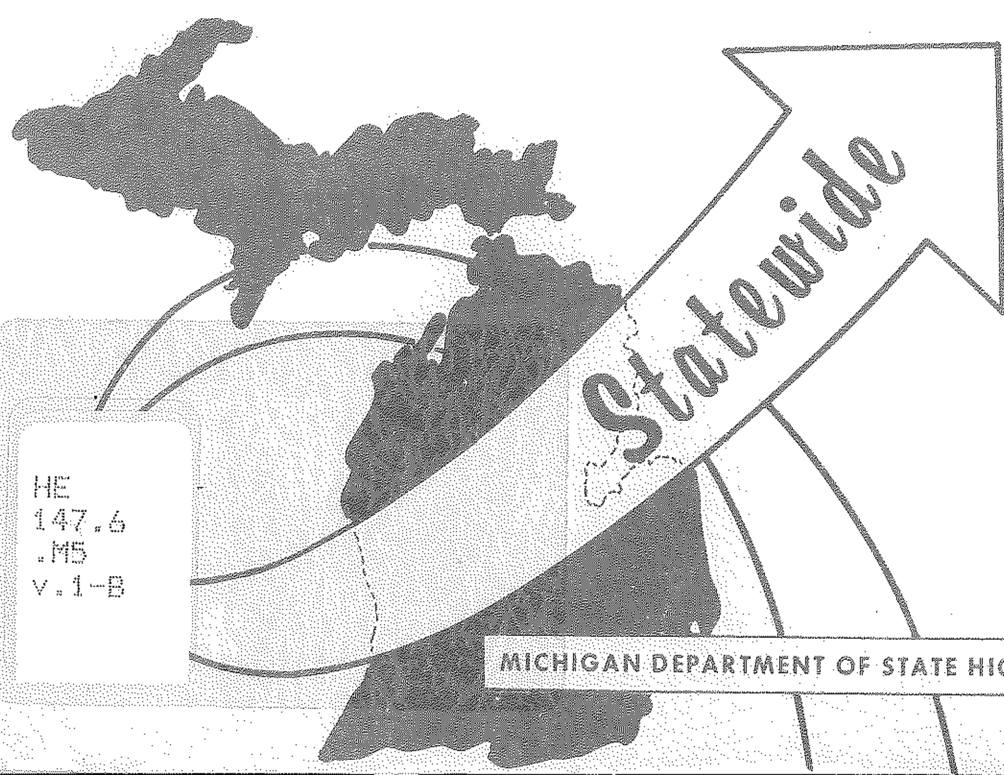
Statewide Transportation Analysis & Research

MICHIGAN'S
STATEWIDE TRAFFIC FORECASTING
MODEL

VOLUME I-B

TRAFFIC FORECASTING APPLICATIONS:
SINGLE AND MULTIPLE
CORRIDOR ANALYSIS

FEBRUARY 1, 1973



MICHIGAN DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION

MICHIGAN'S STATEWIDE TRAFFIC FORECASTING MODEL

VOLUME I-B

TRAFFIC FORECASTING APPLICATIONS: SINGLE AND MULTIPLE CORRIDOR ANALYSIS

FEBRUARY 1, 1973

With the Participation of:
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, GOVERNOR

DEPARTMENT OF STATE HIGHWAYS

STATE HIGHWAYS BUILDING - POST OFFICE DRAWER K - LANSING, MICHIGAN 48904

JOHN P. WOODFORD, STATE HIGHWAY DIRECTOR

February 1, 1973

Mr. Sam F. Cryderman
Engineer of Transportation Planning
Transportation Planning Division

Dear Mr. Cryderman:

The Transportation Survey and Analysis Section of the Transportation Planning Division is pleased to present Volume I-B in a series of reports dealing with "Michigan's Statewide Traffic Forecasting Model." Volume I-B documents the potential of this modeling technique when used in the evaluation of both single and multiple corridor impact on existing and future travel patterns.

Comparisons are made between existing traffic estimating methods and this new traffic simulation technique. An effort was made to show the advantages of the modeling effort and its worth to the total planning process as an instant action forecasting tool. We feel that full development of this simulation process will allow the division to efficiently meet future demands placed on the staff as a result of the 1970 highway act and additional studies such as the needs and national transportation surveys.

The report was prepared by Mr. Lawrence J. Swick of the Statewide Studies Unit with the supervision of Mr. Richard E. Esch.

Respectfully submitted,

Keith E. Bushnell

Keith E. Bushnell
Engineer of Transportation
Survey and Analysis

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PREFACE

PREFACE

Present and proposed federal highway legislation is placing additional emphasis on total highway system evaluation and this, in turn, will increase pressure on existing State Highway Department staff. Travel simulation techniques, such as Michigan's Automated Traffic Forecasting Model, should allow the Department to effectively meet these future requirements. The Federal Highway Administration and several other states are also beginning to recognize the need for developing a Statewide Traffic Forecasting Model that will produce the future traffic volumes needed to evaluate the socio-economic and environmental effects of proposed system improvements. Michigan has such a system and its working benefits are discussed in this report.

Statewide Model Regional Workshops sponsored by the Federal Highway Administration in Minnesota in April, 1971, and Michigan in October, 1971, are possible indications of future emphasis in this area. Additional reports in Michigan's Statewide Traffic Forecasting Model series are listed on the following page.

STATEWIDE MODEL REPORTS

Volume	I	Objectives and Work Program
Volume	IA	Workshops Topic Summaries
Volume	IB	Traffic Forecasting Applications Single and Multiple Corridor Travel Analysis
Volume	IC	Model Application: Turnbacks
Volume	ID	Proximity Analysis: Social Impacts of Alternate Highway Plans on Public Facilities
Volume	IE	Model Applications: Cost-Benefit Analysis
Volume	IF	Air and Noise Pollution System Analysis Model*
Volume	IG	Psychological Impact Analysis Model*
Volume	II	Development of Network Models
Volume	III	Multi-level Highway Network Generator
Volume	IIIA	Semi-Automatic Network Generator Using a "Digitizer"
Volume	IV	Total Model Calibration-547 Zone Travel Model*
Volume	VA	Travel Model Development Reformation - Trip Data Bank Preparation
Volume	VB	Socio-Economic Data Bank Development
Volume	VI	Corridor Location Dynamics

* Indicates report is in Development stage

INTRODUCTION

INTRODUCTION

Statistics, probability theory, sample data and computer memory banks have been combined in recent years to foretell the outcome of events ranging from political elections to stock market declines.

The Transportation Planning Division of the Michigan Department of State Highways has mastered these techniques and applied them to the task of forecasting traffic volumes and travel pattern movements on a total highway system basis. This will begin to allow the Department to monitor the impact of proposed highway improvements.

The process of estimating future events through the use of mathematical simulation is called "modeling", and the Department's application is appropriately labeled "The Statewide Traffic Forecasting Model".

This model has been designed so that the Transportation Planning Division can begin to supply the level of analysis demanded through ever increasing federal and state transportation legislative requirements. The model has the capability to determine the impact of highway improvements on the total trunkline system, not only in terms of traffic volumes and travel patterns, but in terms of inputs to environmental impact, improved highway safety and cost-benefit analysis.

The Statewide model is a computer orientated travel simulation process which will allow the Department to analyze the impact of trunkline changes on the environment from within the office before actual construction is initiated. The "model" is a series of computer programs and sub-models which perform interrelated functions in the process of assigning trips to alternate highway networks for designated design years. As a result of the development of this model, Department personnel now have the ability to efficiently test various trunkline additions and improvements for both present and future highway systems.

The full impact and potential of this travel simulation process is yet to be realized, but this report will attempt to describe its features with the hope that an understanding of its nature can lead to further improvements and applications.

The Regional Statewide Model Workshops sponsored by the Federal Highway Administration proposed a list of probable model applications which may assist the reader in establishing possible future applications.

a. Improvement of travel projection techniques.

b. Projection of trunkline vehicle miles.

c. Analysis of state highway planning goals.

d. Supply factual analysis rapidly as an input to decision making process.

e. Coordination of urban studies.

f. Analysis of future trunkline deficiencies.

g. Trunkline establishment-abandonment process.

h. Total highway system analysis of the impact of alternative highway plans.

i. Test impact of highway plans on community accessibility.

j. Analysis of alternate highway proposals on future safety and accident data.

k. Determine the impact of highway proposals on economic factors, such as vehicle operation cost and time.

l. Test impact of highway plans on functional classification of routes.

m. Basic input required to carry out total system cost-benefit analysis.

n. Input to total systems analysis and the environmental impact of state highways.

Many of these applications have proven useful in the development of state highway plans in Wisconsin, Connecticut and Pennsylvania. Note: Reference is made throughout this report to 540 and 547 zone systems. They are, for all purposes, synonymous. The newer 547 simply has seven more outstate zones than the older 540. Revised graphics were not immediately available for the 547, so 540 graphics were used as a matter of convenience.

TRAVEL
FORECASTING
MODEL
BENEFITS

TRAVEL FORECASTING MODEL BENEFITS

Rapid integration of the Statewide Model within the existing transportation planning process could result in direct benefits to the Department in several areas. Initial benefits occur in the area of project analysis elapsed time.

Speed

The length of time required to complete an alternate corridor traffic assignment and analysis is linked primarily to the speed of the Department's computer. Normal alternate runs take an average of nine hours of computer time to complete. Setup time required for each alternate may take from eight to sixteen hours. Setup time includes mapping the alternate and applying the proper nodes and factors for completion of the assignment. With the combination of the two elements (computer time and setup time) a complete alternate could be ready for analysis within an average time span of 48 hours or less.

Time, as a factor, is only relative when this method of assigning traffic is compared to the current operational subjective process. The model can assign traffic to a freeway, which runs the entire length of the upper peninsula, in a period of 48 hours. The subjective process could take weeks or months.

Cost

The costs of preparing a 1995 assignment through computer modeling techniques are listed as follows. The Statewide Model cost figures were taken from an actual alternate run. (US-2 Upper Peninsula.)

Manpower

One Transportation Analyst	16 Hours	$104.00
One Transportation Technician	16 Hours	64.00
Computer Time @ $60.00/Hour	9 Hours	540.00
Total		$708.00

A subjective estimate for the same route could cost considerably more in terms of both time and money. Even if the cost element were not important, time availability for such a project has often been limited and this would tend to affect the reliability of the final subjective traffic figures.

Reliability and Accuracy

Michigan's Statewide Model is currently the most accurate traffic forecasting instrument in the nation. This is a pious statement but one which will be substantiated in Volume IV of the Michigan Statewide Traffic Forecast Model series. Michigan's model is the only Statewide Model in existence which has been calibrated on a specific link by link basis. [Calibration is the technical process of adjusting the generated base year traffic figures to corresponding actual base year AADT's.] Other states have calibrated models but they were "calibrated" on an area-wide cut-line basis only. That is, lines were drawn across various areas of the state and the assigned base year figures were adjusted to match the AADT's on highways which crossed those lines at the cut-line point. This leaves much to be said for the accuracy of projected figures for highways which may be constructed between these cut-lines or parallel to those cut-lines. Michigan's model does not have this problem or subsequent loss of accuracy.

The projected population figures, which are used as input to the models trip generation formulas, have been modified and projected relative to the latest 1970 census figures. Additional socio-economic data is being gathered and tested through linear-regression techniques for inclusion in future trip generation formulas. This will add even greater accuracy to the assignment process.

The current model employs 547 zones as a base of analysis. Even larger and more sophisticated models, such as the 2300 zone system, are being developed and tested with an eye turned to even greater analysis powers and applications.

