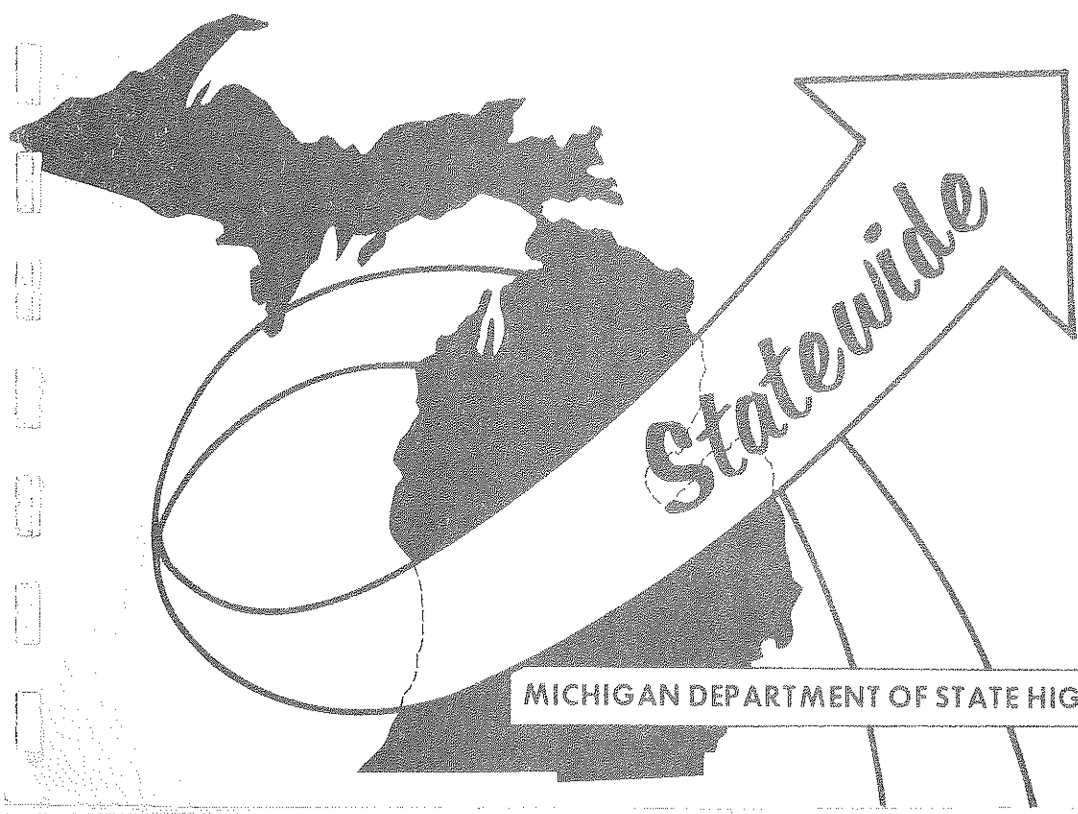
Statewide Transportation Analysis & Research

MICHIGAN'S STATEWIDE
TRANSPORTATION MODELING SYSTEM
VOLUME IV-B

MICHIGAN STATEWIDE TRAFFIC FORCASTING MODEL: OPERATION AND RECALIBRATION

STATEWIDE PROCEDURES SECTION

JUNE 1979



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JUNE 1979

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, GOVERNOR

DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION

STATE HIGHWAYS BUILDING, 425 WEST OTTAWA PHONE 517-373-2090
POST OFFICE BOX 30050, LANSING, MICHIGAN 48909

JOHN P. WOODFORD, DIRECTOR

[redacted]

Mr. Sam F. Cryderman
Michigan Department of State
Highways and Transportation
Bureau of Transportation Planning
P.O. Box 30050
Lansing, Michigan 48904

Dear Mr. Cryderman:

Increased utilization of the Statewide Traffic Forecasting Model as input for traffic studies and regional systems plans has necessitated the need for a report explaining the actual operation and development of the model. This report was written with the intention of fulfilling this need and also serves as a documentation of the recent recalibration of the model to 1975 base year data. This recalibration has greatly enhanced the forecasting capabilities of the model; and, through this report, users of the model can quickly perceive the level of calibration, the utility, and the limitations of the modeling process. The information supplied can also be used as background material for other reports where model forecasts were utilized as a data base.

This report was written by Thomas Bordeaux of the Statewide Procedures Section under the supervision of Richard E. Esch.

Sincerely,

William M. Lepczyk
Assistant Administrator
Highway Planning Division

MICHIGAN STATEWIDE TRAFFIC FORECASTING MODEL:

OPERATION AND CALIBRATION

BY: THOMAS J. BORDEAUX

PREFACE

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The increased utilization of the Statewide Traffic Forecasting Model as input for traffic studies and regional systems plans has necessitated the need for a report explaining the actual operation and development of the model. This report was written with the intention of fulfilling this need and also serves as a documentation of the recent recalibration of the model to 1975 base year data. This recalibration has greatly enhanced the forecasting capabilities of the model; and, through this report, users of the model can quickly perceive the level of calibration, the utility, and the limitations of the modeling process. The information supplied can also be used as background material for other reports where model forecasts were utilized as a data base.

The following pages of this section list other applications and developments of the Statewide Transportation Modeling System.

STATEWIDE SYSTEM DEVELOPMENT REPORTS

VOLUME I	- OBJECTIVES AND WORK PROGRAM
VOLUME I-A	- REGION 4 WORKSHOP TOPIC SUMMARIES
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STATEWIDE SYSTEM REFERENCE HANDBOOKS

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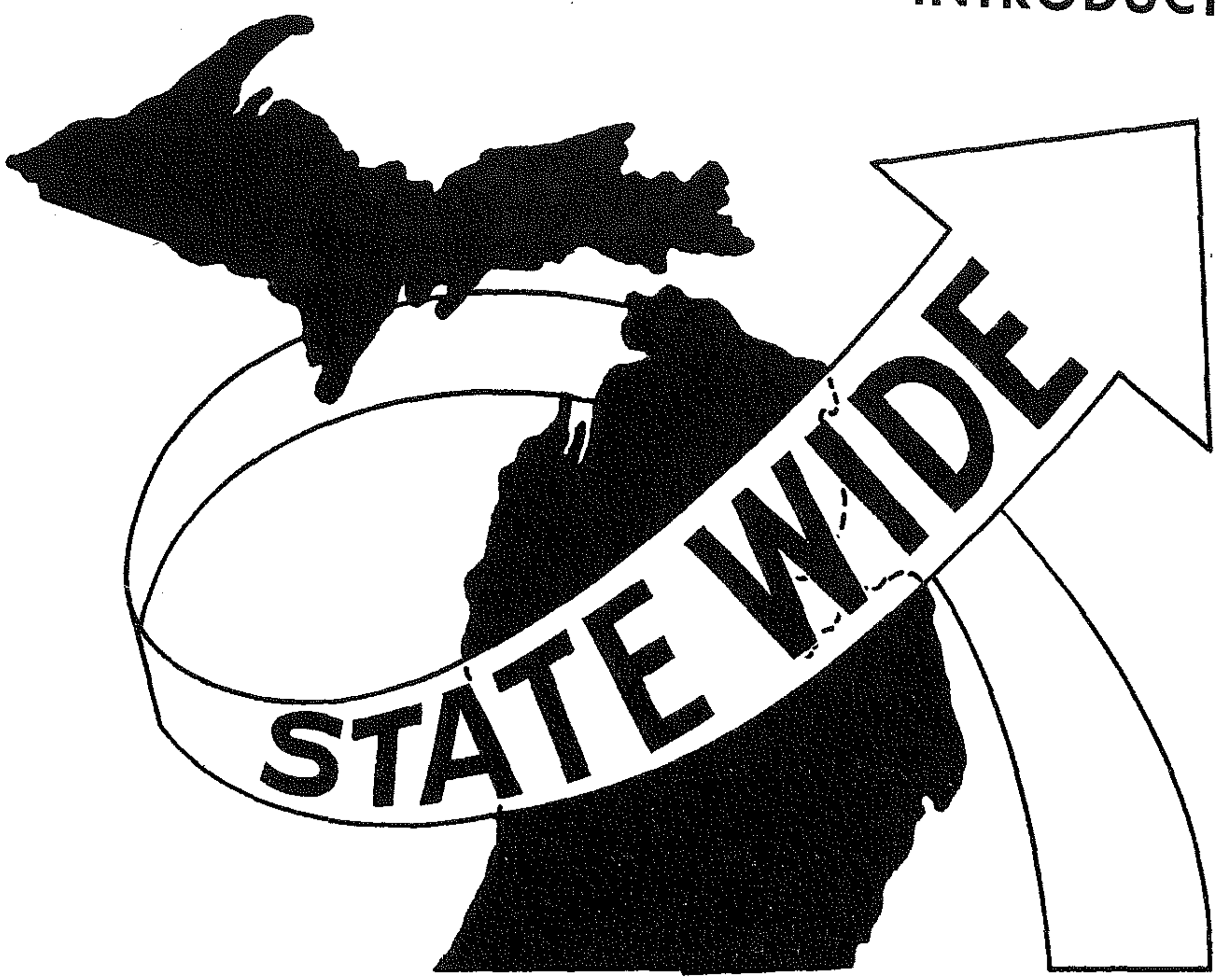
REFERENCE HANDBOOK #2 - MICHIGAN'S PERMANENT TRAFFIC RECORDER TRENDS - POTENTIAL APPLICATION IN TRANSPORTATION PLANNING - ENERGY ANALYSIS
REFERENCE HANDBOOK #3 - MINOR ORIGIN & DESTINATION TRAVEL CHARACTERISTICS - PART A

INTRODUCTION



INTRODUCTION

The Statewide Traffic Forecasting Model is a tool developed in the Bureau of Transportation Planning which allows the Department to forecast traffic on all rural trunklines in the state. The model was developed for three basic reasons:

1. To give the Department the ability to forecast travel using computer technology which will provide a consistent method of forecasting for all proposals whether large or small for any part or all of the state.
2. To give the Department the ability to measure the impact of a highway proposal and the subsequent change in travel patterns on related state trunklines.
3. To extensively reduce the elapsed time required to complete traffic forecasts on many projects, thereby allowing the Department to evaluate a wider variety of concerns.

While many associated impact analysis processes have been integrated into a total transportation modeling system, this report serves only to address the basic traffic forecasting portion and its operation. Since traffic forecasts are of fundemental importance in transportation planning, it is hoped that this discussion will address some of the basic questions surrounding the model and its application.

MODEL DEFINITION

MODEL DEFINITION

A "model" by definition is a representation or simulation of an existing activity. In the case of the statewide transportation model, the Department has simulated through computer processes the existing travel patterns and volumes that occur between various cities and townships in Michigan so that future travel patterns can be evaluated.

Michigan's travel model is a series of mathematical equations which use population forecasts and driving time estimates to predict the number of trips produced by various areas of the state and to predict which roads these trips will use.

MODEL UTILITY

STATE WIDE

MODEL UTILITY

The ability to simulate travel patterns and volumes on Michigan's trunkline system allows the Department to evaluate alternatives identified in the public involvement process. Many of the travel impacts which must be evaluated when determining the need for a transportation project can now be measured systematically at the statewide, regional, or county level. A list of some impact measures include:

1. Future year Average Daily Traffic (ADT) Volumes on state trunklines
2. Future year Design Hour Traffic Volumes (DHV) on state trunklines
3. Identification of Volume to Capacity Deficiencies based on forecasted volumes
4. Level of Service analysis based on volume to capacity measure
5. Measure Changes in Operating Speeds on the state trunkline system as a result of future travel (or due to improvements to the system)
6. Determine Diverted Traffic Volumes as a result of a new or altered trunkline
7. Trip Length Change analysis showing the number of vehicle trips using a rural trunkline summarized by trip length

Travel impact analysis is of primary importance in the identification and evaluation of transportation needs but does not address all of the issues; therefore, the statewide forecasting model has been developed to evaluate other issues such as social, economic, and environmental. The following are three additional examples of impact that can be measured utilizing the statewide forecasting model:

1. Social Impacts - Measure the affect of highway alternatives on accessibility of people to hospitals, jobs, social services, etc.
2. Economic Impacts - Cost/benefit analysis and market area can be measured based on driving times and volume characteristic changes.
3. Environmental Impacts - Gasoline consumption and air/noise pollution levels can be determined for alternatives based on operating speeds and travel characteristics.

MODEL ASSUMPTIONS AND LIMITATIONS

MODEL ASSUMPTIONS AND LIMITATIONS

The assumption and limitations of the statewide forecasting model should be clearly understood; therefore, before using the model, a user should be aware of the following assumptions:

1. The basic trip generation - distribution travel patterns established from actual statewide origin - destination (O&D) interviews are assumed for future year forecasts.
2. Future travel rates are modified depending upon the analysis of the trend in vehicle miles per capita.
3. The model accounts for traffic generated from a new facility because trip generation - distribution takes into consideration the shortened driving time.
4. The "zones of analysis" used in the model are reasonably homogeneous in that most of them include all types of land use.
5. State trunkline travel patterns are simulated using only four socio-economic characteristics (population of the zone, accessibility of zone to surrounding populations, travel time to other zones, and vacation attraction index).

Because of the complexity of actual travel conditions, the following limitations of the statewide forecasting model should be clearly understood:

1. Zone size generally limits the application of this system to rural state trunklines.
2. Traffic volumes in urban areas should be used only in through travel analysis since intracity travel is not generated using the existing model.

3. Impact analysis under ten minutes is not practical because this is the minimum intrazonal driving time.
4. Travel forecasts may be used directly in statewide, regional, and some corridor analysis, but only as a starting point in detailed project level analysis.
5. The model is calibrated to an ADT which is the weighted average of the rural portion of any state trunkline between two cities or major intersections. Therefore, traffic forecasts should be compared with the base year weighted average in order to use model output for detailed traffic analysis.
6. All county road volumes, both present and future, should be treated only as loading links and their actual volumes should be adjusted depending on the total county road pattern in the area.

MODEL OPERATION

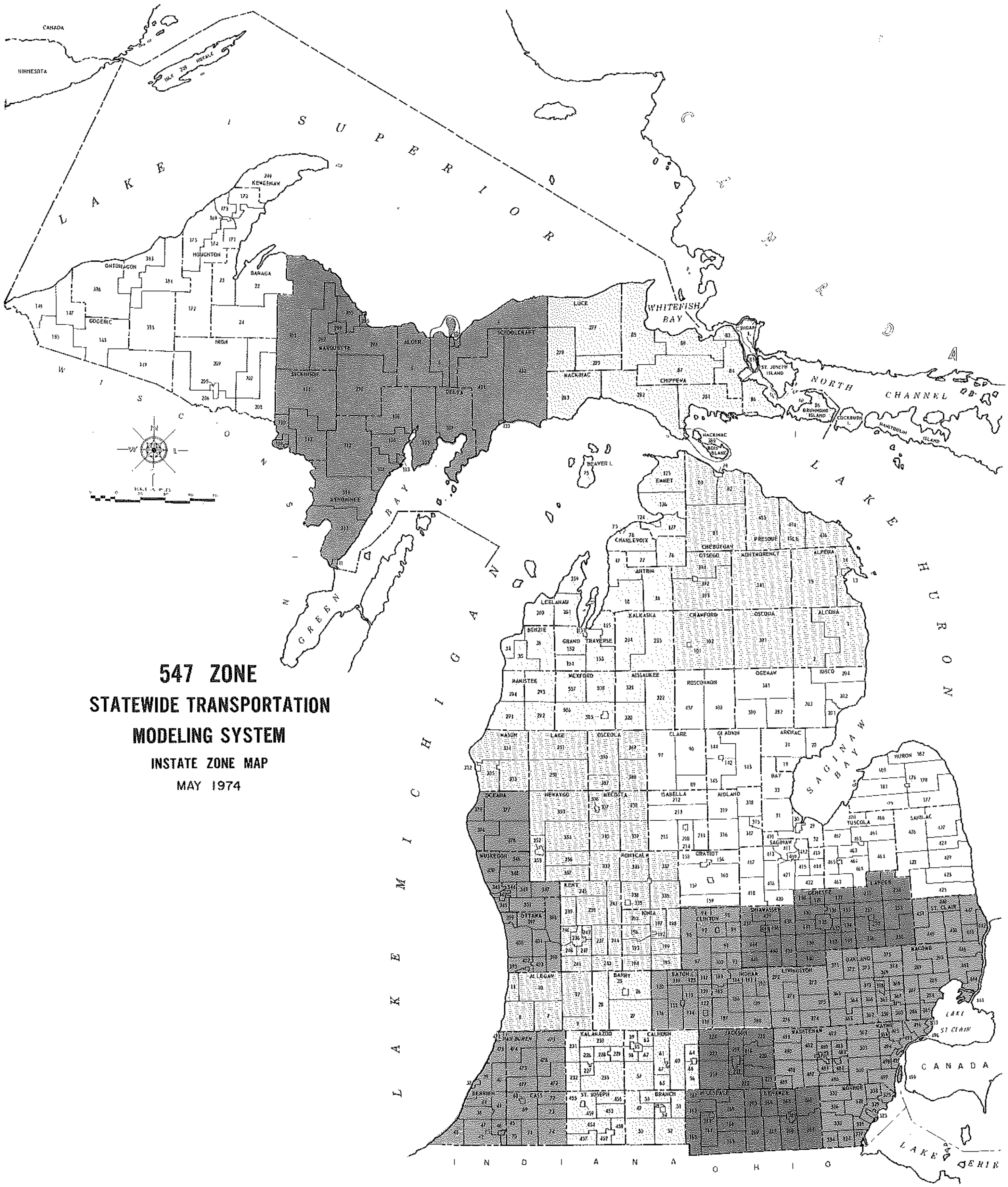
MODEL OPERATION

This section will briefly explain the operation of the statewide transportation model. The zone system identified in Figure 1 is the basis around which the entire model operates and is also the base for storing data. The basic model has been divided into four parts: 1) the highway network model, 2) the trip generation model, 3) the trip distribution model, and 4) the traffic assignment model.

The highway network model is used to define and create in computer terms the highway system under study. Presently, the 547-zone network includes all state trunklines (both urban and rural) as identified in Figure 2. The computer terminology used to discuss the 1975 highway network is referred to as a set of nodes and links. A link is a point identified by the nodes at each end. Figure 3 is a conceptual drawing of a portion of the highway network used in the 547-zone system. The solid data or nodes represent link intersections. The illustration indicates that there are two basic types of system links, regular highway links and zone centroids or "loading links". A regular highway link is used to describe a section of highway while a centroid link is used to connect the people living in an analysis area or zone to the actual highway network. This link is used to feed traffic to and from the highway system.

