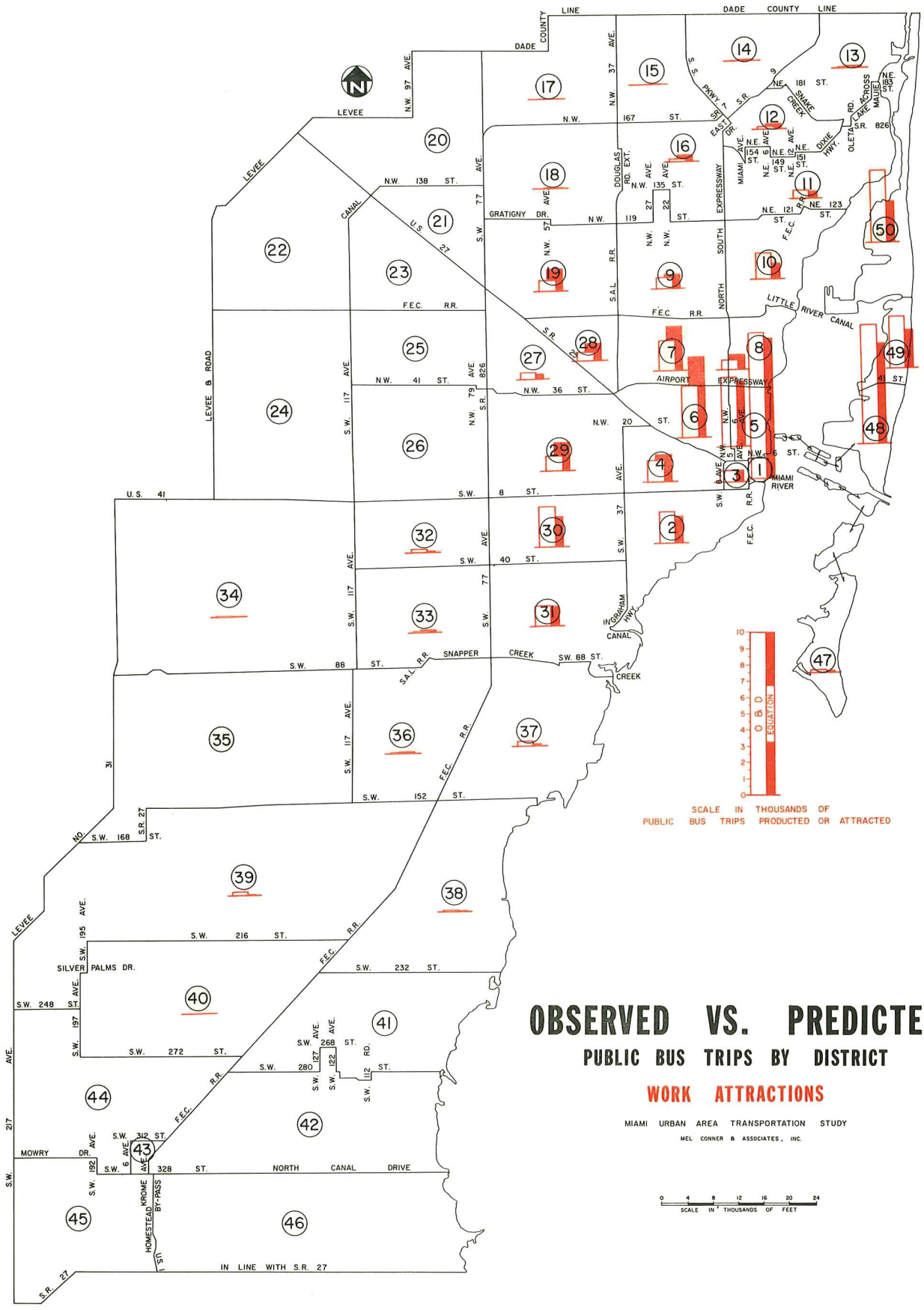
PUBLIC BUS TRIPS BY DISTRICT

WORK PRODUCTIONS

MIAMI URBAN AREA TRANSPORTATION STUDY

MEL CONNER & ASSOCIATES, INC.

FIGURE 4


OBSERVED VS. PREDICTED
PUBLIC BUS TRIPS BY DISTRICT
WORK ATTRACTIONS
MIAMI URBAN AREA TRANSPORTATION STUDY
MEL CONNER & ASSOCIATES, INC.
O B D EQUATION
SCALE IN THOUSANDS OF PUBLIC BUS TRIPS PRODUCTED OR ATTRACTED
SCALE IN THOUSANDS OF FEET
ATLANTIC OCEAN
DADE COUNTY LINE
LEVEE
CANAL
U.S. 27
S.R. 27
U.S. 41
F.E.C. R.R.
S.A.L. R.R.
SNAPPER CREEK
SW 88 ST. CREEK
LITTLE RIVER CANAL
MIAMI RIVER
AIRPORT EXPRESSWAY
SOUTH DIXIE HWY.
NORTH CANAL DRIVE
HOMESTEAD BY-PASS
IN LINE WITH S.R. 27
SILVER PALMS DR.
MOWRY DR.
GRATIGNY DR.
SNAKE CREEK
LAKE MAUE
OLETA
DOUGLAS RD. EXT.
SR 7 EAST
INGRAHAM HWY.
LEVEE 6 ROAD
1
2
3
4
5
6
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8
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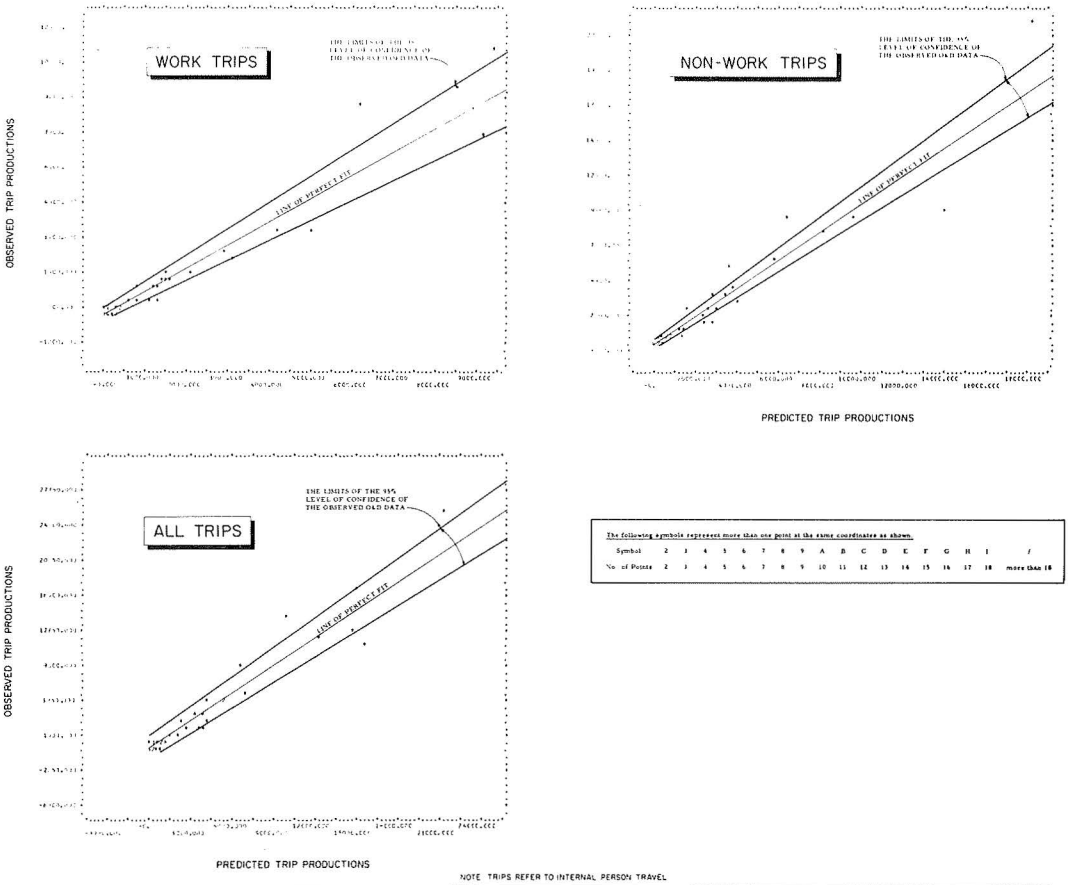
FIGURE 5

PUBLIC BUS TRIP PRODUCTIONS - Observed vs. Modal Split Model by District

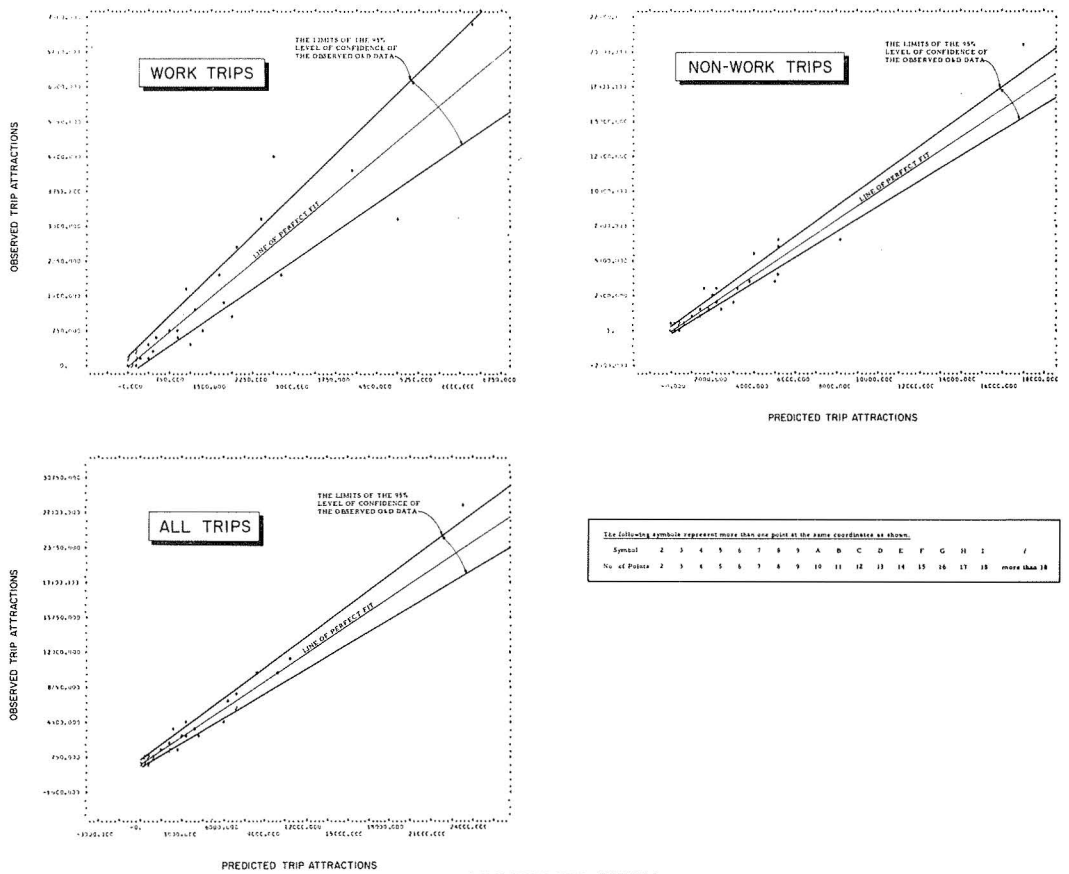


NOTE TRIPS REFER TO INTERNAL PERSON TRAVEL

MIAMI URBAN AREA TRANSPORTATION STUDY — MEL CONNER & ASSOCIATES, INC

FIGURE 6

PUBLIC BUS TRIP ATTRACTIONS - Observed vs. Modal Split Model by District



NOTE TRIPS REFER TO INTERNAL PERSON TRAVEL

MIAMI URBAN AREA TRANSPORTATION STUDY — MEL CONNER & ASSOCIATES, INC

FIGURE 7

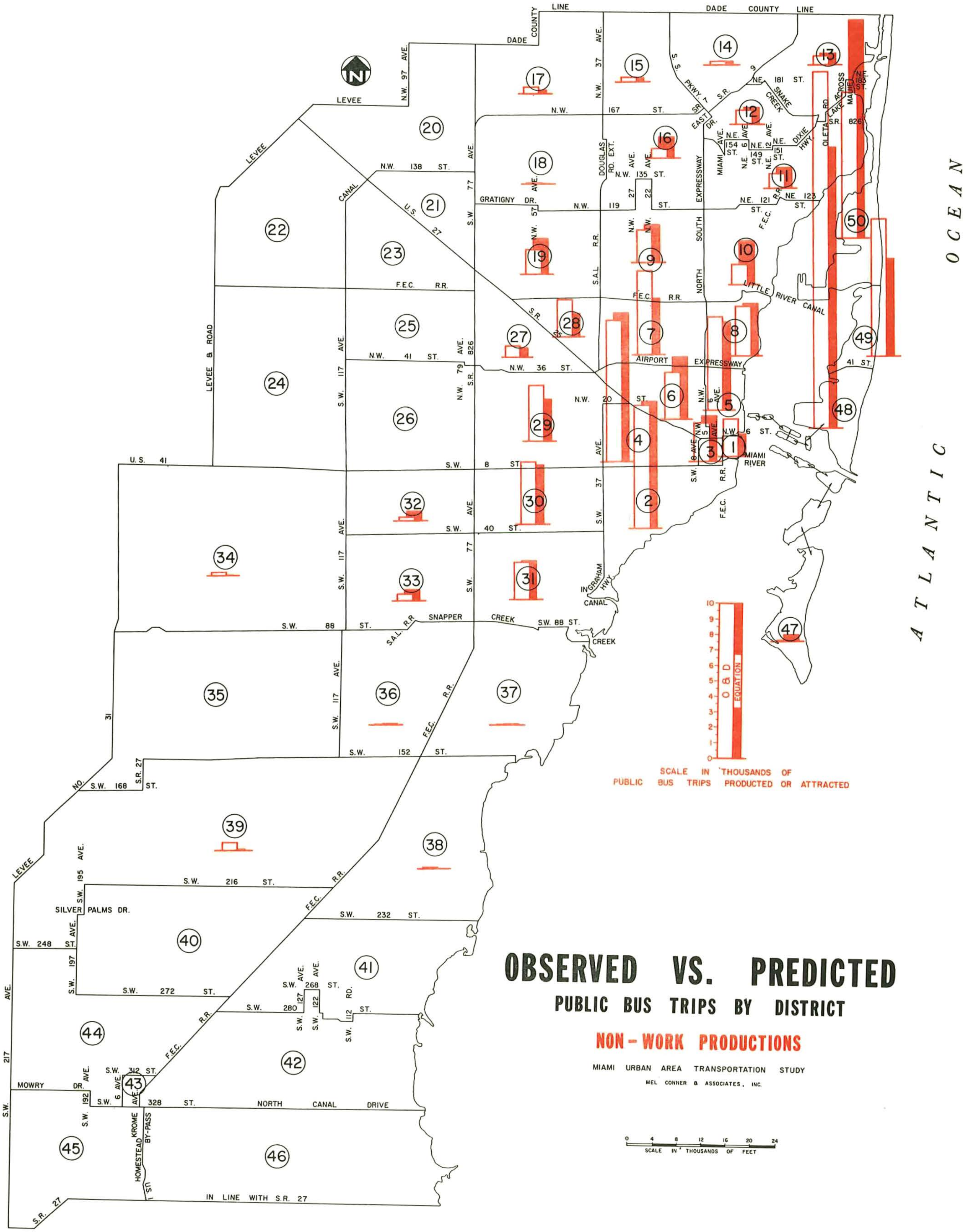
if other sources of trip data were available, and presumably the models and the independent variable data are as accurate as the origin-destination survey data.

Figures 8 and 9 show the comparison of observed and predicted public bus nonwork trip productions and attractions by district. These same types of comparisons of observed versus predicted for all public bus productions and attractions are shown in Figures 10 and 11.

The predicted productions and attractions of public bus trips are generally in agreement with the observed values expanded from the five per cent home interview sample. Generally, the models properly predicted small volumes of trip ends in the outlying districts as well as large volumes of trip ends near the CBD. Despite the small volumes, the models do a satisfactory job of predicting the spatial distribution of public bus trip productions and attractions. Where there are differences they are quite possibly due to sampling variation reflected in the observed values.

Ability to Predict Trip Distribution

Having evaluated how well the models were able to predict public bus trip ends, next an evaluation was made of how well the models could predict public bus person trip distribution. Two procedures were used to evaluate how well the modal split models duplicated the origin-destination public bus person trip distribution. First, a comparison was made between the trip length frequency distribution of both sets of trip data. Figure 12 indicates the degree to which the public bus modal split models are able to reproduce the trip length distribution of the observed bus trip data. The



OBSERVED VS. PREDICTED

PUBLIC BUS TRIPS BY DISTRICT

NON-WORK PRODUCTIONS

MIAMI URBAN AREA TRANSPORTATION STUDY

MEL CONNER & ASSOCIATES, INC.