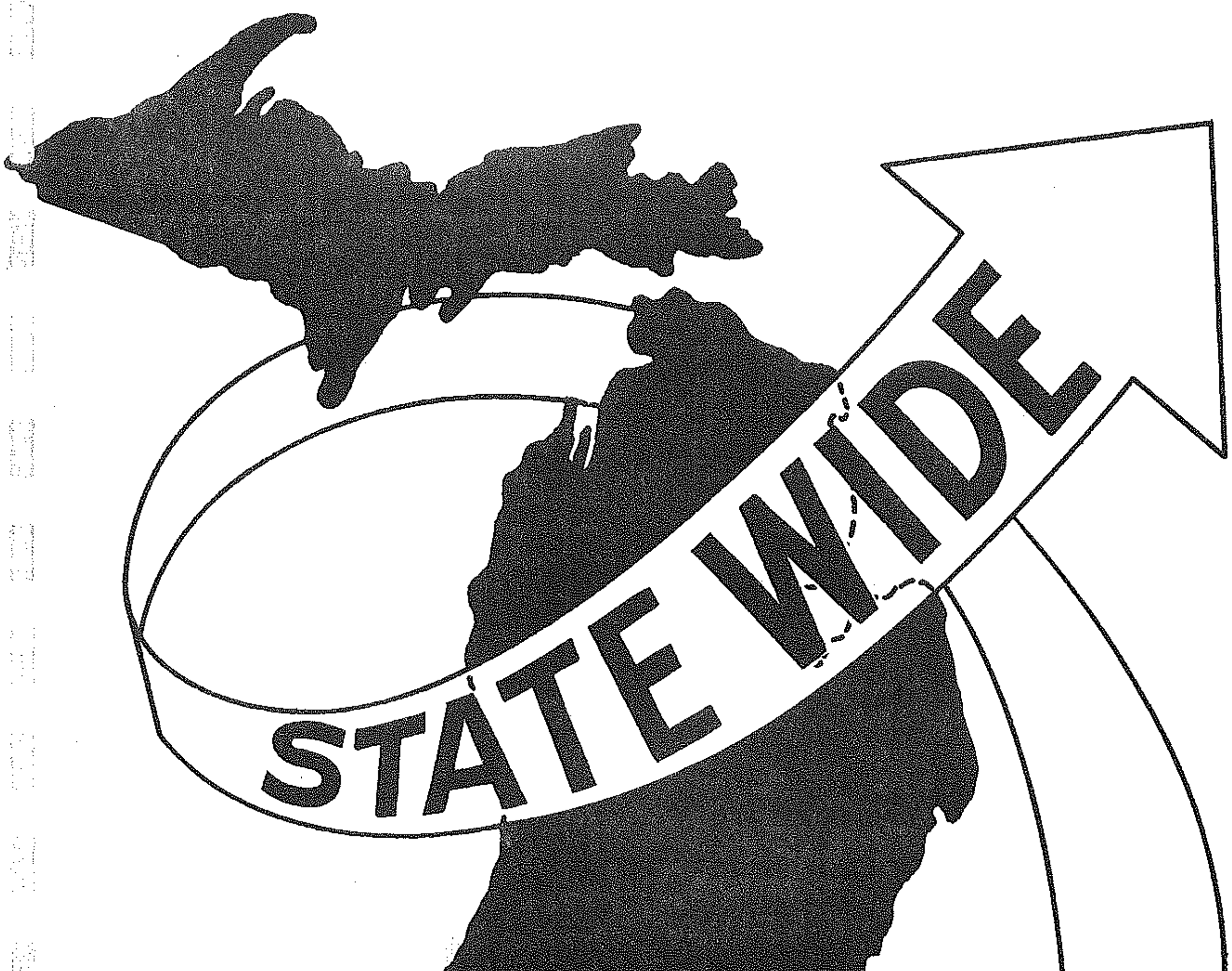
Consistency

In order to properly evaluate alternates, a process must be consistent. Only a computerized modeling process can provide this consistency. The model, due to the nature of the computer assignment process, automatically redistributes traffic on the primary, as well as the surrounding routes, as a highway within the analysis area is improved or replaced with a high speed freeway. The model simulates many of the real world systems of travel economics. It is known that an improved facility can create additional trips upon that facility which normally would not have been there if that particular highway had not been modified. The model operates in a similar fashion. As highways are improved with modifications or replaced with freeways, proportionally more trips are created between those zones which are affected by the changes, and those additional trips are assigned to the new facility which serves those zones. In addition, a certain number of trips are drawn from surrounding routes and placed on the new highway in a manner proportional to the travel advantages offered by the new facility.

The advantages of the model are self-evident. As an alternate route is moved within the model from one study corridor to another, changes in traffic volumes on the primary and secondary routes, as well as the total trunkline system, are automatically calculated and displayed on the appropriate computer network plots. This provides a degree of analysis consistency which cannot be duplicated by subjective techniques.

If the corridor under study is moved slightly to the east or west, the changes in traffic assignments will be slight. As the corridor is moved from one series of counties to another, the differences in assigned traffic volumes would normally reflect greater variations. These variations are precisely what the Department is interested in. Note again that a new corridor location can be submitted and readied for analysis within a period of 48 hours or less. To demand this same turn-around time and accuracy from the subjective process would be fruitless.

TRAVEL
FORECASTING
MODEL
OPERATION



TRAVEL FORECASTING MODEL OPERATION

The Statewide Traffic Forecasting Model is composed of four sub-models: (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 portrays the system of trunklines under study. Figures (1) and (2) display outlines of the routes included in the instate and outstate model. The Trip Generation Model determines the total number of trips which are to be generated to and from each study area in the state. The Trip Distribution Model determines the actual number of trips that occur between each study area and every other study area. The Traffic Assignment Model combines the proposed study route to the existing network and assigns or "loads" the assigned traffic to the modified network. These study areas are referred to as model analysis zones. Figures (3) and (4) identify the zones used in Michigan's 540 model.

(1) The Highway Network Model

The Highway Network Model is composed of all state trunklines plus approximately 1500 miles of county roads. This network was created through standard coding procedures and program runs which output a computer tape describing the total system. The network can be modified in the same manner to include new improvements or proposed freeways. See Figure (8).

(2) The Trip Generation Model

The Trip Generation Model uses a travel analysis process which divides the state into 547 separate study areas or zones.

FIGURE 1

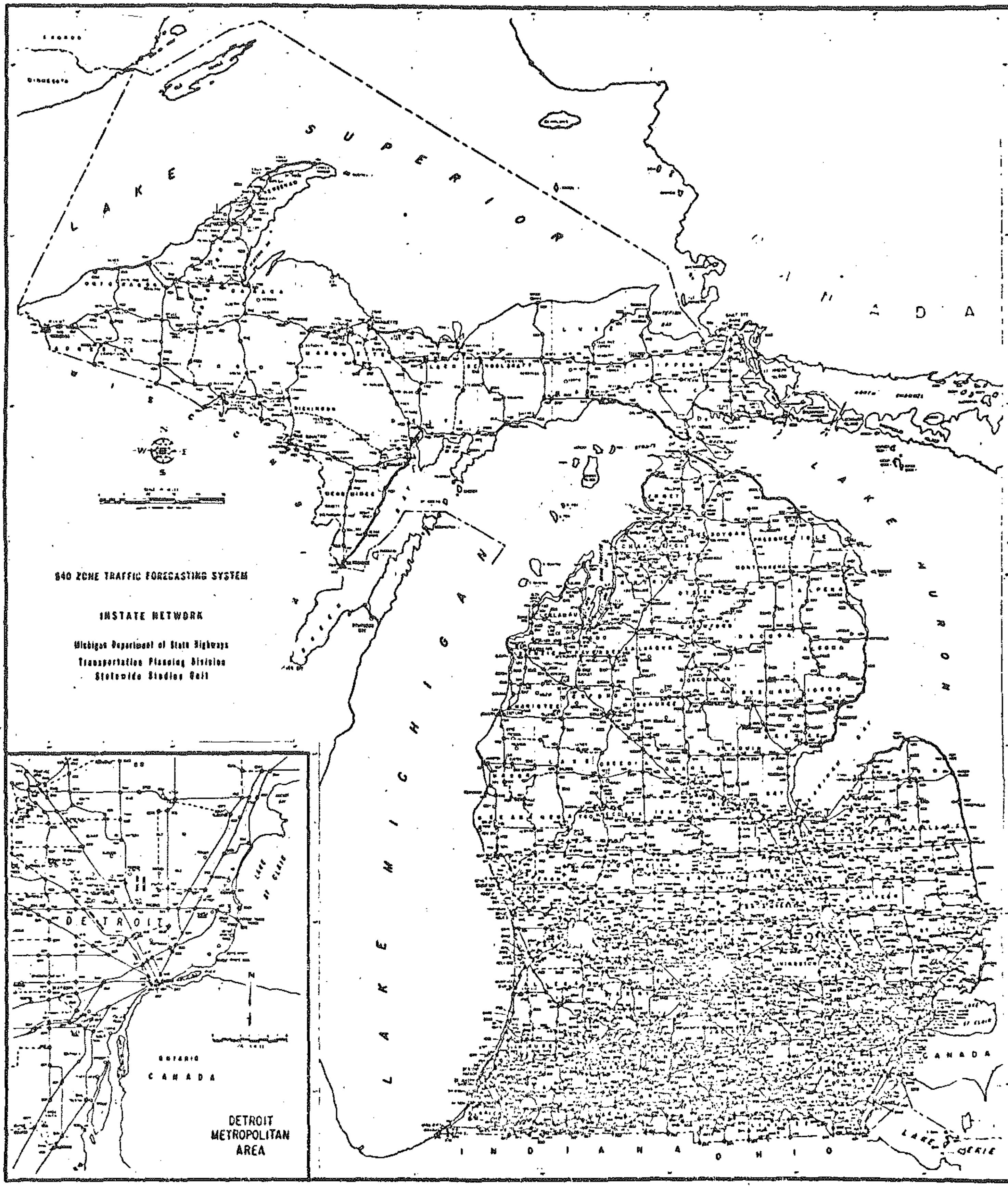
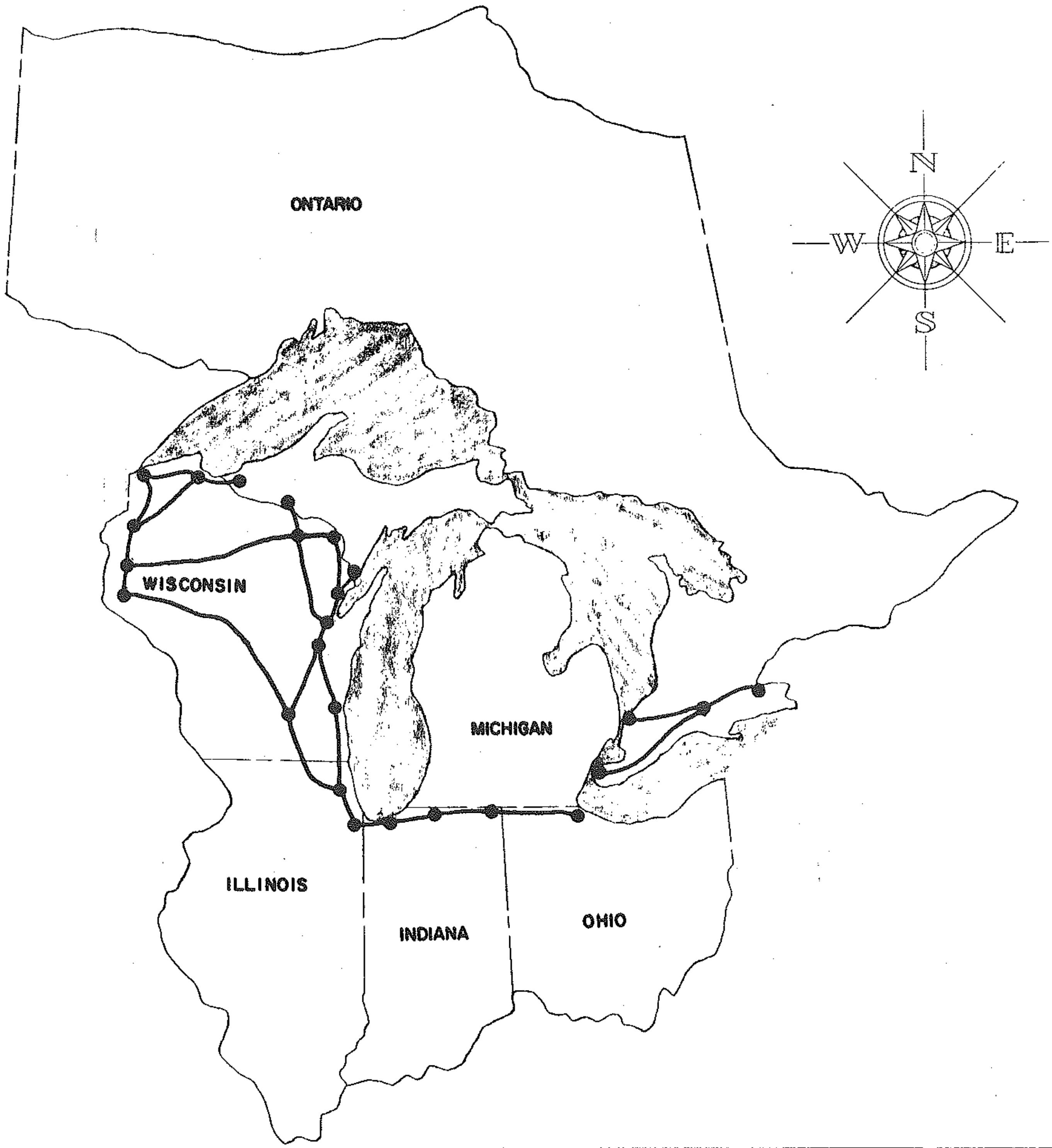

LAKE SUPERIOR
CANADA
LAKE MICHIGAN
LAKE HURON
LAKE ERIE
INDIANA
OHIO
840 ZONE TRAFFIC FORECASTING SYSTEM
INSTATE NETWORK
Michigan Department of State Highways
Transportation Planning Division
Statewide Studies Unit
DETROIT
ONTARIO
CANADA
DETROIT
METROPOLITAN
AREA