The user of the highway network model can differentiate between types of proposed highway links according to certain physical and travel characteristics. The type of data entered during the initial link - node network definition

FIGURE 1



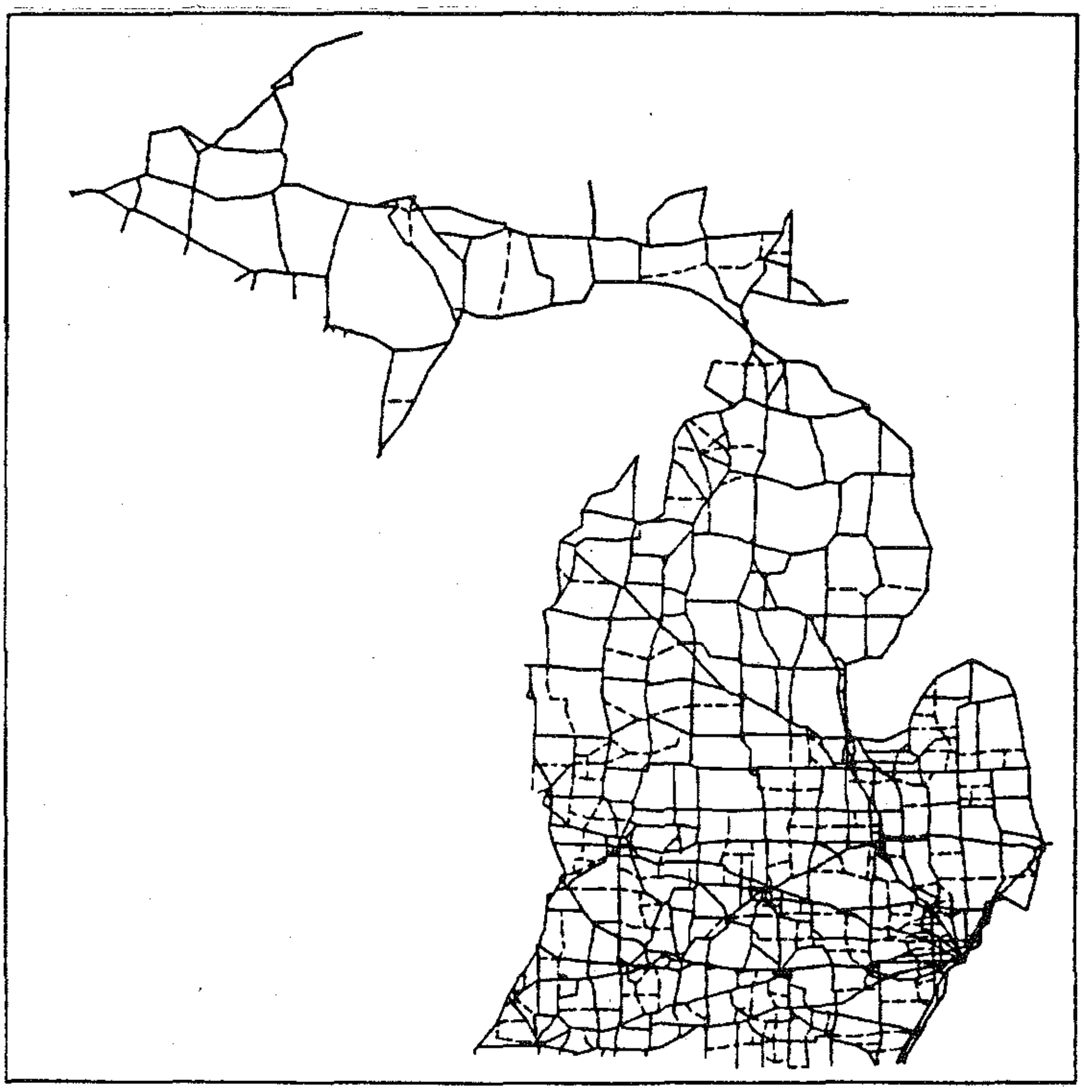
547 ZONE

STATEWIDE TRANSPORTATION MODELING SYSTEM

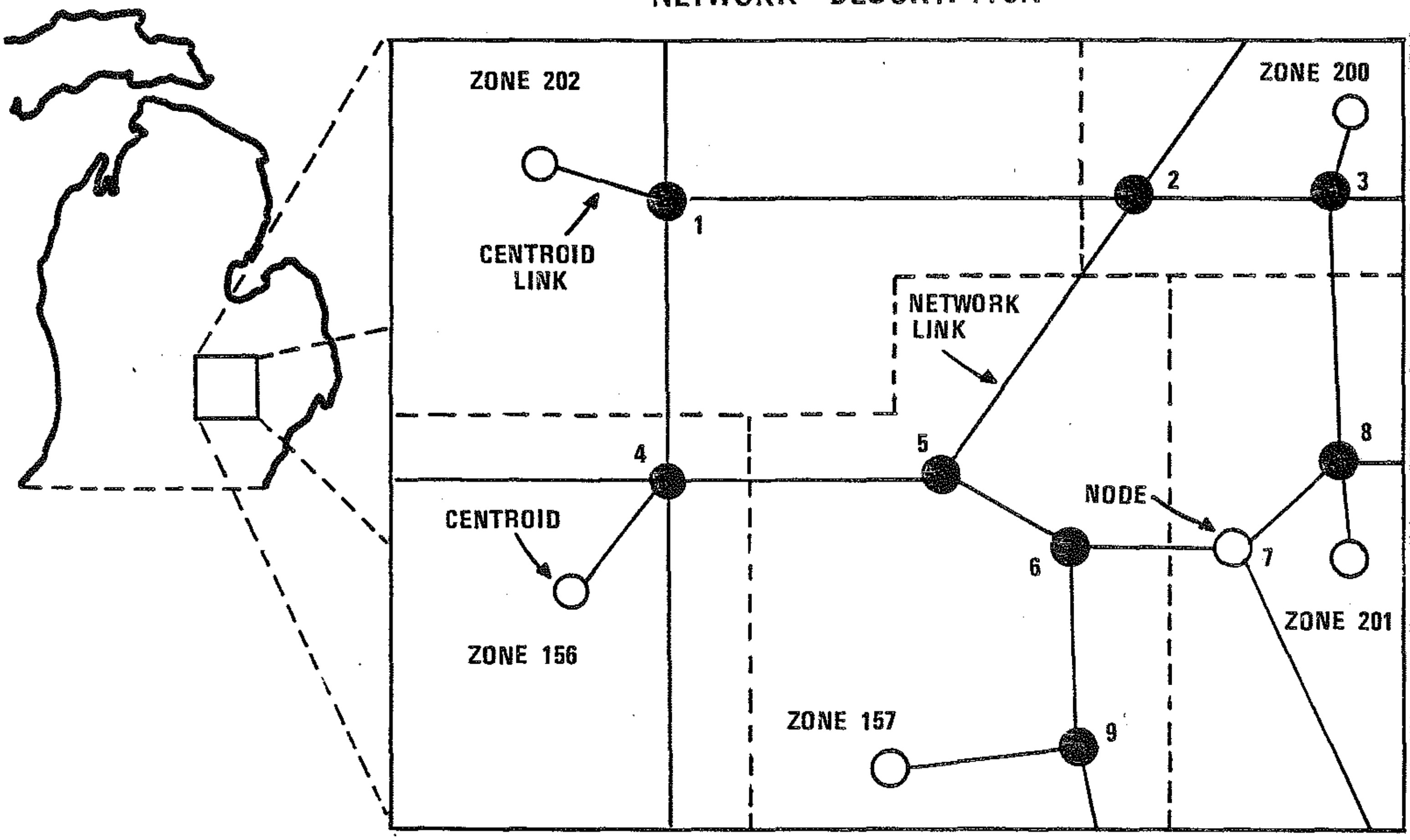
INSTATE ZONE MAP

MAY 1974

HIGHWAY NETWORK



NETWORK DESCRIPTION



includes information such as speed, distance, and capacity information. Since the 1975 network was created through standard coding procedures, this same technique can be used to simulate alternate highway proposals. The output from the network portion of the modeling system is a primary part of the travel forecasting process.

The second part of the statewide traffic forecasting process is known as the trip generation model and developed to simulate the number of actual trips occurring between each of the 547 analysis zones for a predetermined base year which in this case is 1975.

The total trips to and from a zone are dependent on the population of the zone and the accessibility of that zone to other zones. This accessibility is measured by determining the number of people that live within a specific driving time to the zone under study. Knowing the number of generated trips for each analysis area is not enough, their distribution on a statewide basis must also be simulated. This function is performed through the trip distribution model which is the third part of the traffic forecasting process.

The distribution model uses a gravity principle in determining the trip interchange between zones. This process is a mathematical formula which states that the number of trips distributed between zones is related to their population and decreases as the distance between two zones is increased.

The end result of this calculation for each zone interchange is a trip table (matrix) which represents all trips between each of the 547 zones. The total trip table for all 547 zones does not indicate which links within the highway network are utilized but only the travel volume between zones. The task of identifying which routes these trips use is left to the fourth part of the traffic forecasting process known as the traffic assignment model.

The primary function of this model is to bring together the output of the network model and the trip generation - distribution models. Using driving time and a trip table as its input from the base network, the assignment model selects the probable routes the trips identified in the trip table will use in the actual highway network. An example of how this selection or assignment process works is shown in Figures 4 and 4a. The assignment model determines that the trip table contains one hundred trips which have their origin in Zone 156 and their destination in Zone 201. The driving times from the network indicate that links 4-5, 5-6, 6-7, and 7-8 as the shortest highway path between these two zones. Each link on this path has recorded as passing through it the one hundred interzonal trips as shown in Figure 4. The trip table, likewise, indicates that fifty trips have their origin in Zone 202 and their destination in Zone 157. The minimum driving time path was calculated as links 1-4, 4-5, 5-6, and 6-9 and the fifty trips generated in Zone 202 and attracted to Zone 157 as shown in Figure 4a are now assigned to these links. This process is repeated not only until all those trips leaving Zone 202 destined for every other zone within the system have been recorded, but also until the procedure is repeated from the perspective of all analysis zones. The assignment model outputs a highway network with the load or total traffic volume information for each link in the system.

These link volumes become traffic forecasts when projections of future zonal population are employed in the trip generation - distribution submodels.

ASSIGNMENT PROCESS

FIGURE 4

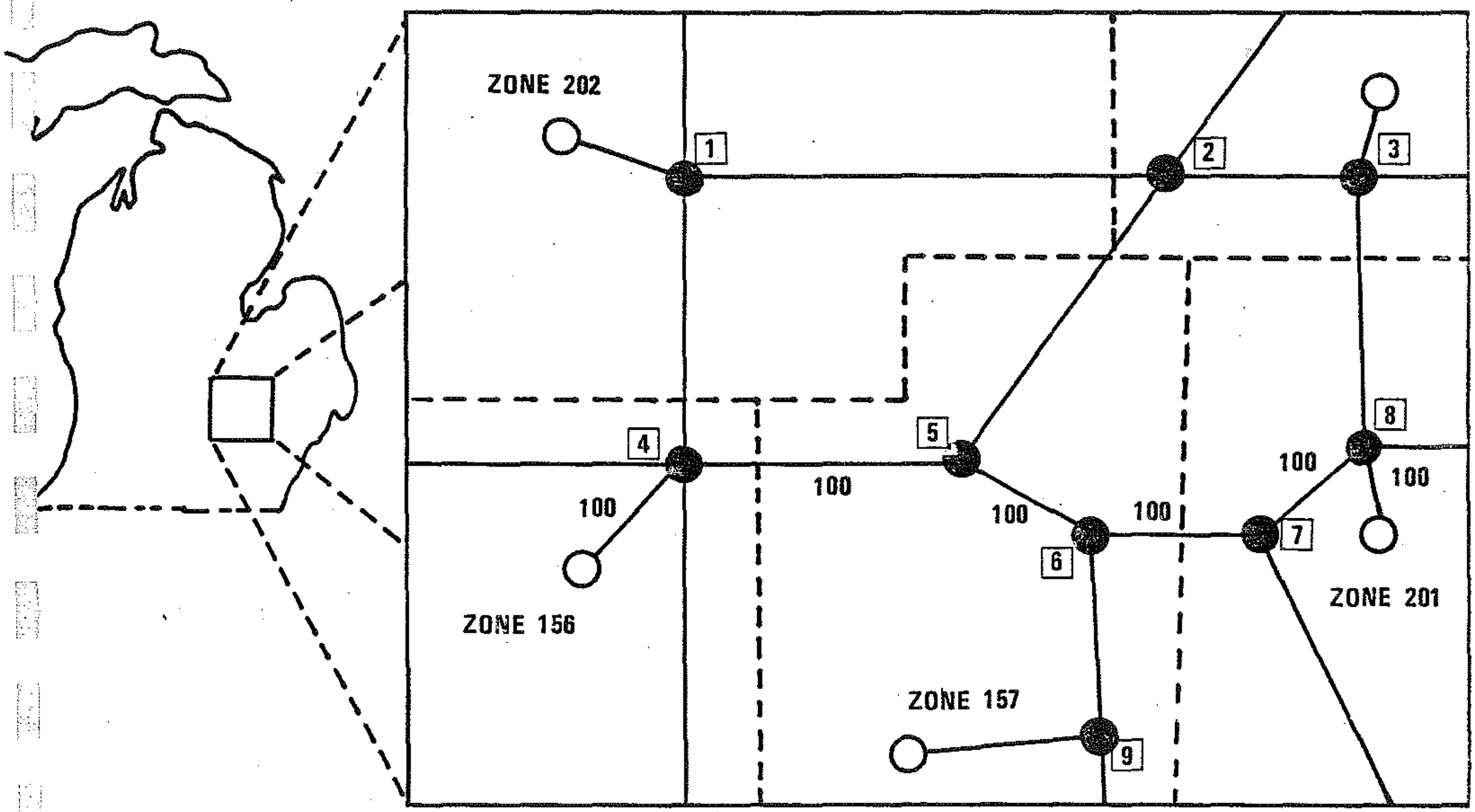
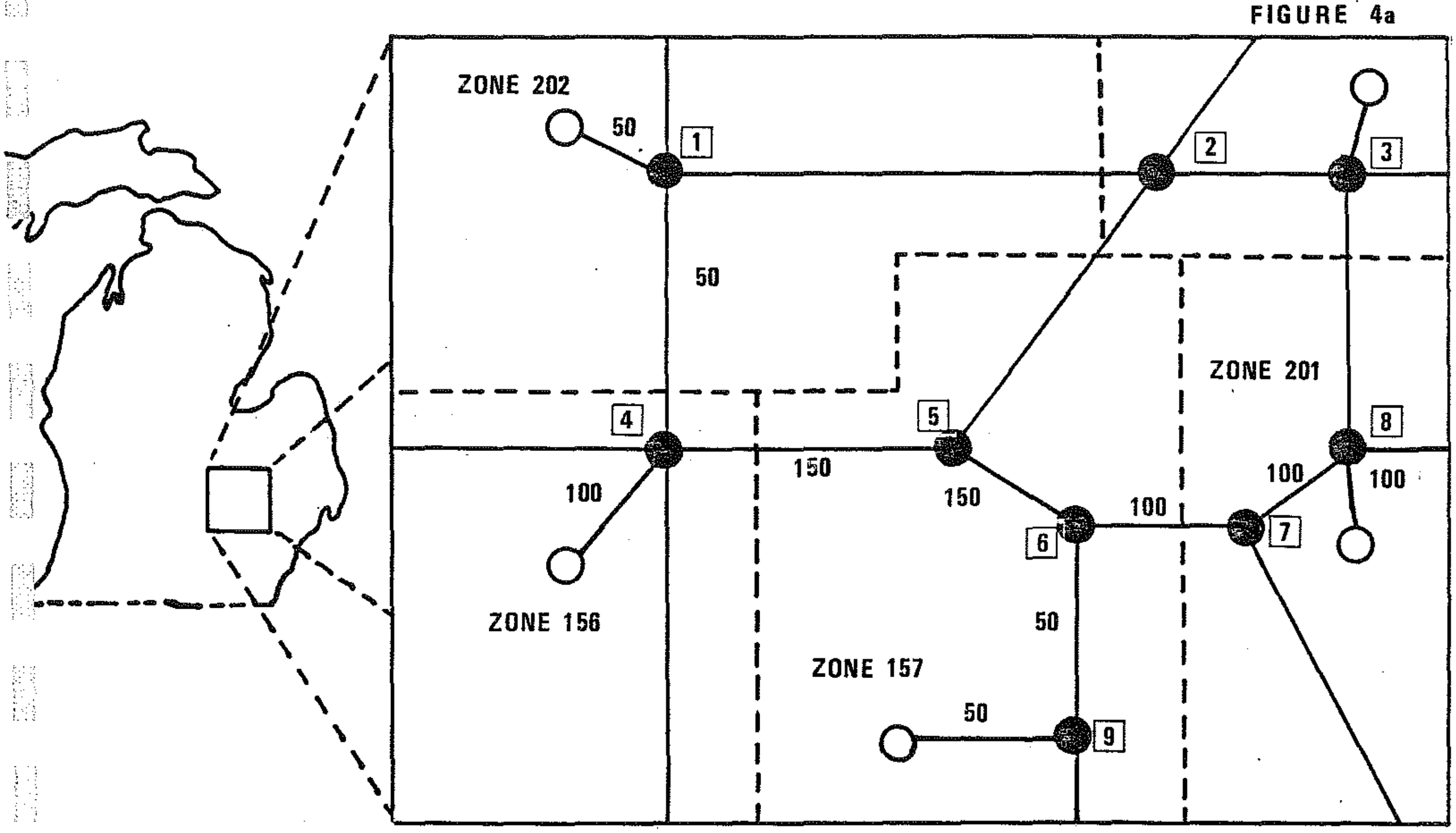


FIGURE 4a



CALIBRATION PROCESS

CALIBRATION PROCESS

The process used to calibrate the statewide forecasting model consists of three basic steps:

1. Network Calibration
2. Trip Generation - Distribution Calibration
3. Total Calibration

A short discussion of each step follows.

Network Calibration

Network calibration of the statewide forecasting model involves first a process of editing the speed and distance for all links in the network. This editing requires a thorough understanding of the road characteristics in each area in order to establish the realistic driving speeds for all links. Figure 5 shows the driving times from Zone 183 as calculated by the speeds and distances carried on the network link file. Once the network is edited relative to speeds, a "tree" building program is run which calculates the shortest driving path between each zone and all other zones. Figure 6 shows the trees, or paths, from Zone 183 (Lansing) to all other zones in the state. Graphic display on a 4014 Textronic Cathodide Ray Tube Terminal allows the analyst to quickly edit travel paths for reasonableness.

Since in reality people travel a multitude of routes, network tree calibration is meant to assure that the model is building the most likely path between each zone pair. Extensive knowledge and understanding of actual travel patterns must be applied in order to properly define realistic link speeds in the network calibration process.

FIGURE 5

TREE FROM ZONE 183

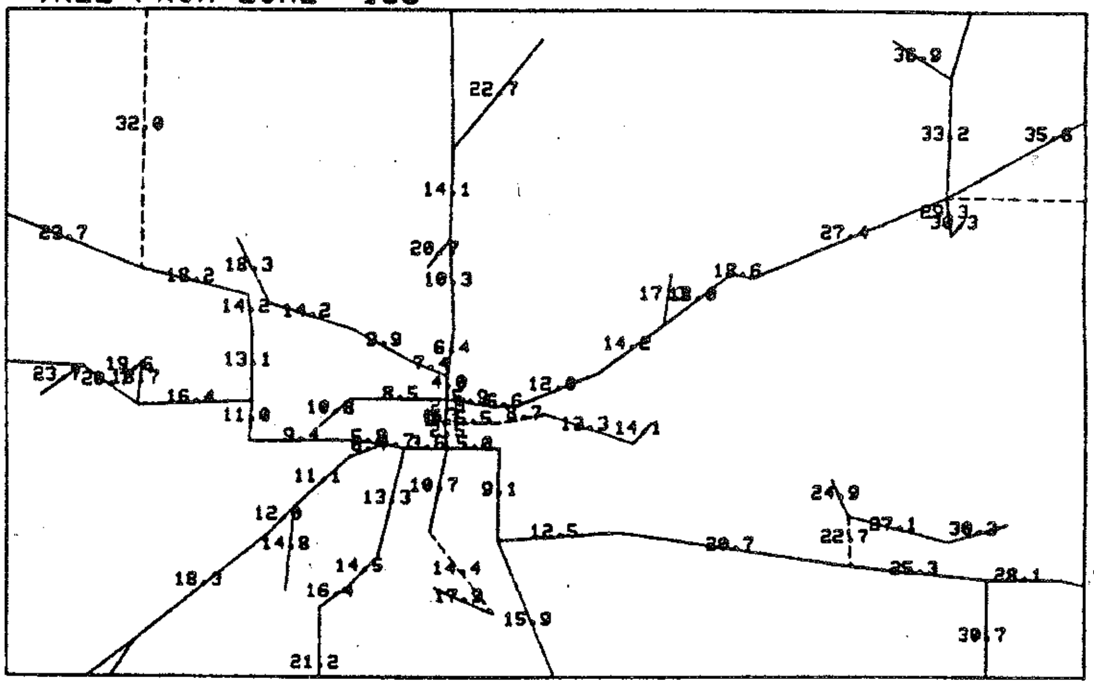
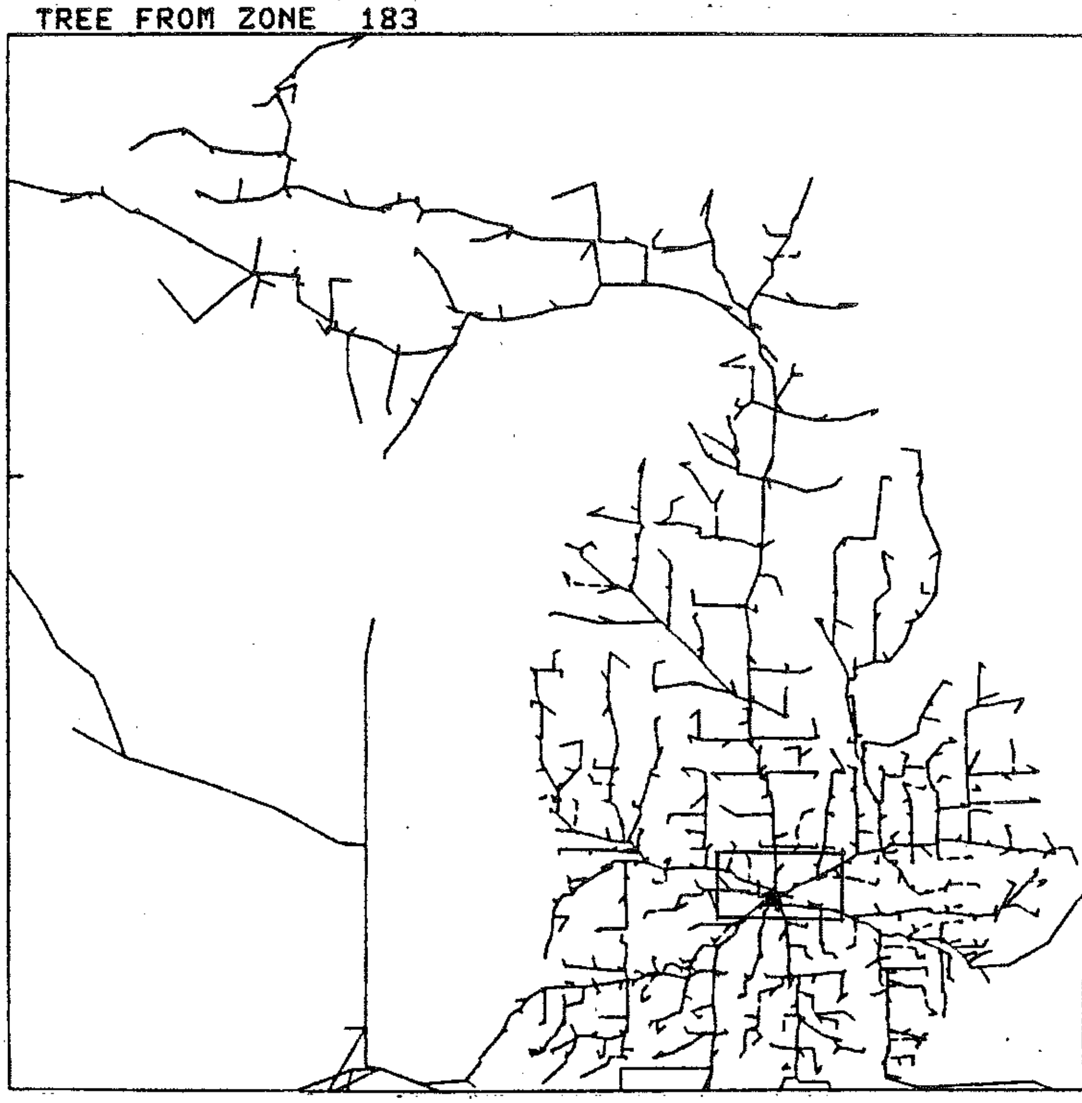