FIGURE 8

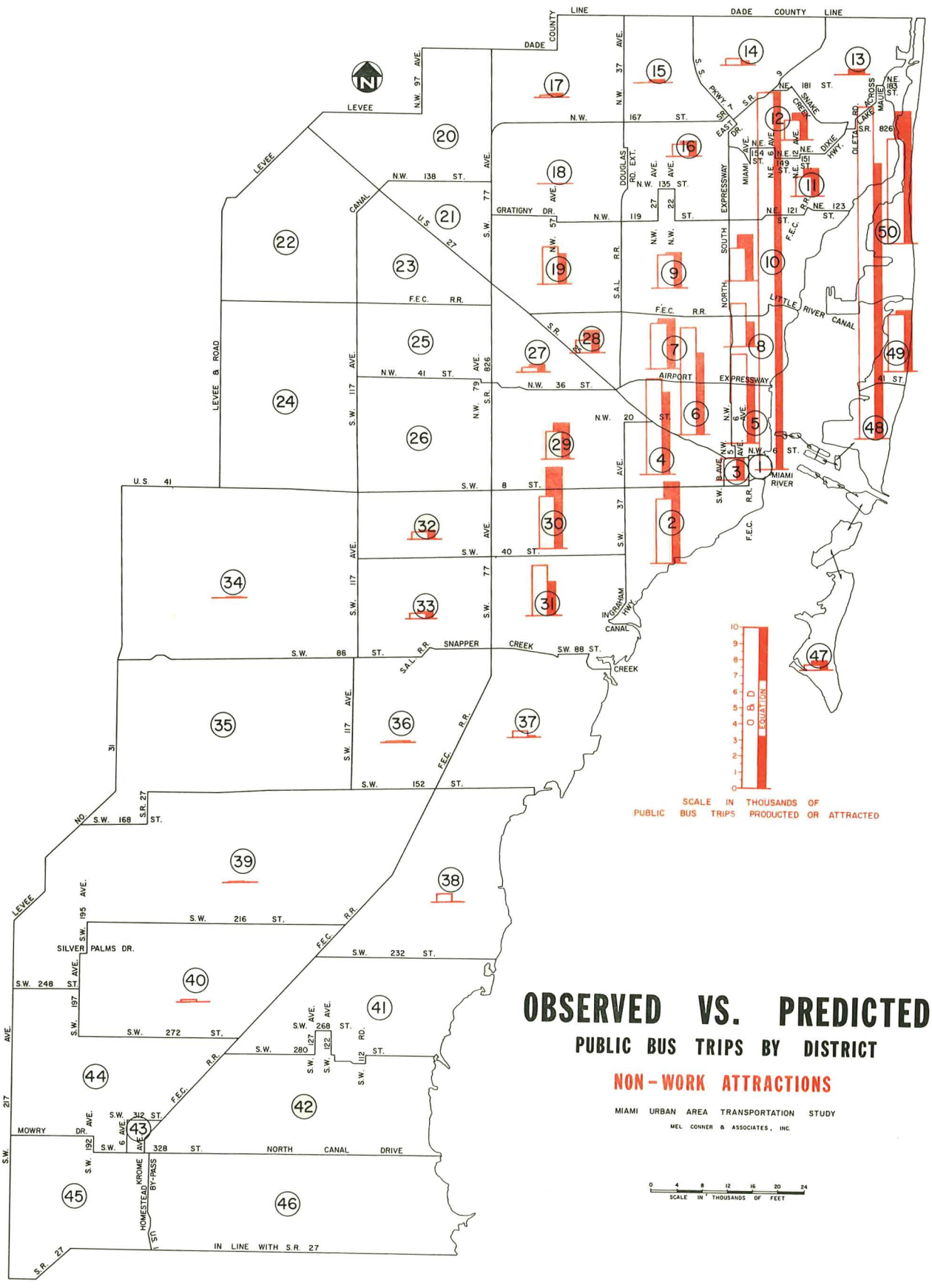

DADE COUNTY LINE
LEVEE
CANAL
U.S. 27
F.E.C. R.R.
LEVEE & ROAD
U.S. 41
S.A.L. R.R.
SNAPPER CREEK
SW 88 ST. CREEK
INGRAHAM HWY.
CANAL
MIAMI RIVER
AIRPORT EXPRESSWAY
LITTLE RIVER CANAL
SOUTH NORTH EXPRESSWAY
GRATIGNY DR.
DOUGLAS RD. EXT.
S.S. PKWY. (SR 9)
EAST DR.
SNAKE CREEK
DIXIE HWY.
OLETA RIVER
ATLANTIC OCEAN
SILVER PALMS DR.
MOWRY DR.
NORTH CANAL DRIVE
HOMESTEAD BY-PASS
IN LINE WITH S.R. 27
O & D EQUATION
SCALE IN THOUSANDS OF PUBLIC BUS TRIPS PRODUCTED OR ATTRACTED
OBSERVED VS. PREDICTED
PUBLIC BUS TRIPS BY DISTRICT
NON-WORK ATTRACTIONS
MIAMI URBAN AREA TRANSPORTATION STUDY
MEL CONNER & ASSOCIATES, INC.
SCALE IN THOUSANDS OF FEET

FIGURE 9

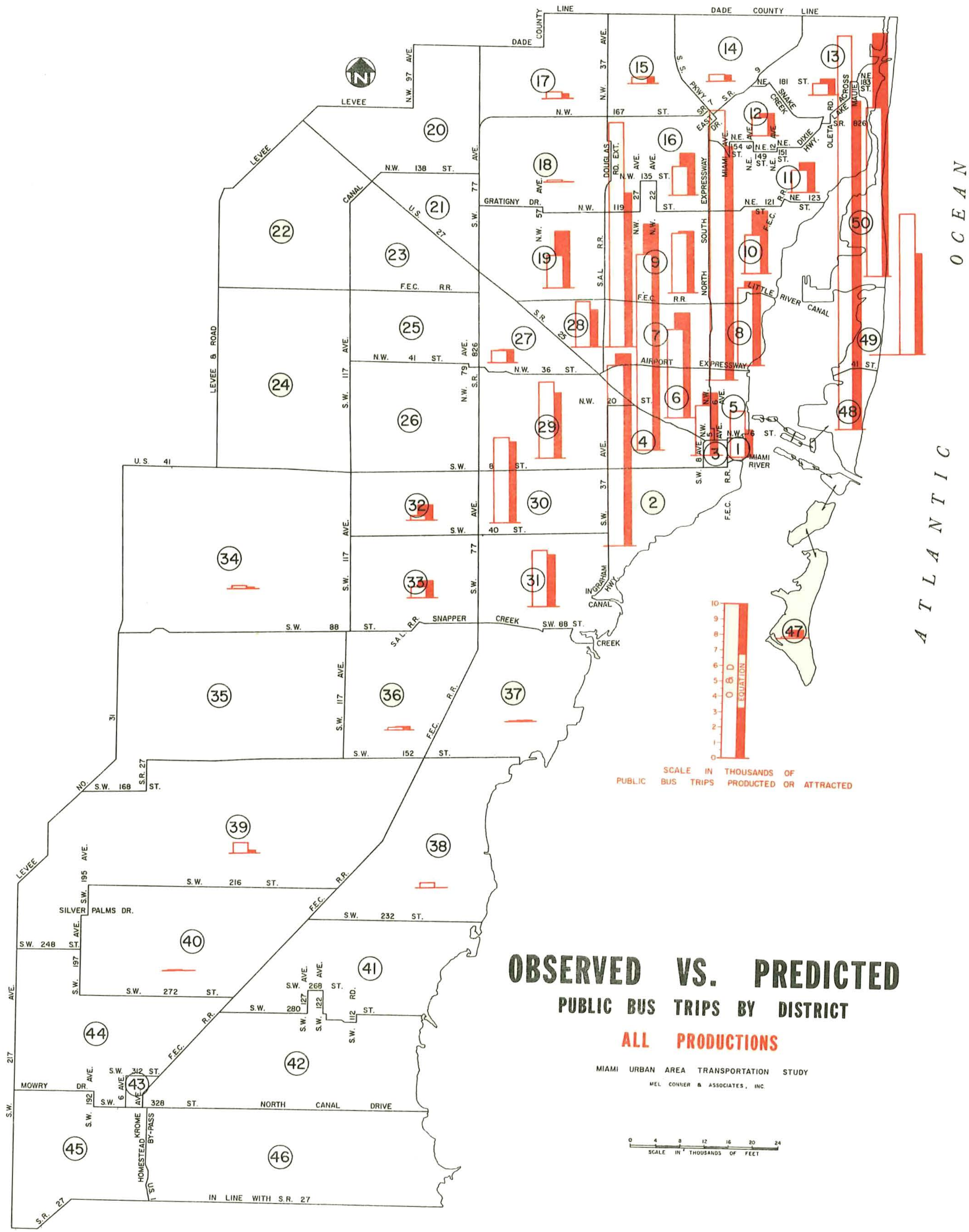

DADE COUNTY LINE
LEVEE
N.W. 97 AVE.
N.W. 37 AVE.
N.W. 167 ST.
N.W. 138 ST.
GRATIGNY DR.
N.W. 119 ST.
N.E. 181 ST.
SNAKE CREEK
DIXIE HWY.
OLETA RD.
ACROSS LAKE MAUIEL
N.E. 183 ST.
N.E. 123 ST.
N.E. 121 ST.
DOUGLAS RD. EXT.
SOUTH EXPRESSWAY
NORTH SOUTH
MIAMI AVE.
F.E.C. R.R.
S.A.L. R.R.
U.S. 27
CANAL
S.W. 77 AVE.
S.W. 117 AVE.
N.W. 41 ST.
N.W. 36 ST.
N.W. 20 ST.
AIRPORT EXPRESSWAY
LITTLE RIVER CANAL
LEVEE & ROAD
U.S. 41
S.W. 8 ST.
S.W. 40 ST.
S.W. 37 AVE.
MIAMI RIVER
INGRAHAM HWY.
CANAL
S.W. 88 ST.
SNAPPER CREEK
S.W. 152 ST.
S.W. 168 ST.
S.R. 27
S.W. 216 ST.
S.W. 232 ST.
S.W. 195 AVE.
SILVER PALMS DR.
S.W. 248 ST.
S.W. 272 ST.
S.W. 280 ST.
S.W. 217 AVE.
MOWRY DR.
S.W. 312 ST.
S.W. 328 ST.
NORTH CANAL DRIVE
HOMESTEAD KROME AVE BY-PASS
U.S. 1
IN LINE WITH S.R. 27
ATLANTIC OCEAN
CBD
EQUATION
SCALE IN THOUSANDS OF PUBLIC BUS TRIPS PRODUCTED OR ATTRACTED
SCALE IN THOUSANDS OF FEET
OBSERVED VS. PREDICTED
PUBLIC BUS TRIPS BY DISTRICT
ALL PRODUCTIONS
MIAMI URBAN AREA TRANSPORTATION STUDY
MEL CONNER & ASSOCIATES, INC.

FIGURE 10

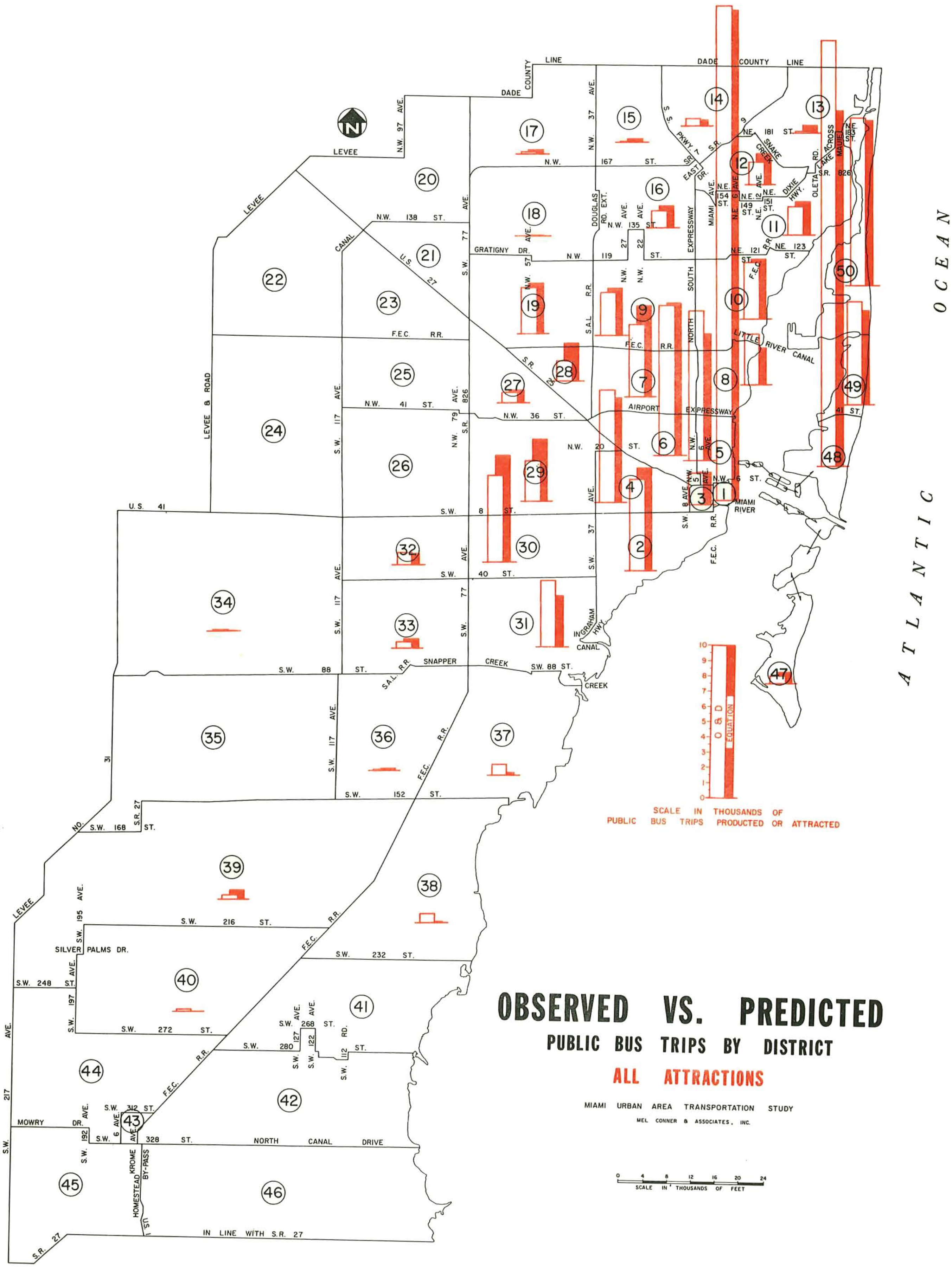
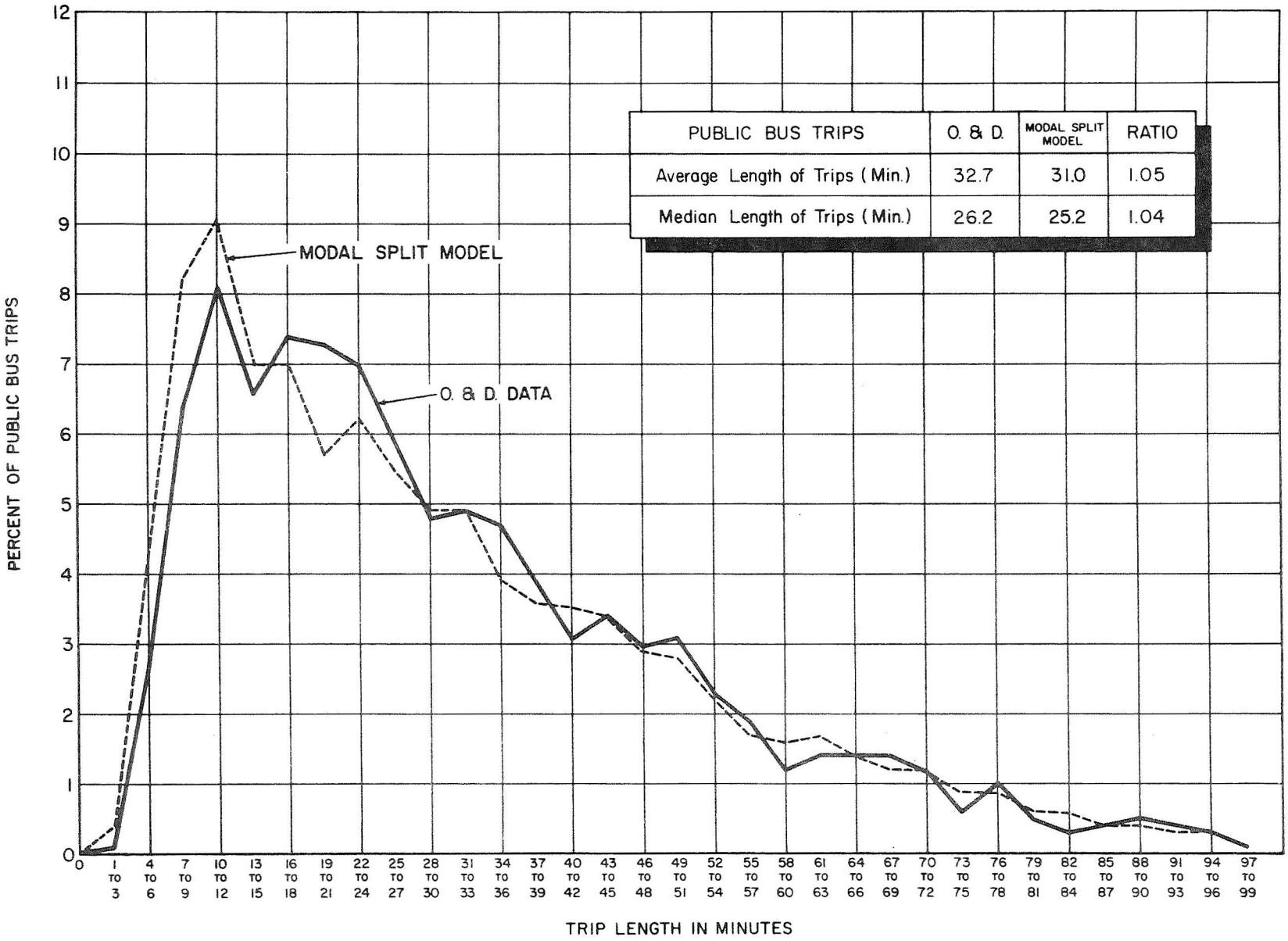

OBSERVED VS. PREDICTED
PUBLIC BUS TRIPS BY DISTRICT
ALL ATTRACTIONS
MIAMI URBAN AREA TRANSPORTATION STUDY
MEL CONNER & ASSOCIATES, INC.
O & D
EQUATION
SCALE IN THOUSANDS OF PUBLIC BUS TRIPS PRODUCTED OR ATTRACTED
SCALE IN THOUSANDS OF FEET
ATLANTIC OCEAN
DADE COUNTY LINE
LEVEE
N.W. 167 ST.
N.W. 138 ST.
GRATIGNY DR.
N.W. 119 ST.
F.E.C. RR.
N.W. 41 ST.
N.W. 36 ST.
AIRPORT EXPRESSWAY
N.W. 20 ST.
U.S. 41
S.W. 8 ST.
S.W. 40 ST.
S.W. 88 ST.
SNAPPER CREEK
S.W. 152 ST.
S.W. 168 ST.
S.W. 216 ST.
SILVER PALMS DR.
S.W. 232 ST.
S.W. 248 ST.
S.W. 272 ST.
S.W. 280 ST.
MOWRY DR.
S.W. 312 ST.
S.W. 328 ST.
NORTH CANAL DRIVE
IN LINE WITH S.R. 27
LITTLE RIVER CANAL
MIAMI RIVER

FIGURE 11

average trip length was 32.7 minutes for the O&D public bus trips and 31.0 minutes for the "synthesized" modal split public bus trips, a difference of only five per cent. As shown in Figure 12, the trip length frequency comparisons were considered to be quite satisfactory throughout the complete travel time range.

As another measure of how well the modal split model was able to duplicate the observed public bus trip distribution, both the observed and the predicted public bus person trips were assigned to the existing public bus network, using the minimum travel time path for routing trips. Several screenlines were then drawn, as shown in Figure 13, and comparisons made between the observed and predicted assigned volumes. The resulting compairsons were considered very satisfactory. The heaviest volumes were those crossing the screenline drawn around the CBD where the observed assignment showed 70,312 public bus trips compared to 66,304 public bus trips predicted by the modal split models. This was a 94.3% comparison.



TRIP LENGTH FREQUENCY FOR PUBLIC BUS TRIPS

MIAMI URBAN AREA TRANSPORTATION STUDY

MEL CONNER & ASSOCIATES, INC.