FIGURE 2

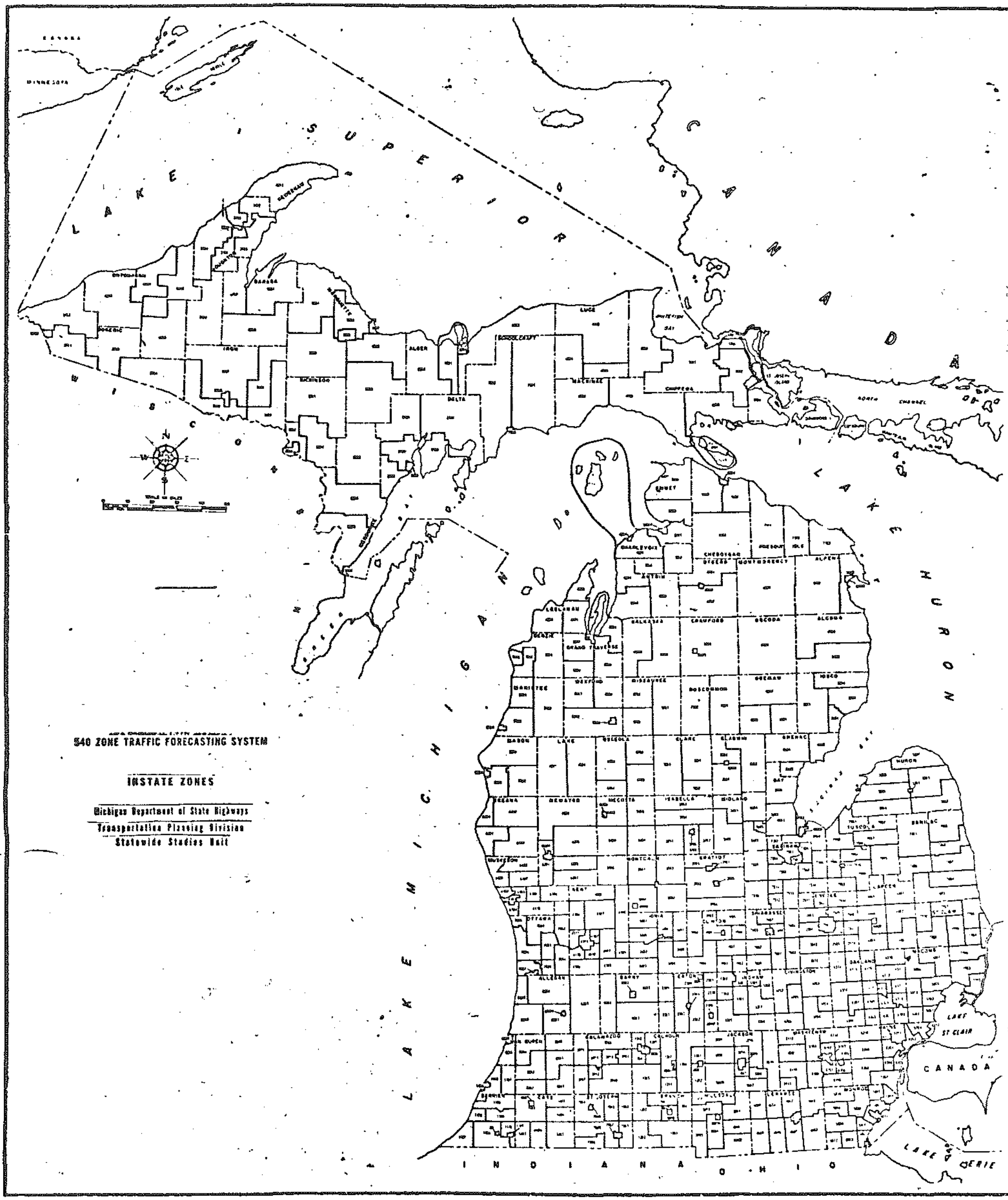


540 ZONE TRAFFIC FORECASTING SYSTEM

OUTSTATE HIGHWAY NETWORK

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRANSPORTATION PLANNING DIVISION
STATEWIDE STUDIES UNIT

Figure 3



L A K E S U P E R I O R
C A N A D A
L A K E H U R O N
L A K E M I C H I G A N
540 ZONE TRAFFIC FORECASTING SYSTEM
INSTATE ZONES
Michigan Department of State Highways
Transportation Planning Division
Statewide Studies Unit
LAKE ST CLAIR
C A N A D A
LAKE ERIE
I N D I A N A
O H I O

540 ZONE TRAFFIC FORECASTING SYSTEM

OUTSTATE ANALYSIS ZONES

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRANSPORTATION PLANNING DIVISION
STATEWIDE STUDIES UNIT

Data is gathered for each area and analyzed to determine the statistical relationship between that data and trips generated by the study zone...Regression Analysis. The data would normally include such items as zonal population, retail sales, employment figures, etc. Generated trips would be determined by analysis of related area urban and single station origin/destination studies.

When the relationships between zonal data and generated trips are expressed as formulas, the data in each zone can be projected to determine their related effect on total future trips. Once the number of generated trips per zone has been determined, the interchange of trips between each zone must then be calculated. This is the function of the Trip Distribution Model.

(3) Trip Distribution Model

The Transportation Planning Division uses the "Gravity Model" concept as the core of its trip distribution system. The gravity model theory is expressed mathematically in the computer programs which distribute the trips. This model states that the number of trips generated and distributed between zones is proportionally relative to the data size of the zones and inversely related to the distance between the zones. In order to determine the distance between zones, trees are built through computer programs from each zone to every other zone. A tree is simply the minimum highway path between zones as expressed in terms of time and/or speed (cost). When these paths are plotted they resemble trees and thus the designation ... "to build trees". The generated trips are then combined with the Gravity Model and a cost set of trees (skim trees), to create a trip table which details the number of trips between zones. The total trips as defined by the trip table are assigned to the proposed network model (see Traffic Assignment Model). When this is accomplished, it can be said that the network is "Loaded" or contains the accumulated trips of all zonal trees. This can be illustrated as follows. (See Figure 5.)

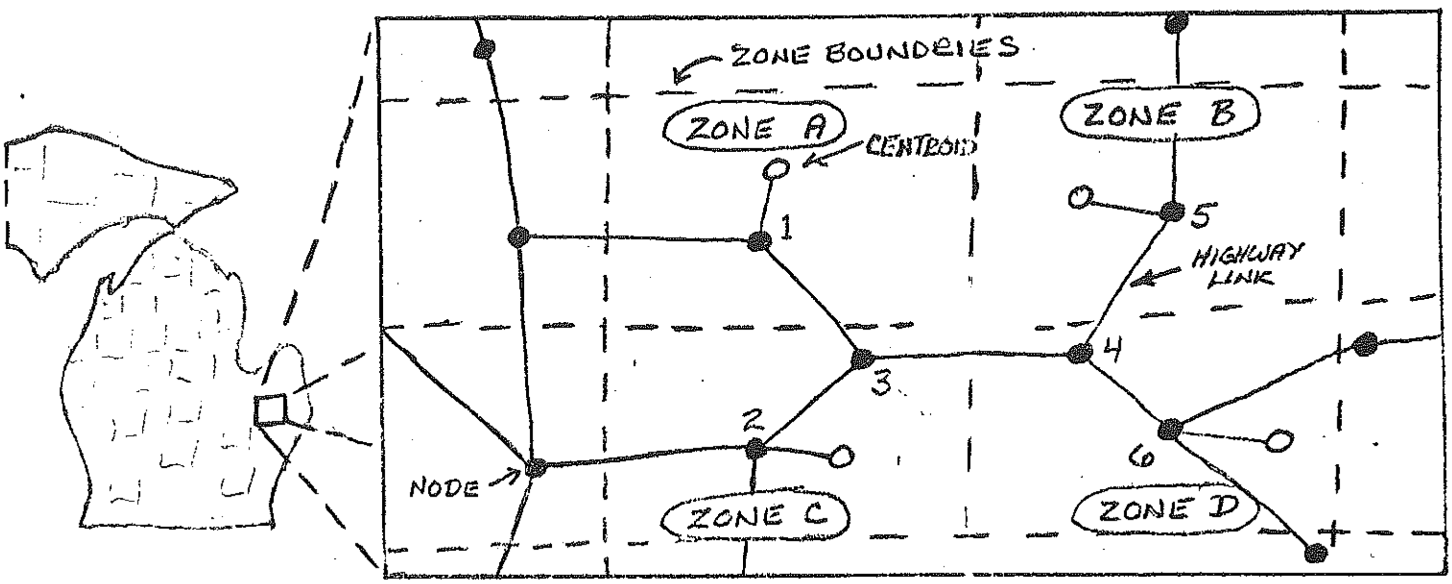


FIGURE 5: Sample Network Before Partial Load

For example, suppose a trip table from zone A to zone B contains 100 trips and the minimum path between A and B is defined by the trees as following the 1, 3, 4, 5, path. The loaded network, at this point, would look like this: (See Figure 6.)

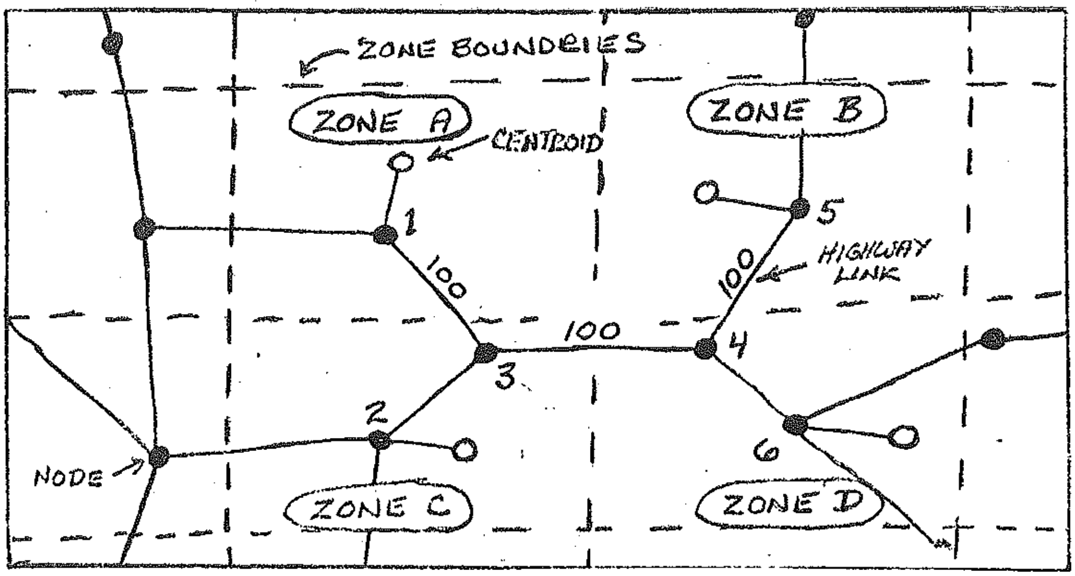


FIGURE 6: Sample Network with Partial Load

Now suppose that the same trip table contains 50 trips from zone C to zone D. The minimum path as defined by the trees is the 2, 3, 4, 6 path. After these trips have been loaded, the network will now appear accordingly. (See Figure 7.)

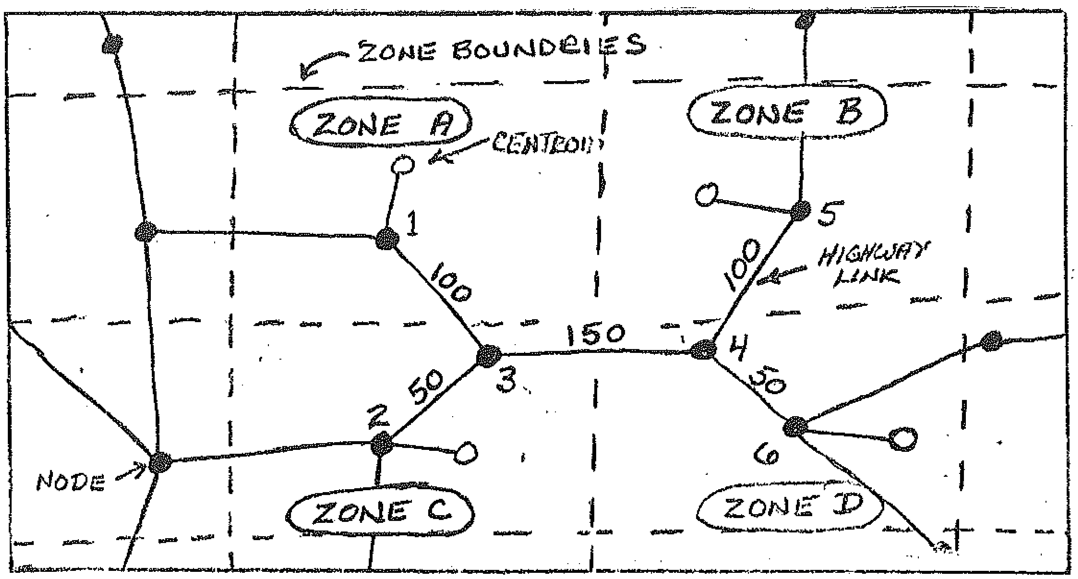


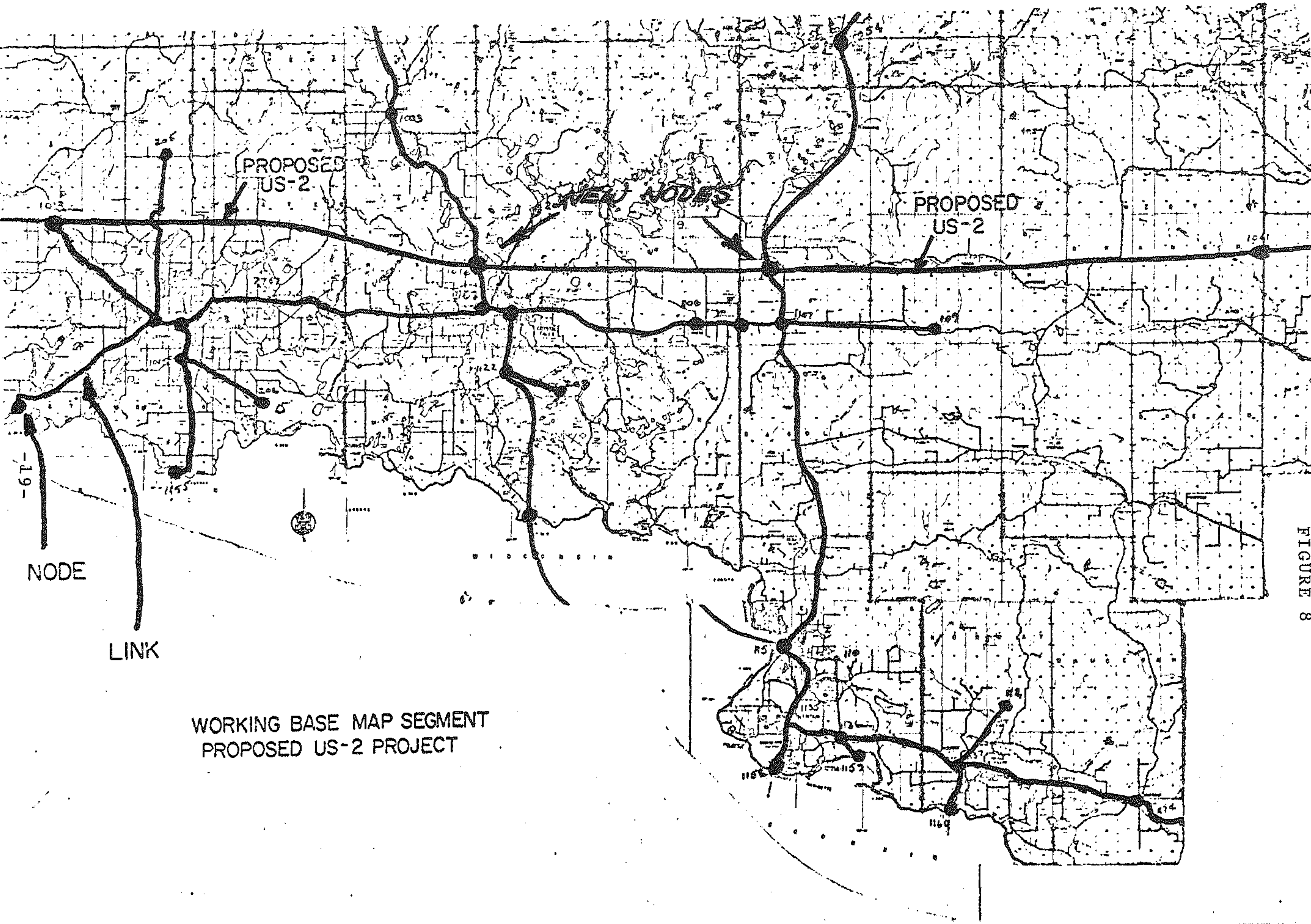
FIGURE 7: Sample Network With Additional Load

The process is continued through the load program until the total network system has been completed. The final result represents a loaded net of proposed traffic volumes. Each link can then be examined to determine the anticipated traffic for that link or a combination of links (trunklines).