FIGURE 6

TREE FROM ZONE 183



Network calibration of the statewide forecasting model also includes a checking and editing process to assure that the trips from each zone are loaded to simulate the most probable traffic loading in the zone. In the model, a centroid link loads all trips generated at the zone level usually to one point on the network; however, in some cases, multi-centroid loadings are necessary. Generally speaking, the finer the road network the more frequently single zone loadings can be applied. Often county roads serve a very important function in an area; and, consequently, many major county roads are added or deleted from the network in the calibration process to assure that the proper paths and connections to the trunkline system are made. Once the travel paths and zone loadings are correct based on actual travel patterns, network calibration is complete.

Trip Generation - Distribution Calibration

Perhaps the most crucial aspect of any computer assisted modeling process lies in the mathematic functions which either explain or predict the real life relationships being simulated. In traffic forecasting, the model must utilize reliable input data in mathematical equations to compute probable trip interchange between each zone pair based on known origin - destination travel patterns. Michigan's traffic forecasting model uses the gravity model concept which states that the travel between two areas (zones) is a function of the size of each area and the distance that separates them.

Adjustments to the initial generation - distribution calibration process are sometimes necessary in the model calibration in order to better simulate actual origin - destination travel patterns. The initial equations and curves in the gravity model must be calibrated to the socio-economic peculiarities of selected Michigan zones and geographic barriers such as the Mackinaw Bridge.

Model trip generation - distribution calibration is done by comparing trip interchanges produced by the model with data available from actual origin - destination studies.

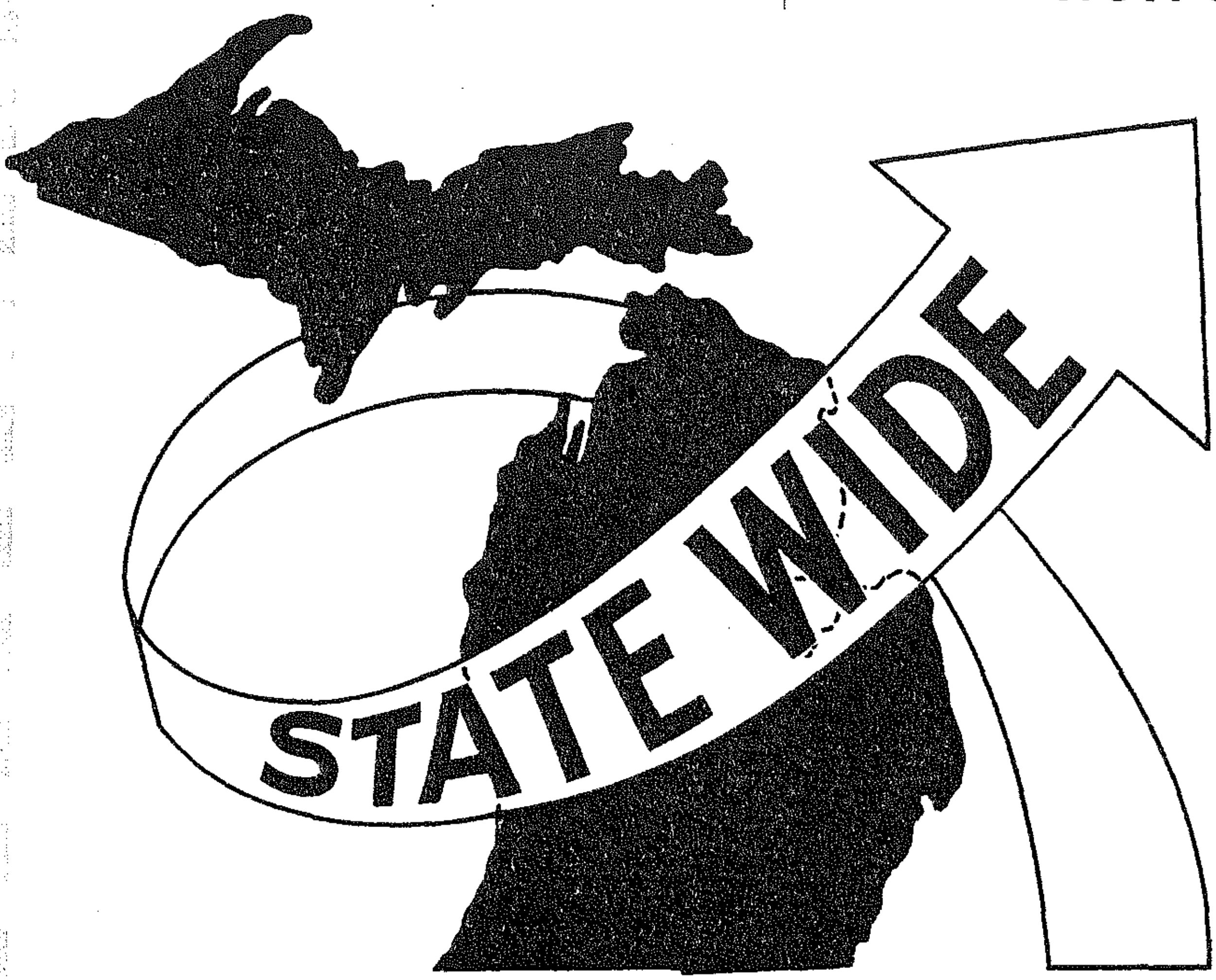
Total Calibration

Once the network and trip generation - distribution equations are calibrated independently, many times selected links are still not calibrated so that reliable forecasting can be done statewide. A measurement of this is made through comparison of the base year (1975) model forecast with known traffic volumes. In the case of the statewide forecasting model, it involved comparing 1975 model forecasts to 1975 ADTs on the 1975 traffic flow map. The 1975 traffic flow map was used because it is the most widely utilized traffic volume reference map in the Department.

The comparison of the model simulated base year ADTs against traffic flow map ADTs illustrated that the trip generation - distribution process and network calibration had been successful in bringing a majority of the links in the network to within the calibration standard range of ± 10% of the actual ADT. In most cases the model's utilization of population as the major socio-economic variable in trip generation - distribution had adequately served to simulate the travel taking place. However, some links still remained uncalibrated. The majority of these cases occurred where a link was affected by a "special generator" or geographic barrier which is not fully accounted for in the initial trip generation - distribution equations using population as the primary variable. The correction for these trip generation - distribution problems took the form of factors called MODS and BETAS. These MODS and BETAS were applied internally in the model to increase or decrease trip interchanges to more closely reflect the real world where the population variable was inadequate. These factors are similar to the K factors and F factors used in the Urban Transportation Planning System process.

The last section of this report is included so that any user of Michigan's statewide travel forecasting model will be able to determine for themselves just how successful or unsuccessful the 1975 model calibration process was.

CALIBRATION STATUS



CALIBRATION STATUS

Recalibration of the statewide traffic forecasting model to base year (1975) data was completed in March, 1978. The recalibrated model has greatly enhanced the reliability and capability of traffic forecasts and allows for more extensive input into regional and statewide model impact analysis programs.

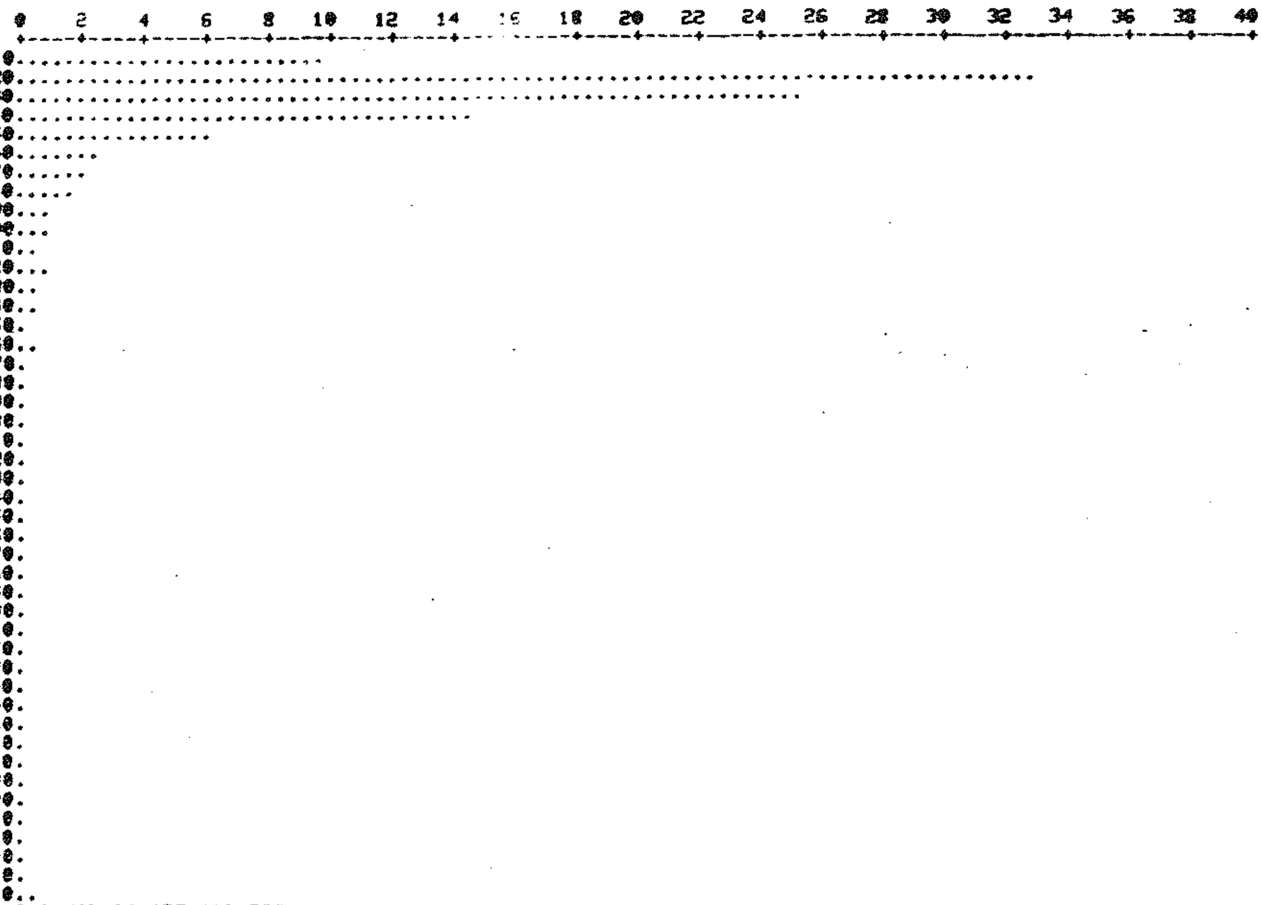
Several important improvements to the model include:

1. Calibration of a model with a 1975 network and 1975 travel patterns, updates the model ten years from the original 1965 calibration.
2. New calibration standards of ± 10% of the base year ADT versus the old model standard of ± 25%.
3. Elimination of the over generation of long distance travel in the trip distribution phase of the 1965 model.

Several means are available for investigating how accurately the model is simulating existing travel patterns. First, the comparison of trip length distribution curves (TLDs), model simulated trips, versus actual origin - destination trips is a good test of whether the model produces a comparable number of trips by trip length class. The actual origin - destination TLD curve in Figure 7 represents a cross section of all the travel in the state since it includes some sixty major and minor O&D surveys taken throughout the state over the last two decades. This curve should be compared to Figure 8 which is the TLD curve for all the trips produced by the model for the base year forecast. Comparison of these two curves shows the patterns to be very similar and the mean trip lengths, model versus actual, to be 30.860 to 35.399 repsectively. Although the difference between these mean trip length statistics are not significantly large, it appears that the margin might even be less, assuming that the origin - destination data is more biased toward long distance travel, since stations in surveys are

FIGURE 7

16AUG78 TRIP LENGTH DIST CURVE FOR COMBINED MAJORS AND MINORS



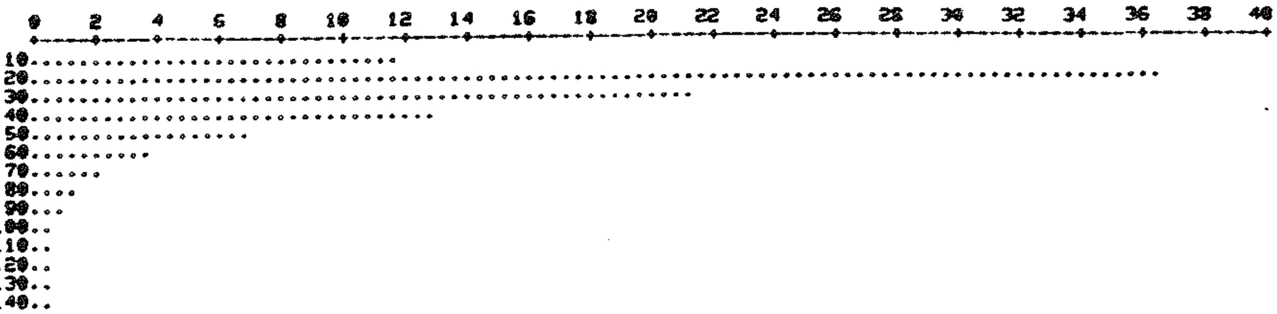
	P.C.	CUM.	ACTUAL
10.	9.515	9.515	200
20.	32.731	42.245	688
30.	25.071	67.317	527
40.	14.462	81.779	304
50.	5.899	87.678	124
60.	2.569	90.247	54
70.	1.903	92.150	40
80.	1.522	93.673	32
90.	0.904	94.577	19
100.	0.666	95.243	14
110.	0.476	95.718	10
120.	0.618	96.337	13
130.	0.476	96.813	10
140.	0.238	97.050	5
150.	0.190	97.241	4
160.	0.285	97.526	6
170.	0.190	97.716	4
180.	0.190	97.907	4
190.	0.190	98.097	4
200.	0.095	98.192	2
210.	0.048	98.240	1
220.	0.190	98.430	4
230.	0.143	98.573	3
240.	0.048	98.620	1
250.	0.190	98.811	4
260.	0.000	98.811	0
270.	0.048	98.858	1
280.	0.095	98.953	2
290.	0.000	98.953	0
300.	0.048	99.001	1
310.	0.048	99.049	1
320.	0.000	99.049	0
330.	0.095	99.144	2
340.	0.048	99.191	1
350.	0.000	99.191	0
360.	0.095	99.286	2
370.	0.000	99.286	0
380.	0.048	99.334	1
390.	0.000	99.334	0
400.	0.000	99.334	0
410.	0.000	99.334	0
420.	0.048	99.382	1
430.	0.048	99.429	1
440.	0.048	99.477	1
450.	0.523	100.000	11

REMAINING VALUES ARE ALL ZERO

NUMBER OF OBSERVATIONS= 2102 SUM= 74409. MEAN= 35.399 VAR= 2944.888 SD= 54.267

FIGURE 8

TRIP LENGTH DIST CURVE FOR 1975 FORCASTED ADT



	P.C.	CUM.	ACTUAL
10	11.750	11.750	618703
20	36.459	48.209	1919839
30	21.097	69.305	1110895
40	12.684	81.989	667905
50	6.992	88.981	368165
60	3.775	92.756	198784
70	1.849	94.604	97338
80	1.005	95.609	52904
90	0.778	96.387	40963
100	0.588	96.975	30947
110	0.451	97.426	23759
120	0.360	97.786	18948
130	0.258	98.043	13566
140	0.221	98.264	11647
150	0.160	98.424	8421
160	0.145	98.570	7657
170	0.143	98.713	7533
180	0.120	98.833	6311
190	0.107	98.940	5652
200	0.093	99.033	4907
210	0.083	99.117	4388
220	0.075	99.191	3935
230	0.069	99.260	3635
240	0.066	99.326	3454
250	0.056	99.382	2967
260	0.048	99.430	2505
270	0.046	99.475	2404
280	0.042	99.518	2236
290	0.034	99.552	1774
300	0.034	99.585	1781
310	0.020	99.606	1061
320	0.017	99.623	894
330	0.019	99.641	975
340	0.019	99.660	997
350	0.019	99.679	997
360	0.021	99.700	1121
370	0.018	99.718	960
380	0.017	99.736	914
390	0.014	99.750	733
400	0.011	99.761	598
410	0.012	99.774	653
420	0.011	99.784	570
430	0.010	99.794	508
440	0.009	99.803	494
450	0.197	100.000	10354

REMAINING VALUES ARE ALL ZERO

NUMBER OF OBSERVATIONS= 5266752 SUM= 162499444. MEAN= 30.860 VAR= 1717.638 SD= 41.444

sometimes not taken on the most local traveled roads since they are the most difficult to survey due to traffic congestion. The conclusion then in reviewing these TLD curves is that the model is doing an excellent job of matching the actual travel based on the number of trips generated and distributed by trip length class. This does not mean, however, that these trips are utilizing the right roads, which brings us to the next step.

As previously mentioned, comparison of model forecasts with 1975 ADTs, as derived from the 1975 traffic flow map, allows for a determination of the level each link is calibrated. Reference to Appendix A permits an examination, by region, of the ratio of the actual 1975 ADT that the model is forecasting for each segment of trunkline road. These plots illustrate that with a few exceptions all links are within a range of ± 10%. As an example, if a link carries a value of 1041 this means the model is forecasting an ADT which is 104.1% of the base year ADT for that link (1000 or 100.0% would be the best possible forecast).

