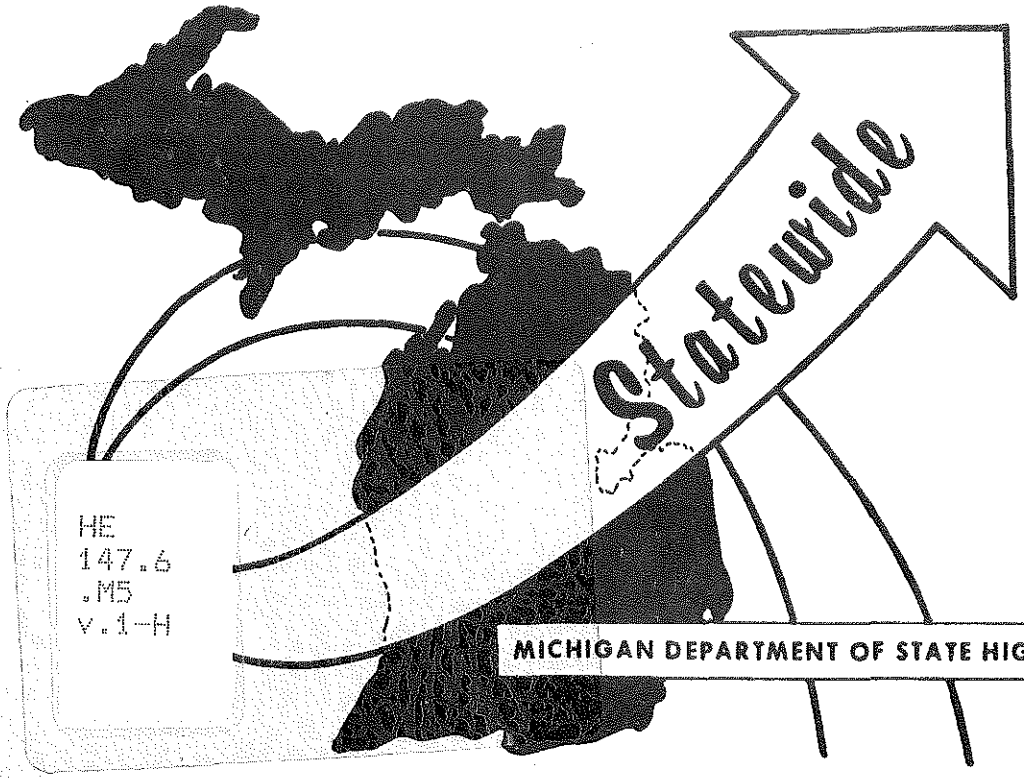
Statewide Transportation Analysis & Research

MICHIGAN'S STATEWIDE
TRAFFIC
FORECASTING MODEL

VOLUME I-H

LEVEL OF SERVICE SYSTEMS ANALYSIS MODEL- A PUBLIC INTERACTION APPLICATION

JULY, 1973
STATEWIDE STUDIES UNIT



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MICHIGAN DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION

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OF

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STATEWIDE STUDIES UNIT

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JOHN P. WOODFORD, STATE HIGHWAY DIRECTOR

August 8, 1973

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

Dear Mr. Cryderman:

To meet Federal guidelines regarding public involvement in areas of alternate highway routes, the Statewide Studies Unit of the Transportation Survey and Analysis Section has developed a tool which effectively illustrates, in laymen's terms, changes in traffic characteristics that occur when alternate highway plans are tested.

Using the Statewide Traffic Forecasting Model as input, the Level of Service program determines at what level of service each road in the system is operating. Running the program before and after an alternate route is incorporated into the network gives the user a comparative view of the effects of each plan.

The output from the program is easily understood by non-highway oriented personnel, being numerical values from 1-6 and identifiable by accompanying photographs of sections of roadway bearing relative traffic volumes.

The following report was prepared by Mr. W. Thomas Franklin of the Statewide Studies Unit under the supervision of Mr. Richard E. Esch.

Sincerely,

Keith E. Bushnell

Keith E. Bushnell
Engineer of Transportation
Survey and Analysis Section

MICHIGAN
THE GREAT LAKE STATE

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PREFACE

PREFACE

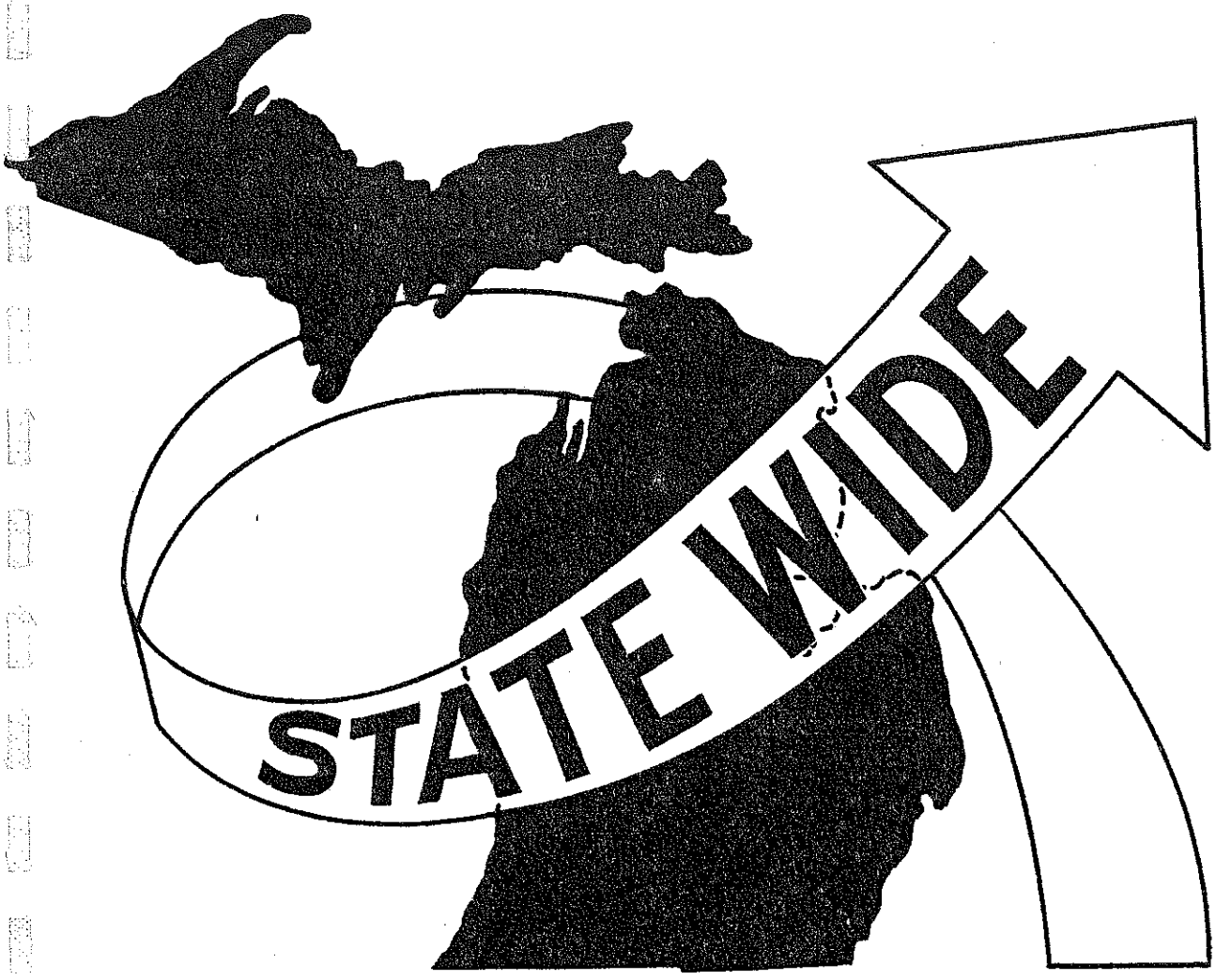
This is Volume I, Part H of the Michigan Statewide Traffic Forecasting Model series of reports, entitled LEVEL OF SERVICE SYSTEMS ANALYSIS MODEL - A PUBLIC INTERACTION APPLICATION.