(4) Traffic Assignment Model (Using US-2 as an Example)

The Highway Network Model, trip generation-distribution formulas, highway coordinates and other model sub-components are presently operational and ready for transportation planning analysis functions. The first step in the traffic forecasting analysis process begins with the addition of the proposed route to the present Highway Network Model. This is done by preparing contiguous county maps which will show the relationship of the proposed route to the existing routes in terms of link placement. (See Figure 8.) The actual route will be drawn on these maps and node numbers will be assigned in order to "mesh" the new route with the present system. Some links will have to be deleted and others will have to be added to the original Highway Network Model. Then coordinates must be determined relative to the new node locations. This is to guarantee proper alignment of the new route with the surrounding highway network.

Zone centroid links in the Upper Peninsula for US-2 would then be adjusted for proper loadings based on the experience gained by model analysts during model calibration. Centroid links are used in the modeling process to connect the study areas or zones with the Highway Network Model. A copy of the 540 zone analysis system appears in Figures (1) and (2). V.O.L.A. (Volume Field Adder) cards would be prepared for the computer deck setups. The model generates summer weekday traffic figures and these cards are necessary in order to adjust the models summer weekday volumes to the Annual Average Daily



WORKING BASE MAP SEGMENT
PROPOSED US-2 PROJECT

FIGURE 8

Traffic Figures for highway design purposes. These factors have been computed for each type of highway relative to their location within the state and the character of traffic they serve. Next, the network changes, coordinate additions, etc., would be placed in the proper traffic assignment program computer decks. The following outline explains the sequence of programs which are used in the model traffic forecasting process. (See Figure 9 for schematic program run description.)

Computer Program Deck Sequence for Alternate Assignment

These programs are actually run in sequence back to back to generate future traffic forecasts.

(1) TP NET Q01402
(2) TP TREE Q01403
(3) TP SKIM Q01404
(4) TRIP TABLE BUILDER Q10105 (CAR)
(5) TRIP TABLE BUILDER Q10105 (TRUCK)
(6) TRIP TABLE BUILDER Q10103 (VACATION)
(7) TP MOD Q01413 (CAR)
(8) TP MOD Q01413 (TRUCK)
(9) TP MOD Q01413 (VACATION)
(10) TP LOAD Q01405
(11) TP VOLA Q01433
(12) TP NAPS Q01422
(13) PREPLOT Q01151
(14) PLOT Q01153 (REGION 1)
(15) PLOT Q01153 (REGION 2)
(16) PLOT Q01153 (REGION 3)
(17) PLOT Q01153 (REGION 4)
(18) PLOT Q01153 (REGION 5)
(19) TP PRIN Q01410
(20) TP NET 1402

The traffic forecast is completed when this series of computer programs is processed. The anticipated traffic on the alternate (US-2) plus the effects of US-2 on surrounding routes can then be presented graphically for analysis. (See Figure 10-A.)

STATEWIDE MODEL
ALTERNATE ROUTE ASSIGNMENT PROCESS

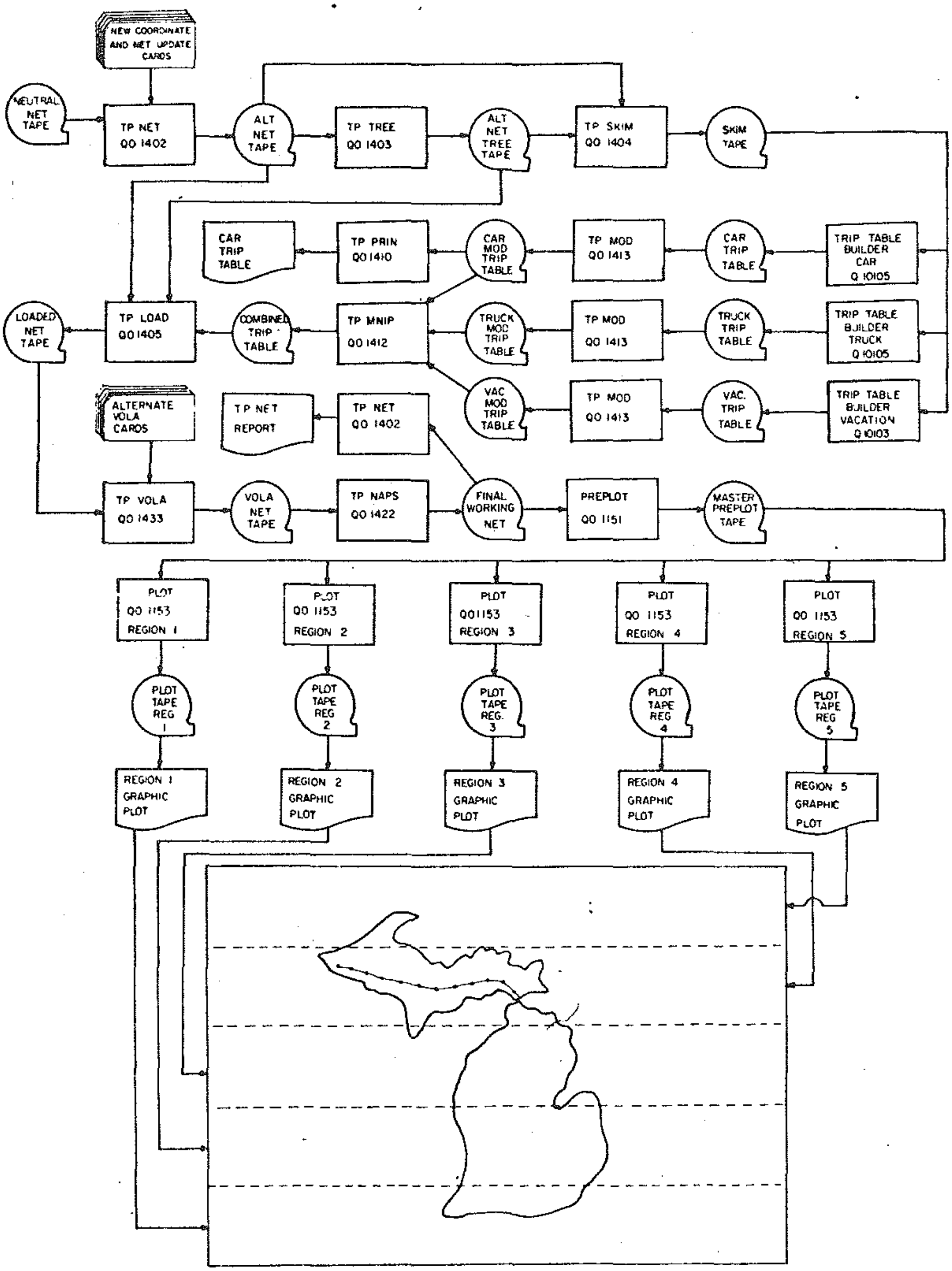
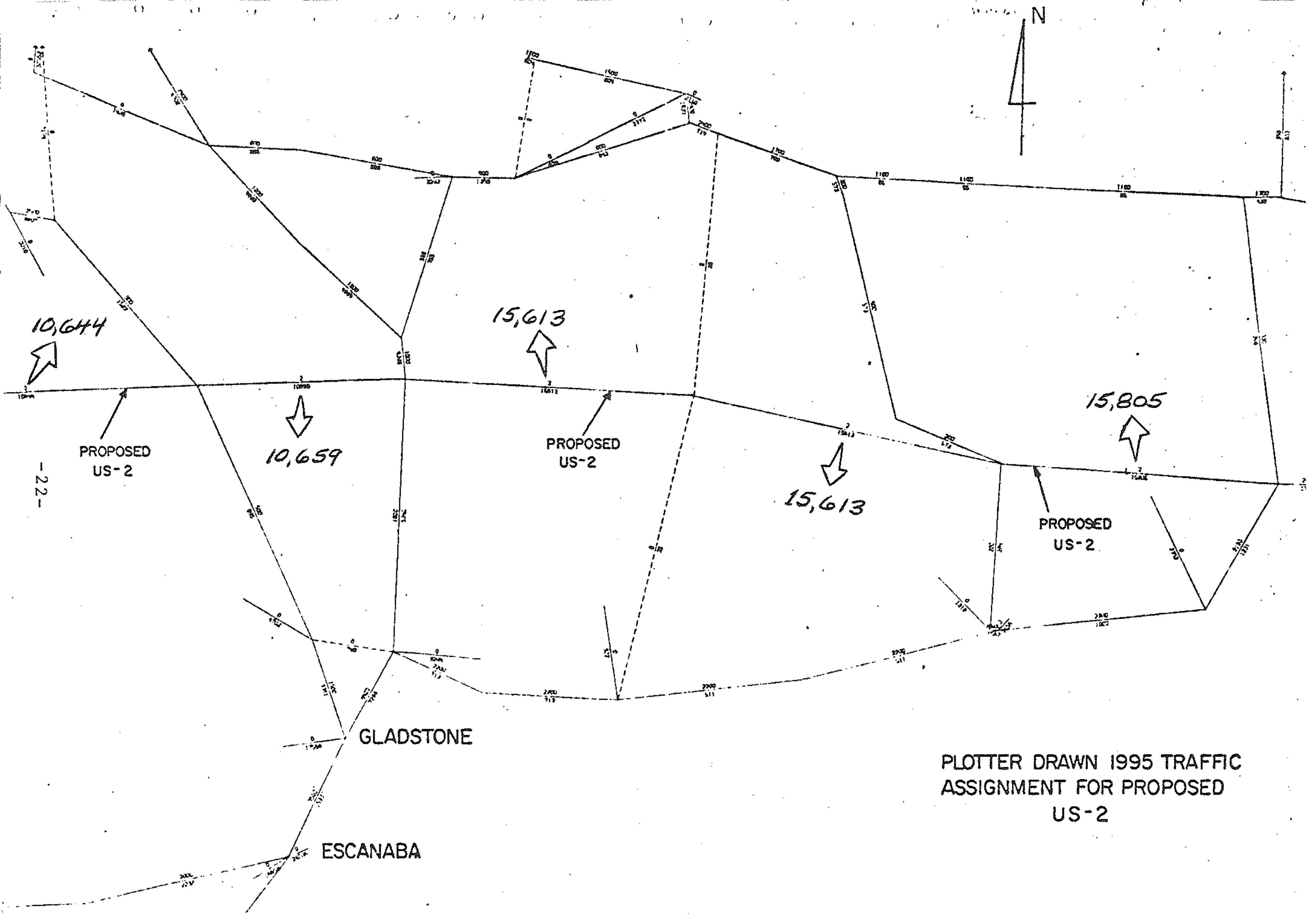


FIGURE 9



N
10,644
15,613
15,805
PROPOSED US-2
10,659
PROPOSED US-2
15,613
PROPOSED US-2
GLADSTONE
ESCANABA
PLOTTER DRAWN 1995 TRAFFIC ASSIGNMENT FOR PROPOSED US-2

(FIGURE 10-A)