A third test made and perhaps the strictest examination of model simulation capability is the comparison of model trip distribution patterns with actual single station origin - destination trip distribution patterns. These plots, in Appendix B, show in bandwidth intervals the distribution of traffic for selected locations around the state. Through comparison of the actual trip data with model simulated trip data for the five stations, the patterns should be similar if the model is simulating real world traffic patterns.

A computer program called TPEVAL was used to complete a fourth test run with illustrates the capability of the model to forecast base year ADTs. This program compares 1975 model forecasted traffic volumes with 1975 actual ADTs for every link in the state. The program then sums, by road type, the number of links with forecasts within a specific range of the actual volumes. The results of this test found that 90% of all rural roads on the model are forecasting 1975 volumes within a range of ± 10% of the actual 1975 ADT. Furthermore, 95% of all rural roads are forecasting within a range of ± 20%.

A final test and another very exacting test is the comparison of model thru trip volumes with the external thru trip volumes at the corridon of an actual origin-destination study. This test is an extremely thorough way of verifying the accuracy of any statewide model because:

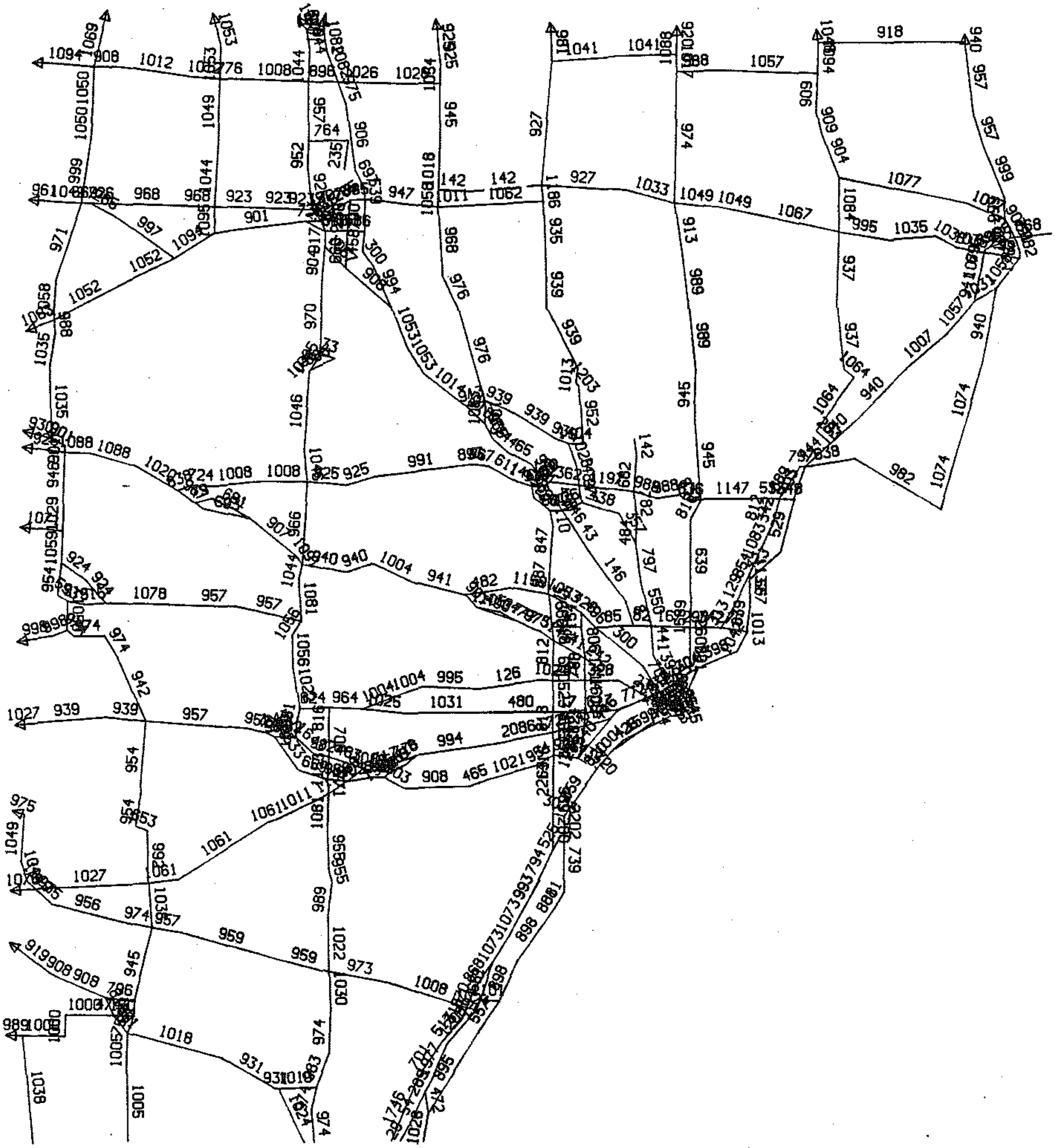
- Total independent data sources must be compared
- Large variations in traffic volumes must be simulated
- Large variations in the trip purpose of roads at the corridon level must be simulated
- Large variations in trip length must be simulated

The thru trip comparisons of model versus actual thru trips appear in Appendix C for Grand Rapids and Flint origin-destination studies.

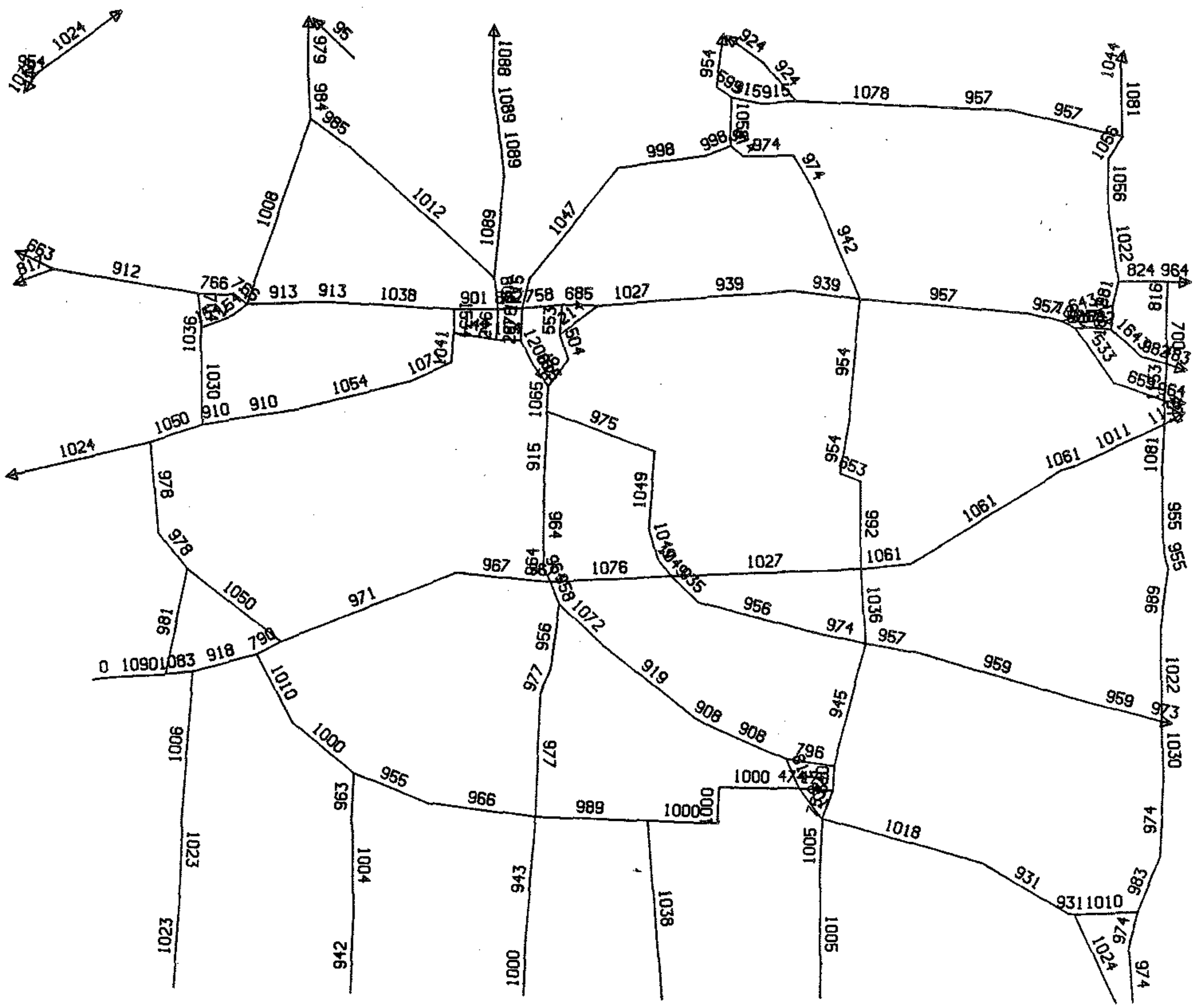
In conclusion, these results seem to illustrate that the model is quite accurately simulating existing travel volumes and travel patterns in the state. If the assumptions and limitations are clearly understood, the model can be used for future year forecasts. Additionally, general consensus by users of the model to date have, for the most part, found future year forecasts to be reasonable relative to other forecasts derived by manual forecasting methods.

APPENDIX A

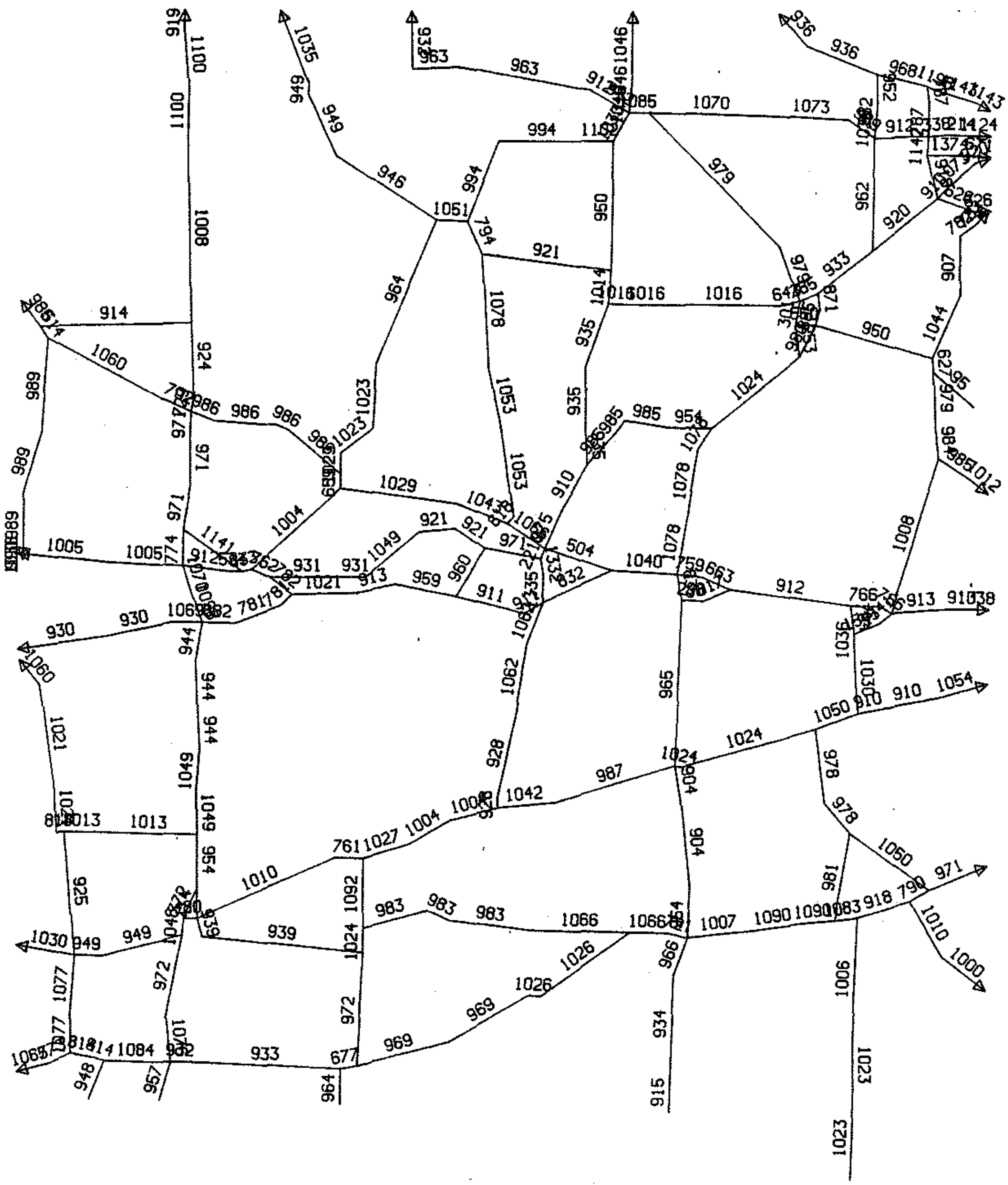
PERCENT, MODEL CALIBRATED TO 1975 ADT (REGION I)



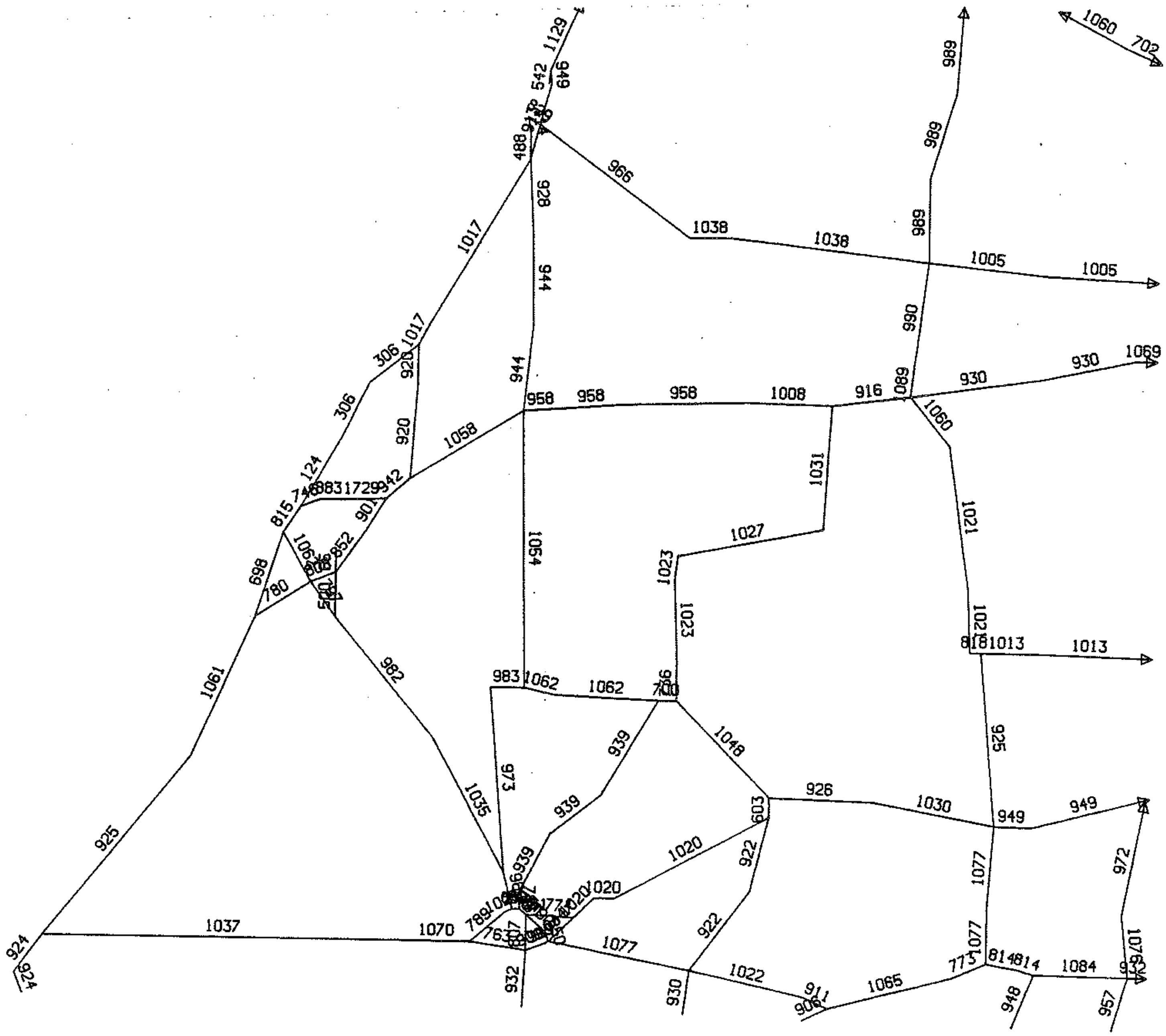
PERCENT MODEL CALIBRATED TO 1975 ADT (REGION 2)



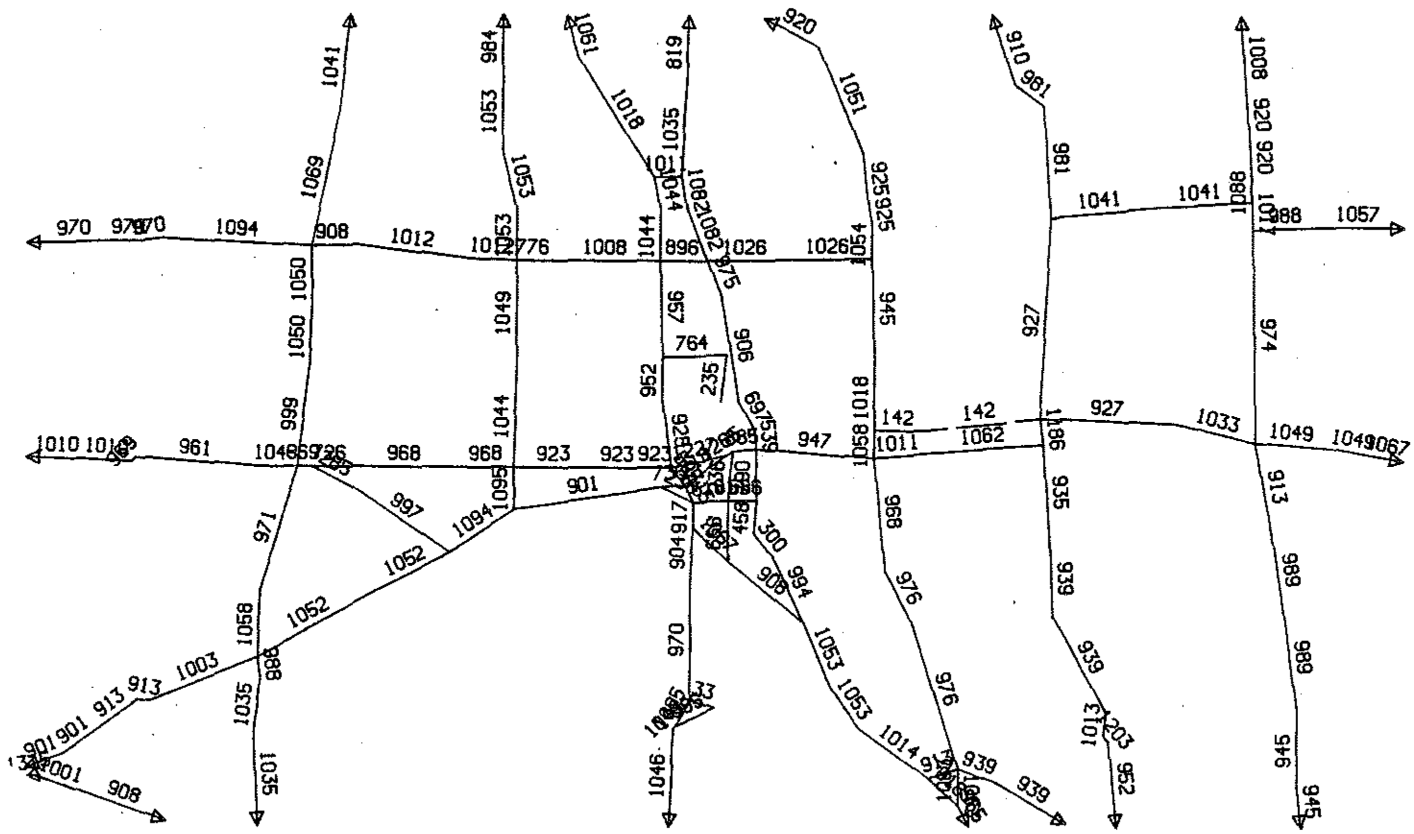
PERCENT MODEL CALIBRATED TO 1975 ADT (REGION 3)