Previous reports in this series are:

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	Transportation Analysis Psychological Impact 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	Development of the Statewide Socio-Economic Data Bank for Trip Generation-Distribution
Volume	VI	Corridor Location Dynamics
Volume	VII	Design Hour Volume Model Development
Volume	VIII	Statewide Public and Private Facility File
Volume	IX	Statewide Socio-Economic Data File

The following report deals primarily with the concept of public communication through the use of the above mentioned level of service program.

INTRODUCTION



INTRODUCTION

As a result of Federal legislation it is now the responsibility of each highway department to effectively communicate with the public in matters concerning future highway projects. The public must now be made aware of the total picture and what effects each project will have on them. The problem up until now has been the inability of the public to grasp the ideas which are fundamental to the planning process. Formulas, numbers, and traffic jargon such as ADT and DHV left the average citizen somewhat confused about exactly what was happening around him.

With the emergence of the Statewide Traffic Forecasting Model, the method of analyzing the impacts of alternate highway routes has increased rapidly. As each alternate route is tested it is compared to the original "network system" and previous alternates to determine its impact. The speed with which these alternates can be produced necessitates, now more than ever, a way to illustrate to the average citizen the reasoning behind such projects, not necessarily in detail but in a manner that will both satisfy his curiosity and give him ample insight into the nature of the process.

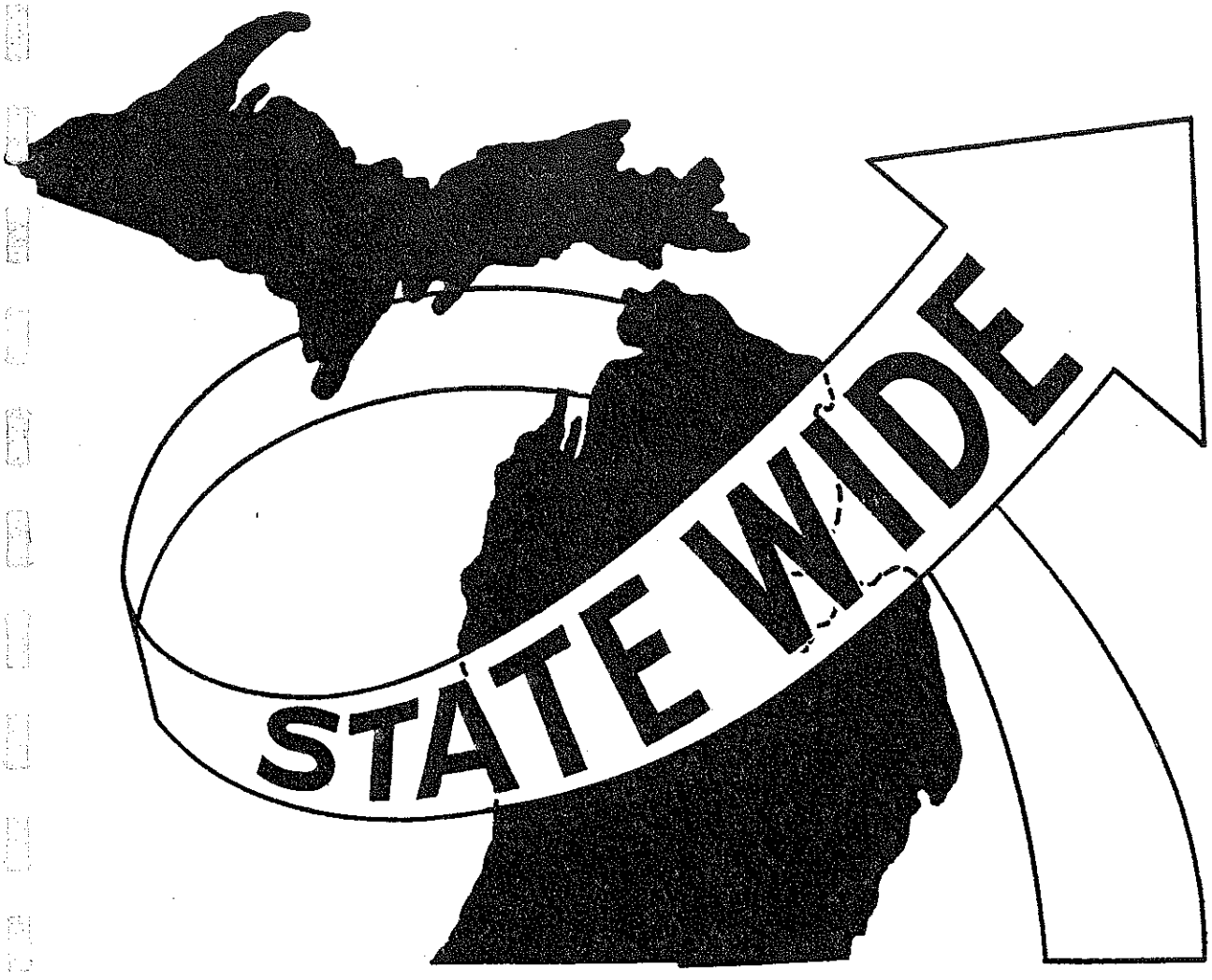
It is the feeling of the Statewide Studies Unit of the Michigan Department of State Highways that such an illustration can be made possible by the use of the Level of Service concept.

According to the Highway Research Board Special Report #87 entitled "Highway Capacity Manual 1965", "Level of Service is a term which, broadly interpreted, denotes any one of an infinite number of differing combinations of operating conditions that may occur on a given lane or roadway when it is accommodating various traffic volumes. Level of Service is a qualitative measure of the effect of a number of factors, which include speed and travel time, traffic interruptions, freedom to maneuver, safety, driving comfort and convenience, and operating costs. In practice, selected specific levels are defined in terms of particular limiting values of certain of these factors".

Report #87 goes further in saying that because of the lack of available data relating to the above mentioned factors, "the committee has selected travel speed as a major factor in identifying level of service. The committee also uses a second factor -- either the ratio of demand volume to capacity or the ratio of service volume to capacity . . . in making this identification". This second variable is referred to as the "V/C ratio".

The following report is meant to illustrate the concept of public communication through the Level of Service Model now used by the Statewide Studies Unit. The emphasis throughout is placed on its use for public involvement rather than on the actual principles of the concept itself. The success or failure of many statewide model operations drastically depends on the ability of each state to develop an effective public communications tool such as the Level of Service Model discussed in this document.

DATA COLLECTION



DATA COLLECTION

The level of service model employed by the Statewide Studies Unit is based on information from the Highway Research Board Special Report #87 entitled "Highway Capacity Manual 1965". Figure 1 is an illustration of the V/C ratios for rural roadways and their corresponding levels of service. This summary table was prepared from individual charts throughout the manual and provides a framework around which the program is defined and structured.

The highway network file tape, which is also input into the model, contains the link specific data for processing by the program. Basically, each record contains pertinent information for each segment of roadway throughout the state. Each segment, or link, is identified by an A-node, B-node notation such as that in Figure 2. Associated with each link is a list of 22 volume fields. Two of these volume fields, Design Hour Volume and Capacity, are used directly by the level of service program for determining the levels for each link.