SINGLE CORRIDOR TRAVEL ANALYSIS

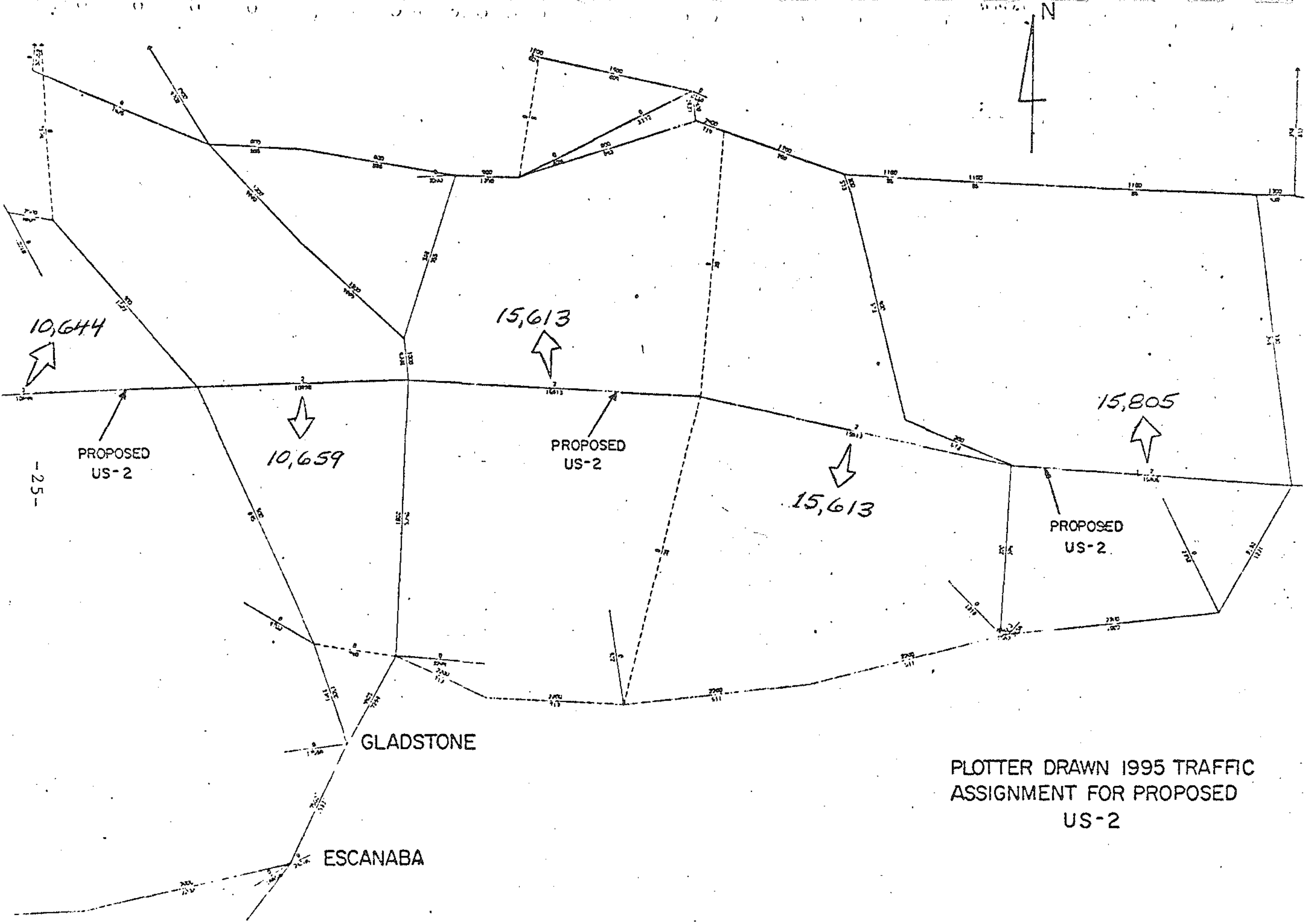
TRAVEL FORECASTING MODEL APPLICATIONS

Single Corridor Analysis US-2 (Example of Application)

Single Corridor Analysis could best be described as a "build, no-build" planning decision. Conditions leading to the conclusion that a new highway facility should be constructed can be gathered and monitored through the application of the Statewide Model. "Neutral" network assignments (Future Assignments with no Highway Improvements) can be run for advancing design years to determine the point in time where existing facilities begin to break down as traffic volumes extend beyond capacity. New freeway facilities can then be "plugged-in" to the model and assigned to determine their impact on the overloading problems. If the impact of the new facility accomplished the goal of alleviating the capacity problems; then it should be designed and built prior to the point in time of capacity crisis. Not only can the model provide information relative to "build, no-build" decisions, but the model can provide basic lead-time estimates or "when to build".

If capacity problems are not of primary concern, and the justification for building a new freeway is primarily travel time and safety, the model can provide traffic figures to confirm or deny the feasibility of such a project. Proposed US-2 in the Upper Peninsula provides an example. The designated freeway was added to the network model and assigned as explained in the preceding sections. The final results were provided by the Department's plotter as illustrated in Figure 10-B. The figures on the plot reflect anticipated traffic on the proposed US-2 freeway for the year 1995. This type of traffic volume presentation can provide the Department with accurate base data with which to continue "build, no-build" feasibility studies. Note that the output of the assignment process is not on stacks of printout but on easy-to-read plots. (Although they appear somewhat small here, the plots were reduced for report purposes and in reality are easy to read under actual circumstances.) The proposed highway is shown "where it will exist" relative to other facilities.

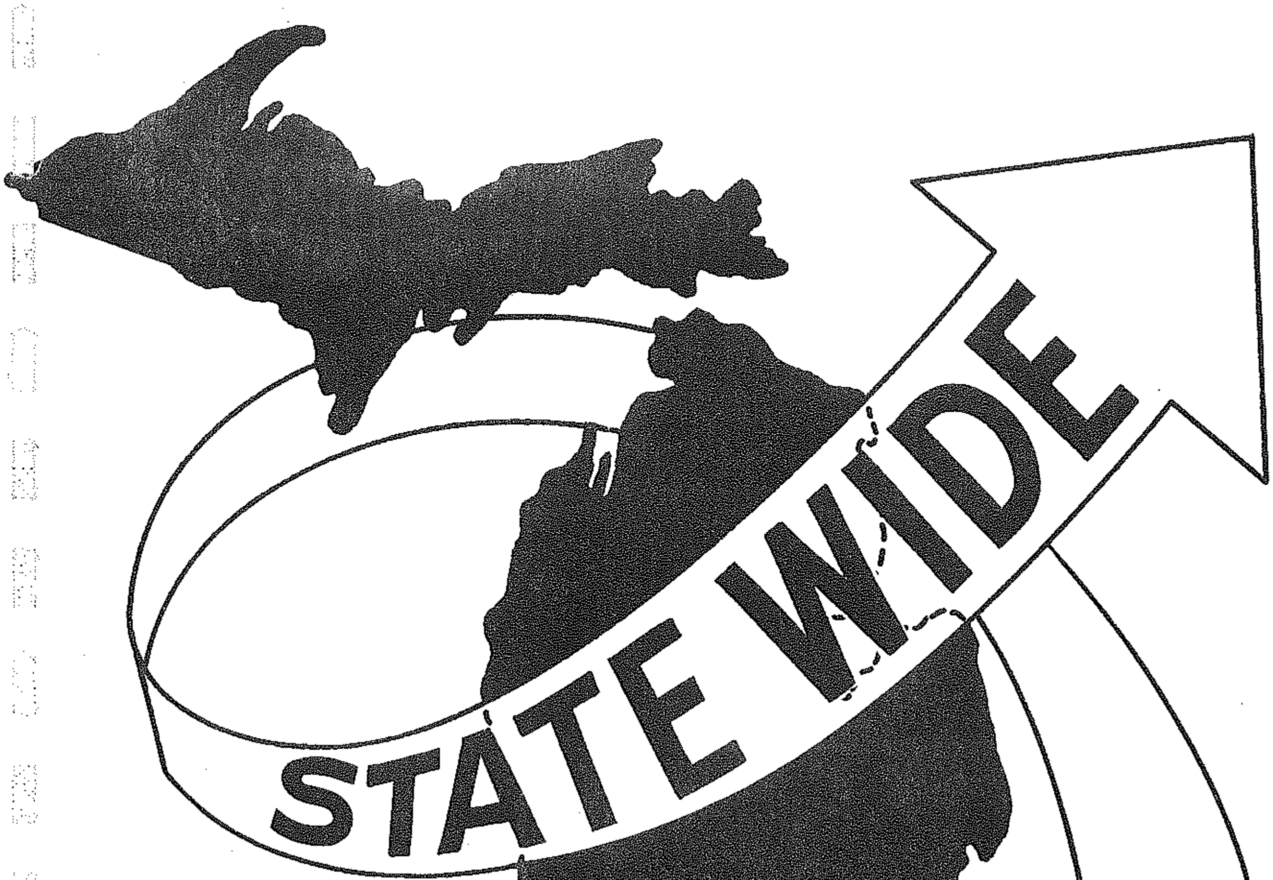
Volumes are also shown on surrounding routes as well as the entire trunkline system. The "effect" of the new route can be determined through examination of a neutral net assignment and through analysis output provided by the current and proposed "impact" batteries. (See Future Applications.)



PLOTTER DRAWN 1995 TRAFFIC ASSIGNMENT FOR PROPOSED US-2

(FIGURE 10-B)

MULTIPLE CORRIDOR
TRAVEL ANALYSIS



MULTIPLE CORRIDOR TRAVEL ANALYSIS

Alternate Route Analysis US-23 (Example of Application)

There may never be an ideal or perfect corridor for a transportation facility. The location of a highway or similar facility can only be governed by the same laws of economics which rule any finite universe. The Route Location or Planning Engineer must satisfy a multitudinal list of demands, each to the ultimate, which are to be placed on the proposed route. Some demands will be satisfied more than others, but the level of importance of each demand must be weighted, one to the other, and then and only then, can a final route location decision be made. The final Route Location and Planning decision must provide the safest opportunity for travel to the greatest number of people at the lowest possible construction cost.

The achievement of this goal can only be furthered through the accurate representations of future traffic figures on alternate corridors. This is accomplished today through subjective estimating techniques. The Statewide Traffic Forecasting Model is now capable of supplanting this process with a dynamic computer orientated technique.

To compare yesterday's technique of traffic estimating with today's computerized method, assume that the department is asked today, to deal with a route whose future looks certain but whose principal location is still under study, e.g., proposed US-23 in the northeastern part of the state. Analysts, in this circumstance, are asked to deal with the future traffic figures on four alternate routes and, by specific criteria, decide on the best one.

These questions are presently confronting Departmental Staff.

1. Which route will serve the greatest number of people per dollar invested?
2. How will each alternate affect the desired use of trunklines surrounding it?
3. Which route, with regard to environmental considerations, will provide the best means of transporting people and goods along the basic corridor?
4. Which segment should be constructed first to satisfy the greatest travel need in the shortest time?
5. Should more of the route be planned than was originally anticipated?
6. Could a shorter version of the highway be build and satisfy an acceptable percentage of the anticipated travel?
7. How will each alternate affect the surrounding communities in terms of economic impact and travel benefits?

Most of these questions can be answered with the use of the computerized Statewide Model. This section of the report will deal primarily with the travel analysis capability of the model.

As an alternative, if the Statewide modeling process were not available, how much time, effort and money would it take to answer these proposals today if they were presented to the analysis personnel in the department? Could planning decisions begin to take shape in a matter of two weeks? The answer today because of the model is "yes". That's exactly how long it took analysis personnel in the Statewide Studies Unit to complete this project on all four proposed US-23 alternates.

When requests of this nature are submitted to the Transportation Planning Division using techniques other than the Statewide Model, the project time and cost factors start to take on geometrically proportioned increases. Due to the extreme complexity of the task, confidence in the reliability of the projected figures also tends to suffer because of the time elements involved. When the cost differential between alternates reaches millions of dollars, the demand for data reliability takes on new meaning. The Statewide Traffic Forecasting Model was designed specifically to meet this type of challenge and responsibility.

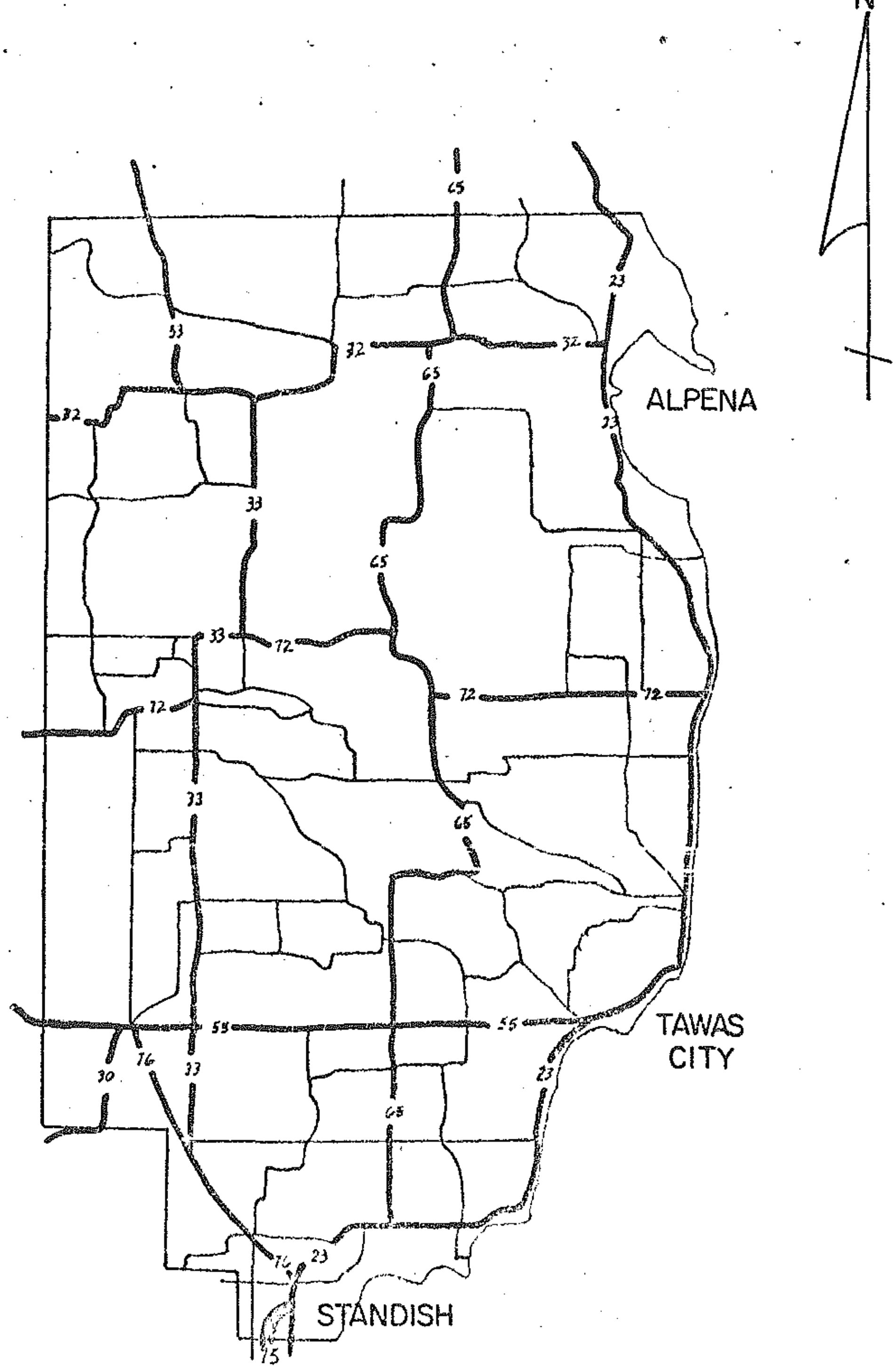
The laws of travel economics previously mentioned are built into the Statewide Model and provide a consistency of traffic volume measurement never before contemplated. Proportioned travel differences on surrounding routes, and the primary route appear automatically as the alternate route is moved from one corridor to the next. The effects of interchange additions or deletions can be visually measured as the travel loading program assigns the trips to the specific network. This method offers a scientific means of measuring design changes for any proposed target year. Choosing any 5-year increment design year between 1980 and the year 2000, the estimated zonal population can then be plugged into the appropriate forecasting process for a close look at alternate route traffic volumes and the effects of adding or deleting given interchanges.