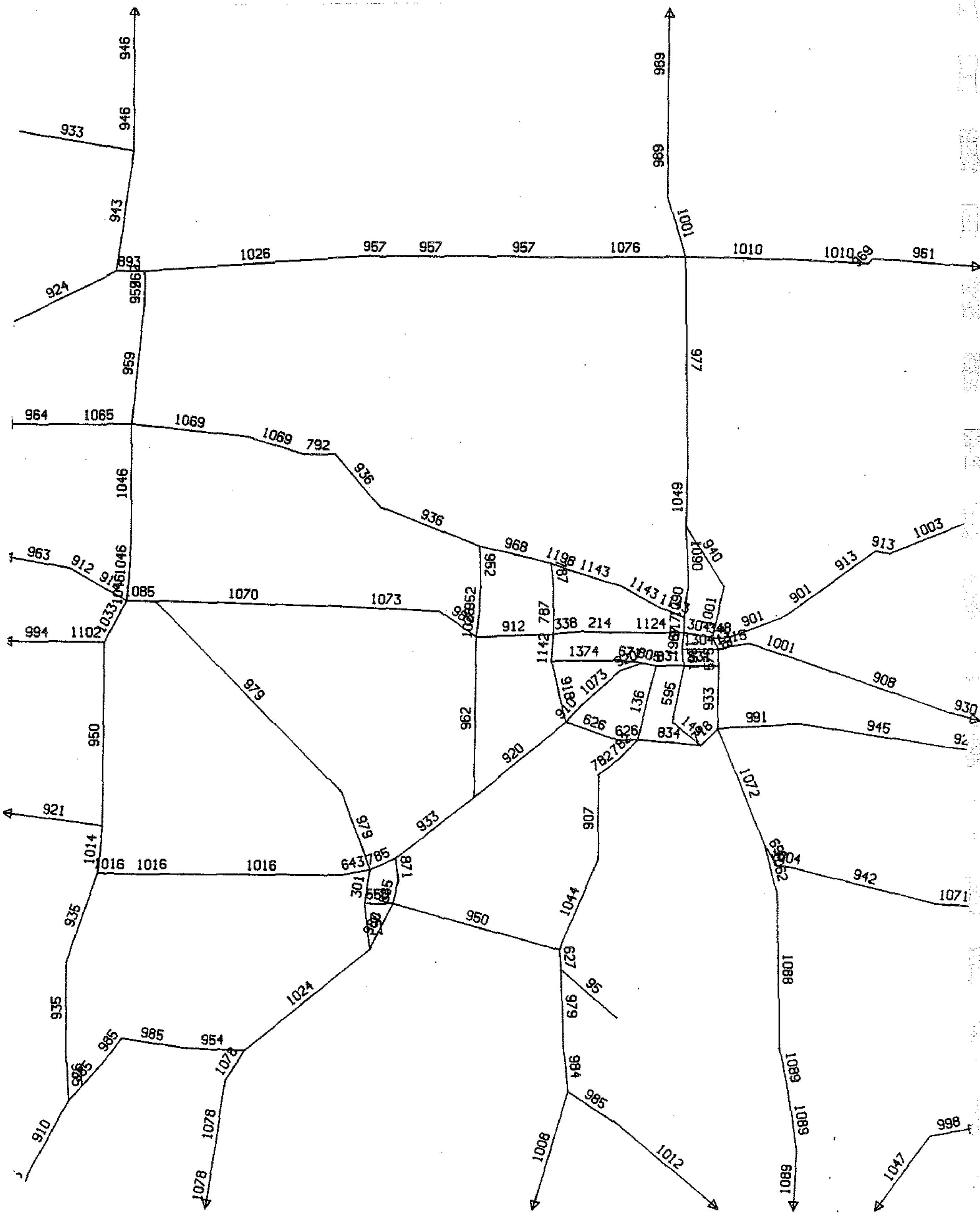
PERCENT MODEL CALIBRATED TO 1975 ADT (REGION 4)



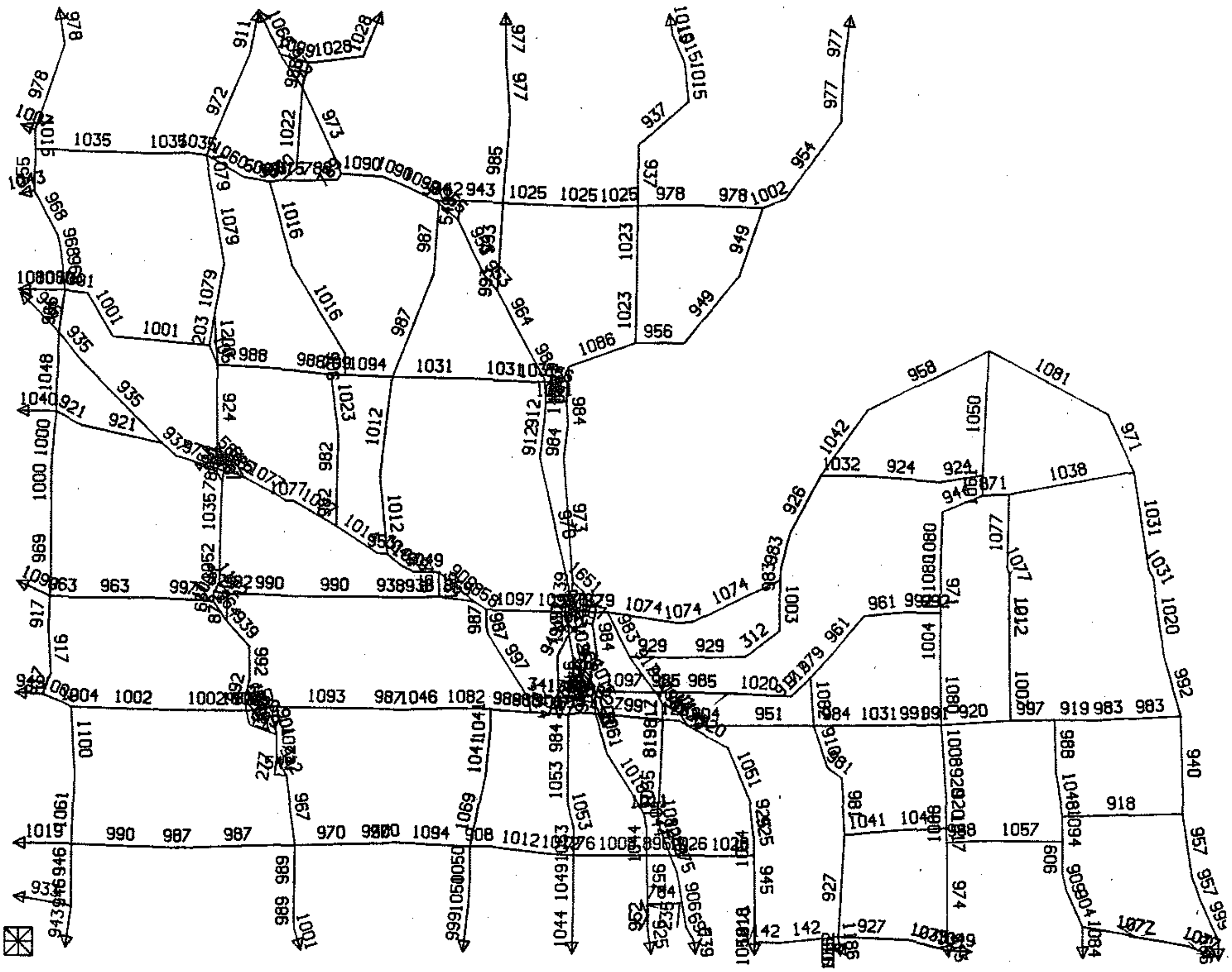
PERCENT MODEL CALIBRATED TO 1975 ADT (REGION 5)



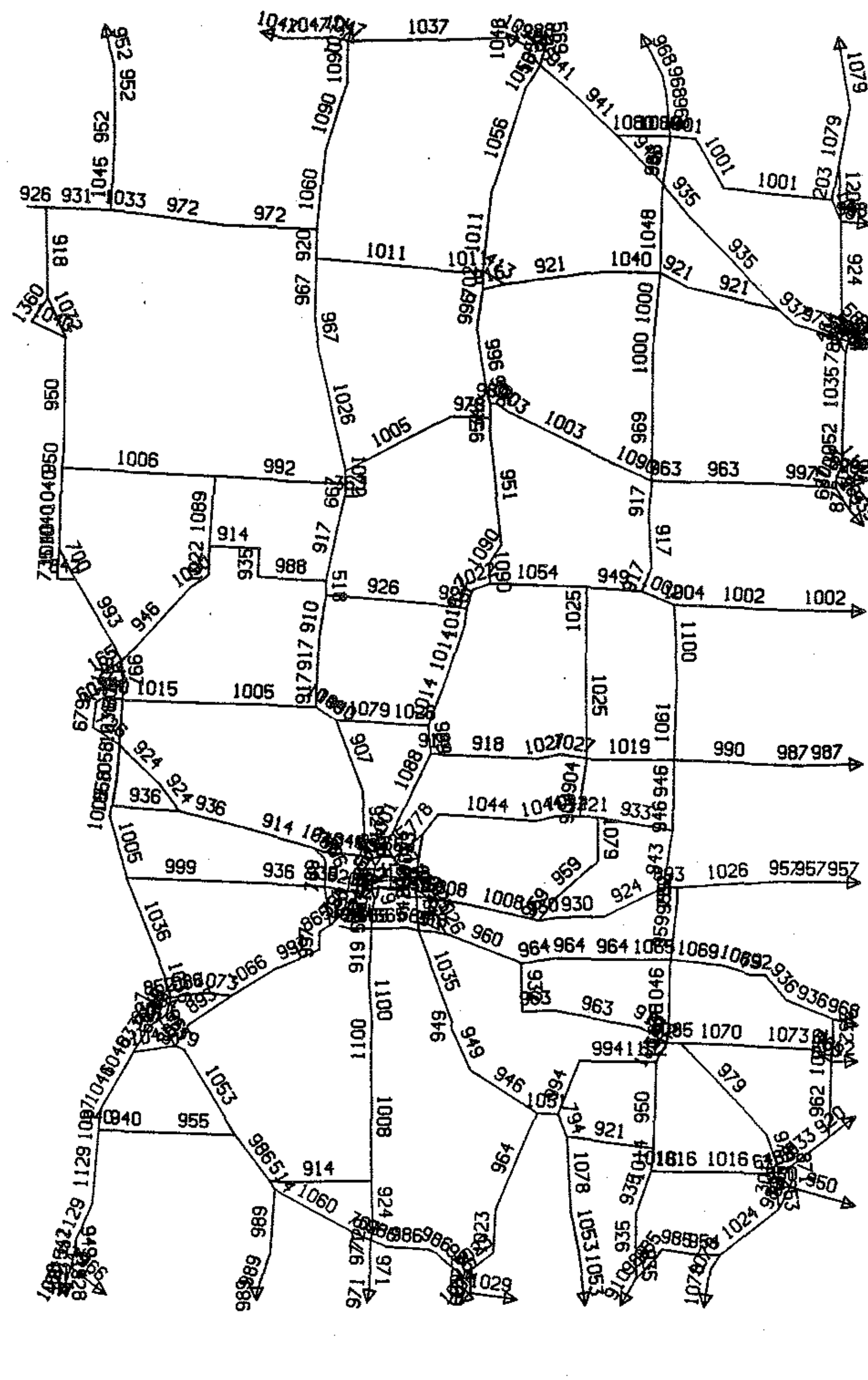
PERCENT MODEL CALIBRATED TO 1975 ADT (REGION 6)



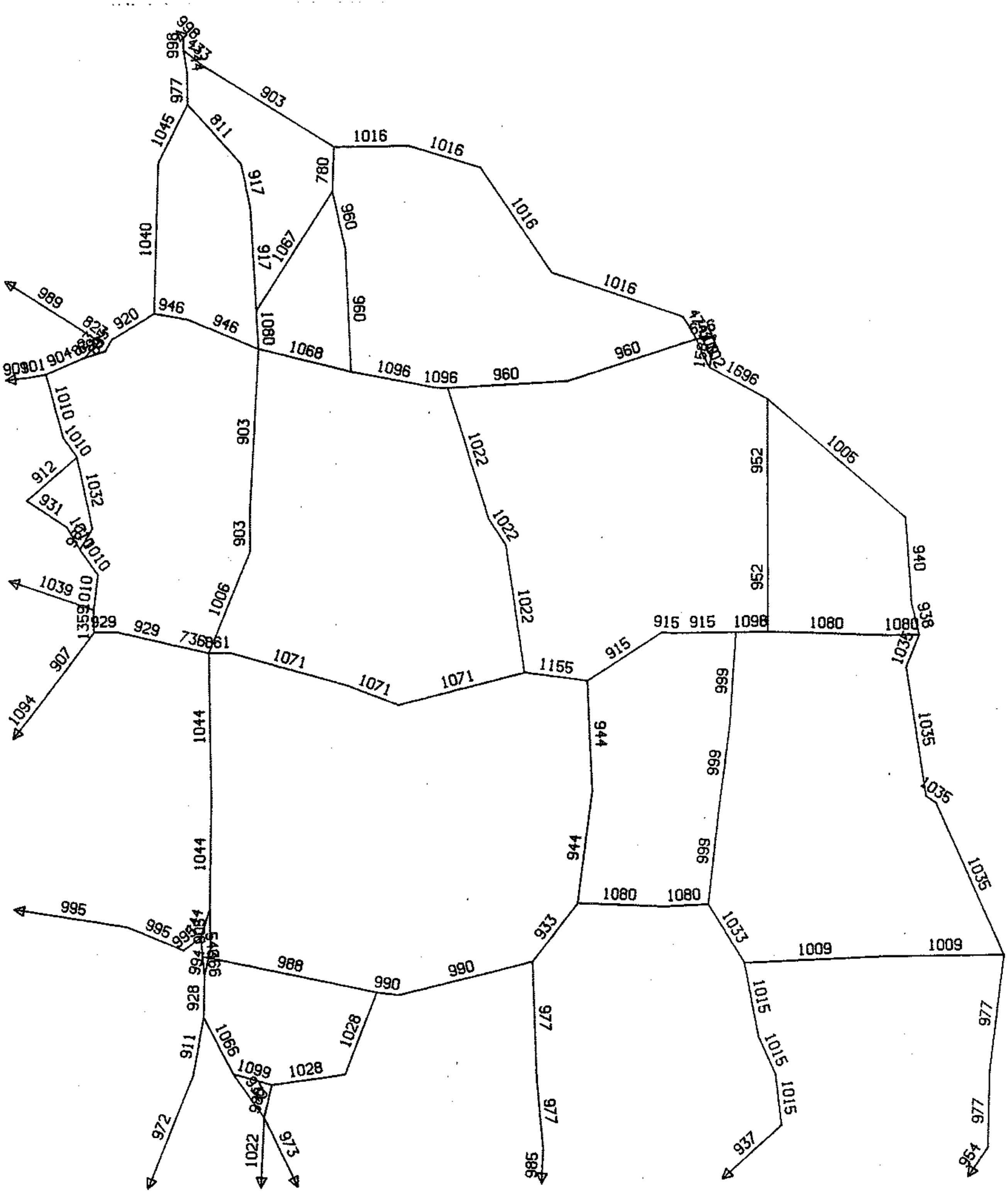
PERCENT MODEL CALIBRATED TO 1975 ADT (REGION 7)



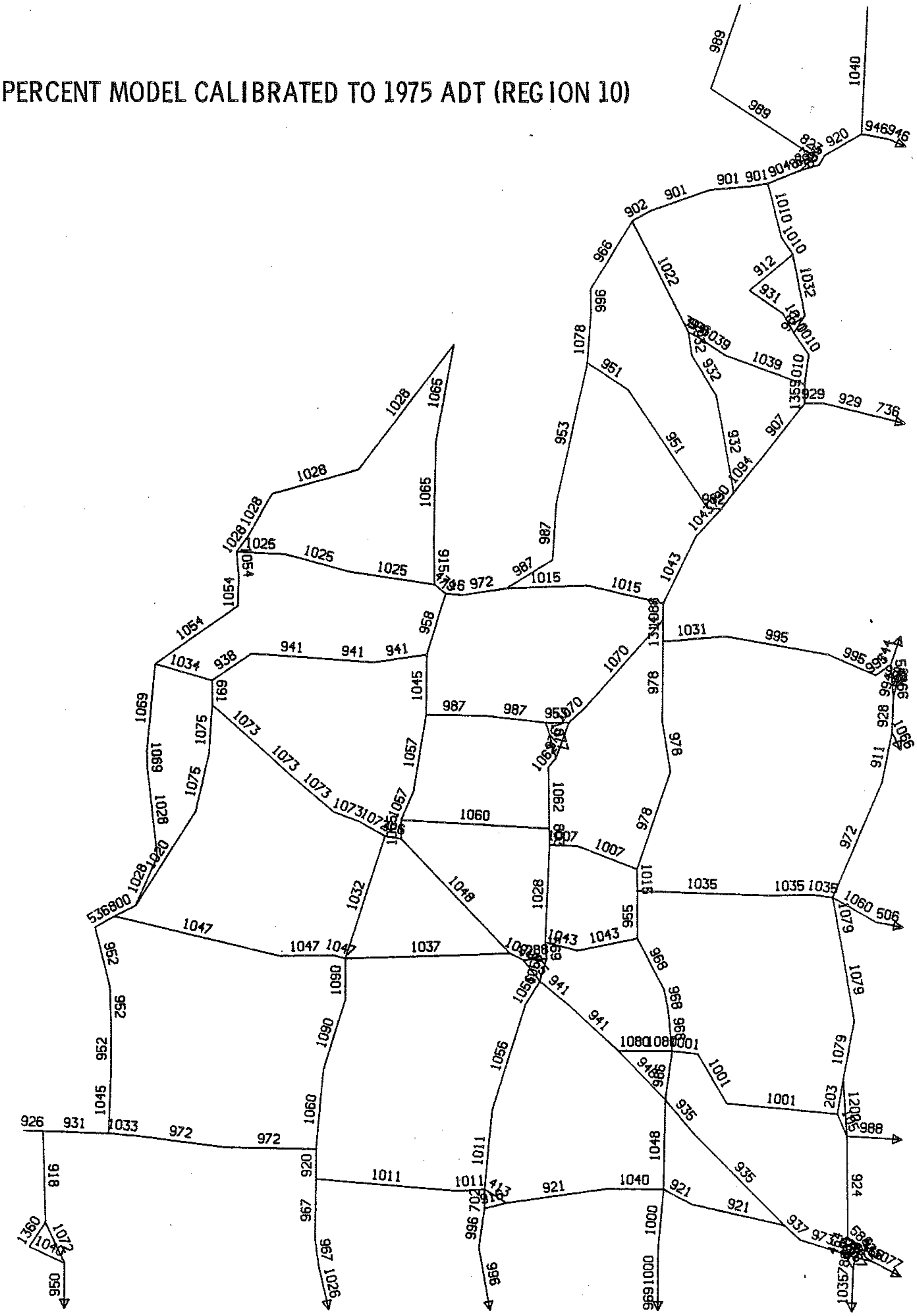
PERCENT MODEL CALIBRATED TO 1975 ADT (REGION 8)