FIGURE 1

V/C RATIOS FOR RURAL ROADWAYS

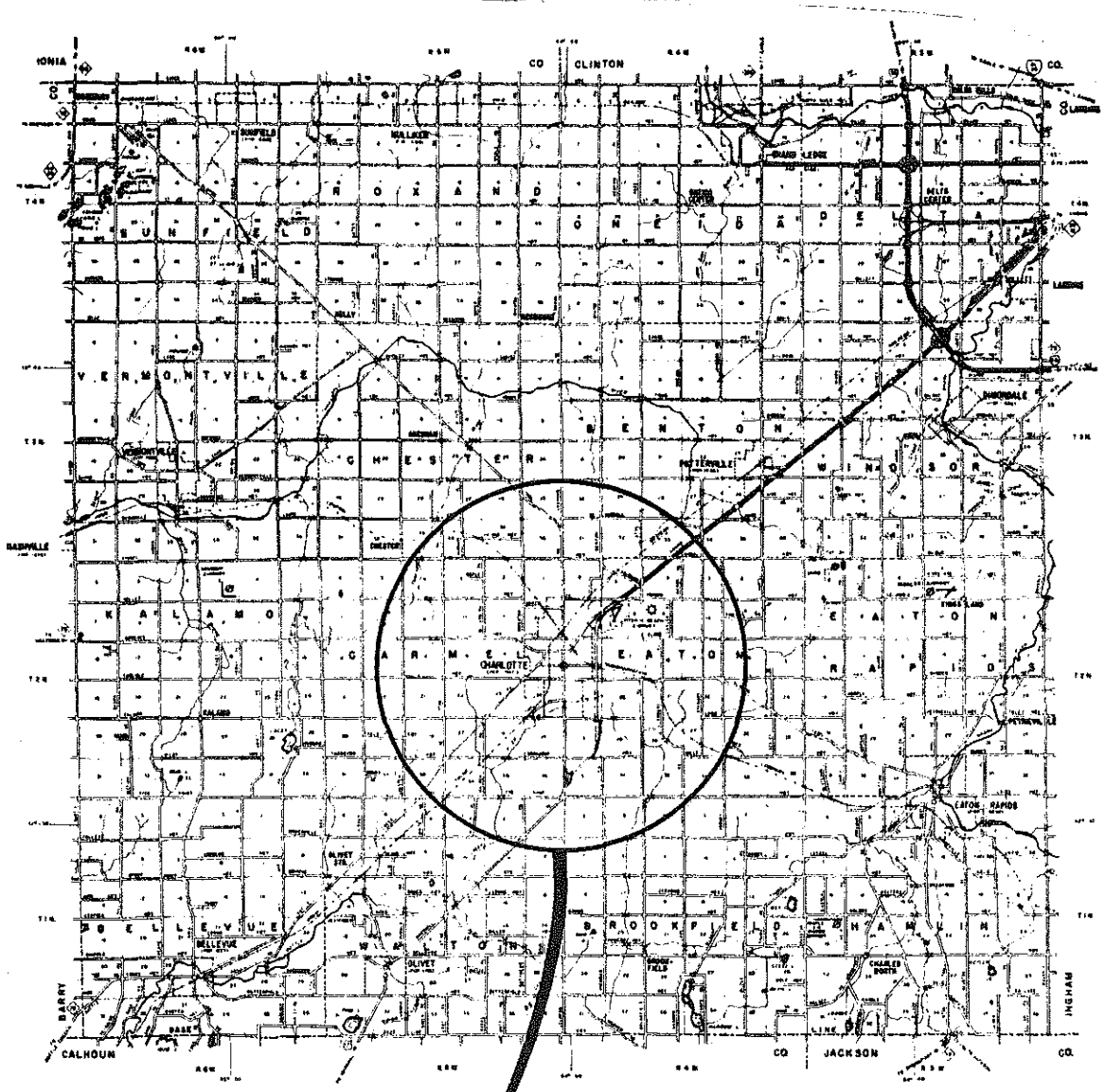
UNDIVIDED AND/OR UNCONTROLLED ACCESS MULTI-LANE HIGHWAY

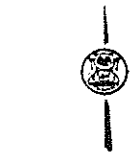
LEVEL OF SERVICE	2 LANES	3 LANES	4 LANES	6 LANES
A	0.286	0.360	0.400	0.400
B	0.643	0.659	0.667	0.667
C	1.000	1.000	1.000	1.000
D	1.214	1.205	1.200	1.200
E	1.428	1.366	1.333	1.333

DIVIDED WITH CONTROLLED ACCESS MULTI-LANE FREEWAY

LEVEL OF SERVICE	4 LANES	6 LANES	8 LANES	10 LANES	12 LANES
A	0.509	0.552	0.567	0.575	0.581
B	0.727	0.805	0.833	0.850	0.860
C	1.000	1.000	1.000	1.000	1.000
D	1.200	1.126	1.100	1.078	1.065
E	1.455	1.379	1.333	1.307	1.290