FIGURE 12

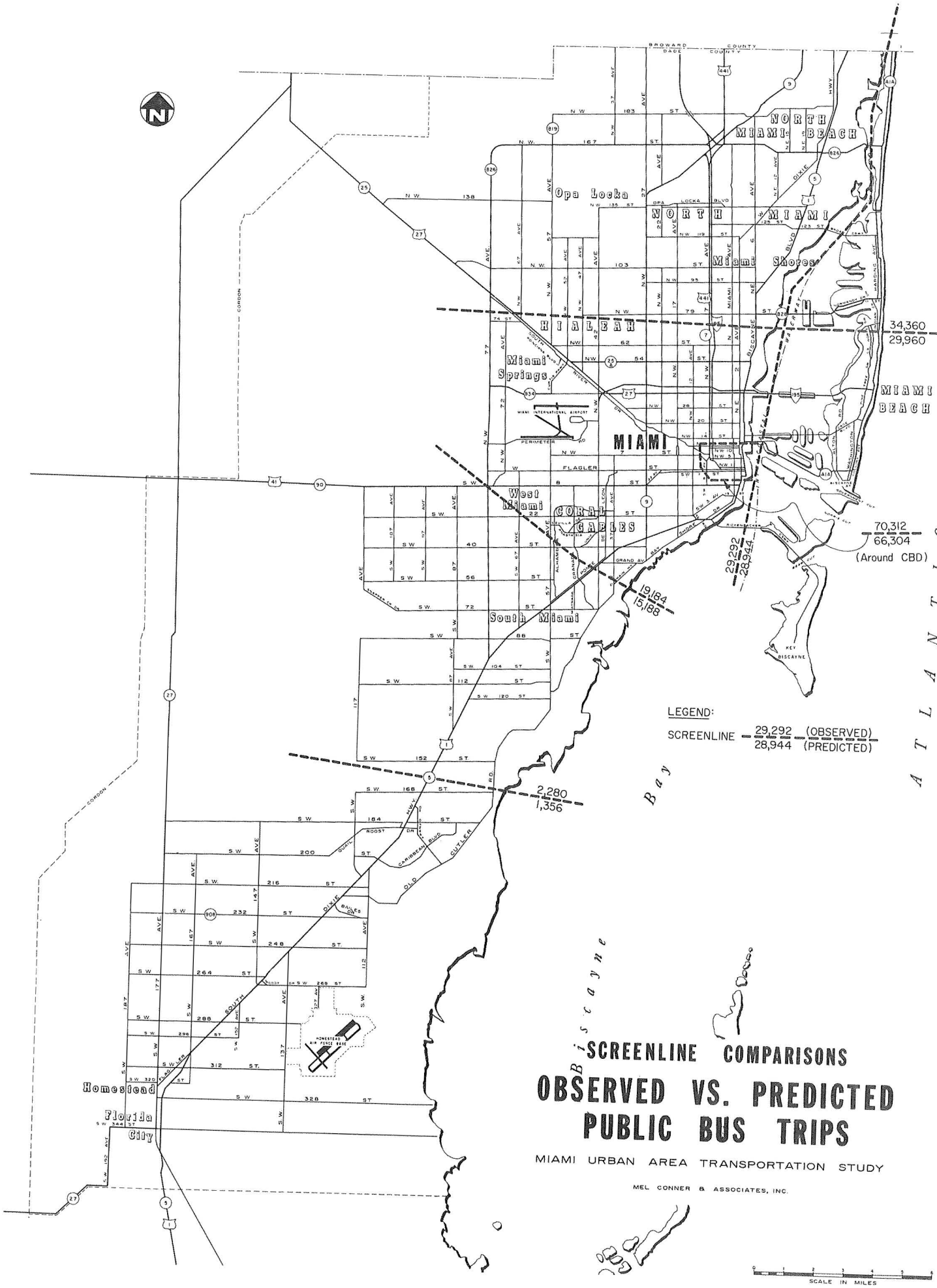

N
BROWARD COUNTY
DADE COUNTY
NORTH MIAMI BEACH
Opa Locka
NORTH MIAMI
Miami Shores
HIALEAH
Miami Springs
MIAMI INTERNATIONAL AIRPORT
MIAMI
MIAMI BEACH
West Miami
CORAL GABLES
South Miami
Homestead
Florida City
HOMESTEAD AIR FORCE BASE
KEY BISCAYNE
OCEAN
ATLANTIC
Bay
Biscayne
34,360
29,960
70,312
66,304
(Around CBD)
29,292
28,944
19,184
15,188
2,280
1,356
LEGEND:
SCREENLINE — 29,292 (OBSERVED) / 28,944 (PREDICTED)
SCREENLINE COMPARISONS
OBSERVED VS. PREDICTED
PUBLIC BUS TRIPS
MIAMI URBAN AREA TRANSPORTATION STUDY
MEL CONNER & ASSOCIATES, INC.
SCALE IN MILES

FIGURE 13

CHAPTER V

MODEL REFINEMENT

After considerable deliberation and review of the model development by the Consultant it was determined that the Department would attempt to further refine the modal split analysis. This additional effort was generally concerned with two items - refinement of the trips purposes and refinement of the districts used to develop the models. With these changes it was determined not to contine with separate CBD models due to the amount of data and since the variables should reflect the significant differences. At the same time it was decided by the State to attempt to use a wider spectrum of variables consistent with the use of several purposes.

Area Refinement

The refinement of the area was initiated in order to provide more sensitivity in the models. Under the basic district configuration used throughout the Miami Study including the modal split there were 50 districts including one for the CBD and three on the Beach. These were the two main areas which required further breakdowns.

For the purposes of this added work the area served by transit was determined from a link-node map of the existing system provided by the transit Consultant for Dade County. A review of the basic districts in conjunction with this definition indicated that 14 of the original districts were wholly outside the transit service area while another 14 were partly outside.

One attempt was made at deriving a work trip model on a zonal basis rather than by districts. A total of 27 variables were entered and the

machine went through 25 steps - with a final multiple correlation of 0.45. This confirmed the Consultant's estimate that it would be futile to develop the modal split on a zonal basis.

The basic districts were generally retained and served as a starting point from which to commence the refinement. Several attempts at redistricting were made including separate districts for the work model and another set for the non-work models. The final configuration for all models consisted of 41 districts including five in the CBD and twelve on the Beach (Figure 14).

Purpose Refinement

The basic trip generation was accomplished with five home-based trips purposes, i.e. work, shop, social-recreation, personal business (including eat meal and medical-dental) and school.

It was determined that an attempt would be made to develop the modal split models for each of these several purposes with the exception of school. In the case of school, previous indications were that this category lacked sufficient stability for individual split models and special public bus generation equations were developed for both the home (production) end and the school (attraction) end of the trip.

In addition an "other" (non-work) category was carried into the development due to the previous difficulties experienced by the Consultant. Later another category was developed by combining the social-recreation and personal business classes.

In view of the Consultant's previous findings and their general

instability, non-home based transit was again omitted from the analysis.

Basic Data

Chapter III indicated that there were 5700 transit trip records. However, when the non-home based transit trips were eliminated as well as any bus records outside of the transit service area, the resulting number of transit records was reduced to 4790. Table G indicates the number of transit trip records by trip purpose. While the Consultant had used a base of 400 factored person trip records, since the trip factors range from approximately 21 in the private dwellings to over 50 in the hotels and motels, a minimum of 5 trip records was considered as the base for inclusion in this further work. This further reduced the number of transit records, as shown in Table G, to the point that there was only slightly better than one transit record per interchange for social-recreation and personal business trips.

Table G also illustrates the mean and standard deviation of the transit ratio for the district interchanges with greater than 5 person trip records as used in the final derivation of models. It is notable that the standard deviation is greater than the mean for all purposes and for non-work purposes, the standard deviation approaches and may even exceed twice the mean.

Another factor which influences the model development is the gradation of the transit ratio from no transit usage to total transit ridership. The transit ratio is based on the 5 per cent sample of dwelling units which was obtained in the field. Table H indicates the very high reliance on automobiles especially for non-work purposes where 93 per cent of the

TABLE G

TABLE OF BASIC DATA

MODEL	TRANSIT RECORDS TOTAL	TRANSIT RECORDS 5 OR MORE	DISTRICT INTERCHANGES	TRANSIT RATIO MEAN	TRANSIT RATIO STANDARD DEU
WORK	1906	1756	692	.1509	.2098
SCHOOL	1016	-	-	-	-
OTHER *	1868	1598	735	0.0982	0.1854
SHOP	689	608	273	0.1126	0.2183
MISCEL-LANEOUS *	1179	990	669	0.0879	0.1771
SOCIAL RECREATION	592	480	449	0.0860	0.1871
PERSONAL BUSINESS	587	510	444	0.0829	0.1795

* SUM OF ITEMS BELOW

zonal interchanges within the transit service area had no recorded transit trips. At the same time for non-work interchanges there were more zones with all records by transit that those somewhere between zero and 100. For work there were fewer interchanges with zero transit ridership. This lack of linearity within the data indicate the reason that it was futile to develop a series of models on a zonal basis.

Table H also indicates the same data on a district basis both for all data and for those interchanges with 5 or more person trip records. There is still a large portion of the interchanges with no transit usage even though both ends were within the transit service area. This appears to be one of the major factors for the inability to develop a better correlation of the models.

Variables

This later work was not limited to the variables originally used by the Consultant but rather all available variables were tested as well as one new variable which the county provided. Variables are divided into three general categories related to the home end of the trip, the transit service at the home end or the relative service between the points of travel, and the attraction end of the trip. In addition, several of the variables were trans-generated to the natural log form where this appeared advantageous. Tables I through K indicate the several variables tested in each of the trip purposes. The "L" indicates that a log trans-generation was also attempted.

Home varaibles generally related to various density combinations of persons, dwelling units, residential land uses and automobiles. For work

TABLE H

TRIP INTERCHANGES & TRANSIT USAGE

	WORK	OTHER
ZONAL INTERCHANGES	8,385	10,032
0% TRANSIT	6,241 (74)	9,277 (93)
100% TRANSIT	640 (8)	408 (4)
OTHER % TRANSIT	1,504 (18)	347 (3)

	WORK		OTHER	
	TOTAL	5 OR MORE	TOTAL	5 OR MORE
DISTRICT ICA	1,075	689	1,132	735
0% TRANSIT	586 (55)	333 (49)	761 (67)	428 (58)
100% TRANSIT	53 (5)	6 (1)	36 (3)	3 (-)
OTHER	436 (41)	350 (50)	335 (30)	304 (42)

TABLE I

HOME VARIABLES

PURPOSE	WORK	OTHER	SHOP	MISC	SOC REC	PER BUS
VARIABLES						
RESIDENT LABOR FORCE (RLF) RESIDENT DWELLING UNIT (RDU)	X					
RLF NET RESIDENTIAL ACRES (NRA)	L					
RLF CAR	L					
RLF RESIDENT CARS (RCAR)	X					
RLF DWELLING UNIT (DU)	L					
RESIDENT POPULATION (RPOP) RDU	X					
RCAR RDU	X					
POPULATION (POP) DU	L	L	L	L	L	L
CAR DU	L	L	L	L	L	L
CAR NRA	L					
POP CAR	L	L	L	L	L	L

(Continued on Page 2)

TABLE I (Con't)

HOME VARIABLES

PURPOSE	WORK	OTHER	SHOP	MISC	SOC REC	PER BUS
POP NRA	L					
POP NET RESIDENTIAL + HOTEL-MOTEL ACRES (N+H)		L	L	L	L	L
NON-WORKING POPULATION (NWP) N+H		L	L	L	L	L
NWP HOTEL-MOTEL ACRES (HMA)		L	L	L	L	X
CAR N+H		L	L	L	L	L
DU N+H		L	L	L	L	L
HOTEL-MOTEL UNITS (HM) NET NON-RESIDENTIAL ACRES (NNRA)		X	X	L	X	X
HM HOTEL-MOTEL ACRES		X	X	X	X	X

TABLE J

ATTRACTION VARIABLES

PURPOSE	WORK	OTHER	SHOP	MISC	SOC REC	PER BUS
TOTAL EMPLOYMENT (EMP) / NET NON-RESIDENTIAL ACRES (NNRA)	L					
INDUSTRIAL EMPLOYMENT (I EMP) / NNRA	X					
I EMP / MANUFACTURING FLOOR AREA (MFA)	X					
COMMERCIAL EMPLOYMENT (CEMP) / NNRA	X	L	L	L	X	X
OTHER EMPLOYMENT (OEMP) / NNRA	X			L	X	X
OEMP / HOTEL-MOTEL UNITS (HM)	X					
HM / NNRA	X			X	X	X
HM / HOTEL-MOTEL ACRES (HMA)	X					
RETAIL EMPLOYMENT (REMP) / NNRA		X	L			X
SELECTED RETAIL EMPLOYMENT (SREMP) / NNRA		X	X			
RETAIL SALES (RS) / NNRA		X	X			
EATING & DRINKING EMPLOYMENT (EDEMP) / NNRA		X			X	X

(Continued on Page 2)

TABLE J (Con't)

ATTRACTION VARIABLES

PURPOSE	WORK	OTHER	SHOP	MISC	SOC REC	PER BUS
EDEMP HMA			X		X	X
O EMP NNRA			X			
SELECTED OTHER EMPLOYMENT (SO EMP) NNRA			X		X	X
POPULATION (POP) DWELLING UNITS (DU)			L	L	L	
CAR DU			L	L	L	
NON-WORKING POPULATION (NWP) NET RESIDENTIAL & HOTEL-MOTEL ACRES (N+H)			L	L	L	
DU N+H			L	L	L	

TABLE K

SERVICE VARIABLES

PURPOSE	WORK	OTHER	SHOP	MISC	SOC REC	PER BUS
VARIABLE						
TRAVEL TIME RATIO	L	L	L	L	L	L
TRAVEL TIME DIFFERENCE	X	X	X	X	X	X
EXCESS TIME RATIO	L	L	L	L	L	L
EXCESS TIME DIFFERENCE	X	X	X	X	X	X
AVERAGE DAILY BUS SERVICE (DB)	X	X	X		X	X
AVERAGE DAILY BUS MILES (BM)	X	X	X		X	X
$\frac{DB}{RESIDENT\ POPULATION\ (R\ POP)}$	X	X	X		X	X
$\frac{BM}{R\ POP}$	X	X	X		X	X

trips there were additional refinements of the variables into residential measures since the large tourist orientation would not contribute significantly to the resident labor force. The resident labor force is another specialized application of the population associated with work trips. In view of some of the previous experiences in the trip generation phase the non-working population was investigated for the non-work trip purposes. Hotel-motel acreage was a new element of measure for use with hotel-motel units in place of net non-residential acres. In addition, since the population and other variables included both resident and tourist population, etc., the residential and hotel-motel acres were combined to make a more compatible areal measurement.

Attraction variables were generally related to some measure of employment density, either total employment or one of the several components. In the Miami data there is considerable refinement in the employment data which permitted selective stratification not otherwise usually possible. For example, within the retail employment category it was possible to utilize general merchandizing employment and similar other selected employments which might be more orientated toward transit ridership, ignoring retail employment such as building materials which are not so transit orientated. Hotel-motel unit densities were seen to attract a large number of work trips and were also included in the social-recreation and related trip purposes. Since social trips are made between people, several home type variables were also included as attractions for these purposes.

Service variables included measures of the relative travel and excess time between transit and autos as well as measures of the quantity

of bus service at the home end of the trip. Since it was intended to utilize these models to test not only an expanded bus system but also a form of rapid transit, an inclusion of a relative travel time measure was mandatory. Log transgeneration of the travel time ratio was attempted in all cases but since there were some instances where transit was faster than auto, producing negative differences, transgeneration was not attempted for the travel time differences. Excess time in the case of transit is the time required for getting to and from the bus as well as transfer times. In order to obtain this excess time the transit network was modified by setting all time links to zero and subtracting the resulting transit movement time network from the original transit net. In the case of automobiles the terminal time is considered as excess and since the centroids were connected directly to the transit network, centroid connectors were also used in the auto excess time in order that the data should be compatible. The transit service variables were supplied directly by the Metro Dade transit Consultant.

In all cases the data was available in a zonal form and it was necessary to compress the zones to districts. In the home and attraction variables this consisted of an aggregation of the zonal data prior to developing the necessary ratios. For the travel time variables it was necessary to compress the times to districts and then these totals were divided by the number of possible interchanges involved.

Model Development

Since the time variables required considerable manipulation before they were ready for input there were generally preliminary runs made

for each purpose prior to the inclusion of the service variables. Following a full run with all of the variables, runs were made with the transgenerations. Through successive runs the number of home and attraction variables were gradually trimmed and the four service variables related to the home end of the trip were eliminated. With the home and attraction variables trimmed to a workable number, generally two to each, a "2T" run was made still retaining all of the travel and excess time variables as well as the transgenerations. These served as the basis for the final determination of which travel time variable to include.

This sequencing varied somewhat in several instances. In the "other" or non-work category an exotic transgeneration of "e" to the power of the number of cars per dwelling unit was attempted. For miscellaneous trips which were a comparatively late combination of social-recreation and personal business trips there was no preliminary and separated regular and transgeneration runs. The first run contained 22 variables and 17 transgenerations.

Figure 15a indicates the development of the work model through step 8 in a mixed run of plain and transgenerated variables. In this run there were eleven variables including the four time variables and five transgenerations. The point of trim for this equation would logically be at step 4 but at this point none of the travel time variables had entered. Travel time difference is shown entering at step 8 and contributes nothing to the improvement at that step. Both the dwelling unit density and its log as well as commercial density and its log were drawn into the equation before the first measure of relative travel time in this run. A review of the several

employment density variables after the second step indicated that all were relatively the same in their improvement of the model and it was decided that the total employment variable would be used in order to improve the areawide coverage. The final equation is indicated in Table L.

Figure 15b indicates the development of the "other" (non-work/school) model in a mixed run through step 7 and step 11 where the first travel time variable entered. In this run there were 12 variables and 5 transgenerations. It must be noted that the sign of the travel time ratio (and others) is not correct and would indicate an increase of transit ridership with poorer relative service. A "2T" run was made but again it was not possible to provide more than one home and one attraction variable before the sign of the travel time variables flopped. The work on this equation was carried on simultaneously with model development for the three components, shop, social-recreation and personal business. In view of the development of the other models this equation was dropped. The final equation includes the home variable of cars per dwelling unit, the attraction variable of commercial employment density and the log of the travel time ratio for the service variable.

Figure 15c indicates the development of the shopping model in a mixed run through step 7 and step 9 where the first travel time variable entered. In this run there were 9 variables and 3 transgenerations. This is the only model where the excess time plays a relatively important role in the model development. However, once an excess time variable enters it is impossible to enter a relative travel time variable with the correct sign. There appeared to be little significant difference between the cars

TABLE L

REVISED MODAL SPLIT MODELS

PURPOSE	MODEL	CASES	CORRELATION COEFFICIENT	STD ERROR OF ESTIMATE	MEAN OF Y	STD ERR OF COEF	F TO REMOVE
WORK	Y = -0.1012 + 0.0730 POP/CAR	692	0.691	0.152	0.151	0.0038	370.2
	+0.0013 HM/NNRA					0.0002	52.8
	+0.0003 EMP/NNRA					0.0001	22.2
	-0.0012 TTD					0.0003	19.7
SHOP	Y = 0.2745 + 0.0009 CEMP/NNRA	273	0.701	0.157	0.113	0.0001	124.2
	-0.1777 CAR/DU					0.0366	23.6
	-0.0506 LTTR					0.0262	3.7
OTHER	Y = 0.2947 - 0.2084 CAR/DU	669	0.573	0.145	0.088	0.0200	108.1
	+0.0006 CEMP/NNRA					0.0001	72.8
	-0.0268 LTTR					0.0162	2.7
SCHOOL TRANSIT PRODUCTIONS	Y = 0.1 DWELLING UNITS						
SCHOOL TRANSIT ATTRACTIONS	Y = -104.28 + 0.34 HIGH SCHOOL ATTENDANCE + 0.53 AVG DAILY BUSES + 0.18 JR H.S. ATTENDANCE + 0.31 OTHER ATTENDANCE	77	0.780	312	348	0.0386 0.1268 0.0626 0.1276	79.7 17.8 8.6 6.0

per dwelling unit and its log and the latter was dropped. In the subsequent run the commercial employment density was followed by the cars, the hotel-motel density and then the time variables as previously indicated, again with the incorrect sign on the travel time variables. In the development of the final equation it was necessary not only to supress the excess time variables but also the tourist accommodations density in order to bring in the travel time variable with the correct sign. As noted in Table L the correlation coefficient for shopping trips is even greater than that for work trips, however, the travel time variable is very weak. The corresponding "F" values for the other travel time variables were 0.04 for the ratio and 0.06 for the difference. The log of the travel time ratio in this equation is of marginal significance.

Figure 15d indicates the development of the social-recreation model in a mixed run through step 8. The highest single correlation for a travel time variable was 0.399 but with the introduction of the first home variable the "F" to enter fell to 3.6 for the log. At the end of step 2 with one home and one attraction variable entered the respective travel time variables "F" level were: log of ratio 0.1321, difference 0.0029 and ratio 0.0001. No reasonable model could be built which reflected relative travel time. The best correlation which could be expected would be approximately 0.60 with a standard error of approximately 175.

Figure 15e indicates the development of the personal business model in a mixed run through step 8. A situation similiar to that indicated for the social recreation trips was also evident for the personal business trips, however, here the travel time variables changed signs after the in-

troduction of the second variable. Again no reasonable model could be developed and the best correlation would be approximately 0.50.