This capability is staggering, but it is a needed capability because the Department can no longer expend the time and money for extended alternate corridor analysis. Answers to transportation planning questions must be answered now because of the increasing travel demands on given facilities.

It takes time to design and build these facilities, and the more advance time the Department has to study the anticipated travel patterns, the better the success of the completed total highway network. (Figure 11 provides a general study area map.) A graphic presentation of the Statewide Model capability follows. Figure 17 illustrates Alternate A of the four proposed US-23 travel analysis corridors used in this test. Notice that a link "A" is defined which contains an interchange connector to Esmond Road. In another alternate run this interchange will be removed to show the effects on the travel patterns of link "A" and the surrounding network. This is a specific example of the "interchange in" -- "interchange out" capability of the Statewide Traffic Forecasting Model and will be reviewed in the next section.

The model's traffic forecasts for the four alternates (Figures 12-16 in the following graphic examples) demonstrates that if the Department has an accurate estimate of the traffic volume differences caused by multiple route locations, the final

FIGURE 11



STATE OF MICHIGAN DEPARTMENT OF STATE HIGHWAYS TRANSPORTATION PLANNING DIVISION	TAB. NO.	TAB. BY	GENERAL STUDY AREA MAP
	ENGR. REP.	DRAFTED	
	CON'T SEC.	DATE	
	SHEET OF UNIT		

corridor location decision can be made.

The "do nothing" alternative may also be analyzed and that analysis appears in Figure 16. With the time factors being as efficient as they are with the model, new dimensions can be added to the route design and location process.

Whereas minor alterations in route and interchange locations would add increased weeks or months to the original subjective estimate, they would be accomplished through the model by the simple addition or deletion of selected link cards. With the needed computer time priority, the results could be ready for additional analysis in a matter of hours.

Alternates "A", "B", "C", "D", and "1" can now be presented for review. (See Figures 12, 13, 14, 15 and 16.) Alternate "B" was run specifically to output one-way volumes and the assigned figures should be doubled in order to compare them to the other alternates which displayed 2-way volumes. Alternate "1" as mentioned above, is a "do nothing" 1995 traffic assignment and is used to determine the effect of the other alternates on surrounding trunklines. The 1965 AADT figures appear on the top of each link segment, and the 1995 estimated volumes appear on the bottom.

An examination of the impact of each alternate will not be presented in this report since the purpose was to present the capabilities of the modeling technique and not the conclusions of its application. By examining the following plots, however, Highway Department personnel can examine the impact of the multiple corridor situation and reach conclusions which will be based on highly reliable traffic figures.

The impact of this capability has yet to be felt within the total planning process, and its future success appears certain as administrators seek immediate answers to formally difficult corridor questions. Firm traffic figures and answers can be forwarded to management within a matter of hours as compared to weeks or months. The application of the Statewide Traffic Forecasting Model leads to the enhancement of an instant-action management traffic information system.

A

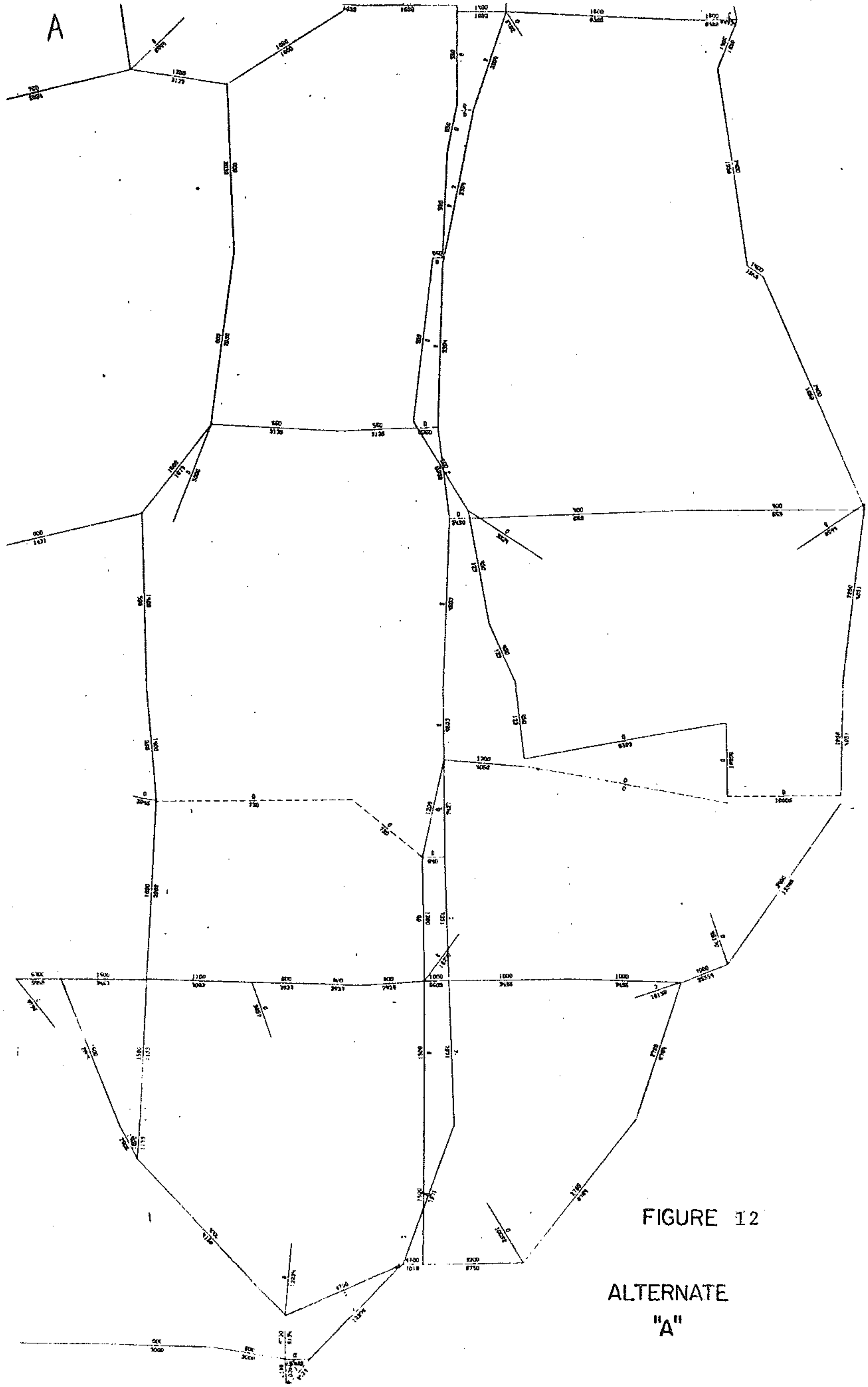


FIGURE 12

ALTERNATE "A"

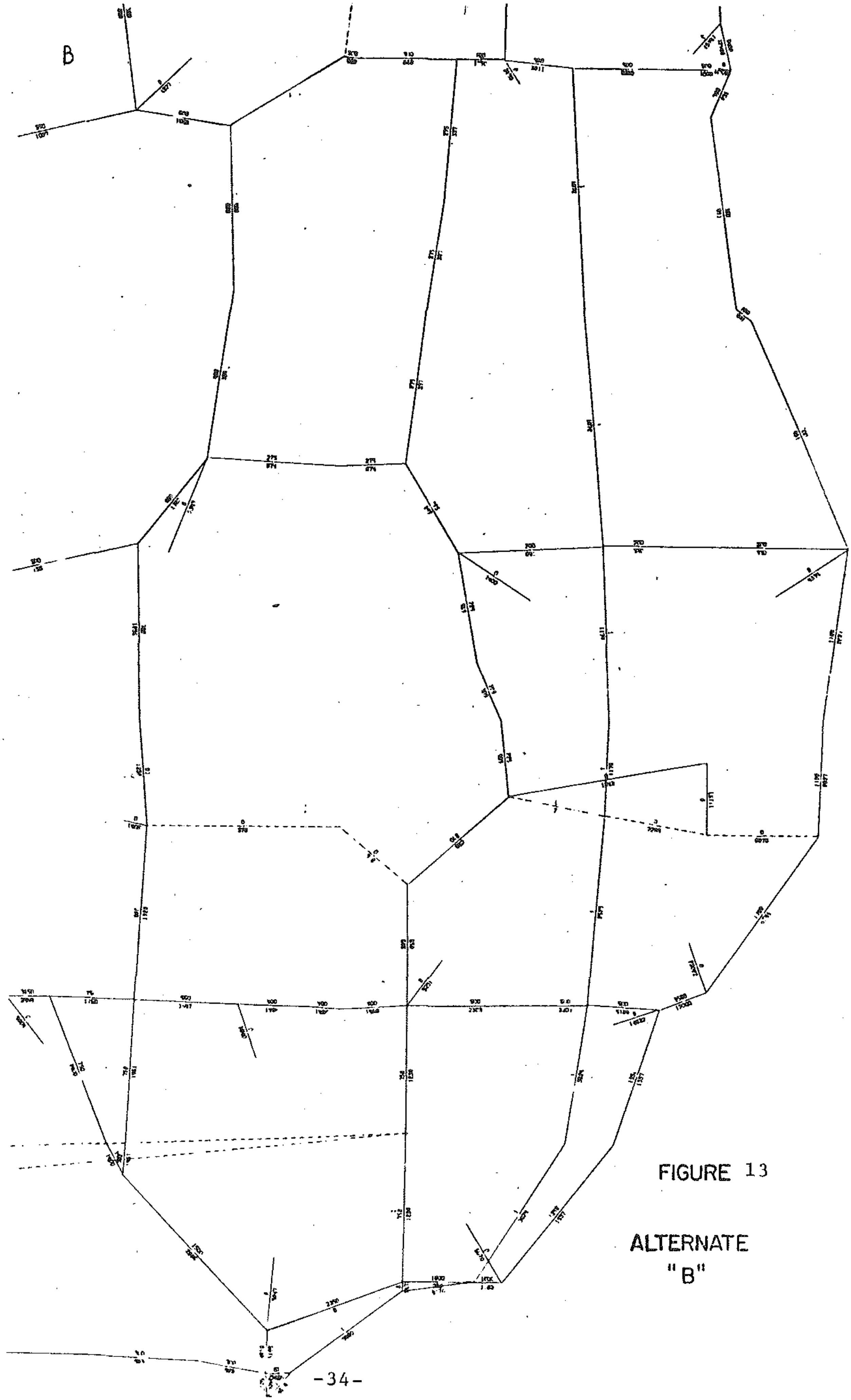


FIGURE 13

ALTERNATE "B"

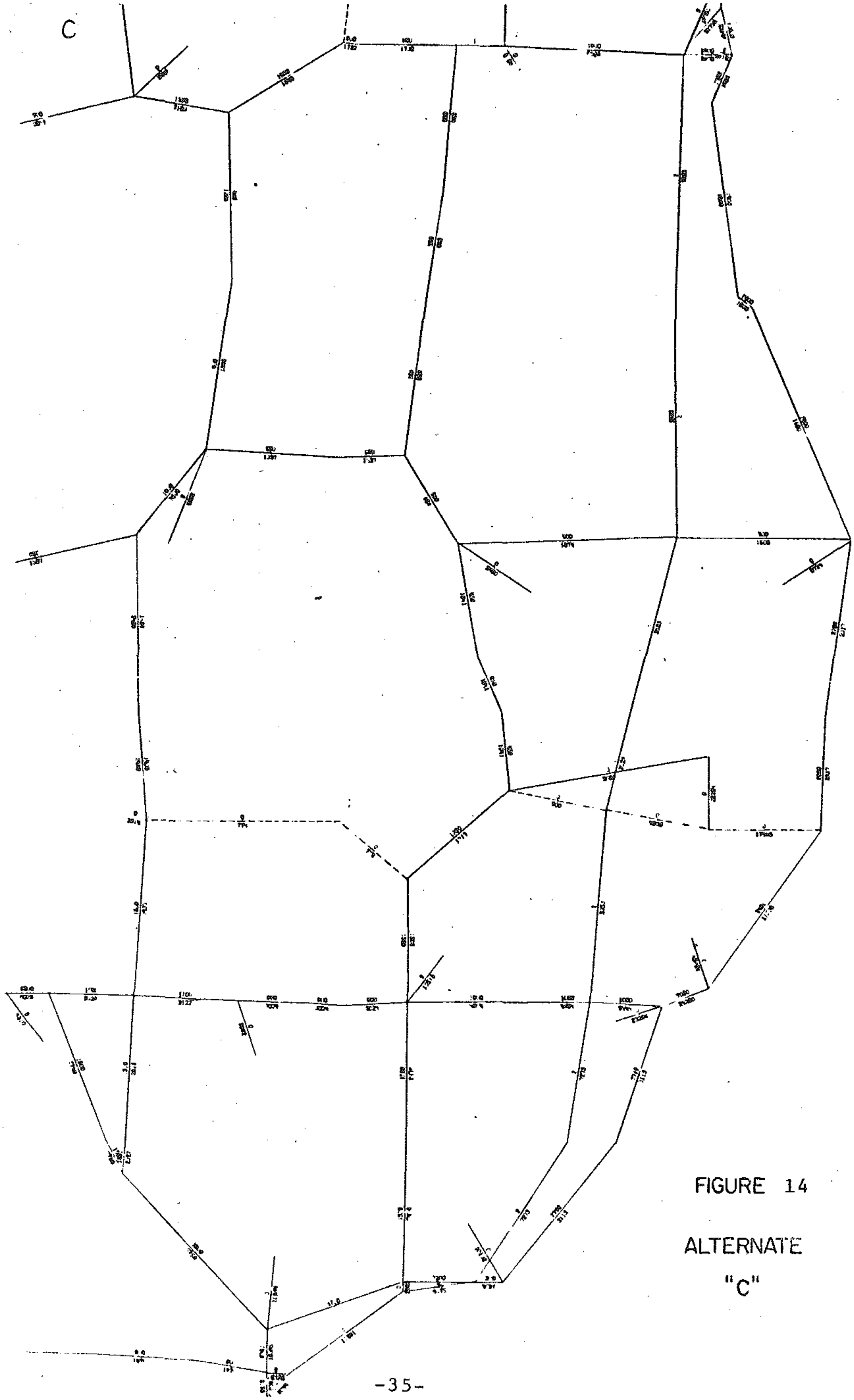


FIGURE 14

ALTERNATE
"C"