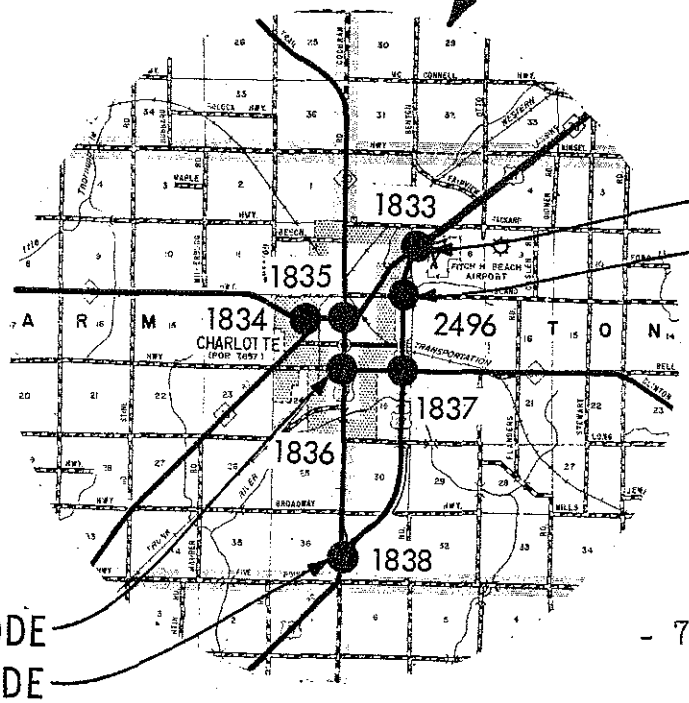
FIGURE 2



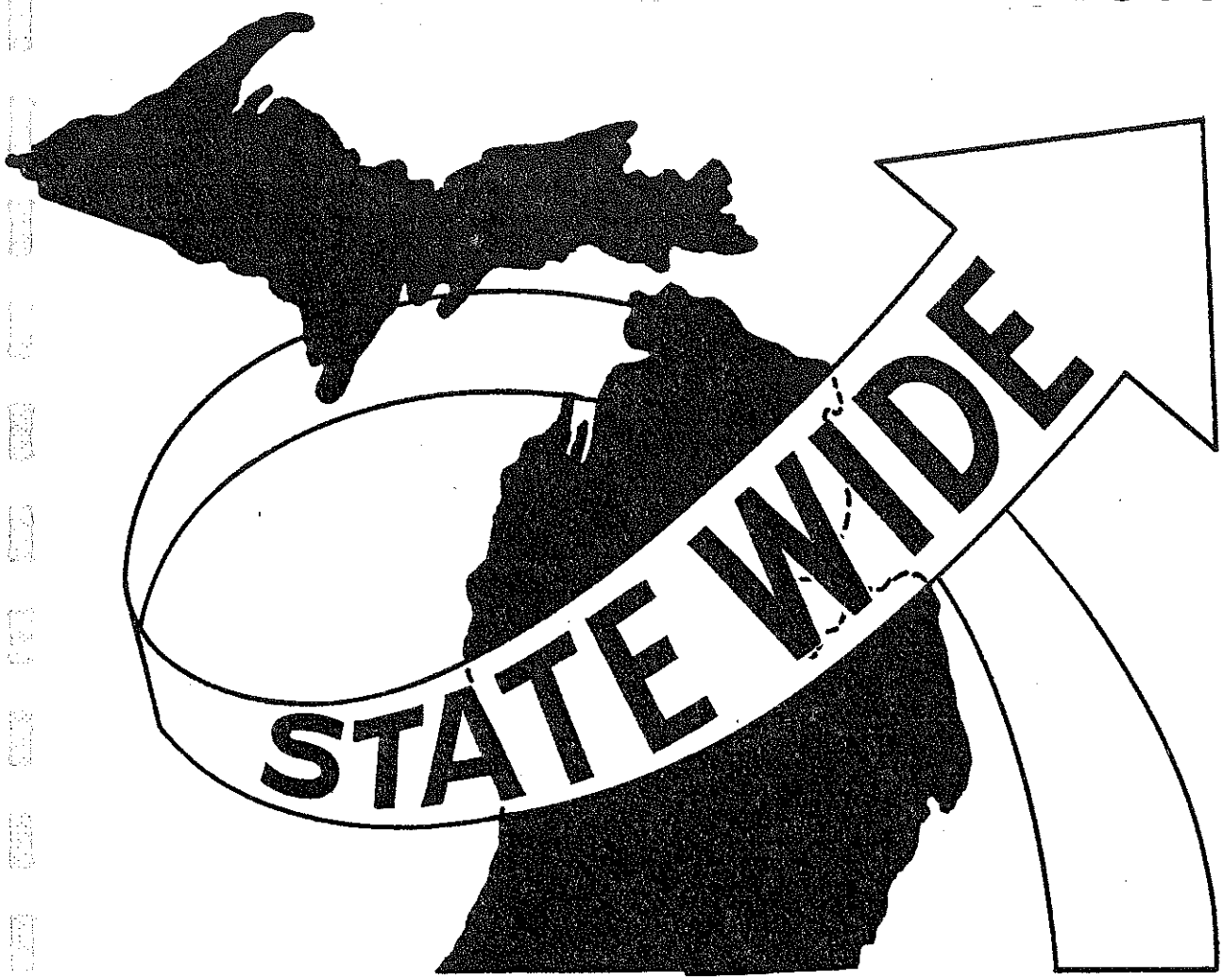


KEY TO COUNTIES

EATON COUNTY
MICHIGAN
STATE HIGHWAY COMMISSION
DEPARTMENT OF STATE HIGHWAYS
DATA OBTAINED FROM
HIGHWAY PLANNING SURVEY
CONDUCTED IN COOPERATION WITH
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS



MODEL DEVELOPMENT



MODEL DEVELOPMENT

As stated in the Introduction, the level of service concept was developed within the Statewide Studies Unit as a means of communication with the ordinary citizen. It was the concensus of the personnel within Statewide that "one good picture is worth a thousand words". Mr. Average Citizen has no feel for large numbers when it comes to traffic. For instance, most individuals could not comprehend an average daily traffic figure of 50,000, or the expression "level of service F", but show him a photograph such as the one in Figure 3b and he will probably relate to you that he has been in similar situations many times. The idea then is to put the complexities of transportation modeling technology into laymen's terms. This is precisely what happens with the level of service model.

Figure 4 is an illustration of the flowchart form of the level of service program. Notice that the first step of the operation is input of the table shown in Figure 1. These values are stored internally in two arrays, one for highway links and one for freeway links. Next, the network tape is read in, one link at a time. The V/C or volume-to-capacity ratio for that link is obtained by simply dividing the two appropriate volume fields (design hour volume and practical capacity). After the program has determined this ratio, the link is checked as to whether it is of highway or