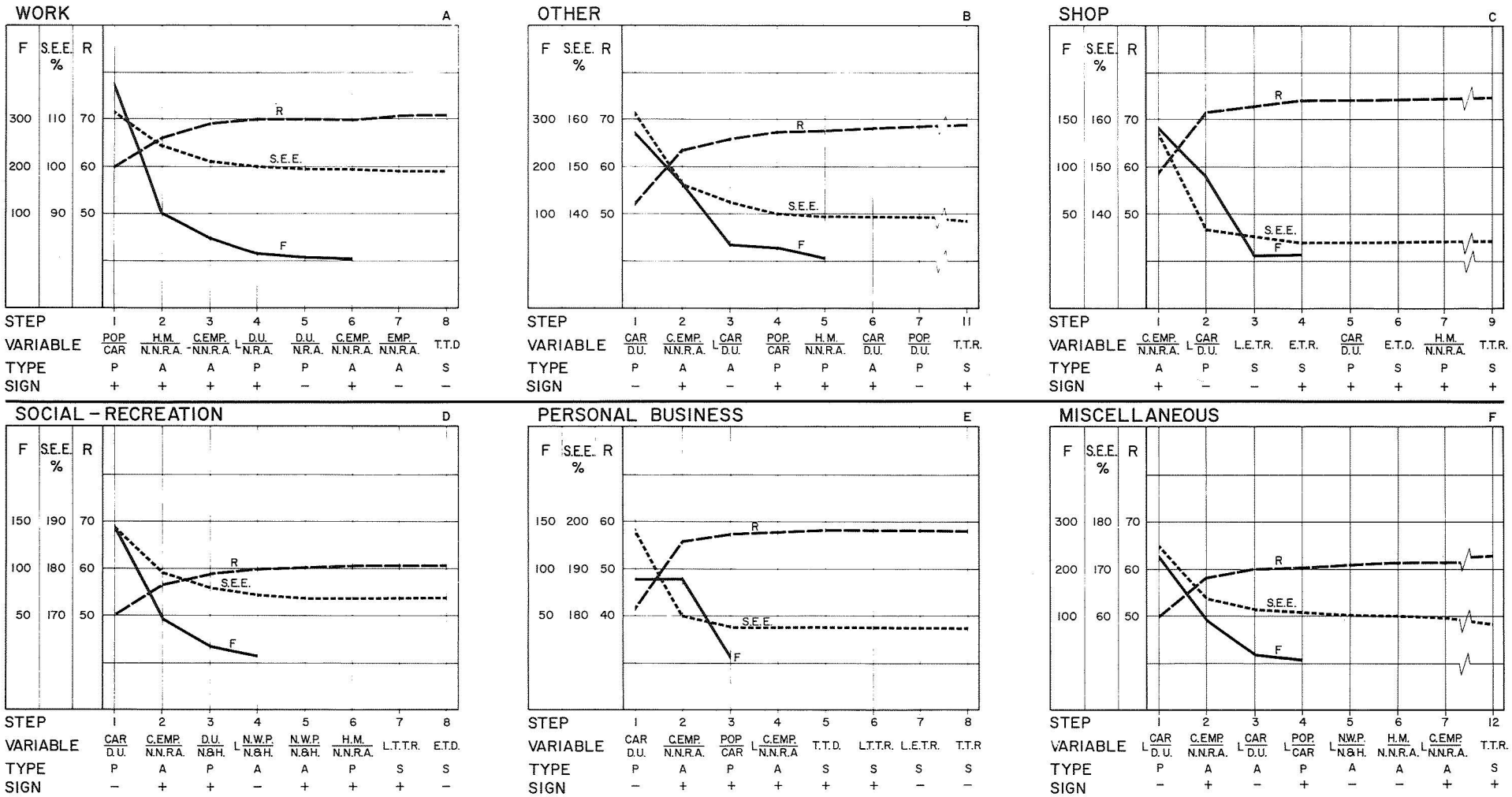
In view of the above it was determined to combinate the two latter purposes. Figure 15f indicates a portion of the first mixed run which included 22 variables and 17 transgenerations. A review of the single correlations indicated that the significant variables and their logs generally were only slightly different in their fit, for example the first variable to enter was the log of cars per dwelling unit with a correlation of 0.501 while the straight variable had a coefficient of 0.488. In the "2T" run it was therefore determined not to use transgenerations except on the time variables. In this run a second attraction variable (HM/NNRA) entered in step 3 after which the only travel time variable with the correct sign was the transgeneration with an "F to enter" of 0.0000. The final equation is shown in Table L. The travel time variable is extremely weak and does not pass the "t" test. However, since no other travel time variable was available, this was retained in the final equation.

As previously noted school transit trips were treated in a different manner. However, an initial attempt was made at the development of a modal split model similiar to the other purposes, but based on home end variables and transit service variables only. Two significant variables appeared, dwelling units per net residential acre and population per net residentail acre - the latter as a negative coefficient. At this point the model had a correlation coefficient of 0.42 and a standard error of 175 per cent.

EVALUATION OF REGRESSION ANALYSIS

MIAMI URBAN TRANSPORTATION STUDY

MODAL SPLIT – HOMEBASED TRIPS BY PURPOSE



A	ATTRACTION VARIABLE
C	AUTOMOBILES
C. EMP.	COMMERCIAL EMPLOYMENT
D.U.	DWELLING UNITS
EMP.	TOTAL EMPLOYMENT
E. T. D.	EXCESS TIME DIFFERENCE
E. T. R.	EXCESS TIME RATIO

F	TEST FOR INCLUSION
H. M.	HOTEL-MOTEL UNITS
L	LOGARITHM
N & H	NET RESIDENTIAL & HOTEL-MOTEL ACRES
N. N. R. A.	NET NON RESIDENTIAL ACRES
N. R. A.	NET RESIDENTIAL ACRES
N. W. P.	NON WORKING PERSONS

P	PRODUCTION VARIABLE
POP.	POPULATION
R	COEFFICIENT OF MULTIPLE CORRELATION
S	SERVICE VARIABLE
S.E.E.	STANDARD ERROR OF ESTIMATE
T.T.D.	TRAVEL TIME DIFFERENCE
T.T.R.	TRAVEL TIME RATIO

FIGURE 15

Subsequent attempts were made with direct generation of both the productions and attractions. No successful equations could be developed for the school transit trip productions with the largest correlation of approximately 0.50 and a standard error of approximately 100 per cent. The most significant variables were the resident dwelling units and the average daily buses. An attempt was made to apply the regression techniques in order to derive a rate equation. Only one variable (non-working population per car) was found to be marginally significant and the resulting equation had a correlation coefficient of 0.14 and a standard error of 129 per cent. In view of the inability to determine any satisfactory relationships a flat rate of 0.1 school transit productions per dwelling unit was established.

Somewhat more success was obtained in the development of a model for school transit attractions. The several categories of enrollment were individually used as well as the bus service variables. Model development was limited to those zones with these attributes. Two additional elements of enrollment, grade school and college, were also used in the model development, as well as several combinations such as total enrollment, high school and college enrollment, etc. The coefficients of the final equations, Table L, indicate some of the variance in transit ridership based on school type wherein less than one of every ten junior high school students use the public bus (assuming two trips per student) while more than one of every six senior high school students use the bus. At the college level this drops to one student in one hundred. The college data comprised the four higher institutions where the enrollment ranged from 129 to 15,000 and the divergence was such that this variable did not have a

statistical importance for inclusion in the final equation. However, a review of the sparce data indicated that the 0.02 college transit attractions per enrollee could be used for an estimate of the ridership and would be of use in areas where there are tens of thousands of students. Grade school enrollment only entered the model development late in the run and then with a negative coefficient. In the urban area where the grammar schools are generally within the walking distance of the student, these trips would not be obtained in the basic data.

Ability to Predict Trips

A detailed study of the ability of the refined modal split models to reproduce the existing transit usage was undertaken with respect to overall tendencies, the productions and attractions by district and to the actual ridership as determined from the home interview sample.

Table M indicates the percentages of transit usages overall and for each of the several purposes. On an overall basis the equations tend to overestimate the transit usage by one per cent. By purpose, only work trips are overestimated by more than one per cent. Two items may be seen to contribute to this tendency to overestimate transit usage. In the application of the equations it is possible to have a negative modal split through the various combinations of data. However, a negative modal split is not acceptable and where such occur they are set to zero. A review of the data indicates that for each purpose the mean transit usage was greater when all interchanges were considered than when only using those with five or more interchanges, Table N. The equations successfully duplicated

TABLE M

PERCENT TRANSIT USAGE

PURPOSE	ESTIMATED	ACTUAL
WORK	12.6	10.7
SHOP	7.0	6.6
SOC-REC/MISC	6.6	5.6
SCHOOL	18.4	17.4
TOTAL	9.2	8.2

TABLE N
COMPARISON OF TRANSIT USAGE BY
TRIP INTERCHANGES

PURPOSE	TRIP INTERCHANGES	% TRANSIT (MEAN)
WORK	A (ALL TRIPS)	15.604
	5 (OR GREATER)	15.087
SHOP	A	12.031
	5	11.255
SOC-REC	A	9.459
	5	8.595
MISC	A	8.614
	5	8.294
SOC-REC/MISC	A	9.387
	5	8.793

this tendency when applied to all interchanges which accounts for over half of overestimation.

Table O indicates transit trips by purposes and totals. These are also subdivided into three generalized areas, i.e. the central business district, the beach and the remaining other areas. The estimated number of transit trips exceeds the observed by 21,000 which is consistent with the percentages evidenced in the preceeding table. The major discrepancies are in the work and miscellaneous purposes with excesses of 8,400 trips each. Except for school all purposes tended to underestimate the CBD trips and all overestimated the beaches and the remaining areas. For work the major discrepancy was found in the other (non-CBD, non-beach) area where there was an excess of 16,000 transit trip ends. The apparent discrepancy in the work trips will be discussed in greater detail below. Miscellaneous transit trip ends were overestimated in the other areas by some 13,000.

Tables P, Q, and R indicate the trip ends by district. All significant differences in the number of trip ends were investigated on a district basis by both home or attraction ends. In the case of work trips there appeared to be two factors which contributed to the discrepancies in the other area. Each of the districts around the edge of the transit service area were overestimated at the home end. It was considered to include a variable relating to the distance to the CBD, however, such is a variable constant rather than a true variable in that for any zone or district the distance to the CBD is fixed and can not change with time, development or improve transit service. The original development of the work equation indicated that commercial employment was more significant

TABLE 0

TRANSIT TRIP ENDS (ORIGINS & DESTINATIONS)

PURPOSE		CBD	BEACH	OTHER	TOTAL TRANSIT TRIPS
WORK	(EST)	9,684	20,469	84,573	57,363
	(ACT)	10,064	19,262	68,585	48,956
SHOP	(EST)	10,829	21,212	25,159	28,600
	(ACT)	11,952	23,321	18,710	26,992
SOC-REC/ MISC	(EST)	9,630	49,443	53,789	56,431
	(ACT)	11,969	43,341	40,736	48,023
SCHOOL	(EST)	2,005	6,099	59,280	33,692
	(ACT)	1,469	5,767	55,608	31,422
TOTAL	(EST)	32,148	97,223	222,801	176,086
	(ACT)	35,452	91,693	183,640	155,392

TABLE P

TRANSIT TRIP ENDS COMPARISON
WORK TRIPS BY DISTRICT

DISTRICT	HOME END		ATTRACTION	
	ACTUAL	ESTIMATED	ACTUAL	ESTIMATED
1	0	0	962	1648
2	0	13	511	447
3	129	111	3681	2955
4	367	261	1885	2010
5	483	535	2045	1704
6	3669	3351	1920	1853
7	3821	5095	1868	2216
8	1134	1422	1539	2870
9	1506	1629	1710	2497
10	7608	8515	750	942
11	1929	2198	1847	1834
12	1907	1392	1758	1711
13	1843	1553	655	1118
14	3901	4155	480	685
15	5184	5156	1427	2850
16	1699	1877	747	1146
17	1154	1053	1699	1331
18	1056	1950	977	1125
19	219	1093	44	284
20	1135	1416	250	560
21	480	1773	756	1351
22	779	1812	944	2134
23	629	613	791	2357
24	2254	1593	1832	1368
25	0	22	839	698
26	464	1776	443	448
27	1099	1107	1214	1072
28	279	703	128	603
29	22	105	196	161
30	304	361	1432	1645
31	1090	1103	736	947
32	249	190	1433	1299
33	448	852	1526	1541
34	334	324	1230	1731
35	23	251	1013	1333
36	57	93	2096	2458
37	219	351	1108	914
38	876	687	2351	1844
39	471	607	1060	704
40	82	165	708	528
41	53	100	363	441
Total	48,956	57,363	48,956	57,363

TABLE Q

TRANSIT TRIP ENDS COMPARISON
SHOPPING TRIPS BY DISTRICT

DISTRICT	HOME END		ATTRACTION	
	ACTUAL	ESTIMATED	ACTUAL	ESTIMATED
1	0	0	183	159
2	0	83	234	29
3	0	17	9644	9528
4	215	171	935	324
5	233	254	508	264
6	2037	2901	404	1274
7	2738	3470	299	1521
8	285	808	57	628
9	164	387	116	313
10	634	487	0	51
11	170	259	75	128
12	387	879	1615	1368
13	975	1180	0	337
14	484	396	508	769
15	736	719	335	559
16	318	404	390	395
17	470	833	228	689
18	738	191	726	600
19	58	33	0	5
20	115	28	0	24
21	197	87	179	18
22	286	195	149	44
23	291	277	187	479
24	731	809	96	172
25	75	92	473	548
26	168	134	75	43
27	523	339	0	36
28	94	99	127	73
29	0	45	0	33
30	1174	1081	641	735
31	1730	1744	0	400
32	646	331	1598	676
33	1053	1141	5633	3199
34	2808	1609	54	22
35	139	484	253	806
36	3151	1623	79	26
37	91	93	192	193
38	2609	3082	999	1558
39	226	780	0	282
40	30	256	0	39
41	215	799	0	253
Total	26,992	28,600	26,992	28,600

TABLE R

TRANSIT TRIP ENDS COMPARISON
SOCIAL-RECREATIONAL-MISCELLANEOUS TRIPS BY DISTRICT

	HOME END		ATTRACTION	
DISTRICT	ACTUAL	ESTIMATED	ACTUAL	ESTIMATED
1	0	1	893	1075
2	291	301	315	231
3	0	69	4986	4772
4	1291	657	2164	1063
5	601	492	1428	969
6	2416	4189	1712	3045
7	4663	6590	1601	3866
8	390	1243	1454	2071
9	650	1015	2506	1602
10	1402	1112	346	672
11	244	796	0	533
12	2362	2094	4403	2929
13	1067	1812	497	1138
14	750	991	569	834
15	1690	1708	470	1117
16	753	1087	227	965
17	252	1499	935	1705
18	574	106	685	1321
19	0	85	0	111
20	91	67	57	132
21	339	113	247	143
22	717	169	753	565
23	543	507	327	1052
24	1315	922	1188	933
25	0	135	471	618
26	533	79	83	258
27	596	298	263	424
28	0	81	189	156
29	30	55	397	846
30	2206	1798	3739	2600
31	2079	2712	653	686
32	2368	1653	1612	1046
33	2113	2476	2276	2698
34	4204	3394	1653	2191
35	1049	1013	743	1163
36	5145	4220	1410	1657
37	0	69	1326	1306
38	3708	6323	2926	3565
39	571	1543	670	1386
40	75	357	0	637
41	968	2600	1851	2350
total	48,023	56,431	48,023	56,431

than total employment, however, the latter was included to give greater area coverage. Of the 53,700 industrial workers employed within the area served by transit, 17,300 or 33 per cent are employed in the four districts where there was a significant overestimation at the attraction end of the trip. Twenty-three per cent of the "other" employment in the Miami area is also engaged in these four districts. No similar patterns could be found to exist in either the shopping or miscellaneous model applications. Median incomes as well as other indicators were reviewed without evidencing a correlation with the comparisons between the estimates. There was no significant overestimation around the edge of the transit service area for non-work purposes.

While it was found that the school productions and attractions disagreed by only two per cent, it was found that there was considerable disparity between the beach and the mainland areas with regard to the productions. Since the attractions were found to agree with the actual trips (3091 attractions compared with 3045 trips), the productions were balanced to the attractions on a beach non-beach basis.

Observed transit trips and those generated by the several models were assigned to a spider network which directly connects all district centroids. The results of these assignments are seen in Figure 16. For comparative purposes four screenlines were cut as indicated on the figure and the results are indicated in Table S. The screenlines generally confirm the previous findings in that the CBD screenline indicates an underestimation while two of the others reflect an overestimation. However, the maximum deviation is 10 per cent which appears within reason for this data.

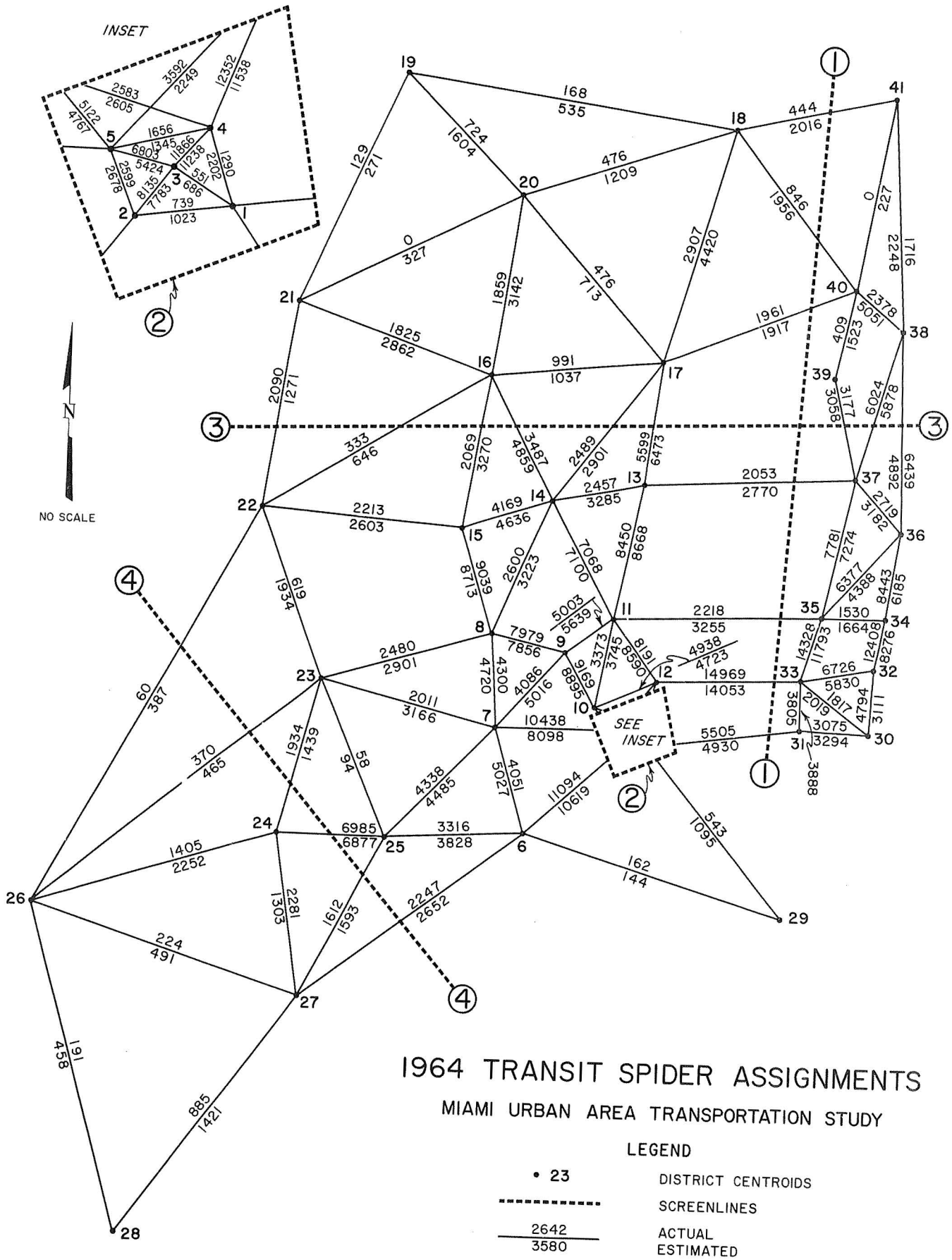

INSET
NO SCALE
N
SEE INSET
1964 TRANSIT SPIDER ASSIGNMENTS
MIAMI URBAN AREA TRANSPORTATION STUDY
LEGEND
• 23 DISTRICT CENTROIDS
SCREENLINES
2642 / 3580 ACTUAL / ESTIMATED