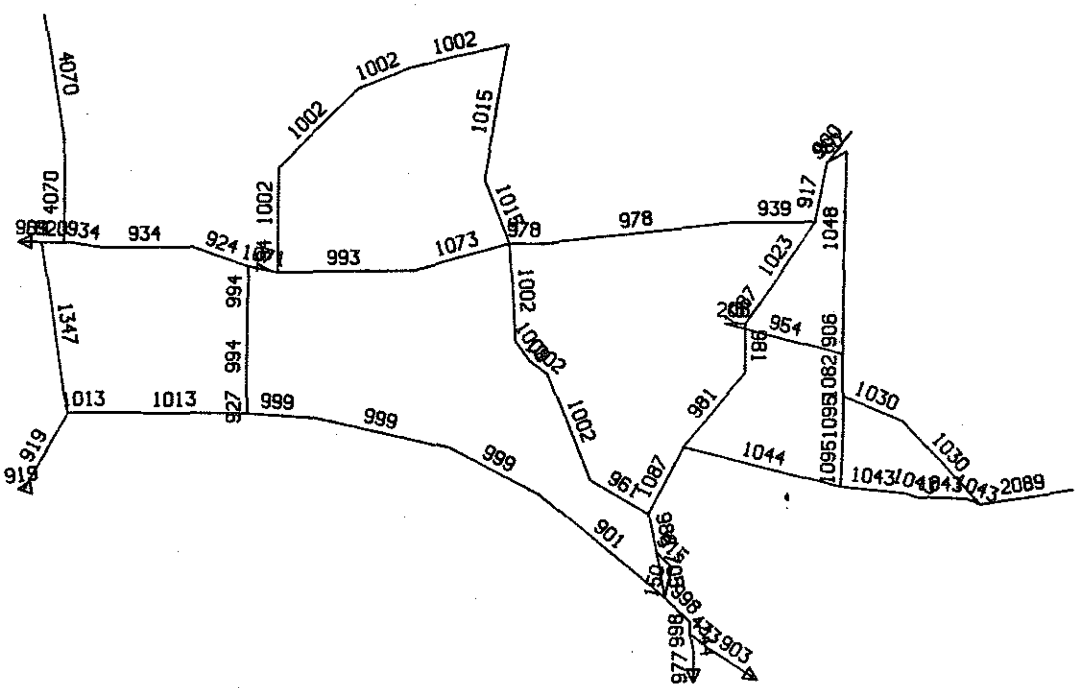
PERCENT MODEL CALIBRATED TO 1975 ADT (REGION 9)



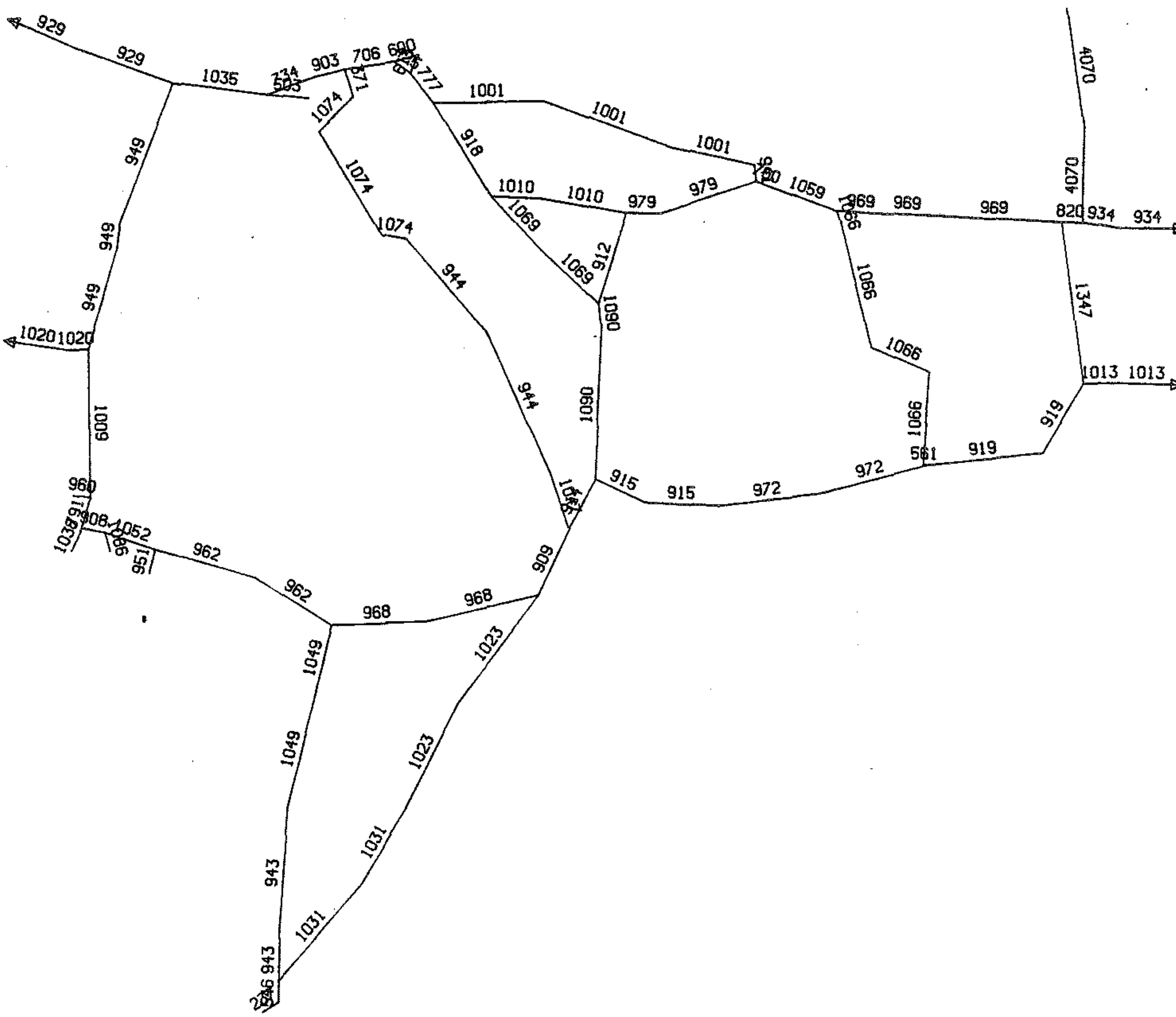
PERCENT MODEL CALIBRATED TO 1975 ADT (REGION 10)



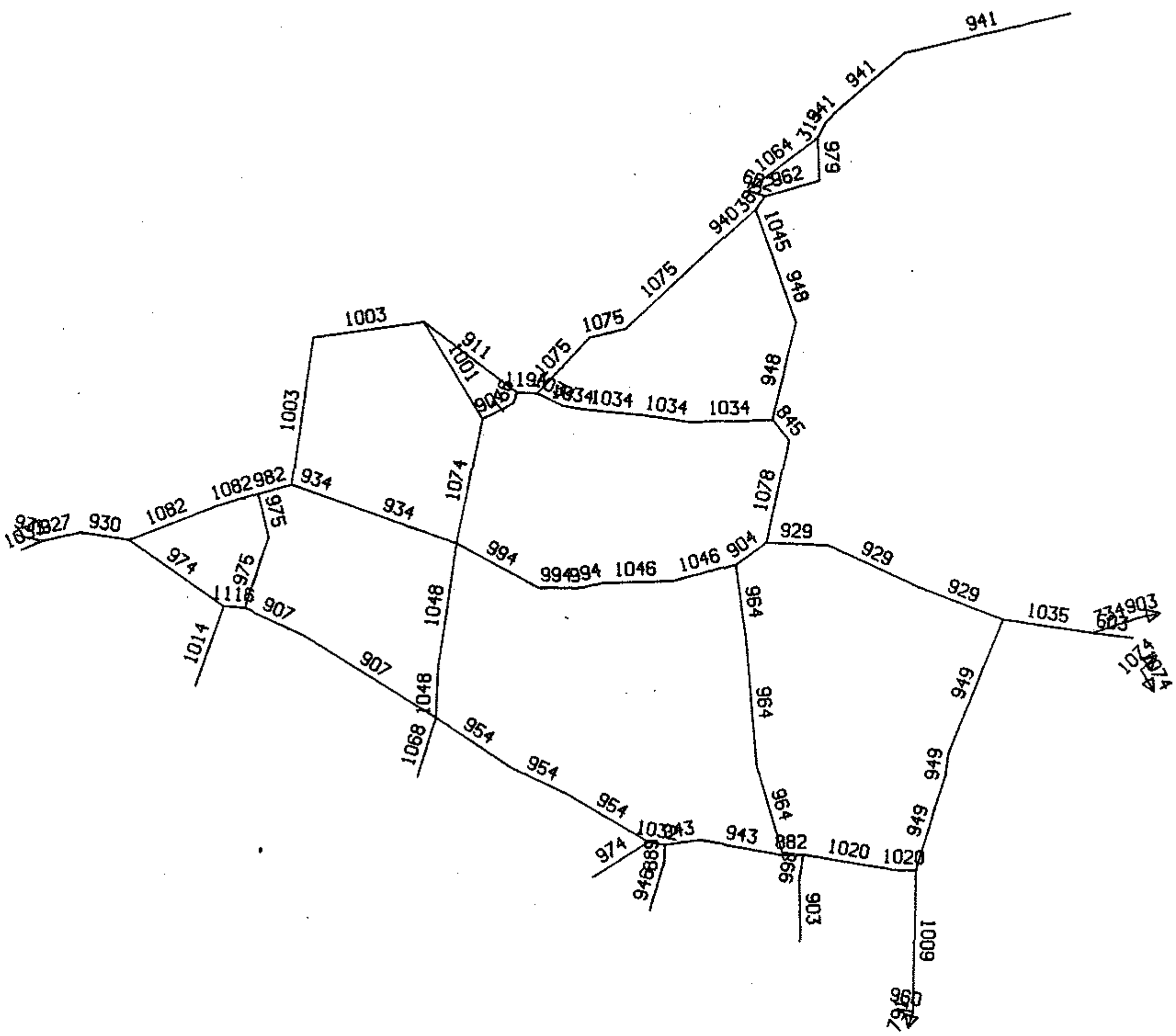
PERCENT MODEL CALIBRATED TO 1975 ADT (REGION 11)



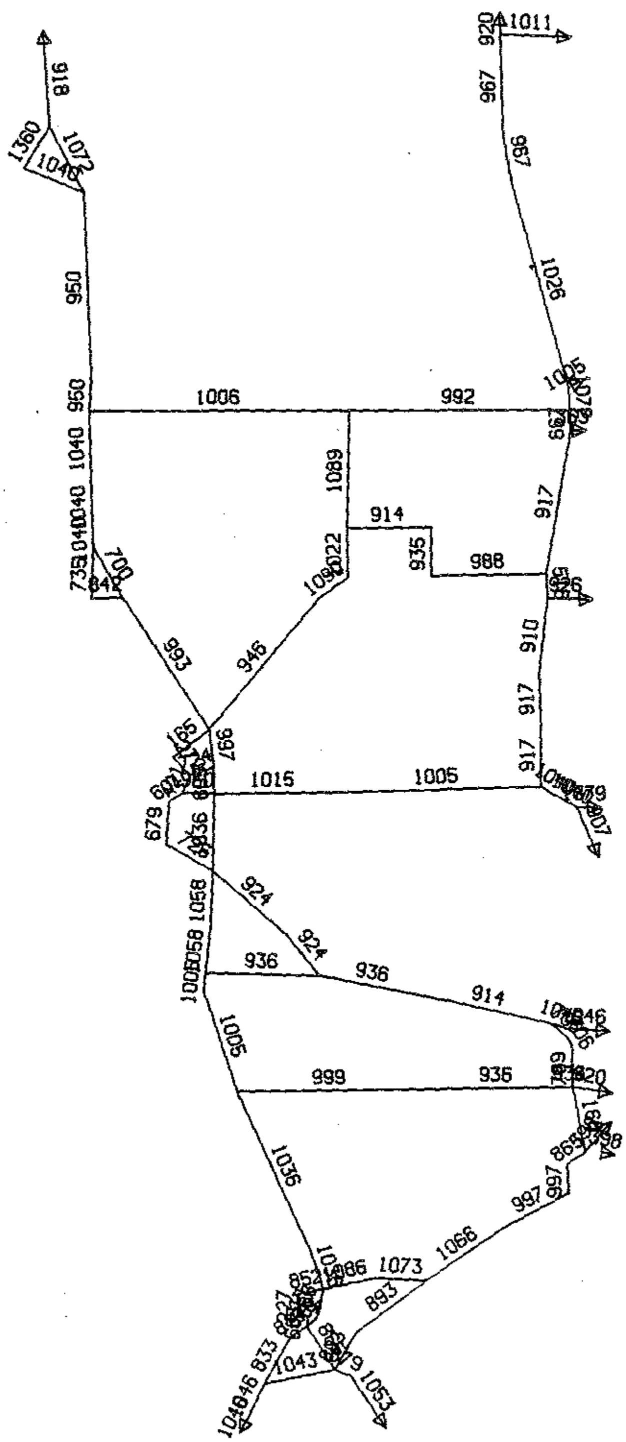
PERCENT MODEL CALIBRATED TO 1975 ADT (REGION 12)



PERCENT MODEL CALIBRATED TO 1975 ADT (REGION 13)



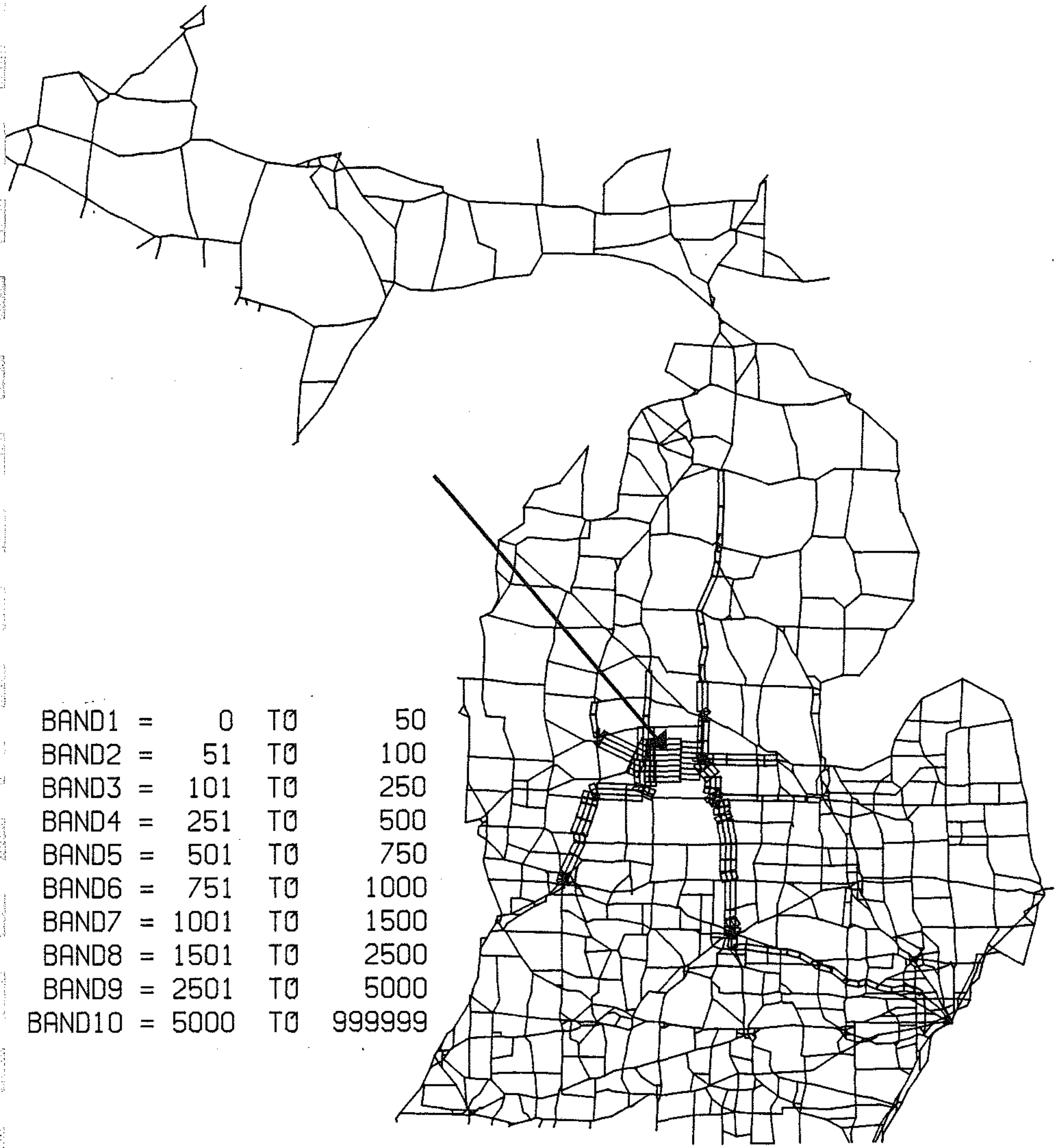
PERCENT MODEL CALIBRATED TO 1975 ADT (REGION 14)