FIGURE 3a

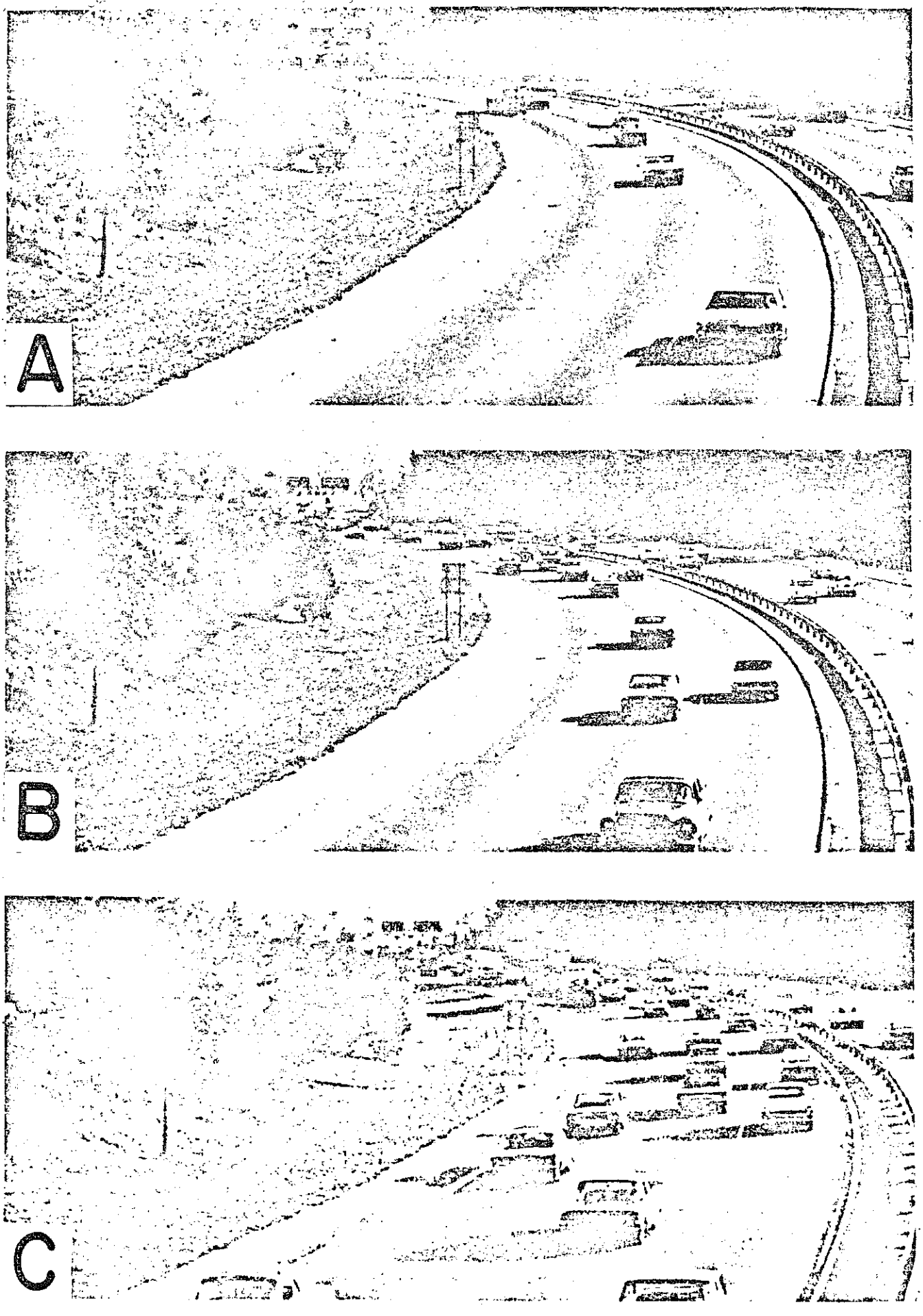


FIGURE 3b

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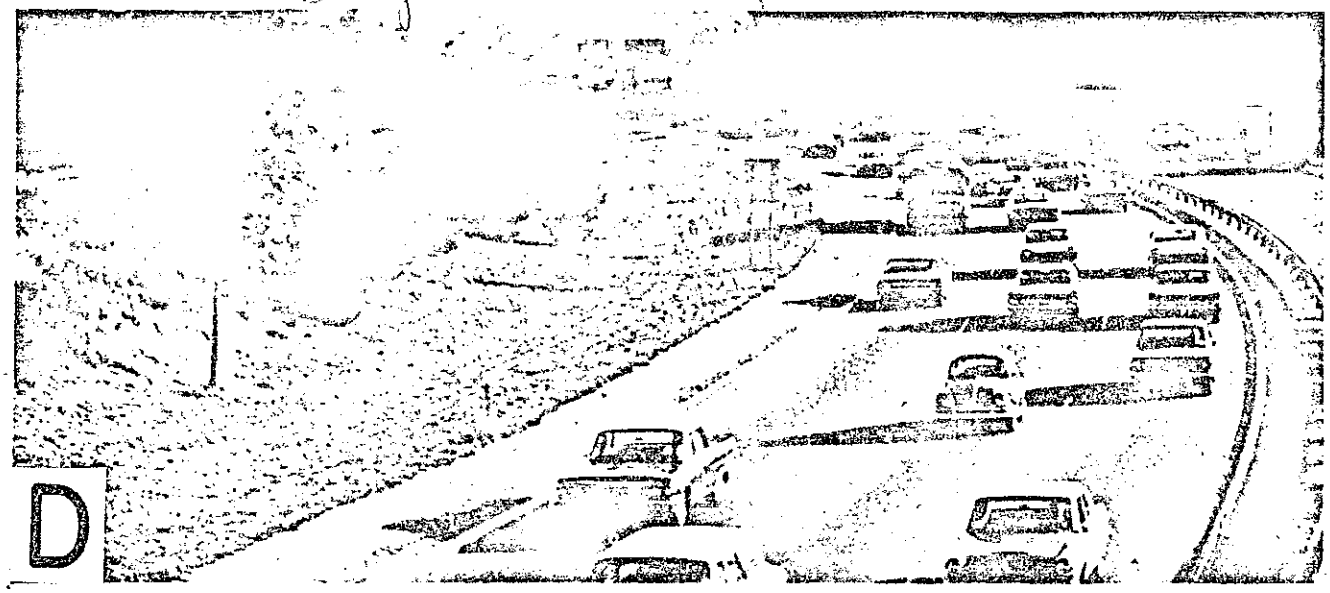


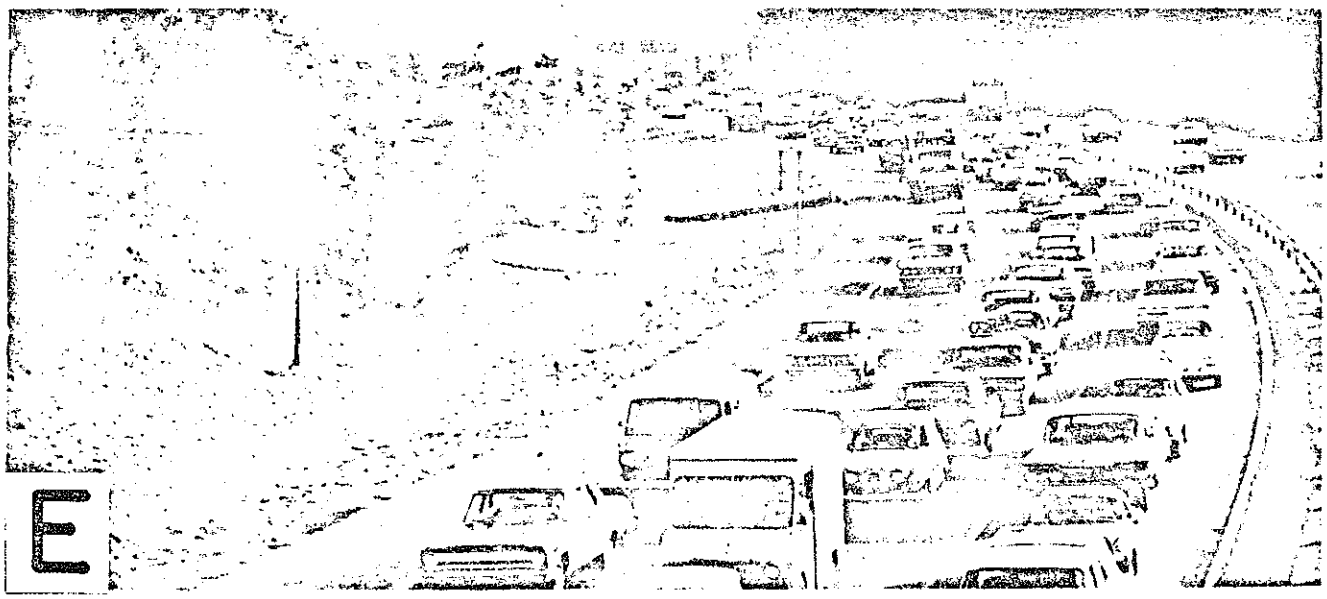
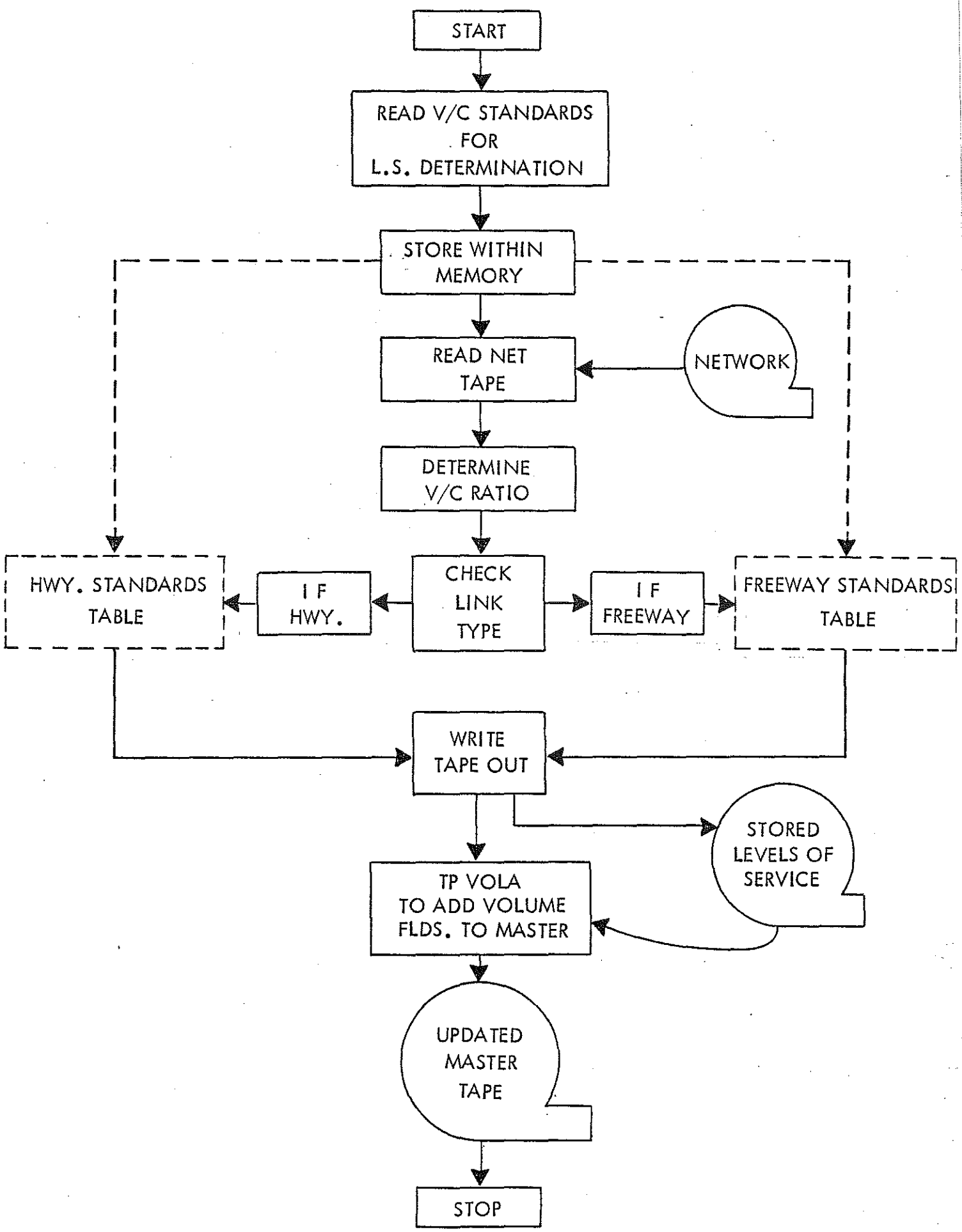