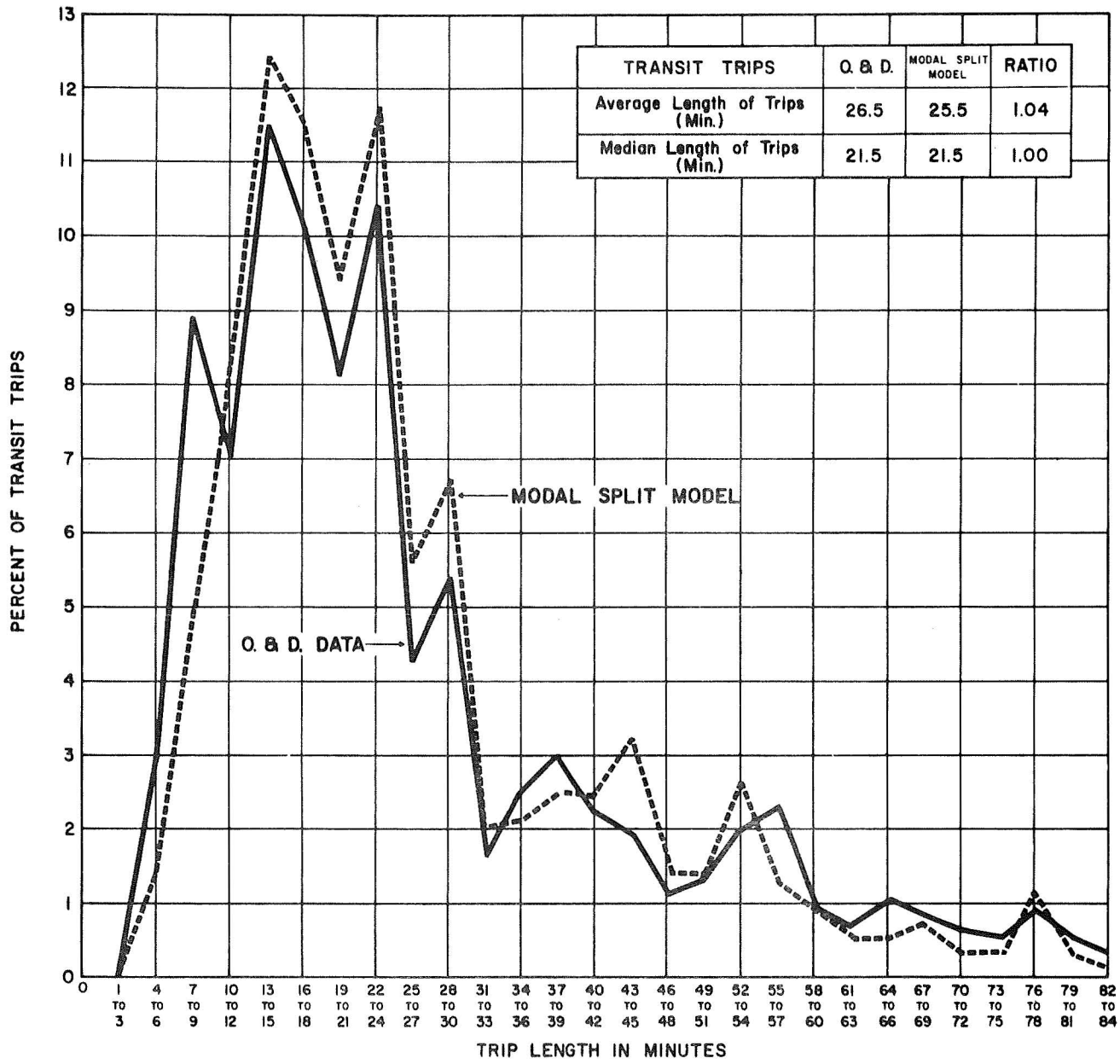
FIGURE 16

TABLE S

SCREEN LINE COMPARISONS

SCREEN LINE	ESTIMATED	ACTUAL	PER CENT DIFFERENCE
1. INTRACOASTAL WATERWAY	30,897	27,996	+10
2. CBD	45,892	51,229	-10
3. 79TH STREET (SOUTH OF)	33,248	31,707	+ 5
4. SOUTHWEST	13,113	13,208	- 1

Figure 17 illustrates the trip length distribution of the observed origin-destination transit trips and those developed through application of the modal split model. Also indicated are the average and mean lengths of transit trips. Although the model trip length peaks are slightly less pronounced, the pattern is similiar and the trip length frequency comparisons are quite satisfactory. The average trip lengths agree within one minute while the median trip lengths are the same, indicating a very favorable comparison.



TRIP LENGTH FREQUENCY FOR TRANSIT TRIPS

MIAMI URBAN AREA TRANSPORTATION STUDY

FIGURE 17

CHAPTER VI

SUMMARY OF MODAL SPLIT PROCEDURES

In the preceding pages have been described the development of the equations which will be used in estimating both future public bus trips and rapid transit trips. Two different approaches were described (trip-end and trip-interchange) with the trip-interchange method being chosen as the better method for the Miami urban area, especially in view of the fact that travel by both public bus and rapid transit systems is to be estimated.

The development of modal split models by the consultant and the Department have been described. Both invested considerable effort and it is problematical which would produce the better future estimates.

In the development of the modal split models, both those developed by the consultant and the later refinements of the Department, the weaknesses of the service variables has been noted. It is apparent that the savings of time is not a major consideration of the present transit ridership. This appears to stem from two distinct groups of riders, those who ride transit from necessity such as the old, the young, the ones without an automobile available, etc., and the tourists. The former, lacking a choice, must conform to the transit schedule while the tourists are not geared to a fixed time and are free to accept a schedule which may not provide the optimum travel time. Neither are actively engaged in seeking competitive forms of travel.

The application of these equations in the testing, analysis and development of future transportation systems will be described in detail in a subsequent technical report. The general procedures to be employed to "split" trips to proposed bus and rapid transit networks are outlined as follows:

1. The generation equations are supplied, using forecasted zonal values

for the social-economic variables, to produce estimates of total person trips, and the gravity models are applied to produce zone-to-zone distribution of these.[1]

2. The appropriate transit modal split equation is applied to each of the zonal interchanges resulting in the percentage of all person trips between them which are estimated to use transit rather than auto.
3. The resulting transit trips may then be assigned to the transit system, using the minimum time path traffic assignment method.
4. The remaining trips (after deducting auto passenger trips), then, are the auto driver trips assignable to the highway network.

Although the method of estimating future transit is based on the supposition that rapid transit usage will be similar in the Miami urban area to that presently seen on public bus, it is believed that the method will adequately accomplish the purpose for which it was intented.

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[1] The development of the generation and distribution models are described in Technical Report No. 3.

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MIAMI URBAN AREA TRANSPORTATION STUDY

TECHNICAL REPORT NO. 5

GROWTH PROJECTIONS 1964 - 1985

MEL CONNER & ASSOCIATES, INC.

1968

MIAMI URBAN AREA TRANSPORTATION STUDY

TECHNICAL REPORT NO. 5

GROWTH PROJECTIONS
1964-1985

Prepared for the

Florida State Road Department

In cooperation with the

U. S. Department of Transportation
Federal Highway Administration
Bureau of Public Roads

and the

Miami Urban Area Transportation Study
Technical Advisory Committee

by

Mel Conner & Associates, Inc.
Tallahassee, Florida

August, 1968

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CHAPTER I

INTRODUCTION

This is the fifth of a series of technical reports which present the pertinent details of progress made in each major phase of the Miami Urban Area Transportation Study.

These reports serve to insure that the membership of the Technical Committee, other administrative officials, and interested technical persons, are thoroughly familiar with the transportation study procedures and processes employed by the Florida State Road Department and its Consultant. This is in keeping with the project's prime objective of initiating a continuing, cooperative, comprehensive transportation planning process.

This report describes the growth of the study area, as projected by the Metropolitan Dade County Planning Department, and demonstrates how this growth is used to estimate future travel. The qualifications which must be placed on the future trip estimates when they are used in the development of the future transportation system are also discussed.

A Policy and Procedure Memorandum -- PPM 50-9 -- on urban transportation planning, which was distributed by the Bureau of Public Roads, lists ten basic elements for which inventories and analyses are required in the transportation planning process. These are:

1. Economic Factors
2. Population
3. Land Use
4. Transportation Facilities
5. Travel Patterns
6. Terminal and Transfer Facilities
7. Traffic Engineering
8. Zoning Ordinances
9. Financial Resources
10. Community Values

Inventory data from the first three categories, along with the survey trip data, were used to develop the trip generation equations described in Technical Report No. 3. Estimates of these data were made for the years 1975 and 1985 to facilitate use of these equations in predicting future trip ends.

Chapter II of this report discusses population data, land use and social-economic data projections as well as the transit, parking and central city studies for the Miami Urban Area.

Other reports which will be prepared by the County Planning Department will provide more specific details of the procedures used in analyzing and projecting the data used in various phases of the study.

CHAPTER II

GROWTH OF THE STUDY AREA

Population, land use and economic studies, as well as transit, parking and central city studies are required in preparing a reliable estimate of future traffic on all the planned principal streets and highways in the study area.

The growth studies for the Miami Urban Area Transportation Study were performed by the Metropolitan Dade County Planning Department. This Chapter presents a review of these studies, while the following Chapters will discuss their use in predicting 1975 and 1985 traffic.

General Review

The Metropolitan Dade County Planning Department forecasts of population and economy have formed the basis for estimating both future land use and travel demands, since the numbers of people and jobs are major determinants of trip-making activity.

The following sources were used by Dade County in making their estimates:

a. U. S. Census of Population and Housing, 1950 and 1960.
b. 1960-63 County Survey of Population and Housing.
c. MUATS interview data pertaining to population and dwelling unit data and length of stay.
d. 1950-64 net In-Migration Study by County.
e. 1960 Report by County on Population Projections.
f. 1963 County estimates of 1985 population and research material related to General Land Use Master Plan.
g. County 1975 population projections by modified interpolation.
h. Developed acreage data prepared by County.
i. Land use maps prepared by County.
j. Florida State Employment Service monthly employment estimates (1947-1964).

Their broad background of earlier planning studies, data and reports was utilized by the County in projecting and quantifying estimated traffic zone characteristics for 1975 and 1985. Descriptive summaries of all definitions, sources, methods and procedures utilized in producing these estimates were documented by the County and are a part of the files of this transportation study, along with the detailed tables containing the estimates.

In the interest of assuring themselves and the State Road Department of the appropriateness of these estimates for use in estimating travel growth, the Consultant's transportation engineering and urban and regional planning

staff reviewed these data and the supporting documentation in detail. In addition to a check of the general soundness of the methods employed, the review included an examination of each zonal estimate and factor to establish:

1. That it reflects and agrees with the development defined by the Land Use Plan, and

2. That it is possible and reasonable to expect that development will occur at the densities indicated.

Where estimates appeared questionable, these were discussed specifically with the County Planning Staff. Partly as a result of this dialogue, but primarily through the closely communicated, iterative process of transportation system testing, "feedback" information was produced which led to modifications in the land use plan. The County's "Revised 1985 Land Use Plan" was established, ultimately, as one which includes and is interdependent with the recommended Transportation Plan, is completely served by it, and is concurred in by the Technical Advisory Committee.

It was concluded that the land use development and population growth described by the General Land Use Master Plan will probably not be reached until after 1985 - perhaps in 1990 - when the area population will be closer to 2.5 million than to the 2.0 million now projected in 1985. This general difference in magnitude of growth is the basic difference between the General Land Use Master Plan and the Revised 1985 Plan used in this study.

The adjusted zonal estimates meet the above criteria of this study and were determined to be appropriate for use in estimating travel. All 1985 analysis and input referred to hereafter pertain to this Revised Plan, unless otherwise noted.

The corresponding 1975 estimates were also made by the County, largely as a modified interpolation between 1964 data and the 1985 estimates. This process is also described in the County documents on file, and was reviewed in some detail by the Consultant's staff. In addition, the 1975 estimated trips by purpose resulting from application of the trip generation equations were carefully analyzed in comparison with corresponding 1964 and 1985 values. No deviations from logically interpolated values were discovered which were not rationally explained. The work sheets, graphs, etc. prepared in this review are also a part of the work files for this technical report.

A series of graphs is presented to illustrate, in summary, the estimated growth trends of total population, automobiles, dwelling units, employment, and the relative increase of resident and tourist population numbers from 1964

to 1975 and from 1975 to 1985. Figure 1 depicts the historical and projected future population trends of the State of Florida, the three southeast "gold coast" counties and Dade County. Figure 2 shows the estimated growth of the total study area population as related to increases in numbers of automobiles and dwelling units. Figure 2 also illustrates the proportionate increases estimated for the resident and tourist segments as well as the total study area population. Resident population increases and study area employment are indicated by Figure 3.

Population Studies

Based on the County Planning Department projections, the study area resident population is expected to reach approximately 1,950,000 persons in 1985. Because this study is designed for the winter season, however, approximately 190,000 seasonal tourists[1/] have been added, making the total study area population in 1985 some 2,138,000 persons. These estimates reflect a total population growth of about 80 percent over a twenty-one year period. Projected resident and tourist population increases for the period of study are 79 percent and 92 percent, respectively.

Basically, the County's master plan was developed on a neighborhood, community and urban core area principle. Saturation population capacities at assumed densities were calculated for each neighborhood. Employing knowledge of present residential development where it existed and known factors of land developability such as accessibility, land elevation and quality, flood criteria, existing zoning, ownership patterns, etc., the County planners designed density patterns for each neighborhood. It was assumed that peripheral areas of Dade County would be developed to about one-half their holding capacity by 1985. Areas nearer the CBD would develop closer to their full holding capacity. The population estimates for neighborhoods were then translated into traffic zones.

Independent checks of the County Planning Department's 1975 and 1985 population projections were made by the Florida State Road Department and by the Consultant's urban and regional planning staff and confirm the local projections. A thorough review of all reports on the subject led to the conclusion that the County approach and methodology was the best available for the task. Analysis of Metro's projected land use patterns, residential densities, and employment densities revealed that their estimates of future population numbers and distribution are well conceived and sound.

As a part of this review, the Dade County study area was divided into fifty (50) districts. The projected 1985 population was assigned to these districts on the basis of population trends, land use trends, attractions, access and ownership. Utilizing the same criteria and assuming a logical growth pattern, a further subdivision of population was made and assigned to the 550 traffic analysis zones.

1/ It was assumed that all persons staying a total of six months or less would constitute tourist population for use in this study, as they would not be a part of the resident population considered by the census. This quantity represents an average daily population for the winter season.

A district comparison was then made with the data furnished by the County. Within areas of major change zonal comparisons were also made to verify the reasonableness of the projections.

Figure 4 graphically depicts the increase, on a district basis, of existing and anticipated resident population. Investigation of Figure 4 reveals that the projected rapid population increase will result in rather substantial numerical increases in areas already developing in an urban manner and even more obvious increases in those areas where current population levels are relatively small.

The north-central parts of the City of Miami--now the most densely developed areas--are expected, naturally, to experience the least percent of increase in population, the range being from 4% to 32%. The northern developed area will increase faster at rates varying from 28% to over 100%. The beach areas, although already densely developed, are expected to increase remarkably, at rates from 48% to 99%. This growth reflects the recent trend toward dense high-rise development in much of urban Dade County. South and west Dade County will also increase at a very high rate, these being the less populated districts at present.

Population densities per residential acre, by district, have been calculated for both 1964 and 1985. Because of their importance in predicting future transportation complexities accurately, these densities are presented in Table I.

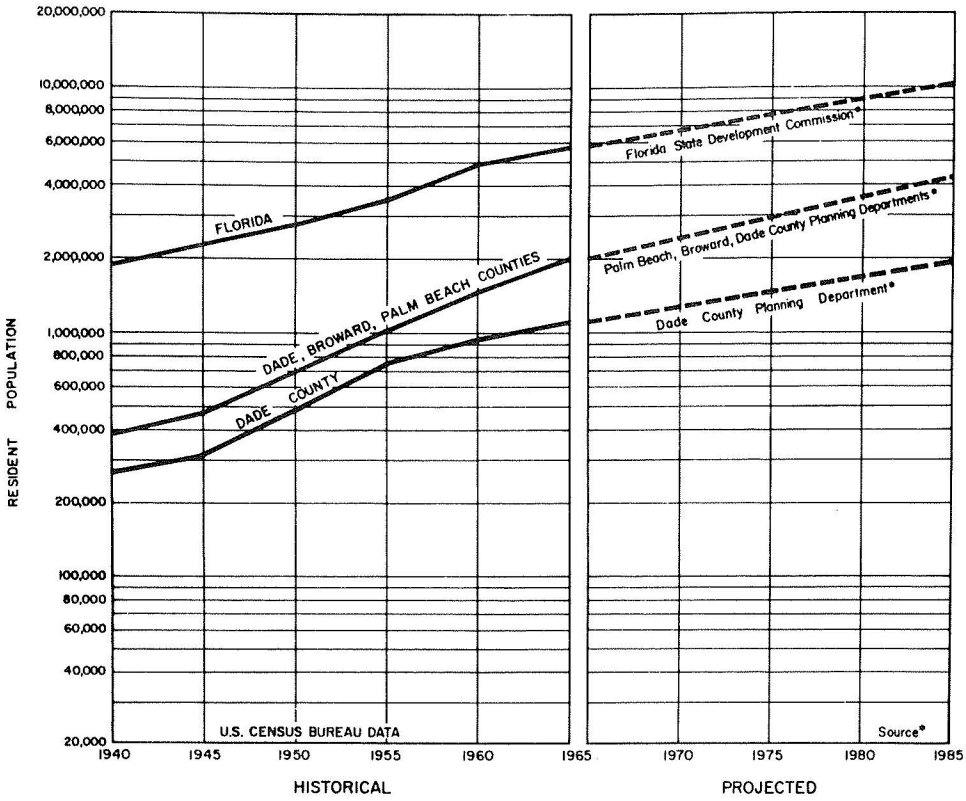
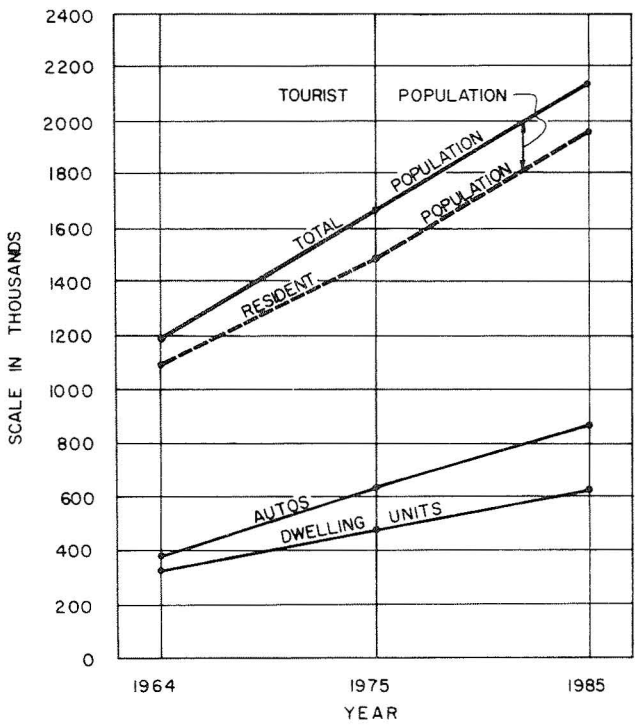


FIGURE 1

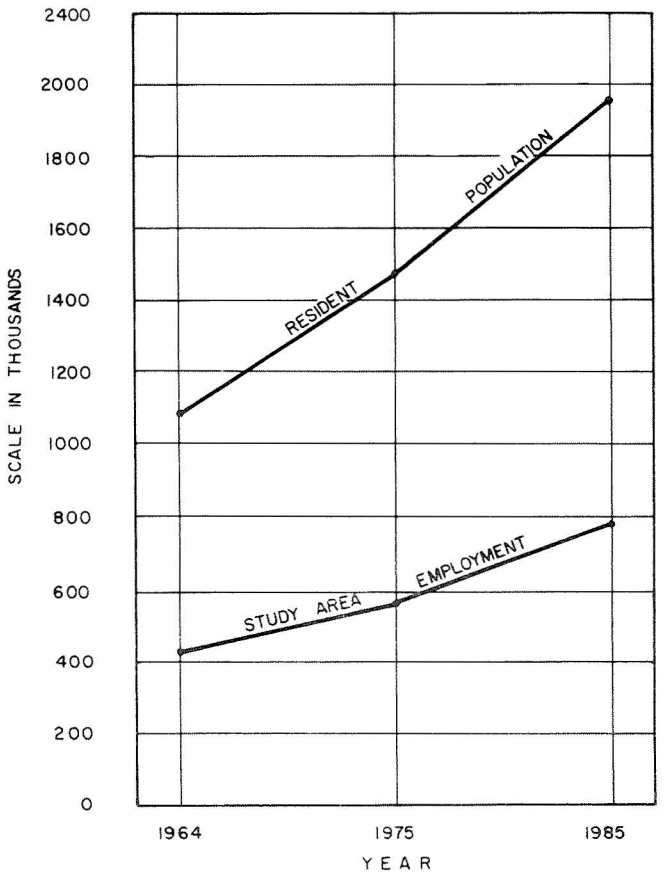


MIAMI URBAN AREA

1964, 1975, 1985 — POPULATION, AUTOS, DWELLING UNITS

MIAMI URBAN AREA TRANSPORTATION STUDY MEL CONNER & ASSOCIATES, INC.