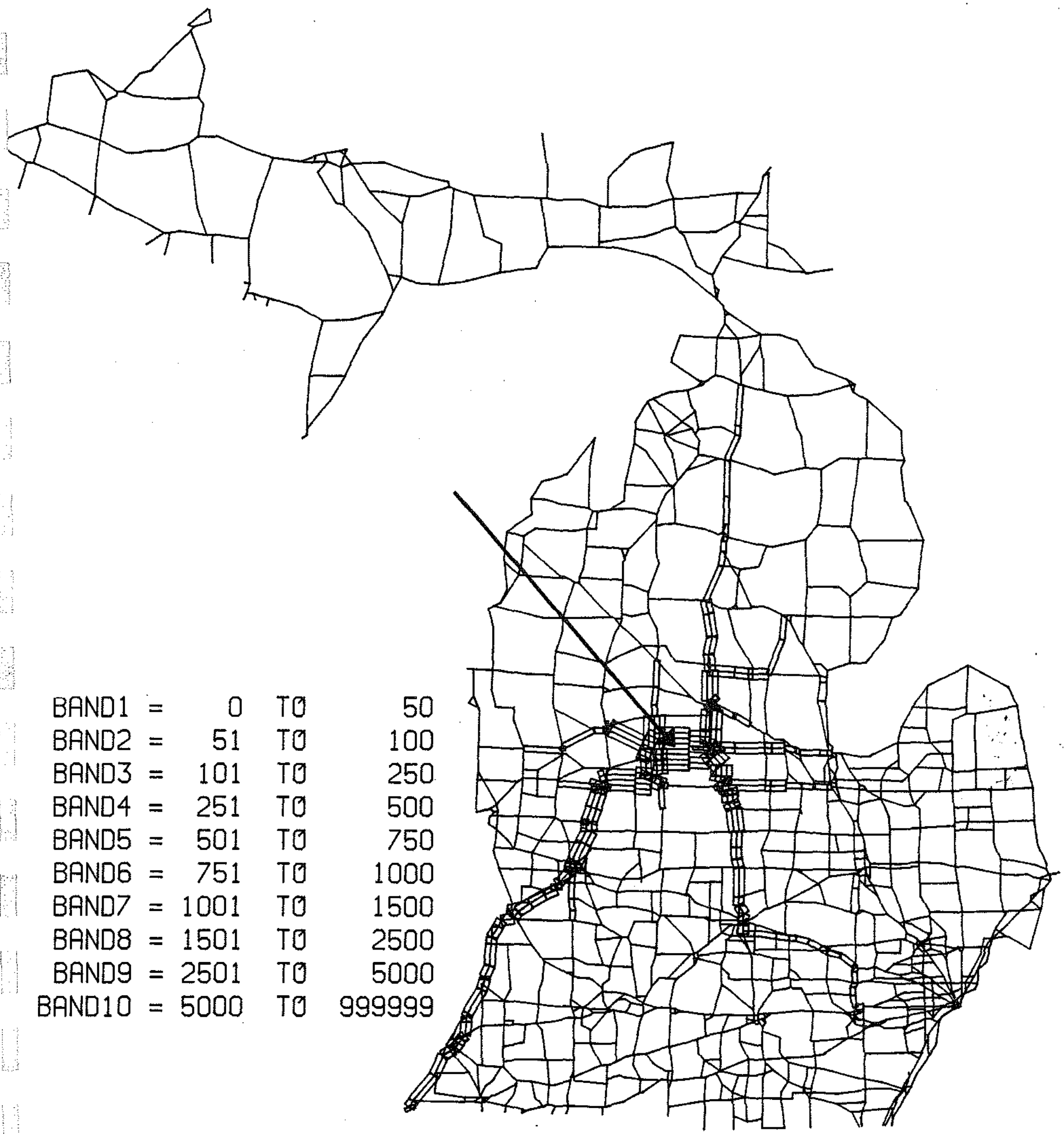
APPENDIX B

TRIP LENGTH DISTRIBUTION ON M-20 ISABELLA COUNTY

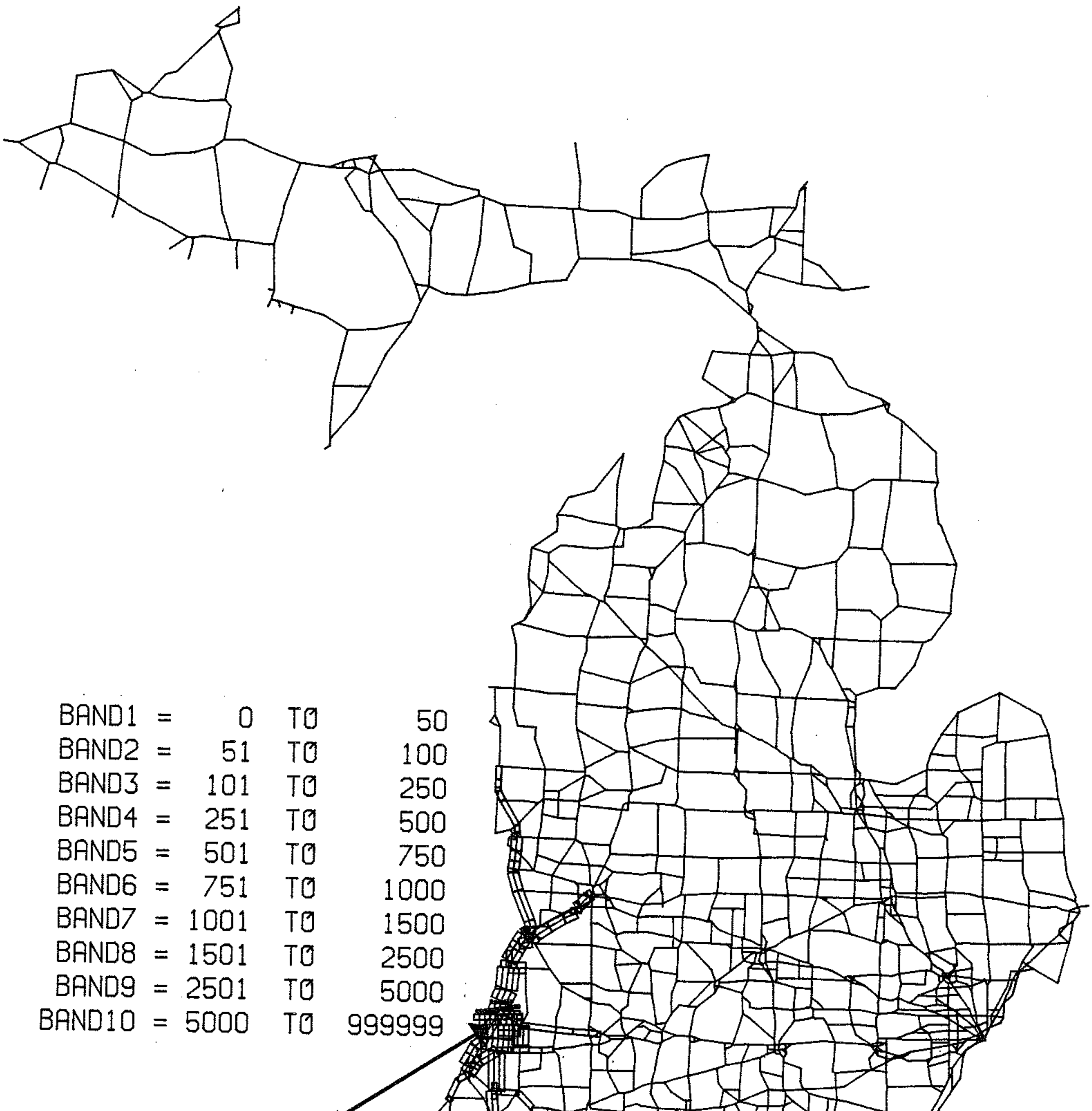
ACTUAL SUMMER WEEKDAY VOLUMES



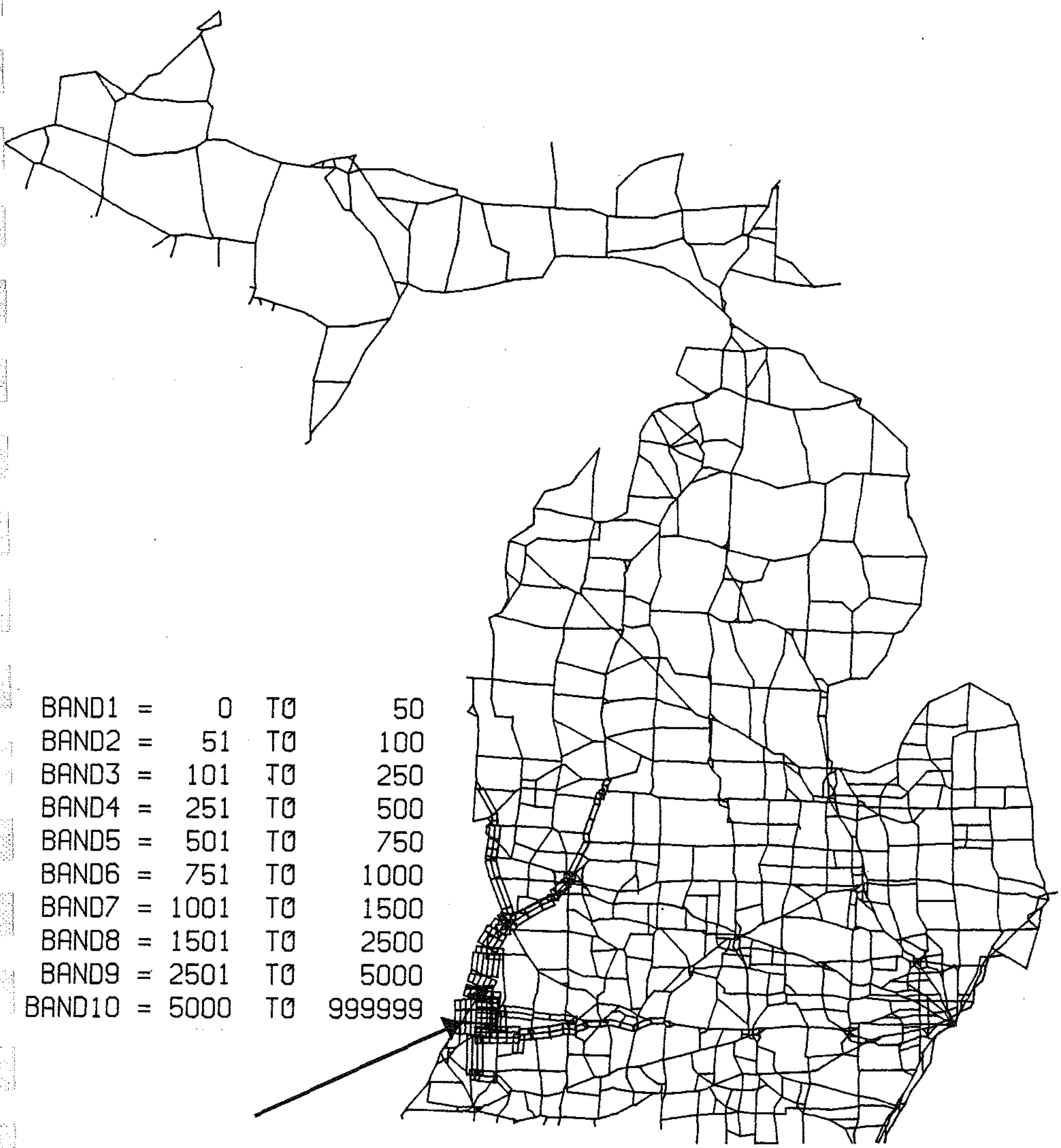
TRIP LENGTH DISTRIBUTION ON M-20 ISABELLA COUNTY
MODEL SIMULATED SUMMER WEEKDAY VOLUMES



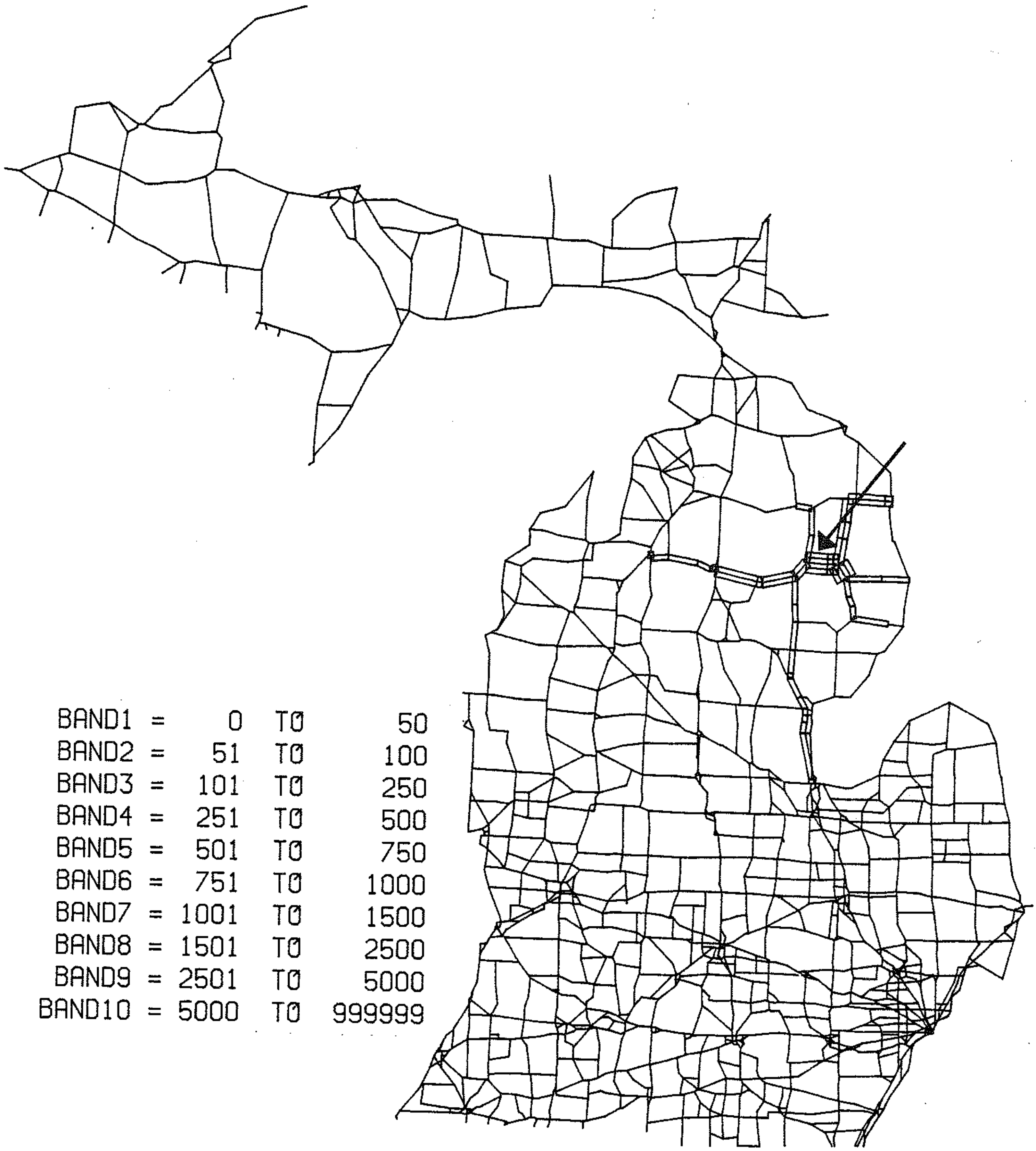
TRIP LENGTH DISTRIBUTION ON M-140 VAN BUREN COUNTY
ACTUAL SUMMER WEEKDAY VOLUMES



TRIP LENGTH DISTRIBUTION ON M-140 VAN BUREN COUNTY
MODEL SIMULATED SUMMER WEEKDAY VOLUMES

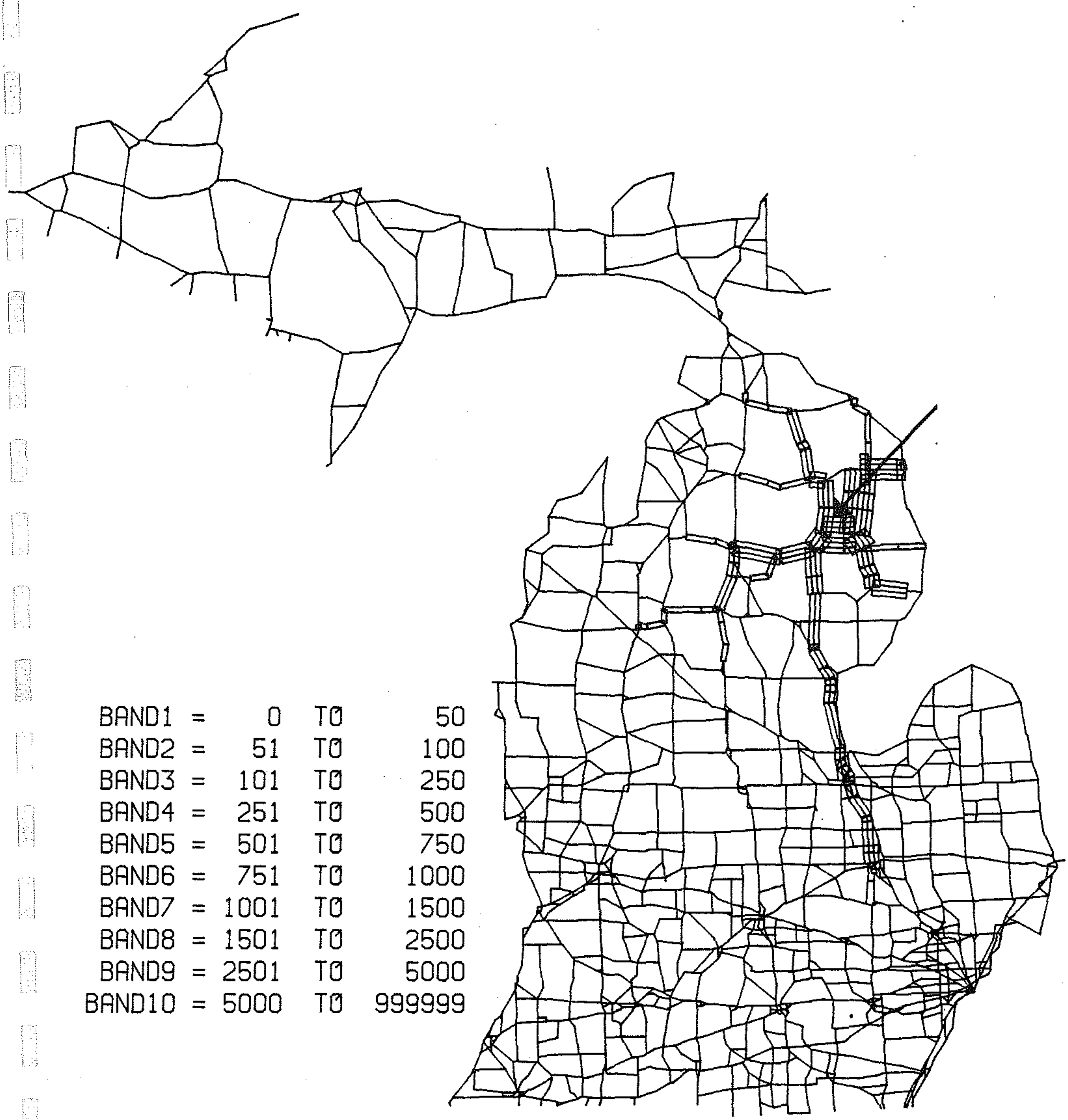


TRIP LENGTH DISTRIBUTION ON M-72 ALCONA COUNTY
ACTUAL SUMMER WEEKDAY VOLUMES



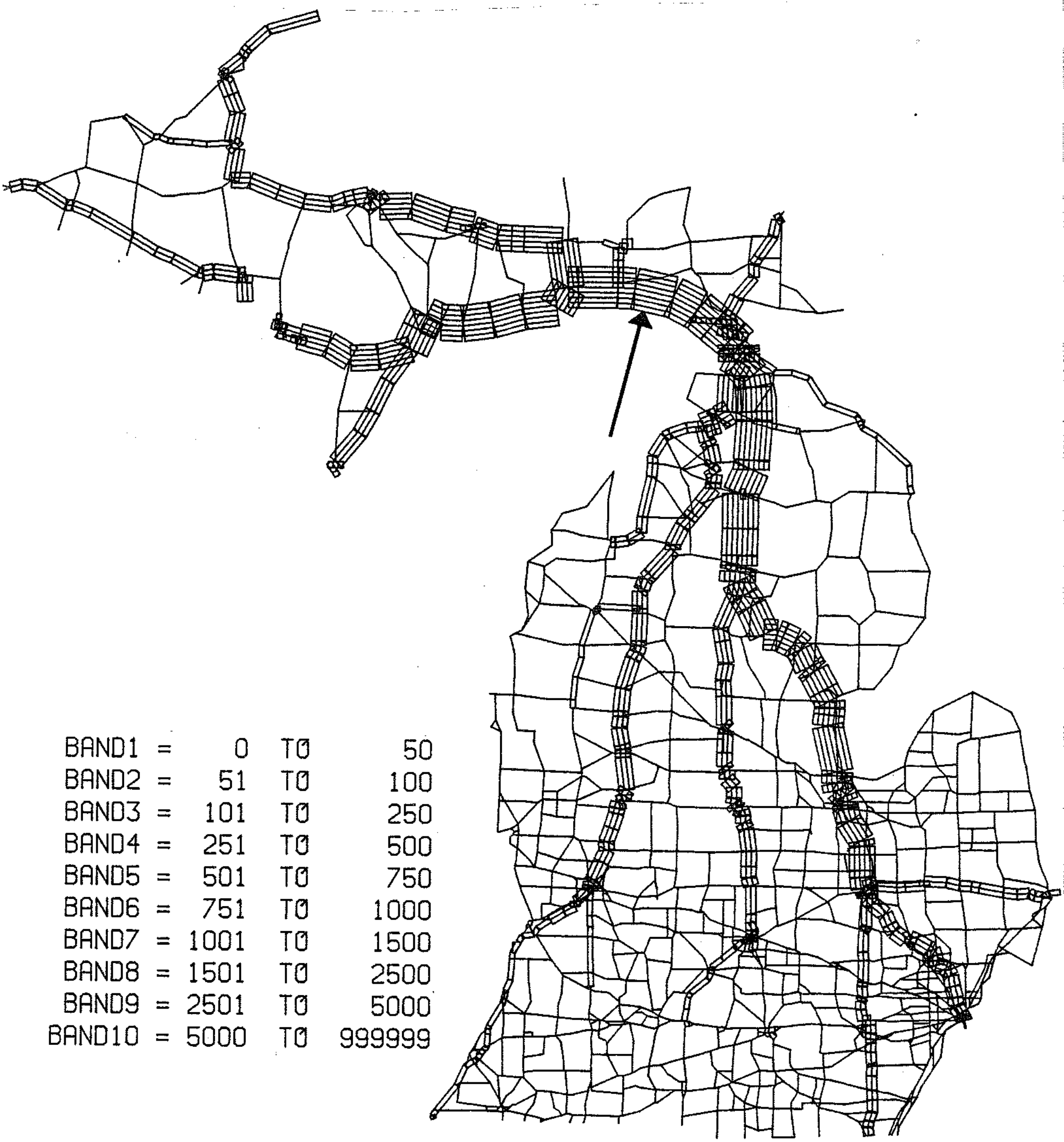
BAND1	=	0	TO	50
BAND2	=	51	TO	100
BAND3	=	101	TO	250
BAND4	=	251	TO	500
BAND5	=	501	TO	750
BAND6	=	751	TO	1000
BAND7	=	1001	TO	1500
BAND8	=	1501	TO	2500
BAND9	=	2501	TO	5000
BAND10	=	5000	TO	999999