FIGURE 4

LEVEL OF SERVICE



freeway classification. Depending upon its classification, the appropriate level of service is attached to it based upon the values contained in the arrays from the beginning of the process. The program then writes the information onto a magnetic tape which is used in connection with another program to update the master network link file.

The next step in the analysis process involves a way of graphically presenting the information stored on master tape. With the aid of standard computer programs, this information can be visually interpreted in a number of ways. Figure 5 is a reproduction of a band-width plot. Each link is defined as being from one to six lines in width, with one line representing level of service A, through six lines for level F.

Figure 6 illustrates each link plotted with numerical values written above and below the link (V/C ratio,level of service). The V/C ratio on this plot is actually to two decimal places.

FIGURE 5

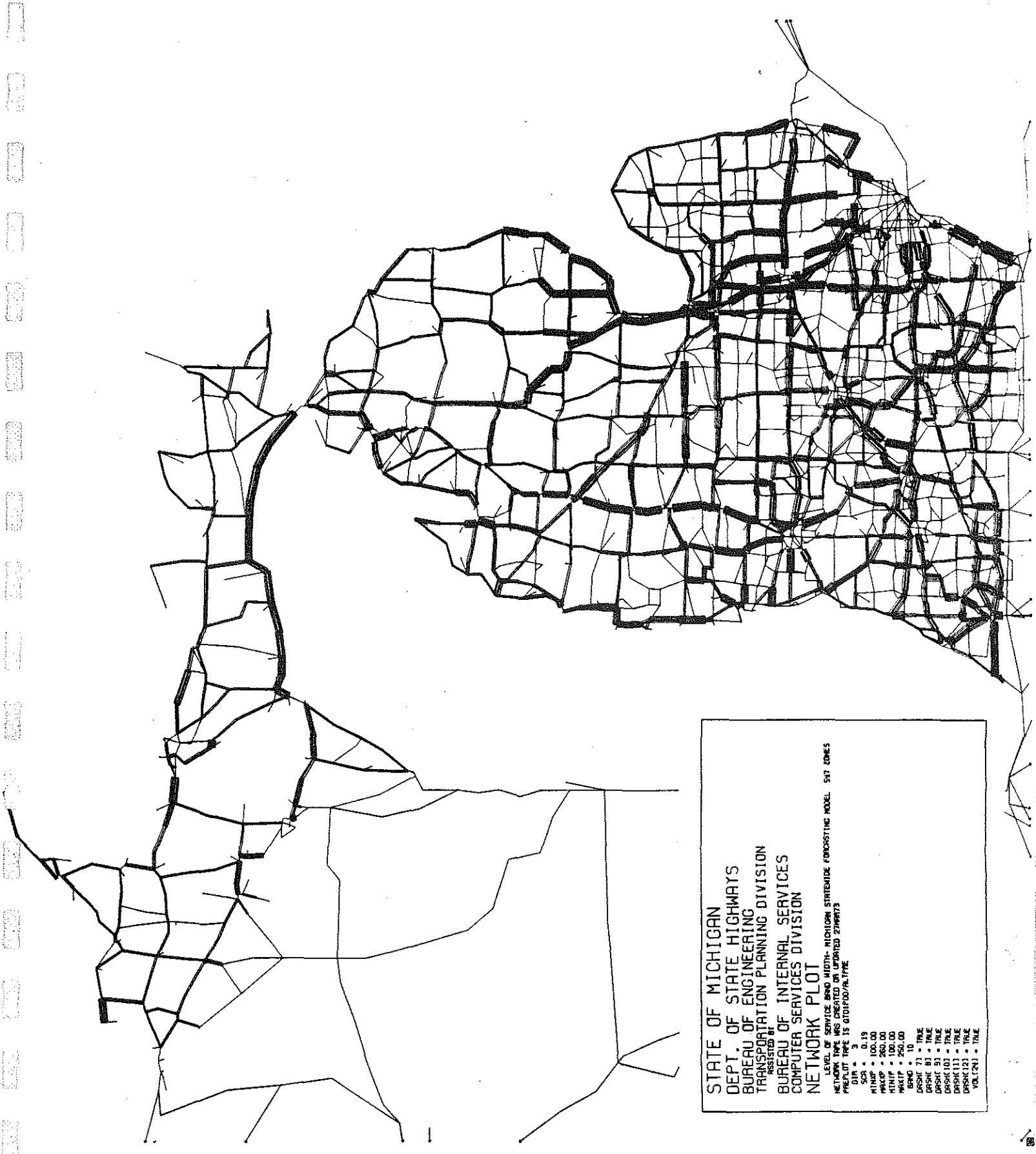
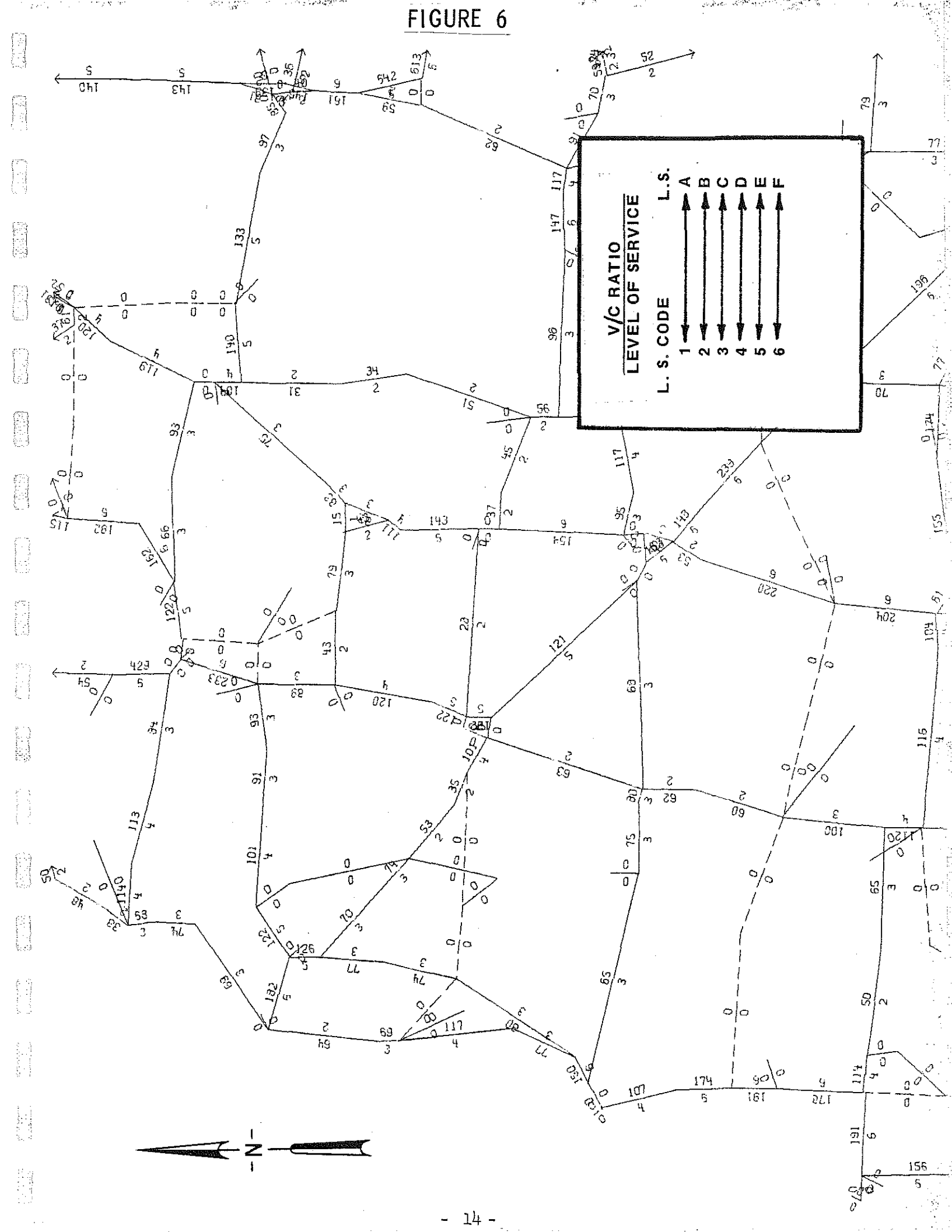
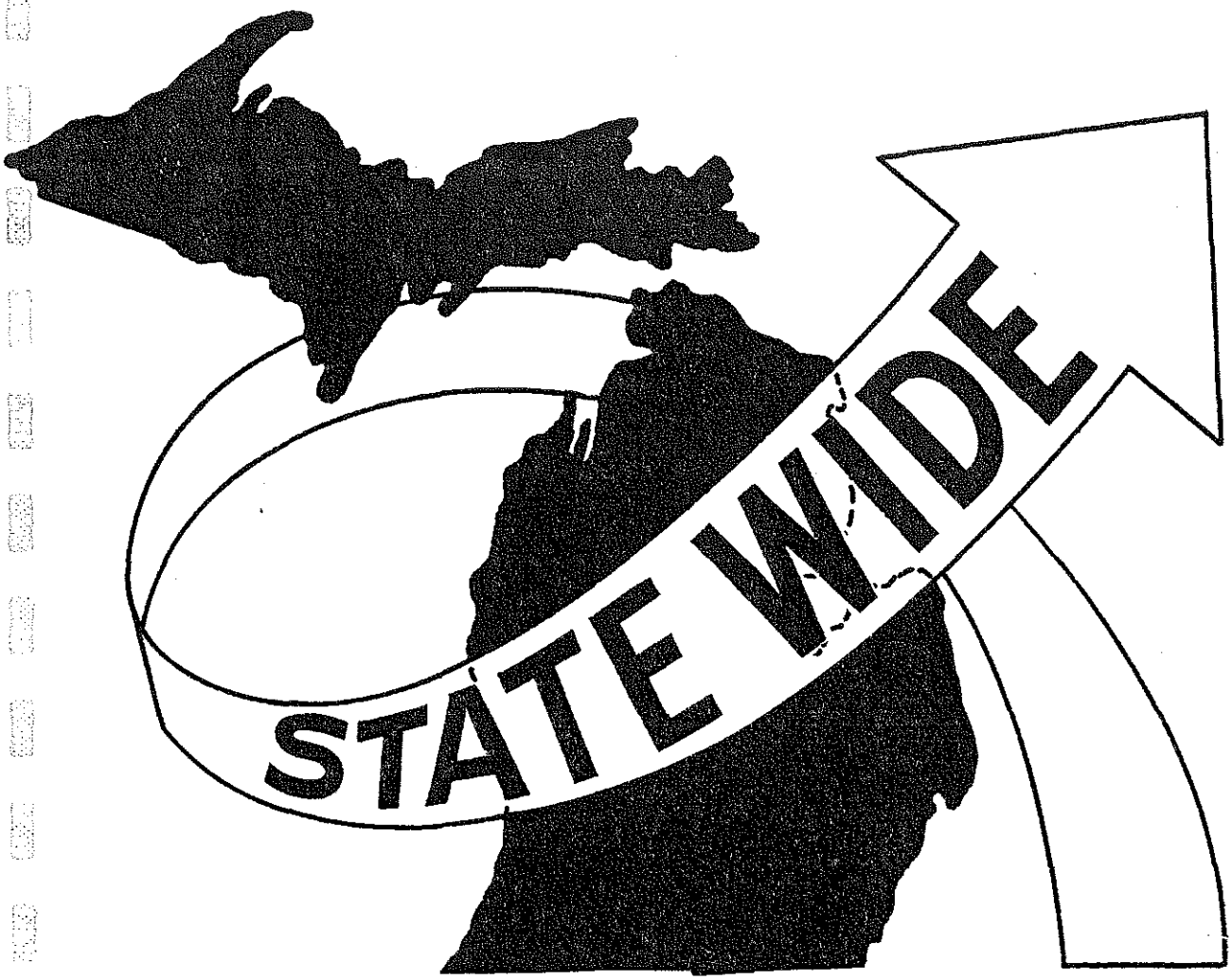