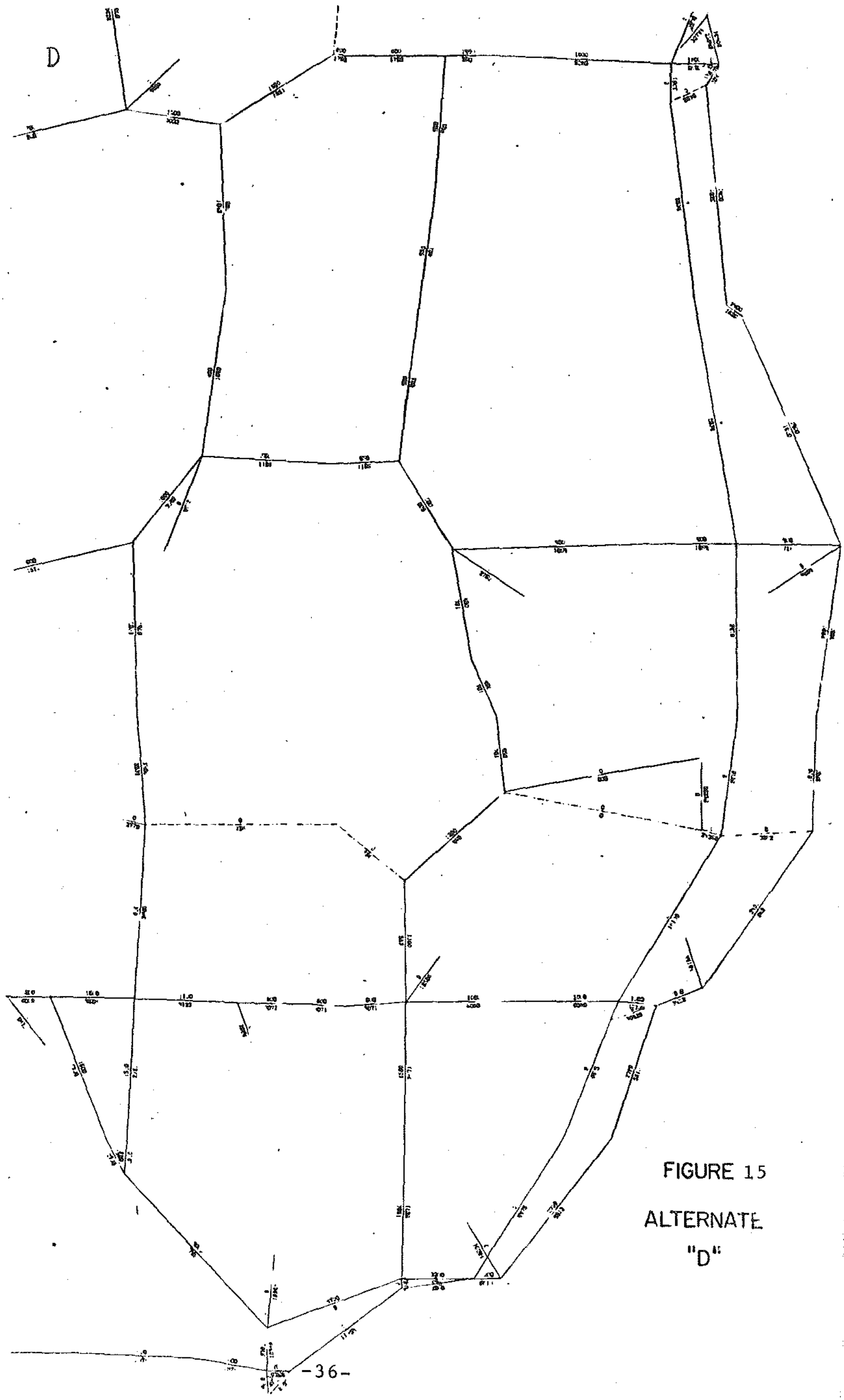


FIGURE 15

ALTERNATE "D"

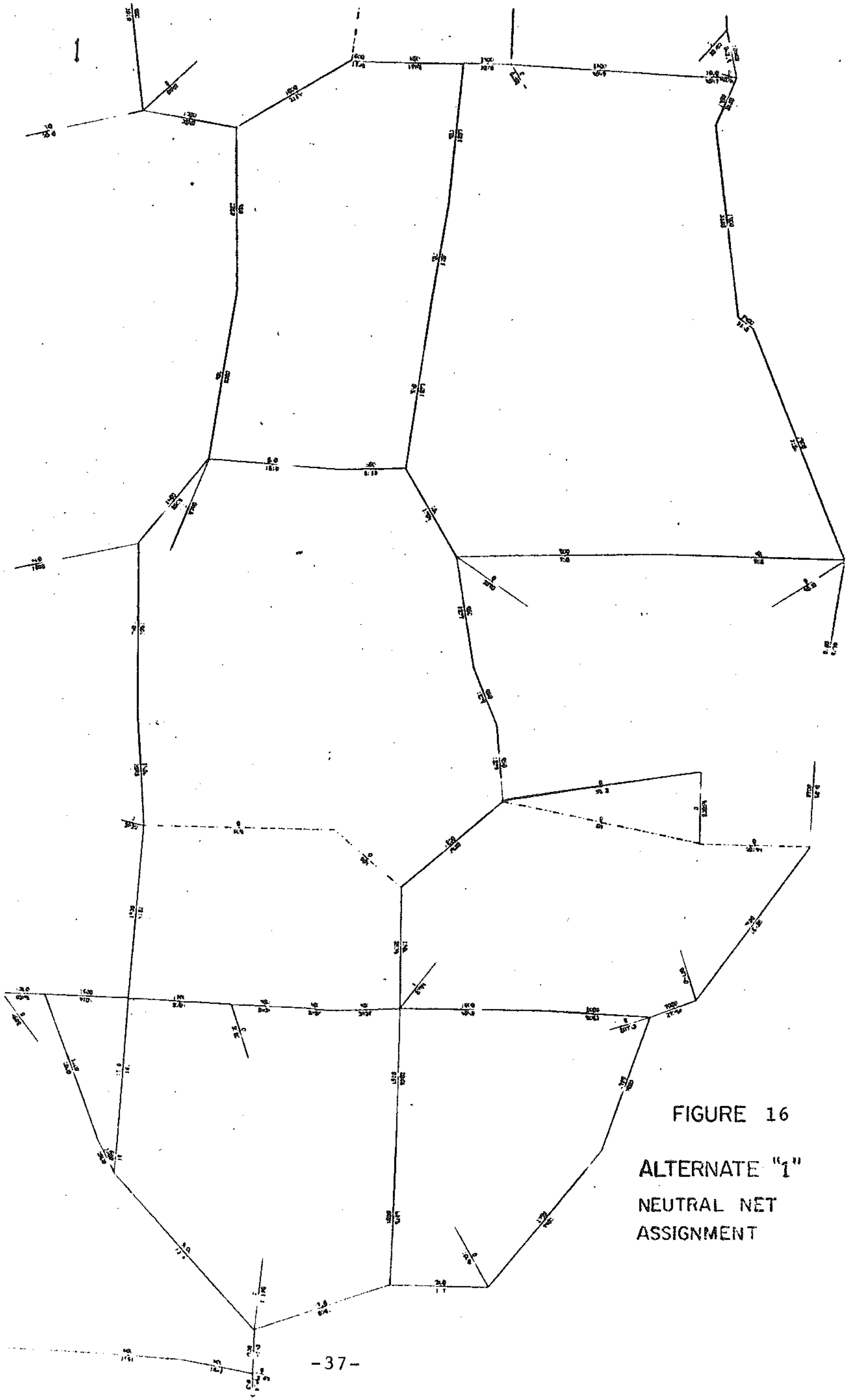
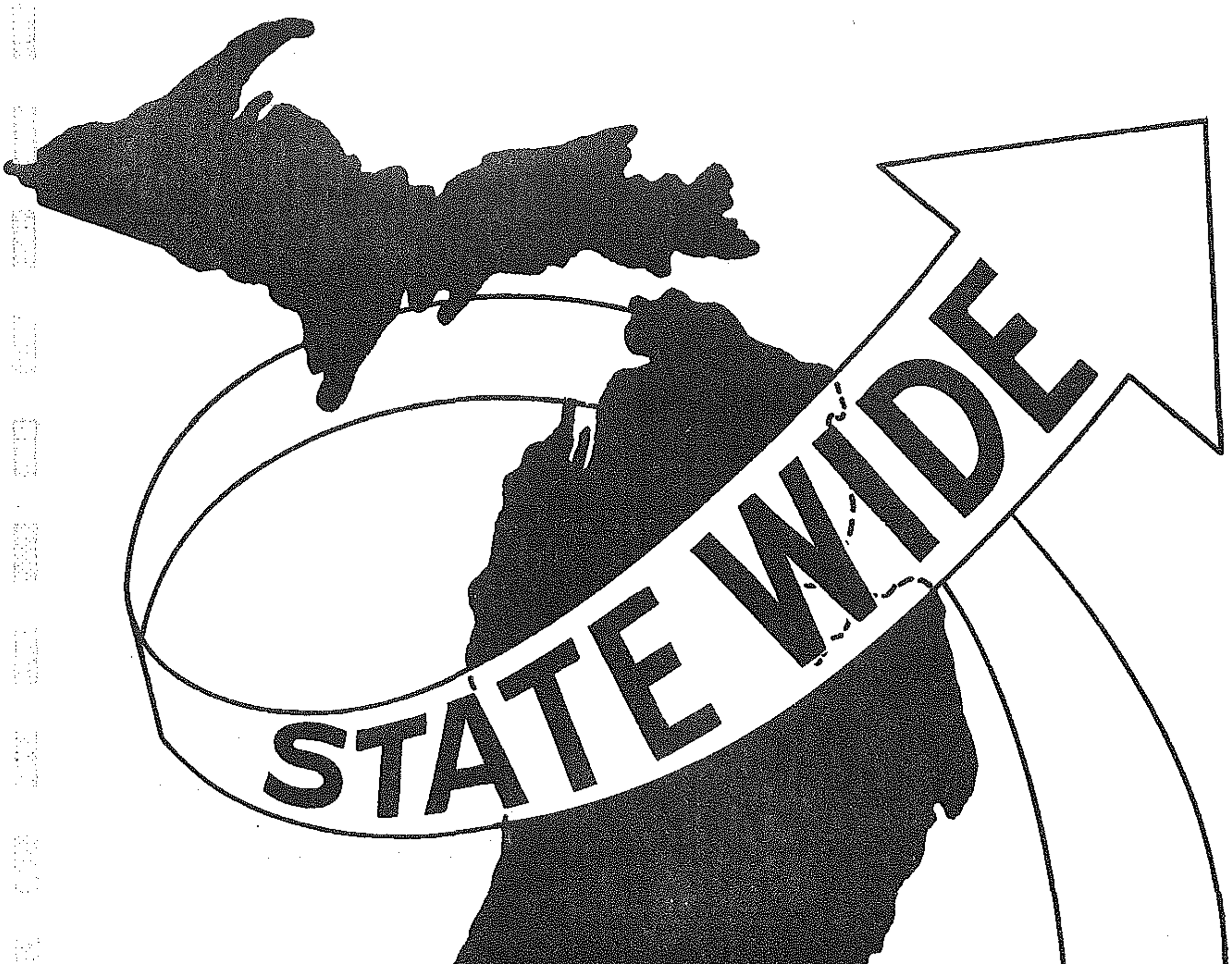


FIGURE 16

ALTERNATE "1"
NEUTRAL NET
ASSIGNMENT

INTERCHANGE
ADDITION
DELETION
ANALYSIS



INTERCHANGE ANALYSIS

Again the efficiency and consistency of the modeling process appears. Interchanges can be added or deleted along alternate routes and the impact, in terms of traffic and vehicle miles, can be measured more accurately than ever before. The larger 2300 zone system lends itself more readily to interchange analysis because of the increased accuracy of the assignment process, but the 540 zone model can be used until the larger system is developed. The inclusion and exclusion of Esmond Road on the previously described alternates provides an excellent example.