TRIP LENGTH DISTRIBUTION ON M-72 ALCONA COUNTY
MODEL SIMULATED SUMMER WEEKDAY VOLUMES



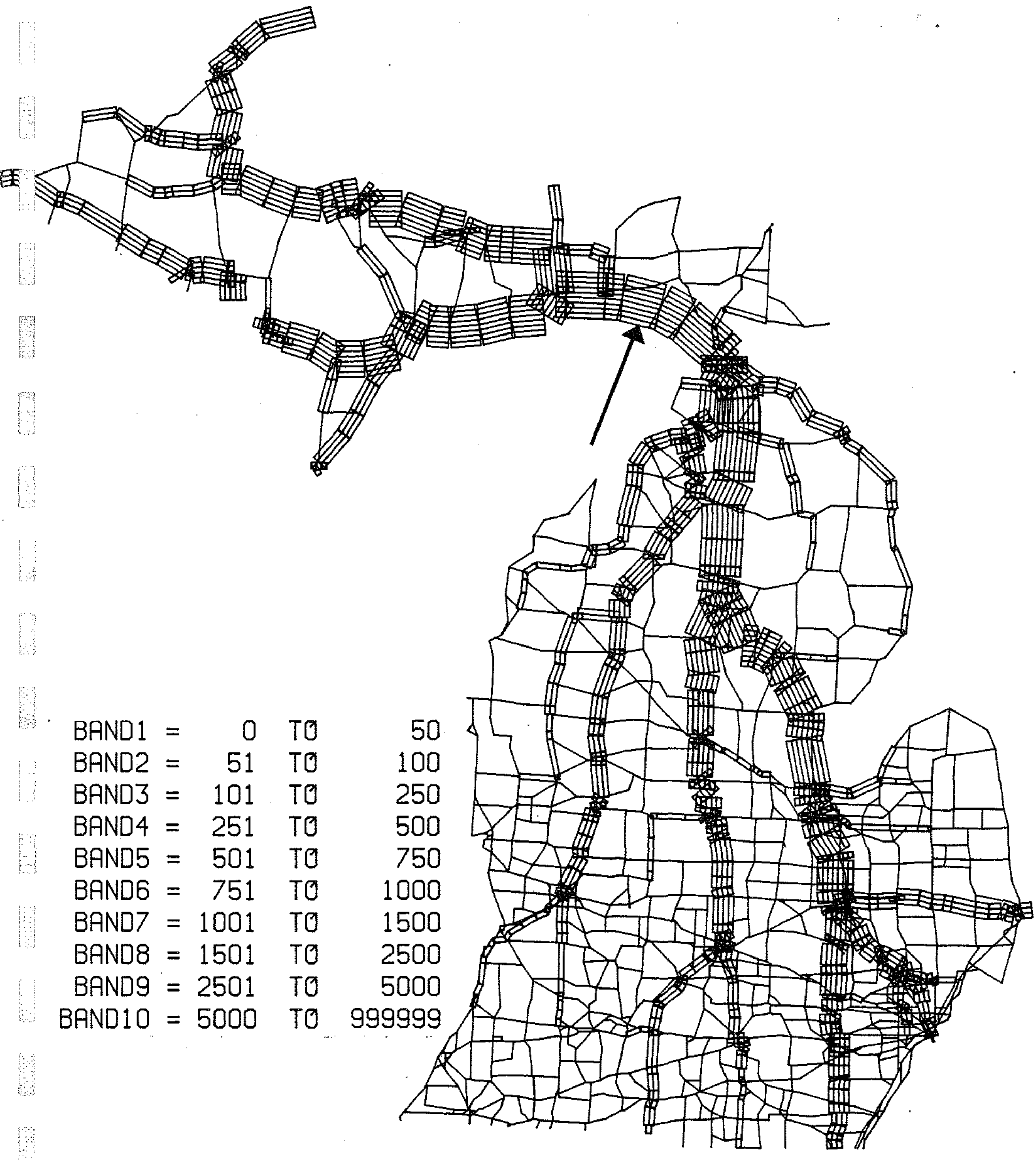
TRIP LENGTH DISTRIBUTION ON US-2 MACKINAC COUNTY

ACTUAL SUMMER WEEKDAY VOLUMES

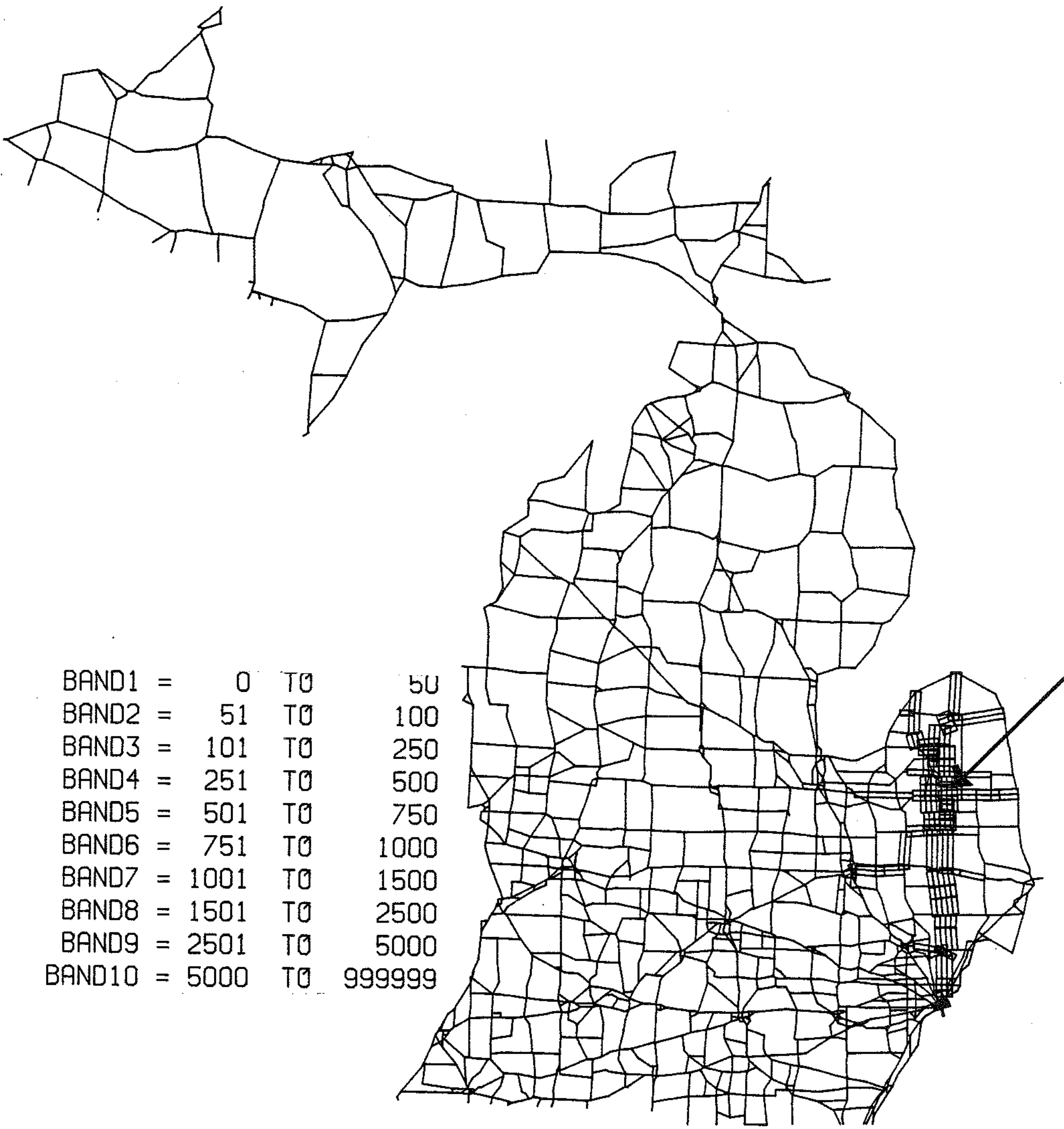


TRIP LENGTH DISTRIBUTION ON US-2 MACKINAC COUNTY

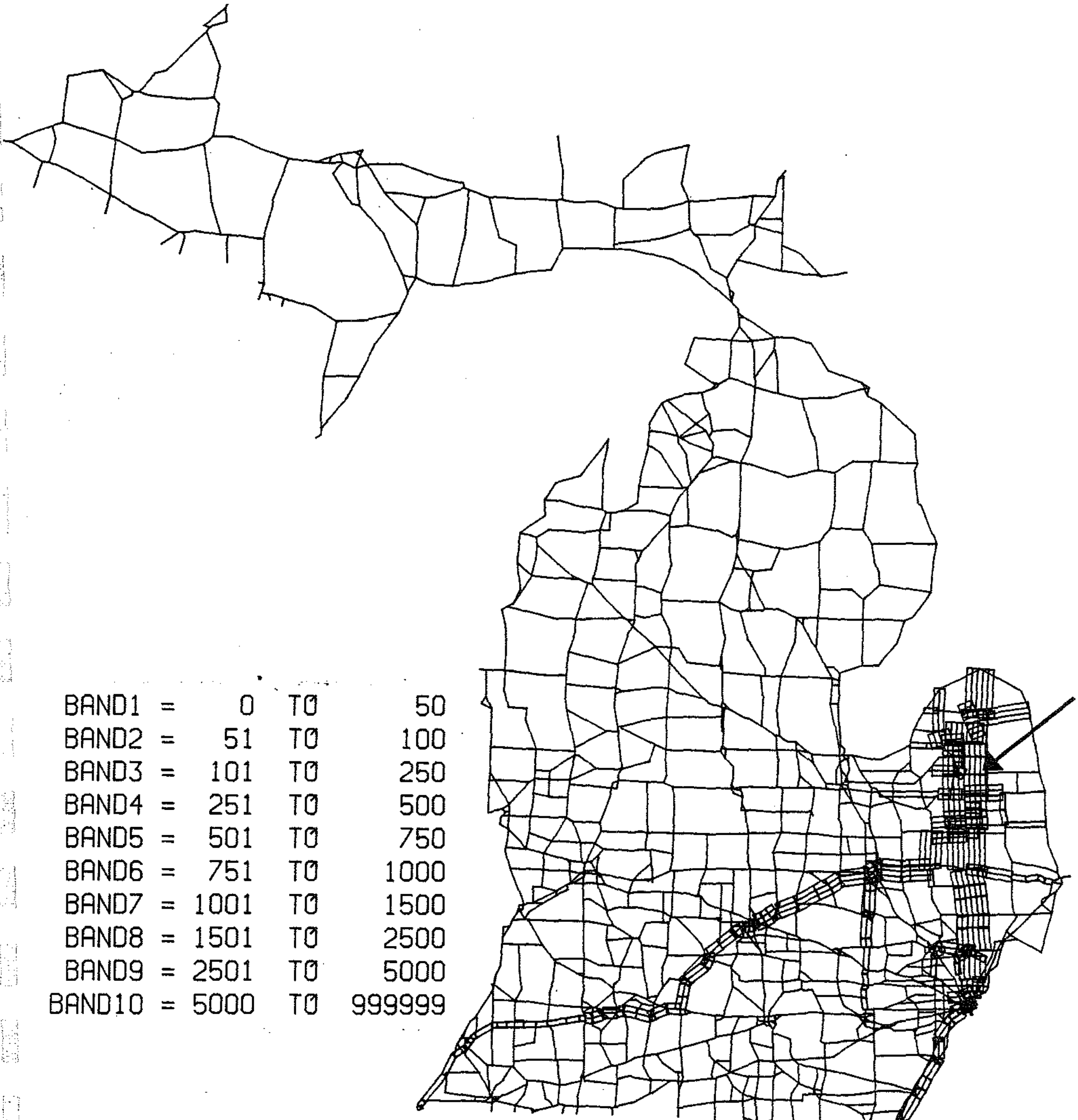
MODEL SIMULATED SUMMER WEEKDAY VOLUMES



TRIP LENGTH DISTRIBUTION ON M-53 SANILAC COUNTY
ACTUAL SUMMER WEEKDAY VOLUMES



TRIP LENGTH DISTRIBUTION ON M-53 SANILAC COUNTY
MODEL SIMULATED SUMMER WEEKDAY VOLUMES



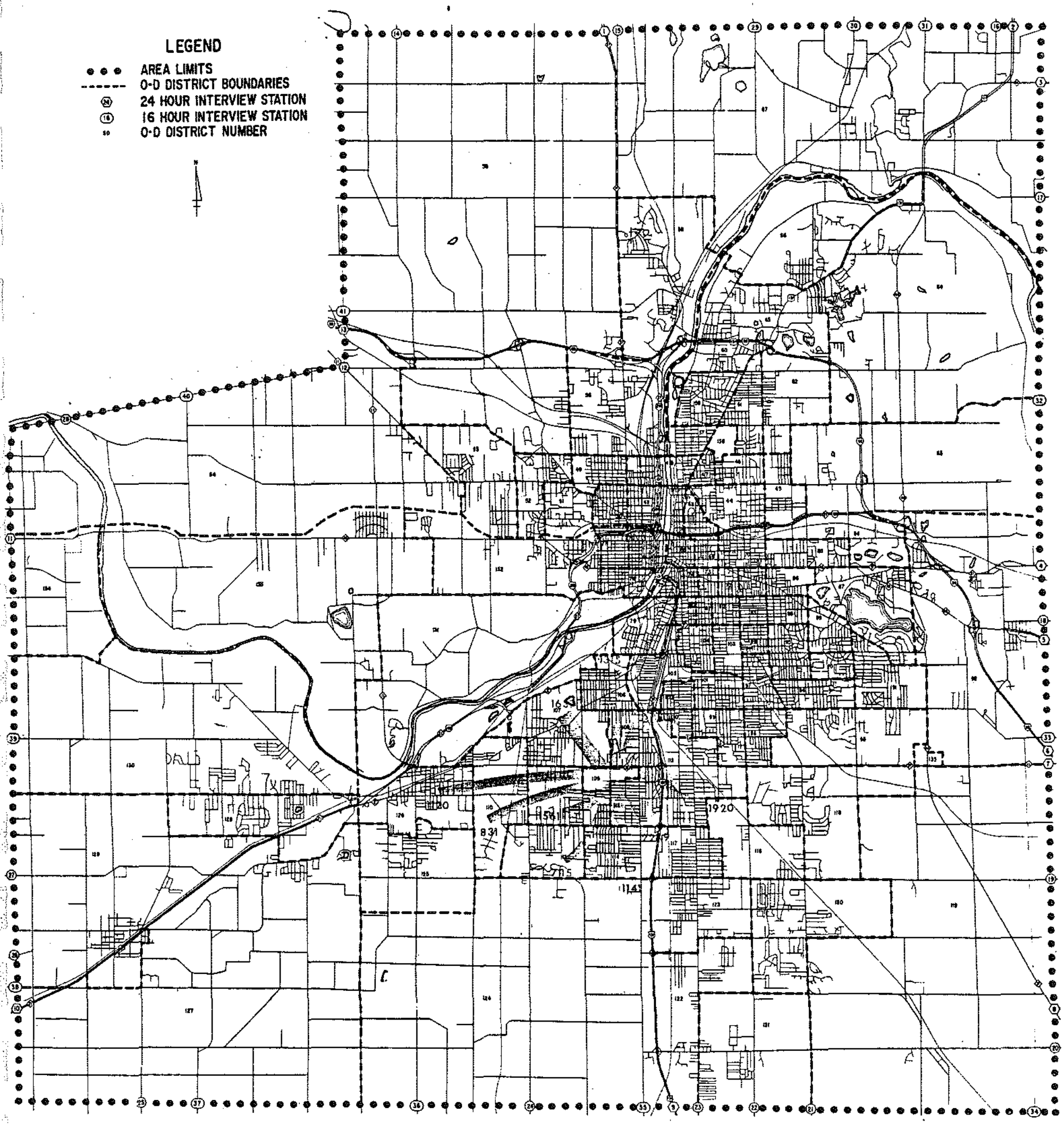
APPENDIX C

STATE WIDE

GRAND RAPIDS AND ENVIRONS TRANSPORTATION STUDY

AREA BASE MAP

SUMMER WEEKDAY 1965



DISTRIBUTION OF INTERNAL TRIPS BETWEEN DISTRICT 109 AND OTHER DISTRICTS BY ORDER OF IMPORTANCE.

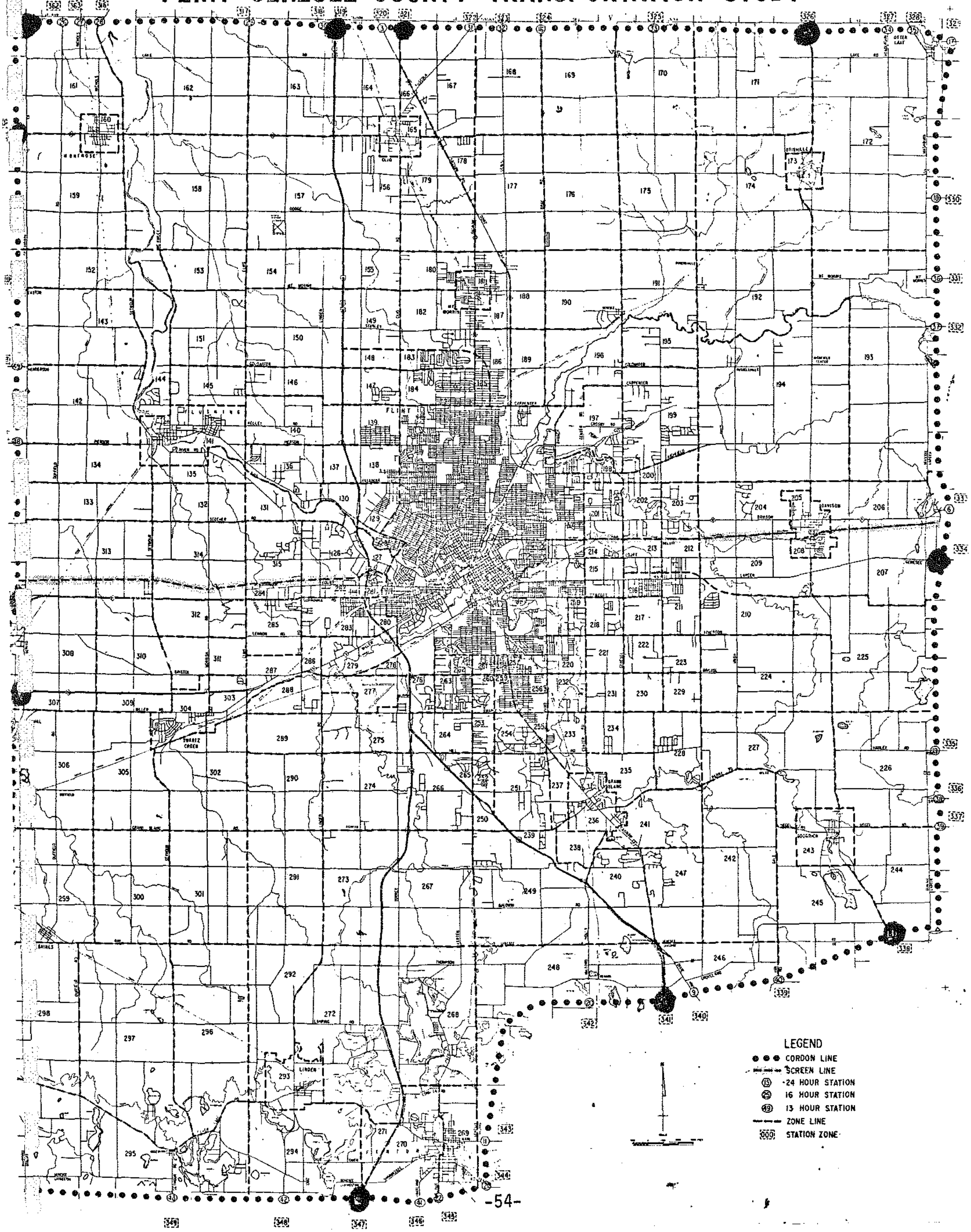
OUT OF 29,850 INTERNAL TRIPS WITH A TERMINAL IN DISTRICT 109, 10 DISTRICTS ACCOUNTED FOR 15,009 TRIPS OR 50%. DISTRICT 109 HAD

GRAND RAPIDS O&D STUDY

STATION	THRU PERCENT 1965 O&D	THRU PERCENT STATEWIDE MODEL
1	13	23
2	25	28
3	20	15
4	13	17
6	43	40
7	8	18
8	10	28
9	19	22
10	16	25*
11	8	18
13	31	45

* Road relocation occurred since origin-destination study

FLINT-GENESEE COUNTY TRANSPORTATION STUDY



FLINT O&D STUDY

STATION	THRU PERCENT 1965 O&D	THRU PERCENT STATEWIDE MODEL
4	5	3
5	19	20
7	19	37*
8	16	7
10	49	39
12	37	39
13	29	39*
14	20	30 West of M-13** 10 East of M-13
15	10	37
	33***	38***
1	50	38

* Station 7 and 13 exhibit a higher percent because the statewide model contains I-69 from Lansing to Port Huron

** This station was compared both east and west of M-13 because all local trips load at one location

*** These two stations show combined figure again because of a singel loading problem where all trips must get on M-57 where in real life they use both routes