STATE OF MICHIGAN
DEPT. OF STATE HIGHWAYS
BUREAU OF ENGINEERING
TRANSPORTATION PLANNING DIVISION
ASSISTED BY
BUREAU OF INTERNAL SERVICES
COMPUTER SERVICES DIVISION
NETWORK PLOT
LEVEL OF SERVICE BAND WIDTH- MICHIGAN STATEWIDE FORCASTING MODEL 547 ZONES
NETWORK TAPE WAS CREATED ON UPDATED 27MAY73
PREPLOT TAPE IS GTOIPOD/ALTYPE
DIR = 3
SCA = 0.19
MINSP = 100.00
MAXSP = 250.00
MINTP = 100.00
MAXTP = 250.00
BAND = 10
DASH(7) = TRUE
DASH(8) = TRUE
DASH(9) = TRUE
DASH(10) = TRUE
DASH(11) = TRUE
DASH(12) = TRUE
VOL(24) = TRUE

FIGURE 6



ACTUAL MODEL APPLICATIONS



ACTUAL MODEL APPLICATIONS

This section discusses an actual application of the level of service program. Plots of the same area before and after the addition of a new expressway illustrate the change in level of service on various links. Again, the program basically operates using design hour volume (DHV) and capacity as inputs for determining a V/C ratio.

Michigan roads are constructed mainly on the consideration of DHV which is briefly described below. Hourly traffic volumes for a specified segment of roadway are studied for a one-year period. The DHV then, is considered to be the 30th highest hourly volume on that roadway segment over that one-year period of time. With this idea in mind, it is more easily understood why the level of service will likely change on specific roads with the addition of such an expressway. With the new expressway operative, some surrounding roads will be less attractive to drivers who will consequently use the new facility. This will drop the amount of the daily total of traffic on these surrounding roads, which in turn drops the DHV and alters the level of service.

Figures 7 and 8 are illustrations of a section of the State with and without the addition of two new alternate freeway routes. The added freeways are shown in Figure 8 as dotted lines. A few changes in levels of service are also illustrated.