FIGURE 2



MIAMI URBAN AREA

1964, 1975, 1985 — RESIDENT POPULATION, EMPLOYMENT

MIAMI URBAN AREA TRANSPORTATION STUDY MEL CONNER & ASSOCIATES, INC.

FIGURE 3

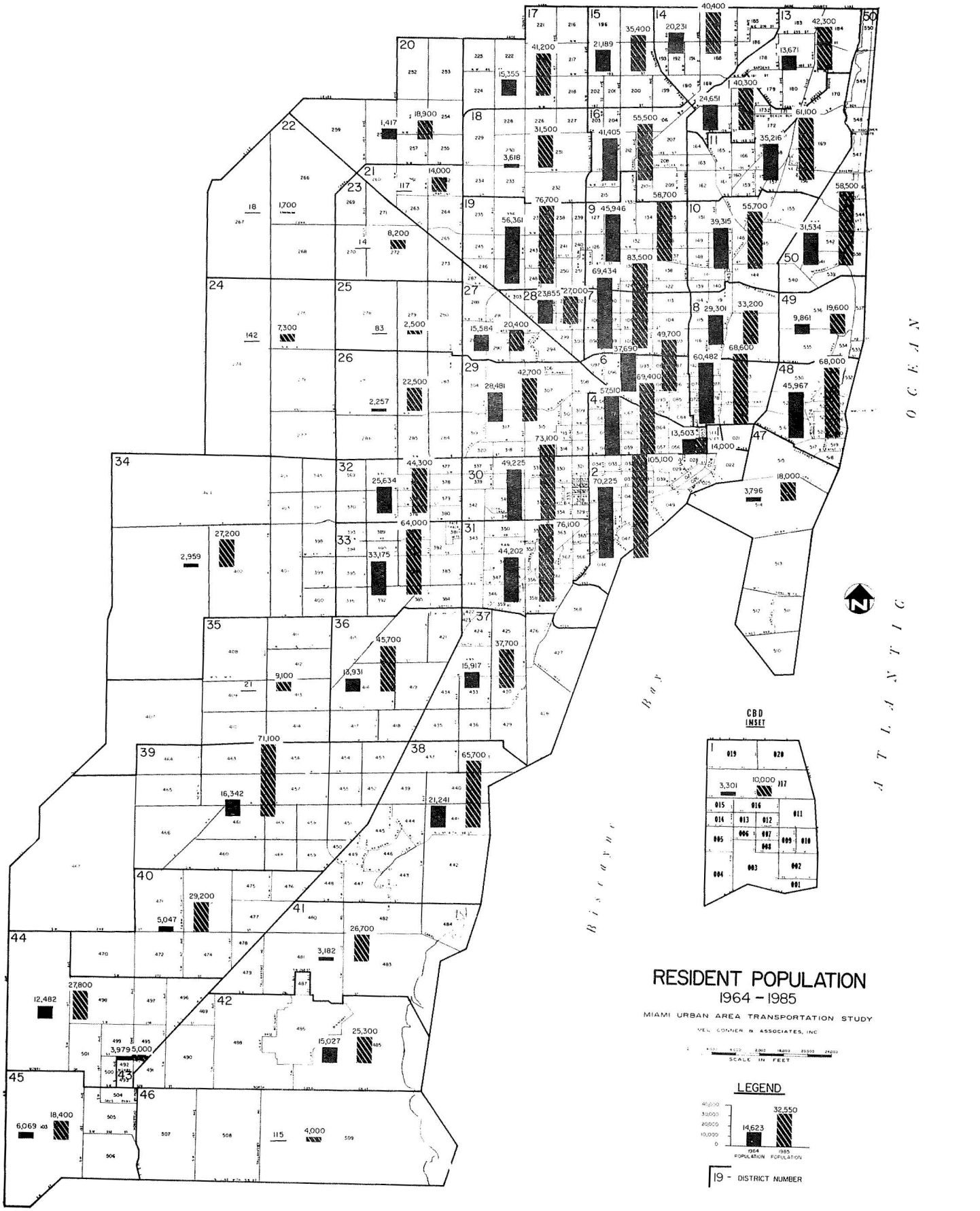

OCEAN
ATLANTIC
Bay
Biscayne
CBD
INSET
RESIDENT POPULATION
1964 - 1985
MIAMI URBAN AREA TRANSPORTATION STUDY
WILBUR SMITH & ASSOCIATES, INC
SCALE IN FEET
LEGEND
14,623
32,550
1964 POPULATION
1985 POPULATION
19 - DISTRICT NUMBER

FIGURE 4

TABLE I
POPULATION DENSITY, 1964 - 1985
(Resident Population/Net Residential Acre)

District	Population Density 1964	Population Density 1985	District	Population Density 1964	Population Density 1985
1	144	357	26	22	14
2	25	34	27	17	20
3	103	107	28	23	26
4	37	43	29	19	28
5	100	107	30	18	24
6	35	48	31	12	19
7	42	50	32	16	20
8	29	31	33	12	17
9	20	22	34	20	16
10	16	15	35	1	16
11	16	22	36	9	11
12	18	23	37	5	9
13	17	28	38	17	17
14	19	22	39	15	19
15	17	19	40	12	9
16	21	23	41	8	18
17	19	19	42	21	20
18	7	20	43	27	30
19	23	23	44	18	12
20	19	12	45	26	14
21	2	12	46	19	11
22	6	10	47	16	32
23	2	14	48	50	66
24	6	11	49	19	33
25	12	12	50	24	42

Land Use Studies

Forecasts of land use, essential in determining future travel demands, were prepared by the Metropolitan Dade County Planning Department. The Consultant has reviewed and analyzed these forecasts for purposes of verifying reasonableness and reliability of the estimates, and aside from his own verification, has reviewed and discussed the forecasts with all agencies involved.

Residential and non-residential land use estimates for 1975 and 1985 have their basis in existing and expected land use development patterns, land accessibility, and population trends. Residential land use was projected in a manner compatible with the 1975 and 1985 traffic zone population growth factors. A comprehensive review of the land use forecasts and the County Planning Department's reports on their projections led to the conclusion that these data were of sound professional quality and useful in estimating future traffic.

Economic Studies

The economic study of the Miami urban area provided the data needed, when combined with the projections of population, to make the land use and travel forecasts. The study was accomplished by the Metropolitan Dade County Planning Department and provided data on employment, automobile ownership, and tourist facilities. The County followed a step-wise ratio-trend approach in establishing projections of 1985 employment categories for the county as a whole. This involved a logarithmic projection of historical (1947-1964) labor force participation rates.

The Consultant reviewed the forecasts for those traffic analysis zones which were fully developed in 1964 and which are not expected to experience any drastic compositional change in the next 20 years. They were based on existing ratios relating to zonal population and land use areas. On the other hand, zones which were partially or totally undeveloped in 1964 were examined individually and assigned logical ratios for economic distribution.

Employment in the south and west sections, although experiencing large percentages of increase, will continue to be only a small part of the total County employment. Although some significant increases in jobs will occur in the northern parts, the preponderant bulk of employment is expected to continue to be in the four largest municipalities and in the vicinity of Miami International Airport. The rates of increase predicted for these areas of greatest employment are as follows:

Miami area	14% to 77%
Miami Beach area	93% to 182%
Hialeah area	52% to 79%
Coral Gables area	48% to 73%
Airport area	133%

Densities of total employment have been calculated by district for 1964 and 1985 and are shown in Table II. Figure 5 graphically illustrates the 1964 and anticipated 1985 employment on a district basis.

TABLE II
EMPLOYMENT DENSITY, 1964 - 1985
(Employment/Net Non-residential Acre)

District	Employment Density 1964	Employment Density 1985	District	Employment Density 1964	Employment Density 1985
1	237	226	26	4	12
2	33	43	27	7	12
3	61	65	28	34	34
4	39	45	29	8	20
5	60	60	30	49	41
6	48	60	31	21	22
7	32	35	32	4	12
8	31	30	33	5	6
9	14	20	34	7	8
10	22	24	35	6	4
11	16	24	36	9	10
12	22	37	37	12	11
13	9	20	38	9	11
14	8	15	39	11	7
15	4	10	40	8	7
16	11	18	41	6	7
17	6	11	42	3	4
18	1	8	43	19	19
19	24	21	44	10	8
20	0	8	45	19	13
21	7	9	46	2	3
22	0	8	47	11	17
23	4	9	48	78	117
24	1	8	49	98	228
25	10	17	50	43	76

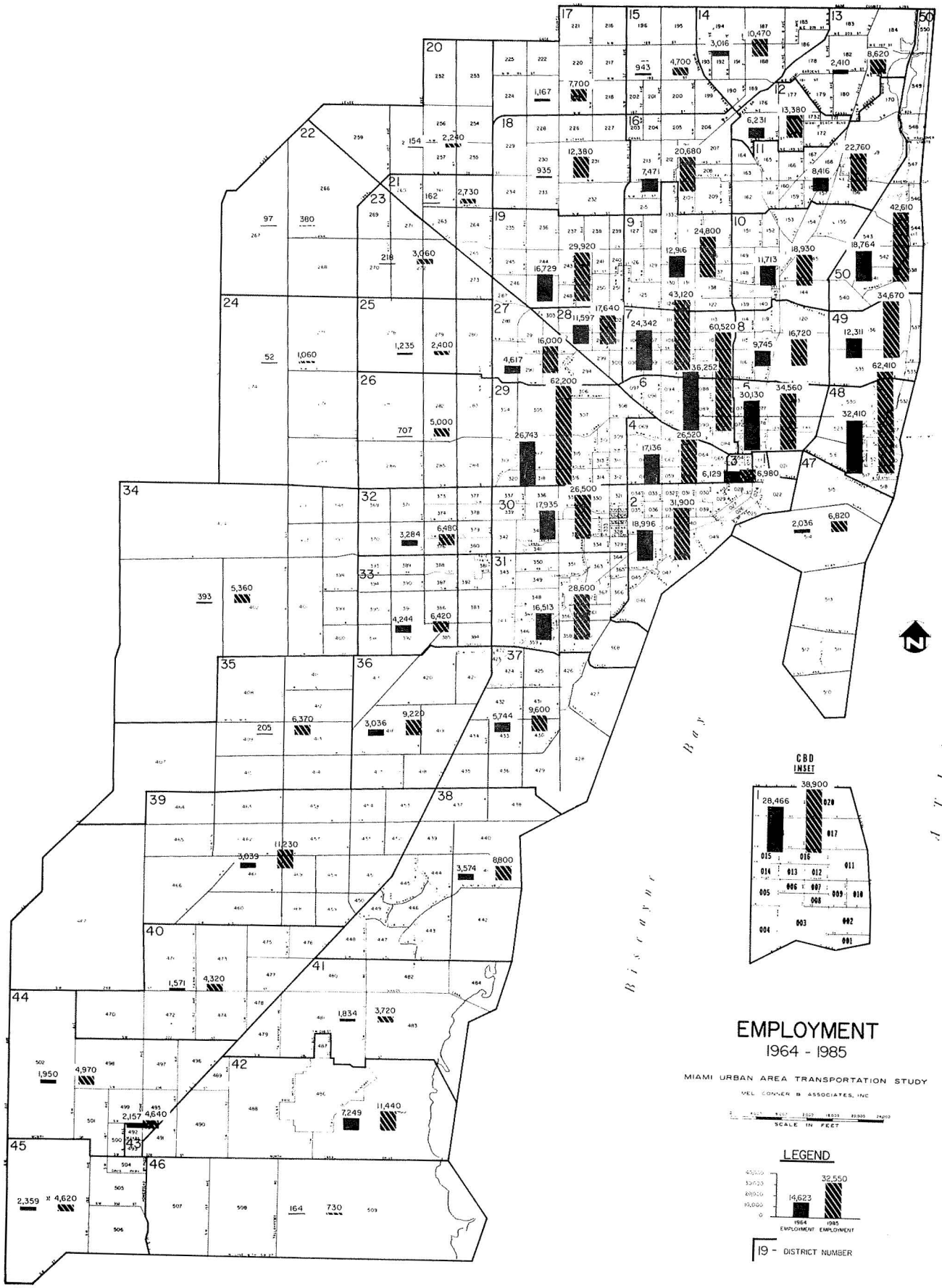

EMPLOYMENT
1964 - 1985
MIAMI URBAN AREA TRANSPORTATION STUDY
WILBUR SMITH & ASSOCIATES, INC
SCALE IN FEET
LEGEND
14,623
32,550
1964 EMPLOYMENT
1985 EMPLOYMENT
19 - DISTRICT NUMBER
CBD INSET
OCEAN
ATLANTIC
Bay
Biscayne

FIGURE 5

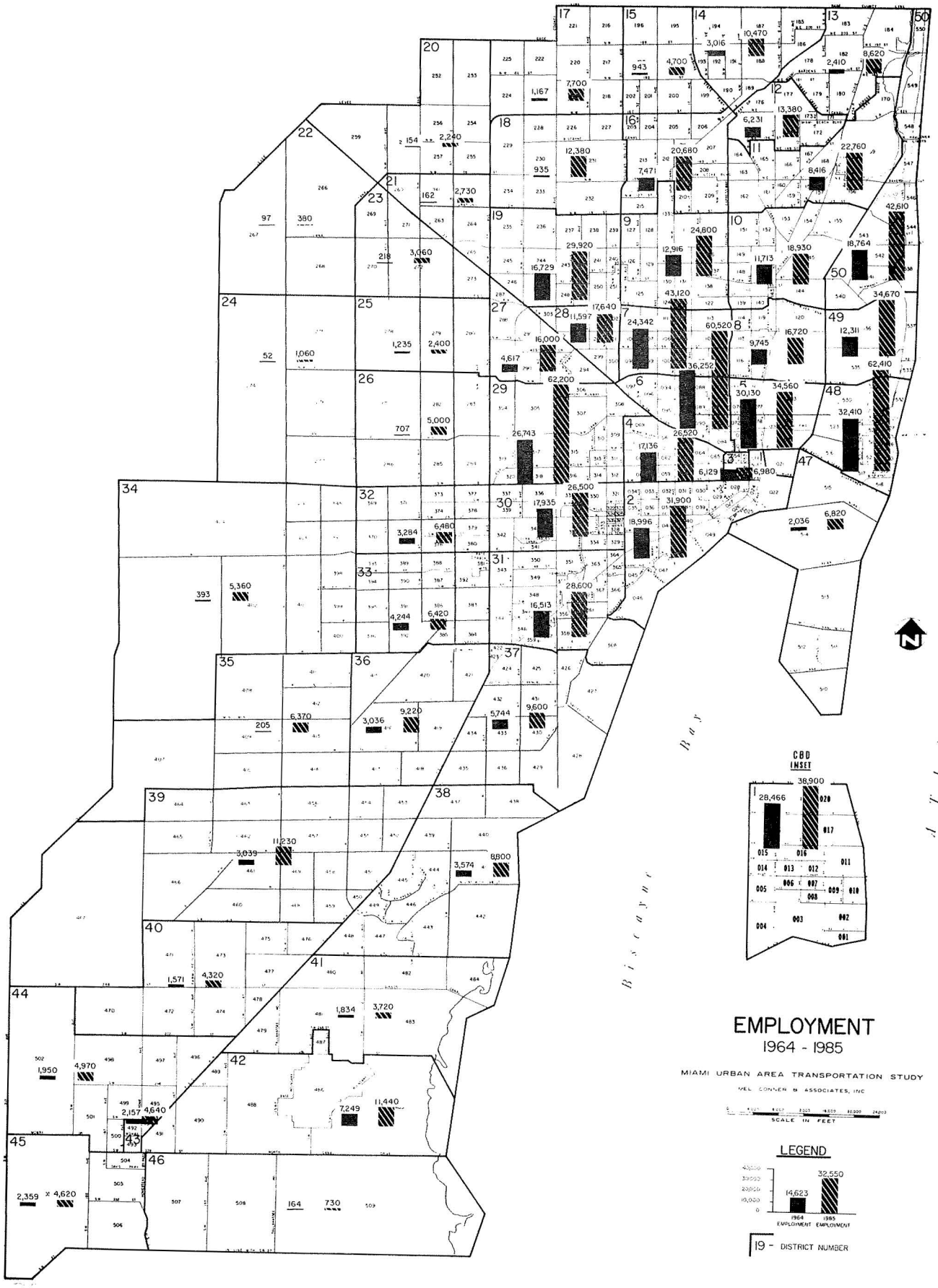

EMPLOYMENT
1964 - 1985
MIAMI URBAN AREA TRANSPORTATION STUDY
CBD INSET
LEGEND
14,623
32,550
1964 EMPLOYMENT
1985 EMPLOYMENT
19 - DISTRICT NUMBER
Biscayne Bay
ATLANTIC OCEAN

FIGURE 5

Transit Studies

In developing a recommended major street and highway system to serve 1985 vehicle traffic, the person trips expected to be served by transit were to be deducted from the total predicted future person trip table before the vehicle trips were calculated. To perform this "modal split" operation, a mathematical model, developed as described in Technical Report No. 4, was to be used. Technical Report No. 4 was initially prepared in February, 1967; subsequent analysis by the Florida State Road Department has also been described in the report as revised by the Department in July, 1968.

The purpose of the modal split analysis was limited, in this stage of the continuing study, to providing an approximation of the amount of reduction of travel on the highway system which would be expected by assuming some increased level of transit service to be provided in 1975 and in 1985.

The matter of the degree of accuracy, in defining the level of future transit service, required for this purpose,was considered at some length by the Consultant and by the Technical Committee. The 1964 survey data showed that the then-existing bus system in Dade County served 6.4% of all person trips. Using the preliminary bus and rapid transit networks designed by Dade County, and applying the modal split model, resulted in the estimate that approximately 5 percent of the 1985 person trips will be served by transit. Based on the preliminary transit studies to date, and in view of the anticipated continued importance of the automobile mode in Dade County, the Technical Committee has generally concluded that transit cannot reasonably be expected to serve more than 10 percent of the person trips in 1985, even with the most elaborate system which could be expected through subsidization.

The transit system assumed is the preliminary system now under study by the County. It includes both an expanded bus system and a rapid transit system to serve the more dense corridors of usage generation. Descriptions of these systems are contained in Technical Report No. 6, "Development of the Recommended Plan", along with a discussion of the analysis procedures followed and considerations of inter-system effects and combined highway transit facility design. While it is possible that further studies will result in a transit program which provides greater service, and while such increased service might permit some lane reductions in the highway system design, it was concluded that no major highway system changes would result, such as deleting an arterial street link or changing a freeway recommendation to an arterial street recommendation.