To begin, review Alternate "3" without the Esmond Road interchange. (See Figure 18.) Alternate "3" without the interchange, shows a decrease in traffic on link "A", (as compared to Alternate "A") but the level of decreased traffic can now be monitored so that the Department may rapidly determine the need for an interchange at a predetermined location such as this. Conversely, the increased link traffic on a specific route (Alternate "A"), which can be attributed to the addition of an interchange, can likewise be studied to determine if the increase in traffic is sufficient to warrant the construction of the interchange. The model's power in this area represents a giant step forward toward the solution of problems which have plagued highway analysts for years.

To review specific figures, look at the Alternate "3" assignment (Figure 18). Link "A" contains a projected traffic figure of 7,195 vehicles. Now looking at Alternate "A" (Figure 17), with an addition of an interchange at Esmond Road, the traffic figure to the north of the interchange increases to 7,427 as compared to 7,195, and traffic to the south of the interchange increases to 7,351 as compared to 7,195. A total increase in anticipated traffic of 388 vehicles.

We can see that traffic volumes increase on proposed US-23 with the addition of the interchange, but this still does not tell us how many people are using the interchange or what effect this interchange will have on other interchanges located along the route.

A program called TP TURN Q01432 can give us this information when used in conjunction with the addition or deletion of interchanges and the "loaded" highway network. TP TURN tells the analyst exactly how many vehicles are expected to use any given interchange on a specific turn-by-turn basis. Other programs are available which will list the effects of interchange combinations in terms of total system vehicle miles.

Not only will this capacity help in the decision making process, but if the choice is made to build a specific interchange combination, the geometrics engineer will have highly reliable traffic figures with which to design the facilities and to what level of efficiency. This system of analysis approaches for the first time, the level of accuracy demanded of modern interchange design and placement.

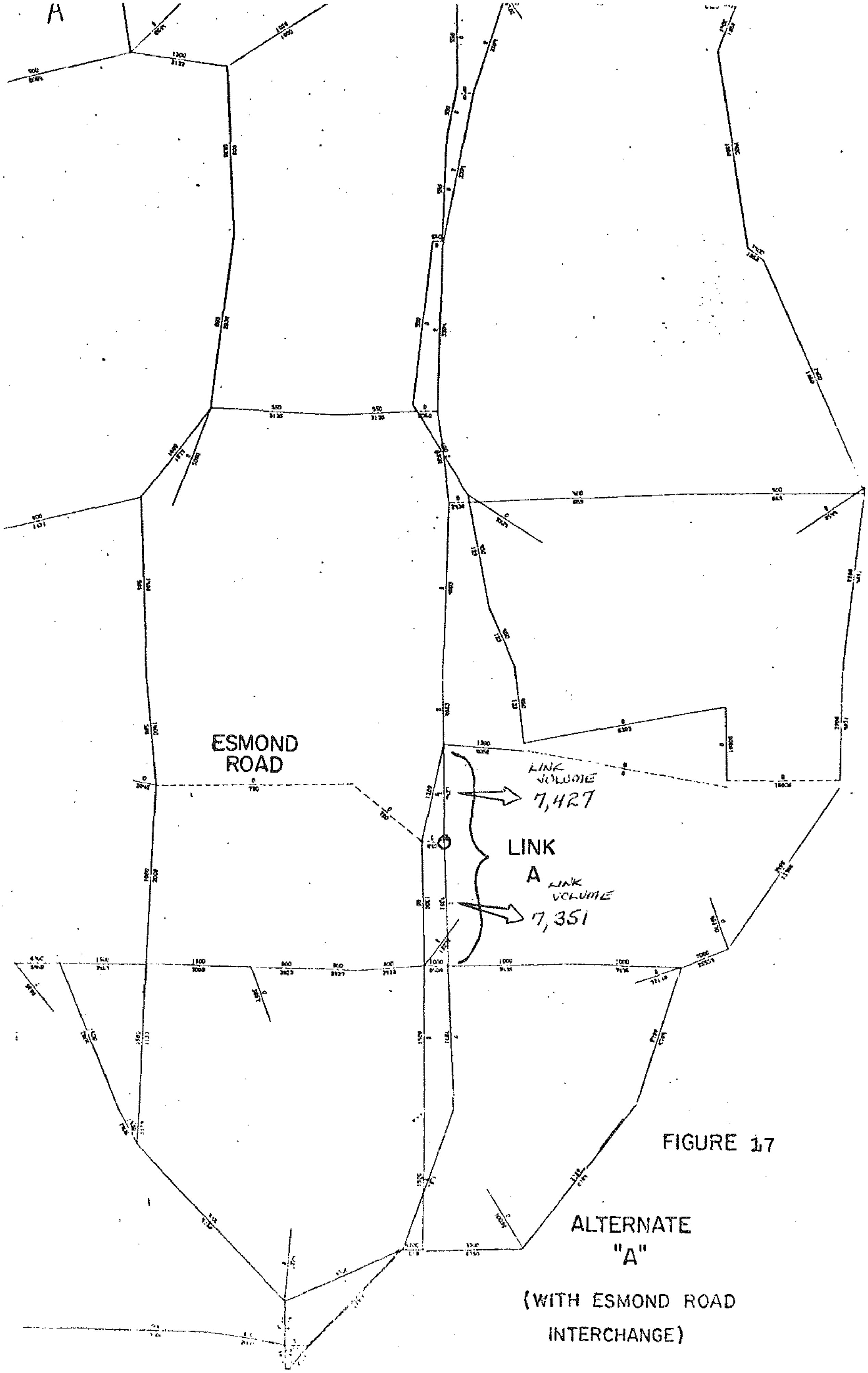


FIGURE 17

ALTERNATE
"A"
(WITH ESMOND ROAD
INTERCHANGE)

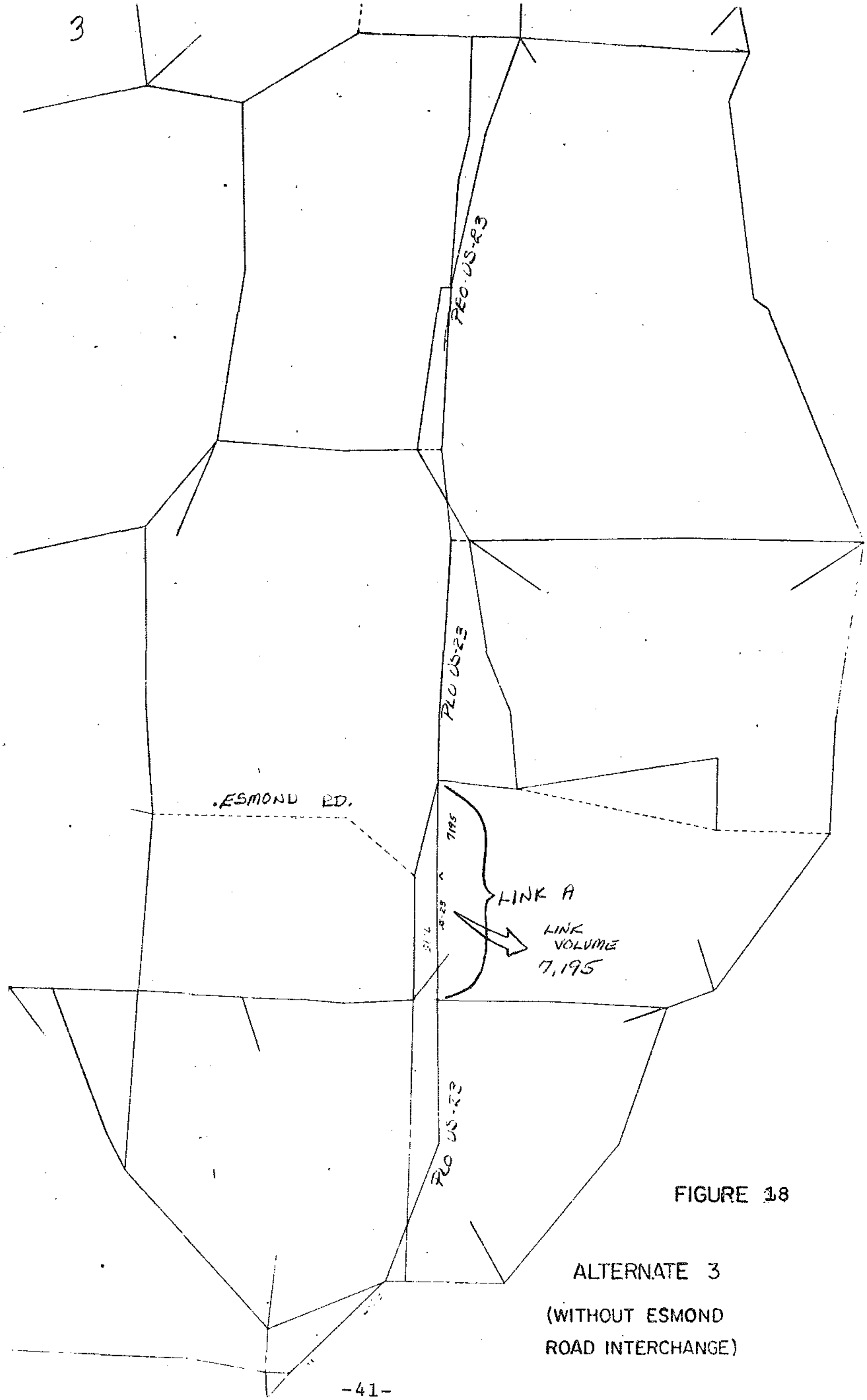


FIGURE 18

ALTERNATE 3

(WITHOUT ESMOND ROAD INTERCHANGE)

FUTURE MODEL APPLICATIONS

FUTURE MODEL APPLICATIONS

The Statewide Traffic Forecasting Model process encompasses an extremely dynamic system. Management can easily test the multiple impact of corridor decisions on traffic volumes and travel patterns prior to the highways actual construction. Because the actual models themselves are dynamic from the standpoint of simulating highway system changes, the Statewide Model may service many additional uses as suggested in the following brief paragraphs.

Accessibility Analysis

In the process of forecasting travel patterns, the Statewide Model must determine both the optimum path from each region of the state to every other region and the average driving times required to traverse the paths. This information can then be used to analyze the degree to which an alternative transportation plan makes any given region of the state more accessible -- that is, easier to reach. The concept of accessibility is not limited to relating one population group to another. It may also be used to analyze the service potential of hospitals, police installations, fire stations, or any other public facility. Such analyses are among the type required by recent Federal law, most notably Section 109(h) of Title 23 USC.

Cost-Benefit Analysis

Since the model gives the capability of rapidly generating traffic forecasts on alternate construction plans, a natural extension would be to calculate user costs and user benefits for all links of the alternate networks and to do cost-benefit analysis on a networkwide basis. Summaries will then be made by area, probably county or state planning regions. This broad view is very important. Most existing cost-benefit analyses consider only links in the neighborhood of the alternate construction projects being considered; thus they fail to consider that the addition of a major corridor disrupts traffic flow patterns throughout the state. Until now, this fact has not been ignored by analysts; they simply have not had the capability of examining several entire alternate networks without the expenditure of a great deal of time and money. Now with the Statewide Traffic Forecasting Model, a planner has the capability to perform such a comparison quickly and cheaply. (See Model Report I-E.)

Proximity Analysis

By combining the Statewide socio-economic data bank with a set of skimmed trees, we plan to develop a process to analyze the closeness of a zone characteristic (such as population) to a zone of interest. The primary use of this process will be in trip-generation update. Therefore, we want to know how many people live within a given driving time (for example, 0-15 minutes or 15-30 minutes) of each zone in order to be sure that the trip-generation predictor called "surrounding population" is adequately defined. The basic technique will be shown to have extensive applications in many areas of planning. (See Model Report I-D.)

Psychological Impact Analysis

Psychological Impact Analysis or "Comfort Analysis" as it is also called, attempts to measure the degree of relative driving strain placed upon the motorist by the type and condition of highway being traveled. Many factors such as traffic volume congestion, surface condition, and lane width contribute to the "comfort" or lack of "comfort" experienced by the majority of motorists traveling a given distance of highway. With this process, the effect of highway improvements and reconstruction projects could be measured in terms of relative driver comfort for the entire state or per project area. (See Model Report I-G.)

Trunkline Establishment - Abandonment Analysis

This technique describes how existing technology, used in conjunction with the Statewide Traffic Forecasting Model, can be used to provide a systematic and factual basis for evaluating the present level and character of service for any proposed trunkline establishment or abandonment.

Application of the system analysis techniques currently available will allow the Department to effectively supply a thorough evaluation of each trunkline turnback and its impact on state, regional and local master plans. (See Model Report I-C.)

CONCLUSION

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One can see that the computerized graphic presentations of the alternate corridors and their corresponding projected traffic figures is a marked advance in the field of Transportation Planning. This capability, coupled with the speed of computer turnaround times, places the first phases of the planning process on an equal footing with the contemporary demands being placed upon the process.

The extreme degree of flexibility associated with the model eliminates much of the frustration normally associated with the subjective estimating procedure. The time-lag differential between the computerized modeling technique and the subjective technique allows corridor placement questions to be answered while the questions still have fresh meaning and significance. Many more situations and types of alternates can be considered within a reasonable time span. This increases the odds of picking a better alternate if more possibilities are available for study.

When examining the effects of a proposed freeway on the surrounding trunkline system, the dependability and consistency of the model is unsurpassed. This capability adds a new dimension to the corridor placement process and demands a widening of the scope of the total planning analysis considerations.

In order for the model to achieve recognition and proper placement within the total planning system, details of its capabilities must be documented for review. The preceding report covers a significant portion of the modeling capabilities and applications. The task ahead of us demands that we use this new transportation analysis model to its full potential.