Plans are now being formulated by Metropolitan Dade County to undertake an extensive and detailed study for the purpose of establishing a financially feasible transit development program. As later discussed in Technical Report No. 8 ("The Continuing Planning Process"), the results of the transit study should be examined to determine how the recommended transit systems

differ from those assumed for this study, and if the differences are significant, a check of the 1985 highway system plan should be performed using any refined modal split models which may then be available.

Parking Study

The State Road Department's Division of Traffic and Planning undertook a study of parking as it is related to this transportation study. The following description of this parking study was prepared by the Department.

> As a part of the overall transportation study the State Road Department has been engaged in a study of eighteen areas which are generally commercially oriented and which were selected by the Technical Committee as present or potential parking problem areas. This study is not intended to provide a feasibility analysis for parking facilities but only to demonstrate the ability of an area to provide for the number of vehicle trips which will be attracted according to the anticipated land use and activity and based on the generation determined predominately by the attraction models discussed in Technical Report No. 3.
>
> The basic studies of these areas included an inventory of the parking supply and measurement of usage such as turnover, duration, etc. The usage information was correlated with the trip and parking information obtained in the home interview to determine demands. Based on the established criteria which included an assumed maximum walking distance of 750 feet, only a portion of two of the eighteen areas selected for study were considered to have parking deficiencies at the time of the study.
>
> On Miami Beach a deficiency of approximately 300 spaces was found on Washington Avenue south of the Lincoln Road Mall. In the Miami Central Business District there was a need for 425 spaces in the vicinity of Flagler Street and N.E. 1st Avenue. However, both the Miami Beach and the Miami Central Business District possessed a gross parking surplus.
>
> The 1985 parking demands were based on the future travel determined in this study and have been compared with the existing parking supply augmented in the Civic Center and Miami Central Business District areas with the additional spaces created in conjunction with the construction of the East-West Expressway and the Downtown Connector, respectively. Table III indicates the additional 1985 space requirements in the five areas which evidenced deficiencies. With the exception of the International Airport and Cutler Ridge, the other areas have a gross parking surplus. The International Airport, like many of the areas studied, is unique in its travel and its parking requirements and

would require in-depth study to determine the true requirements. The 1964 person trip data included not only trips by private vehicles (both auto driver and auto passenger) and transit passengers, but also taxi and limousine passengers. In 1985 all person trips were assumed to be by means of private vehicles or transit and the latter, taxi and limousine, were not considered but would be of major importance at the airport.

TABLE III

1985 ADDITIONAL PARKING SPACE REQUIREMENTS 1/
(PRELIMINARY)

No.	Study Area Location	Additional Spaces
9	Miami International Airport	3,937
10	Civic Center	989
11	Miami Beach	412
12	Miami Central Business District	2,471
19	Cutler Ridge	115

1/ Data from Florida State Road Department Parking Study

It is estimated that at least 800 spaces could be deducted from the 1985 parking requirements because of these alternate means of travel. An in-depth study is required to refine the preliminary parking requirements indicated in Table III. The Miami Central Business District evidences the second largest number of additional space requirements. As noted in Technical Report No. 4, it appears that the modal split tends to underestimate the Central Business District transit trips by approximately ten percent, conversely raising the automobile trips and, in turn, the parking requirements. It is estimated that this overestimation of the vehicle trips may have raised the 1985 additional parking requirements by approximately 1100 spaces and that the actual 1985 requirements will be approximately 1400 spaces.

The Civic Center area indicates a need for a substantial number of additional parking spaces, chiefly related to the area in the vicinity of the new Veterans Administration Hospital, where new spaces should be provided, and Jackson Memorial Hospital.

The Miami Beach area indicates a moderate increase in the number of required parking spaces over the deficit of 1964. In addition to the Lincoln Road Mall area, some additional spaces will be required south of Fifth Street in the Alton Road

area and, to a lesser degree, north of Fifth in the Washington Avenue area.

Some minor deficiency is observed in the Cutler Ridge area; however, since much of this area is not currently developed, it is anticipated that these added parking spaces will be provided with the development.

As noted in Table III, and in the Department's discussion above, the parking study results are preliminary since that phase of the study has not yet been completed. Obviously, it was not possible, without undue delay to the entire study, to utilize this information in order to determine the 1985 parking facilities required to accomodate the forecasted vehicle trips. It was concluded by the Technical Committee that this delay was not justified, and it was concurred that an assumption would be made at this time that the required parking will be made available as necessary. In summary it was concluded and agreed by the Committee that at this time there is no evidence of any parking shortage in 1985 which would preclude development of land use as now projected. As a part of the continuing phases of this study, the final results of the parking study must be reviewed with particular attention to the land use and activity in the four critical areas described.

Other Studies Related to Growth Projections

Throughout the transportation study excellent communication between the participating agencies via the Technical Advisory Committee has assured that the findings of other current studies have been given due consideration.

During 1966-67 a "Comprehensive Plan for Downtown Miami"[1/] was prepared for the Downtown Development Authority of the City of Miami. That study identified existing conditions, recommended goals and policies, and presented a physical development plan for the year 2000. Growth trends as developed in the Miami Urban Area Transportation Study for the year 1985, and as generally described in this technical report, were acknowledged in the Doxiadis study; however, the latter plan assumes, for the year 2000, a much greater density and concentration of activity in the center city. The pattern of development considered in this 1985 transportation study is directed toward the Doxiadis plan, contingent on the attainment of proper balance in parking, transit and highways; i.e., a system which provides a good accessibility to downtown Miami.

All other known current plans of the cities and agencies within Dade County were also given consideration, directly or indirectly, in the analysis of growth. The plans of the Metropolitan Dade County Transit Authority and

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1/ Doxiadis Associates, Inc., June 1967

Public Works Department were directly accounted for through the active participation of staff members of those agencies as members of the Technical Advisory Committee. Communications with the municipalities, as a normal operating procedure of the Metropolitan Dade County Planning Department, has assured that their goals have not been ignored in the overall transportation planning effort. Among the numerous data, reports and plans referred to by the County Planning Department in preparing growth projections for this study, the following earlier documents published by that agency were reported as being substantially utilized:

Dade County Economic Base Study, Summary Report, 1960
Personal Income, Setting Dade County's Goals, 1960
Urban Growth in Dade County, Florida;
Planning Staff Report No. 2, 1960
Economic Appraisal and Projections, 1960
Population Change in Dade and Broward Counties,
Published annually since 1950
Population and Housing Estimates as of June 30, 1963
Population and Housing Estimates as of June 30, 1966
Proposed General Lane Use Master Plan, 1963

Summary

The preceding paragraphs have described primarily that work undertaken by the Metropolitan Dade County Planning Department in developing 1964, 1975 and 1985 economic and demographic data for use in the urban transportation study.

The results of their analyses indicate that by 1985 the study area population will have increased 80% to 2,138,000 persons; its employment will have increased 85% to 795,000 employees; the number of dwelling units will have increased 93% to 636,000 units; auto ownership will have increased 126% to 867,000 autos; and school enrollment will reach 531,000--a 107% increase.

The forecasts of these data are shown in Table IV, along with the intermediate 1975 values and the rate changes in household size, auto ownership and relationship between persons and jobs.

The increase factors give dramatic indication of the magnitude of change which may be expected in Dade County over this 21-year period. The examinations made of the methodology and the estimated zonal quantities which describe the projected development of the area to 1975 and 1985 verified that the best methods available were used and that the forecasts were logical and produced an excellent base for determining the 1975 and 1985 travel demands.

TABLE IV
SUMMARY OF PLANNING DATA FORECASTS

Study Area Planning Data	1964	1975	1985	Increase Factors To 1975	Increase Factors To 1985
Population	1,187,000	1,663,000	2,138,000	1.40	1.80
Employment	429,000	564,000	795,000	1.31	1.85
Dwelling Units	329,000	481,000	636,000	1.46	1.93
Automobiles	383,000	635,000	867,000	1.66	2.26
School Enrollment	257,000	384,000	531,000	1.49	2.07
Rates					
Population/ Dwelling Unit	3.61	3.46	3.36		
Autos/ Dwelling Unit	1.16	1.32	1.36		
Population/ Employment	2.77	2.95	2.69		

CHAPTER III

GROWTH OF INTERNAL TRIPS

The development and testing of equations which predict future trip ends for each traffic analysis zone were covered in Technical Report No. 3. As was outlined therein, existing population, land use and socio-economic data were used to develop these equations so that they would satisfactorily simulate 1964 winter season weekday trip productions and attractions. These same equations have been used to predict the 1975 and 1985 winter season weekday trip productions and attractions.

Solution of the Trip Generation Equations

The trip generation equations, which are linear relations between trip productions, trip attractions and land planning data, were solved for each traffic zone using the 1975 and 1985 land use plan data supplied by the Metropolitan Dade County Planning Department as finally revised for the base study. The solution of all the trip generation equations summed over all internal traffic zones resulted in the trip values shown in Table V. These were reviewed, and it was found desirable to analyze 1985 generation of certain special zones; this is discussed further in the next section of this Chapter.

During the early phases of the transportation study basic data from Metropolitan Dade County's General Land Use Master Plan (GLUMP) were expanded to provide additional variables needed in the trip generation equations. This Master Plan had been developed for a population of 2.5 million, and was initially assumed as the basis for the 1985 transportation study. However, during the analysis of alternate transportation systems, discussed in Technical Report No. 6, a revised estimate of 1985 planning data was made providing for approximately 2.0 million population. The trip estimates for the two plans are compared in a later section of this report.

Each internal person trip for any one purpose must have a production end, as well as an attraction end, in the study area; therefore, the total number of person trip attractions must equal the total number of person trip productions for any one trip purpose. Also, a generation equation was used as an area wide control of the nonhome-based trips. Since separate equations were used to estimate, independently, the trip productions and attractions for most trip purposes, the solution of these trip generation equations did not initially result in a perfect balance between productions and attractions. However, adjustments are made to obtain this balance, and this procedure will be discussed in a later section of this Chapter. The large differences between productions and attractions noted for the shopping and miscellaneous trip purposes are due to the fact that the County Planning Department predicts commercial employees will serve more trips in the future, because of the

TABLE V

SOLUTION OF TRIP GENERATION EQUATION

Trip Purpose	1975 Internal Person Trips		1985 Internal Person Trips	
	Productions	Attractions	Productions	Attractions
Work, Home-Based	872,389	652,180	1,146,063	937,008
Shop, Home-Based	763,916	543,626	1,043,690	666,571
Social-Recreation, Home-Based	741,619	718,267	996,948	979,776
School, Home-Based	378,165	323,902	516,468	450,674
Miscellaneous, Home-Based	826,865	605,940	1,118,698	747,499
* Nonhome-Based	536,923	536,923	685,456	685,456
* Truck	214,621	214,621	286,148	286,148
* Taxi	18,561	18,561	25,630	25,630
**Total Production Control	4,229,897		5,778,643	
**Nonhome-Based Generation	671,867		917,975	

* The same equation was used for both trip attraction or production estimates.

**The equations for these figures were developed for control of totals, excluding truck and taxi.

Note: Data in this table are discussed in the following paragraphs and in later sections of this chapter. All figures shown are winter season weekday trips.

trend toward an increase in self service for shopping and personal business. This opinion is supported by some planners, although certain analysts believe a reversal in this trend will occur. Therefore, it is essential that the continuing planning phases of this study consider the experienced or anticipated changes and their effect on estimated trip generation.

Zone Changes

During the analysis of future trip generation, it was found desirable to subdivide certain traffic analysis zones in order to avoid an extremely high number of trip ends in a zone. Certain zones with lower number of trip ends were combined in order to retain 550 internal zones. The zone number revisions made are as itemized in Table VI.

TABLE VI
ZONE CHANGES

Initial Zone	Revised Zone
80, 81	81
141, 142	141
344, 345	344
403, 404	404
405, 406	405
467, 468, 469	467
East 1/2 Zone 76	76
West 1/2 Zone 76	142
South 1/2 Zone 79	79
North 1/2 Zone 79	80
N. E. 1/4 Zone 397	345
S. E. 1/4 Zone 397	397
S. W. 1/4 Zone 397	403
N. W. 1/4 Zone 397	406
E. 1/2 Zone 458	458
W. 1/2 Zone 458	469
E. 1/2 Zone 459	459
W. 1/2 Zone 459	468

Shopping Trips

It should be noted that, as described in Technical Report No. 3, separate generation equations were developed for "general shopping" and "shopping center" attractions. The sixty-one zones assumed in the latter category were:

058	165	194	309	370	422
068	171	201	316	372	432
094	173	204	318	374	434
104	174	205	320	378	439
117	176	209	336	380	449
125	177	218	338	386	451
135	179	236	341	388	489
137	190	237	350	389	499
143	191	298	359	417	512
157	192	302	362	421	540
					549

No additional major shopping center locations were assumed for 1985.

Estimation of Special Zone Generation

During the development and testing of the trip generation equations, as noted previously in Technical Report No. 3, it was found that 1985 trip attractions for certain zones could not be predicted accurately by the equations. This was true even though these equations fit the overall area and the majority of zones. These zones (called special case zones) included the airport, parimutuel race tracks, and certain other recreational areas. Before adjustments were made to balance productions and attractions, 1985 trip attractions for these special case zones were estimated by the Metropolitan Dade County Planning Department staff using special growth studies which included examination of development planned by owners and managers of establishments within these zones. The estimates are shown in Table VII. In continuing activities of this study consideration should be given to other zones which may require special estimates.

TABLE VII
SPECIAL ZONE TRIP ATTRACTION ESTIMATES
(Source: Metropolitan Dade County Planning Department)

Zone Description	Special Zone No.	Est. 1985 Trip Attractions* (Social-Recreation)
Bayfront Park	21	25,000
Jai Alai Fronton	97	12,000
Biscayne Kennel Club	151	20,000
Interama	169	120,000
Hialeah Race Track	249	40,000
Miami International Airport	307	12,000
West Flagler Kennel Club	311	20,000
Tropical Race Course	381	24,000
Crandon Park	513	12,000
Seaquarium - Marine Stadium	514	20,000
Miami Beach Kennel Club	518	14,000
Lummus Park - Fishing Pier	519	3,000
(Indian Beach Park)	533	14,000
(North Shore Park), (Altos Del Mar Park)	538	30,000
(Bakers) Haulover Park	547	20,000

*Revised Land Use, per Metropolitan Dade County Planning Department, 12/67

Note: All special estimates are for the purpose of social-recreation.

Only fifteen of the final 550 internal zones required this special handling.

Trip attractions directly from generation equations were used for 1975, with no special estimates from the County being required. These values were reviewed for reasonableness and found to be satisfactory.

Adjusting Future Trip Productions and Attractions

As described in Technical Report No. 3, two control trip generation equations were developed and tested. The first of these control equations was for nonhome-based trip generation, which related the number of these trips generated in the study area to economic characteristics (number of automobiles is referred to as an economic characteristic since it reflects wealth) of the study area's tripmakers. The second control equation related total person trip productions to economic characteristics of the study area. These two equations from Technical Report No. 3 are stated as follows:

Equation No. 1 -- Nonhome-Based Trip Generation =
1.059 (No. of Autos)

Equation No. 2 -- Total Person Trip Productions =
6.665 (No. of Autos)

The control figures, determined by the solution of the two above equations for each 1985 zone and then totaled, are: (As shown in Table V)

Nonhome-Based Generation Control=
917,975 internal person trips

Total Production Control =
5,778,643

To adjust the person trip productions to the control figures, these steps were followed:

1. Nonhome-based productions and nonhome-based attractions were adjusted to the nonhome-based generation total by a uniform factor determined by dividing the nonhome-based generation control figure by the total of the nonhome-based production solutions.

2. The nonhome-based generation control was subtracted from the total production control to obtain total home-based production control.

3. A factor was determined for adjusting the solution of each home-based production equation including special cases so that the total of all solutions would be equal to the home-based production control. This factor was determined by dividing the total home-based production control figure by the sum of all production equation solutions.

4. The home-based productions for each purpose were adjusted by multiplying each production equation by the factor described above and solving the adjusted equations. In the application of the revised planning data, the difference between the total home-based productions and the total home based control productions was found to be less than one percent so the calculations described above were unnecessary.

The results of these adjustments are shown in Table VIII, which also shows the relationships with 1964 trips, by trip purpose, and the resulting ratio or growth factor (1964-1975 and 1964-1985). Figure 6 illustrates this Table, showing growth relationships.

TABLE VIII
INTERNAL PERSON TRIP GROWTH

Type of Trip	Estimated 1964 Trips	Percent	Estimated 1975 Trips	Percent	1975 Incre. Factor	Estimated 1985 Trips	Percent	1985 Incre. Factor
Home Based								
Work	503,737	18.5	872,389	19.4	1.73	1,146,063	18.9	2.27
Shop	450,666	16.6	763,916	17.0	1.70	1,043,690	17.3	2.31
Social - Recreation	444,596	16.4	741,619	16.5	1.67	996,948	16.5	2.24
School	244,321	9.0	378,165	8.4	1.55	516,468	8.5	2.11
Miscellaneous	496,438	18.3	826,865	18.4	1.67	1,118,698	18.5	2.25
Subtotal	2,139,758	78.7	3,582,954	79.7	1.67	4,821,867	79.7	2.25
Nonhome-Based								
Person	403,012	14.8	671,867	15.1	1.67	917,975	15.2	2.28
Truck	162,739	6.0	214,621	4.8	1.32	286,148	4.7	1.76
Taxi	12,852	0.5	18,561	0.4	1.44	25,630	0.4	1.99
Subtotal	578,603	21.3	905,049	20.3	1.56	1,229.753	20.3	2.13
Total Internal Trips	2,718,361	100.0	4,488,003	100.0	1.65	6,051,620	100.0	2.23

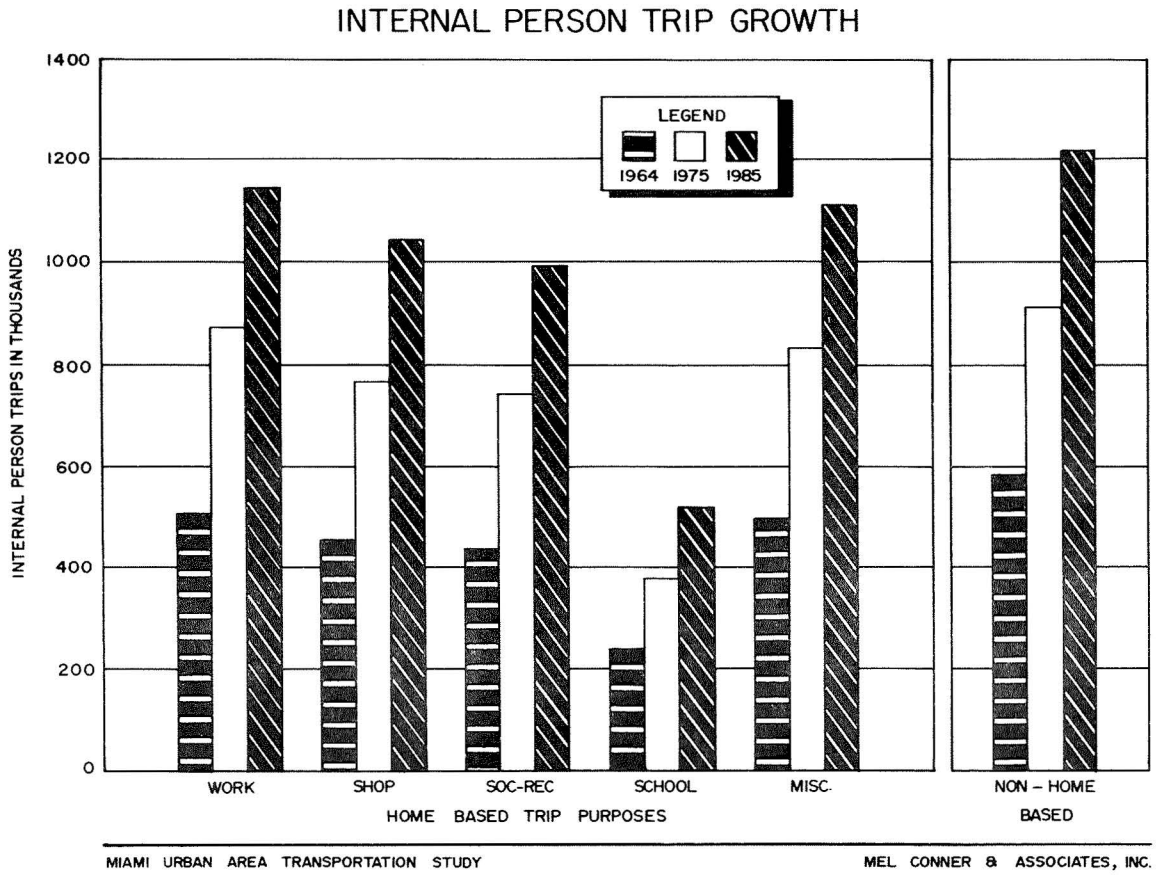
INTERNAL PERSON TRIP GROWTH
INTERNAL PERSON TRIPS IN THOUSANDS
1400
1200
1000
800
600
400
200
0
LEGEND
1964 1975 1985
WORK
SHOP
SOC-REC
SCHOOL
MISC.
NON – HOME BASED
HOME BASED TRIP PURPOSES
MIAMI URBAN AREA TRANSPORTATION STUDY
MEL CONNER & ASSOCIATES, INC.

FIGURE 6

After the 1985 person trip productions were adjusted to the control values, the trip attractions are adjusted, by purpose, to balance with the productions. The reason for using the productions as the control for adjustments (the attractions are adjusted to equal the productions) is that the data used to calculate these productions are considered more reliable than the data used to calculate attractions. More specifically, population, autos and dwelling units are used for productions, whereas nonhome-based data, primarily employment by various categories, are used to calculate attractions.

This balance between productions and attractions reflects the accepted theory that trip beginnings for a given purpose must have an ending of the same purpose. The balancing is done by the computer when distributing the trips, in order to facilitate the mass of computations involved. The computer program automatically adjusts each zone's attractions to equal its productions, by trip purpose, using the zone's attraction value as a relative index for adjustment. The gravity model distribution and modal split of person trips will be described in Technical Report No. 6.

Solution of the truck and taxi trip production and attraction equations resulted in the values shown in Table VIII These figures represent a growth in truck and taxi trips of 76 and 99 percent, respectively, from 1964 to 1985. The comparatively small percentage increase in truck trips (from 1964 to 1985) resulted from the use of a generation equation containing a constant (intercept value) which was approximately 28% of the mean of the independent variable (in 1964). In 1985 this constant accounts for 18% of the trips and tends to dampen the increase which would otherwise result from the relation to automobiles and employment. The truck travel as estimated by the previously described equation has been accepted as a reasonable growth. However, this is one example of the need to re-evaluate the models and their application during the continuing phases of this study, as will be further described in Technical Report No. 8.

As previously mentioned, two land use plans were considered during this base study: The General Land Use Master Plan for 2.5 million population and a revised 1985 Land Use Plan. The adjusted internal trips for these two plans are compared in Table IX.

TABLE IX
TRIP COMPARISONS BETWEEN 1985 LAND USE PLANS

Trip Purpose	Future Internal Person Trips: Land Use Plan For 1985	GLUMP [1] (Net 3)
Home-Based Work	1,146,063	1,329,110
Home-Based Shopping	1,043,690	1,361,124
Home-Based Soc.-Rec.	996,948	1,277,796
Home-Based School	516,468	673,927
Home-Based Misc.	1,118,698	1,444,503
Nonhome-Based	917,975	1,148,889
Truck	286,148	325,550
Taxi	25,630	28,655
TOTAL	6,051,620	7,589,554

The major trip difference between the two land use plans is in accord with the plan differences as described in Chapter II; i.e., there is a general reduction in all trip purposes, and the total reduction in travel is commensurate with the change from a plan for 2.5 million population to a plan for 2.0 million.

Table X shows the relationship of 1964 trip rates to those predicted for 1975 and for 1985 under the revised land use plan.

TABLE X
INTERNAL TRIP RATE COMPARISONS

	1964	1975	1985
Trips/Dwelling Unit	8.26	9.34	9.52
Trips/Population	2.29	2.70	2.83
Trips/Automobile	7.09	7.07	6.98
Dwelling Units	328,920	480,722	635,760
Population (Total)	1,187,326	1,663,110	2,138,420
Automobiles	383,345	634,679	867,046
Trips	2,718,361	4,488,003	6,051,620

The increase in trip rates shown in Table X illustrates the travel growth resulting from increased automobile ownership. The overall trip production control equation contains only autos as the independent variable. Since the private automobile is predicted to continue as the primary mode of travel in the Miami Urban Area, it was concluded that automobile ownership is the best variable for estimating 1985 total trip generation. Historically, it has

[1] General Land Use Master Plan for 2.5 million population in Metropolitan Dade County.

been found that as families obtain more than one car, they make more trips per day. Passenger car ownership is expected to increase from 1.16 autos per dwelling unit in 1964 to 1.36 in 1985, which means a reduction in persons per auto from 2.92 in 1964 to 2.47 in 1985, including the tourist auto ownership rate.

Analysis of Trip Growth

The growth of the trips in the Miami Urban Area predicted between 1964 and 1985 has been illustrated in Table VIII and Figure 6. This growth would be considered extremely high in most areas of the country, but the urban area of Dade County is growing rapidly, and the large annual increases are expected to continue.

The growth described in Chapter II can be further exemplified in Figure 7 which illustrates the internal trip growth rates expected during the twenty-one year period from 1964 to 1985. In reviewing this map, reference should also be made to Figures 4 and 5 which describe volume increases rather than growth rates. It is noted that the very high growth rates occur in the southern, western and north-western portions of Dade County; i.e., those not presently urbanized. However, much of the area now extensively developed will experience a growth of 2 to 5 times. Thus, much of the increased travel demand by 1985 can be expected in the corridors now served by heavily traveled expressways -- I-95, Palmetto Expressway and the Airport Expressway. This increased density and resulting need for additional high capacity roadways will require thorough analysis to determine an optimum balance between highways and socio-economic activities.

It has been concluded, based upon extensive review by Road Department staff and the Consultant, that the 1985 trip estimates are acceptable for use in testing future alternate transportation systems. This latter testing, to be described in Technical Report No. 6, must (and did) provide "feed back" information for developing a desirable balance among land use and various modes of travel. Of primary interest in the continuing study activities will be the consideration and analysis of development density and how it could greatly affect the highway and transit needs.

The trip rate growths shown in Figure 7 appear realistic for the rapidly growing urban area of Dade County. It has been concluded by the Consultant that the 1985 trip estimates are acceptable for the task of testing future alternate transportation systems.

As stated in Chapter II, the review of the 1975 trips by purpose reflected the interpolative process used by the County in estimating the 1975 zonal quantities used as input. All apparent variations were resolved, and it was concluded that the 1975 trip estimates are acceptable for use in analysis for staging the transportation development plan.

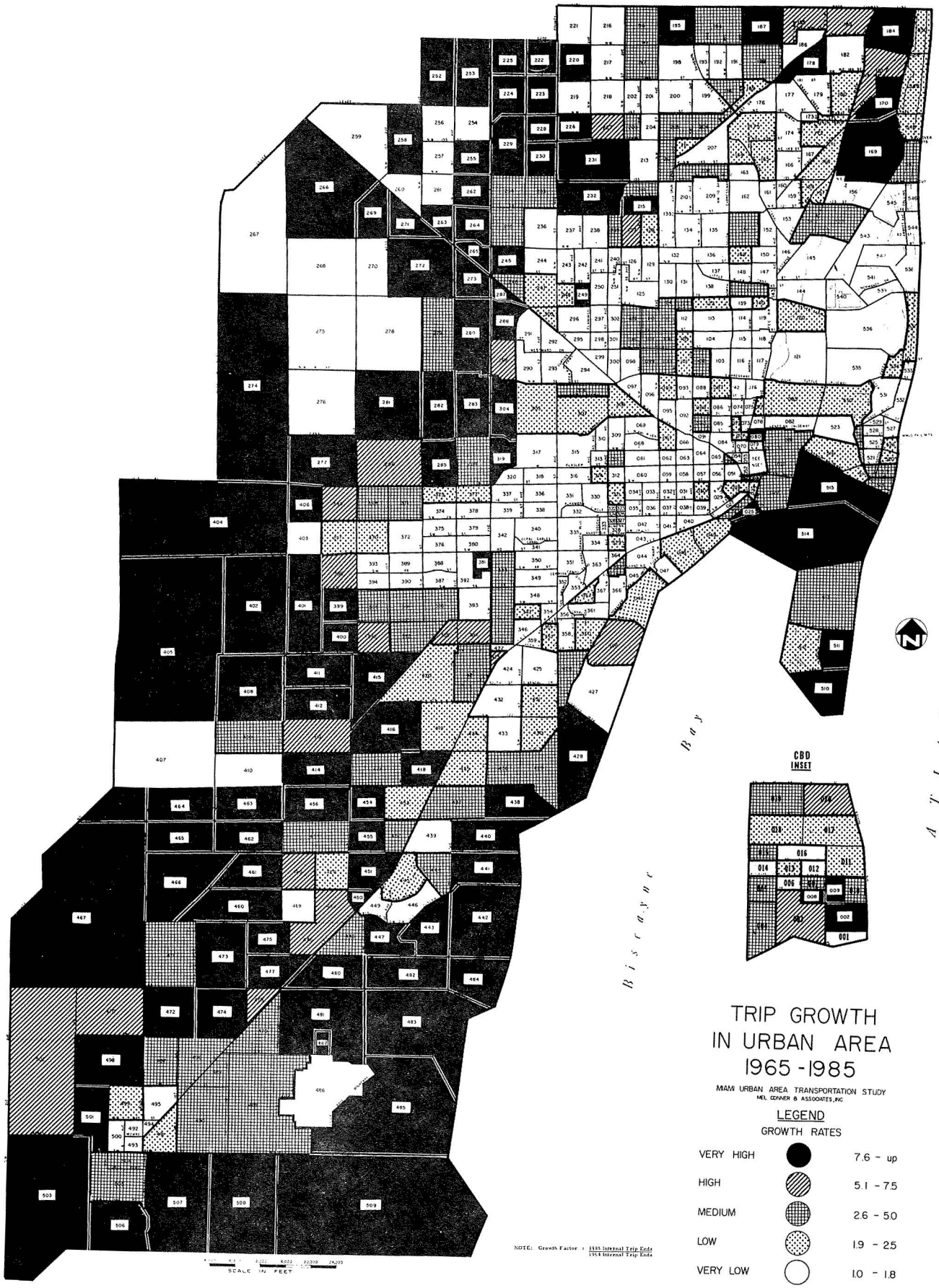
OCEAN
ATLANTIC
Bay
Biscayne
CBD
INSET
TRIP GROWTH
IN URBAN AREA
1965 - 1985
MIAMI URBAN AREA TRANSPORTATION STUDY
MEL CONNER & ASSOCIATES, INC
LEGEND
GROWTH RATES
VERY HIGH 7.6 - up
HIGH 5.1 - 7.5
MEDIUM 2.6 - 5.0
LOW 1.9 - 2.5
VERY LOW 1.0 - 1.8
NOTE: Growth Factor = 1985 Internal Trip Ends / 1964 Internal Trip Ends
SCALE IN FEET

FIGURE 7

CHAPTER IV

GROWTH OF EXTERNAL TRIPS

The trip generation equations used to predict trip productions and attractions, discussed in Chapter III, were developed and used only for the traffic zones within the internal study area. A growth factor procedure was used to estimate the number of 1975 and 1985 trips to and from areas outside the study area, as well as those which will pass completely through the study area.

External Trip Growth Factors

All of the 1964 winter season external trip origins and destinations were coded to standard State Road Department location codes, except those within the study areas of Dade, Broward and Palm Beach Counties. Since urban transportation studies were being performed within these counties, origins and destinations in Broward and Palm Beach Counties were coded to "districts", each comprised of several internal traffic zones as delineated for the respective study. See Figure 3, Technical Report No. 6.

It was necessary to calculate growth factors for internal as well as external areas. Having calculated 1985 total internal trips by zone within each of the three southeastern coastal county study areas through use of trip generation equations, 1985 trip growth factors were determined for the zones and districts of those areas, using both existing and 1985 internal person trip ends. It is important to note here that 80% of the 1964 external trips traveling in Dade County were either to or from Broward and Palm Beach Counties. The external growth factors were calculated for the three counties as follows:

$$\text{Growth Factor} = \frac{\text{1985 Trip Ends}}{\text{1964 Trip Ends}}$$

Note: The travel data for Broward and Dade Counties were obtained during the 1964 winter season, while the Palm Beach County data were obtained in 1965. In the calculation of growth factors for use in the three studies no adjustment was made to account for the 1-year difference. This was considered insignificant in view of the subsequent application of these values as described below.

Growth factors were developed for those external areas not in the Dade, Palm Beach, or Broward County study areas, by using existing and estimated 1985 population figures. The 1985 population estimates for these other external areas within Florida were made by the Florida Development Commission. Projections for the areas outside Florida employed an analysis of historical growth of the United States. The external growth factors for locations outside the three coastal county study areas were calculated as follows:

$$\text{Growth Factor} = \frac{\text{1985 Population}}{\text{1964 Population}}$$

Note: as described above regarding trip ends, no adjustment was deemed necessary for the 1-year difference in some of the population data.

Estimates of 1975 growth factors for Dade County were made similarly, using the ratio of 1975 trip ends to 1964 trip ends. The 1975 growth factors for areas outside Dade County were taken as an interpolation of growth midway between 1964 and 1985.

Application of Growth Factors

After growth factors were determined for all external areas, they were used to expand the 1964 external trip origin-destination table to a 1975 table and a 1985 table. This table factoring procedure was performed using the Fratar growth factor procedure as described in the report, "Vehicle Trip Distribution by Successive Approximation", by Thomas J. Fratar.1/ The estimated future trips for each zone were then distributed to the other zones in proportion to the attractiveness indicated by the 1964 interzonal trip volumes and by the estimated growth of each of the other zones. After the initial distribution of external trips between pairs of zones, the volume of distributed trip ends in many of the zones did not agree with the originally predicted volume of trip ends for these zones. Therefore, new pseudo-growth, or adjustment factors, were calculated and a new distribution of trips was made. This process was carried out for four iterations.

The Fratar expansion increased the external vehicle trips from 136,586 in 1964 to 306,236 in 1975 and to 467,053 for 1985. This growth is illustrated by Figure 8. External vehicle trips in 1985 represent approximately 11% of the total vehicle trips expected daily in Dade County. (In 1964 about 7% of the total vehicle trips were external).

The apparently large overall growth in external trips (a factor of 3.4) was brought about because of the large growth predicted for the urban areas immediately to the north were many external trips will be generated. Approximately 29% of the 1964 Dade County external trips began and ended in South Broward County. It is estimated that this area will generate 33% of the external travel in 1985. Eighty-four percent of the future external trips are expected to have an origin or destination in the Broward-Palm Beach area. This emphasizes the need for a continuing improvement in inter-county planning for the Gold Coast area.

1/ Traffic Quarterly, Vol. 8, No. 1, January, 1954, Pages 53-65

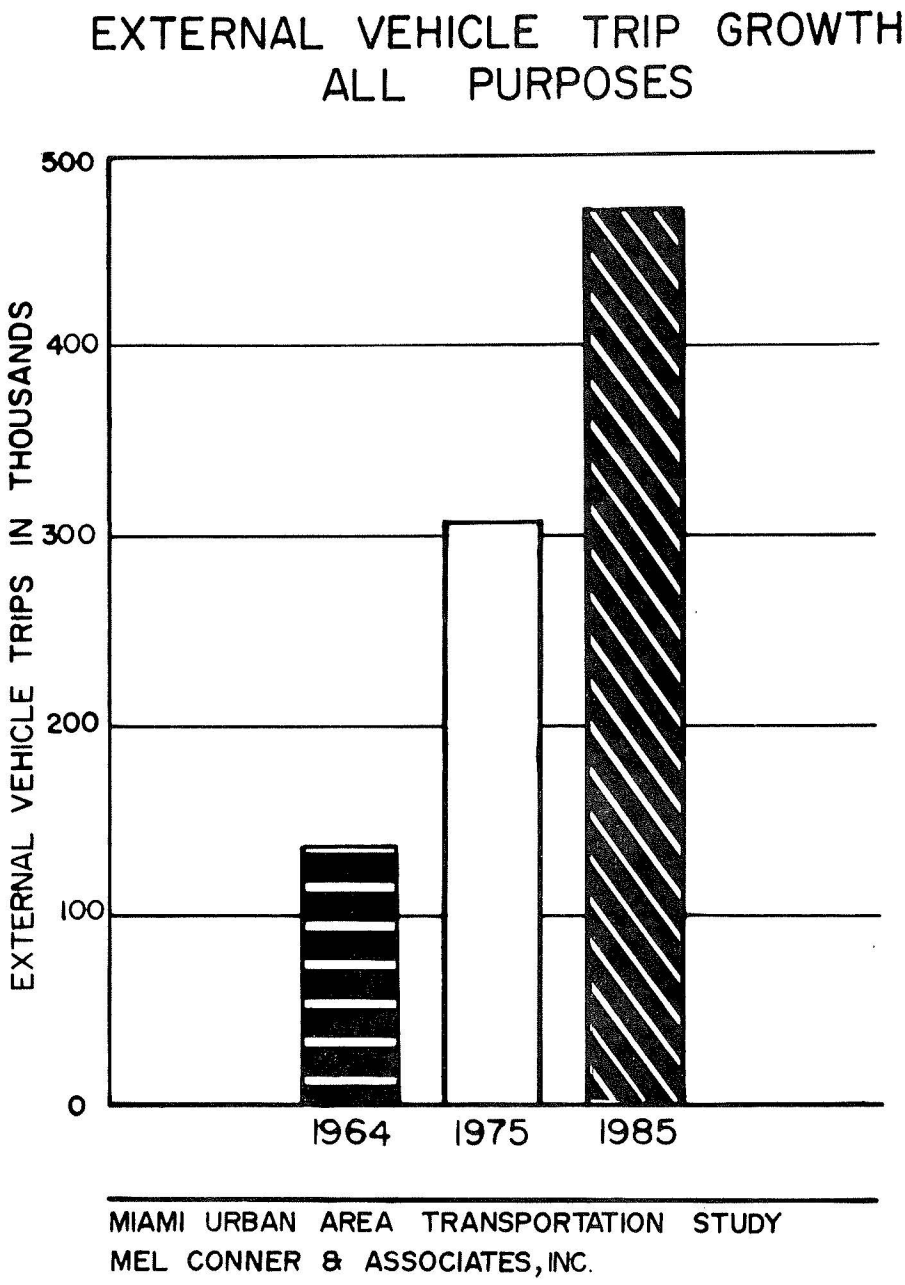
EXTERNAL VEHICLE TRIP GROWTH
ALL PURPOSES
EXTERNAL VEHICLE TRIPS IN THOUSANDS
500
400
300
200
100
0
1964
1975
1985
MIAMI URBAN AREA TRANSPORTATION STUDY
MEL CONNER & ASSOCIATES, INC.

FIGURE 8

CHAPTER V

SUMMARY

This report has covered the estimating of 1975 and 1985 internal person trip productions and attractions, using forecasted land use data supplied by the Metropolitan Dade County Planning Department and the trip generation equations described in Technical Report No. 3. It also covered the expansion of the existing external vehicle trips to 1975 and 1985 by a factoring procedure. Using the gravity models and modal split model, these data were later used to develop 1975 and 1985 total vehicle trip tables for traffic assignments to future highway systems.

The next technical report (No. 6) will cover the development and testing of future alternate transportation systems and land use plans by use of traffic assignments, and the analysis of these assignments. These tests included assignment of 1985 vehicle trips to the present-plus-committed highway and street system, and to the several 1985 alternate highway and street plans developed from analysis of preceding traffic assignments in a trial and adjustment procedure.