FIGURE 7

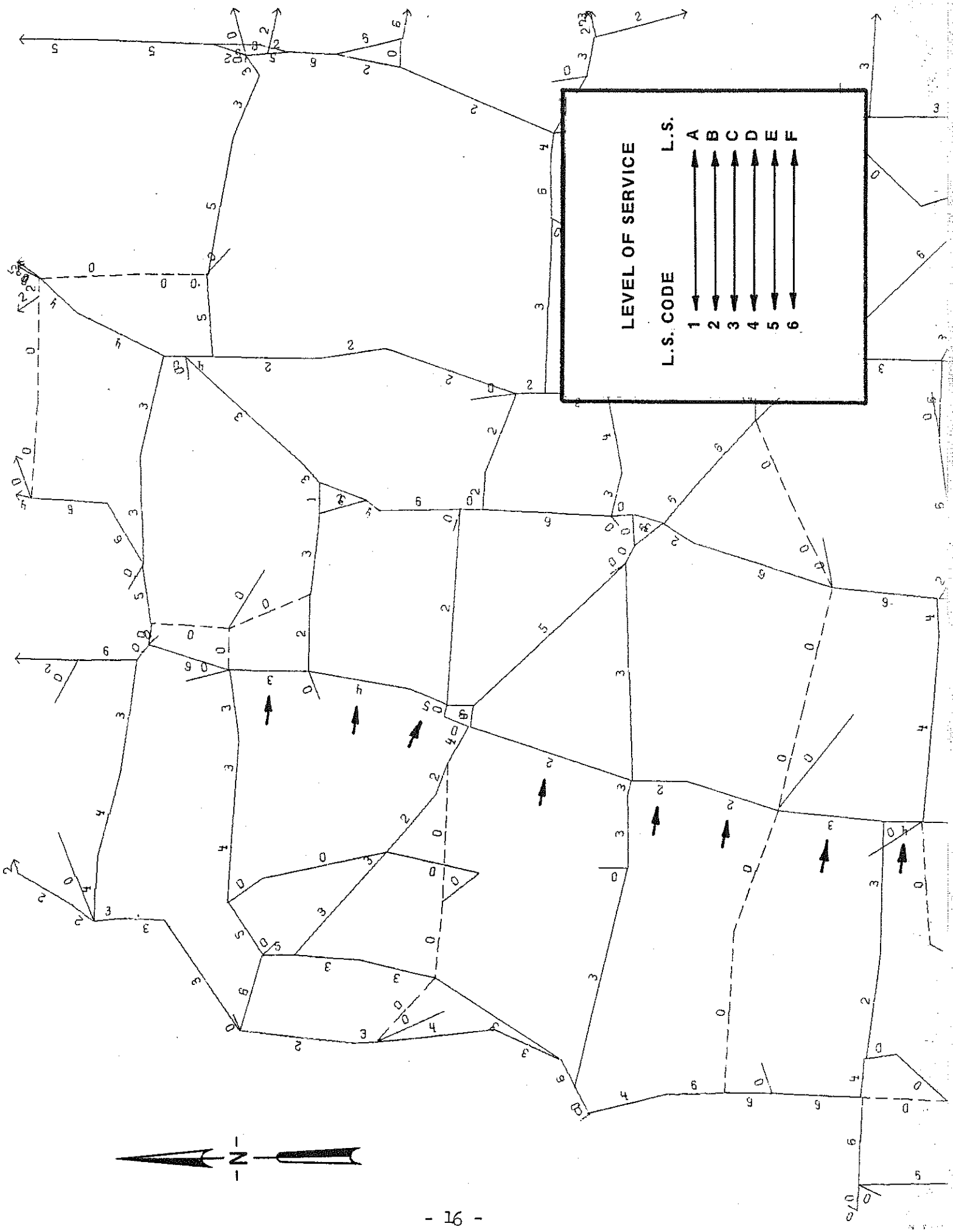
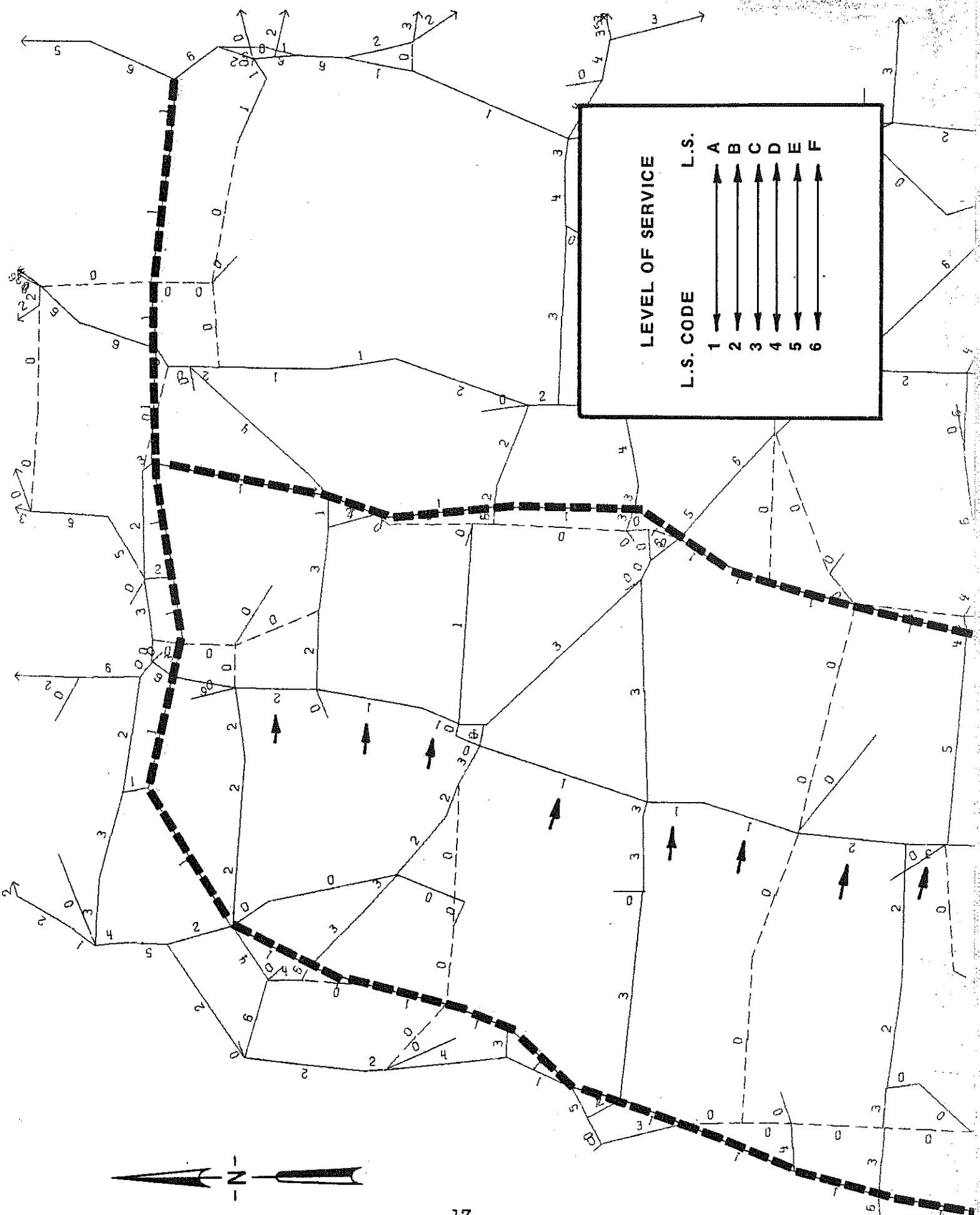


FIGURE 8



PROPOSED MODIFICATIONS

PROPOSED MODIFICATIONS

As was mentioned in the Introduction, the lack of data or the inadequate knowledge of the relative weights of available data has limited the input to the level of service program mainly to speed and travel time and V/C ratio. The Statewide Studies Unit has, since the time of the Highway Capacity Manual's publishing, researched and collected data which pertains to an updated version of the existing program. Among this data is driving comfort and convenience, operating costs and safety.

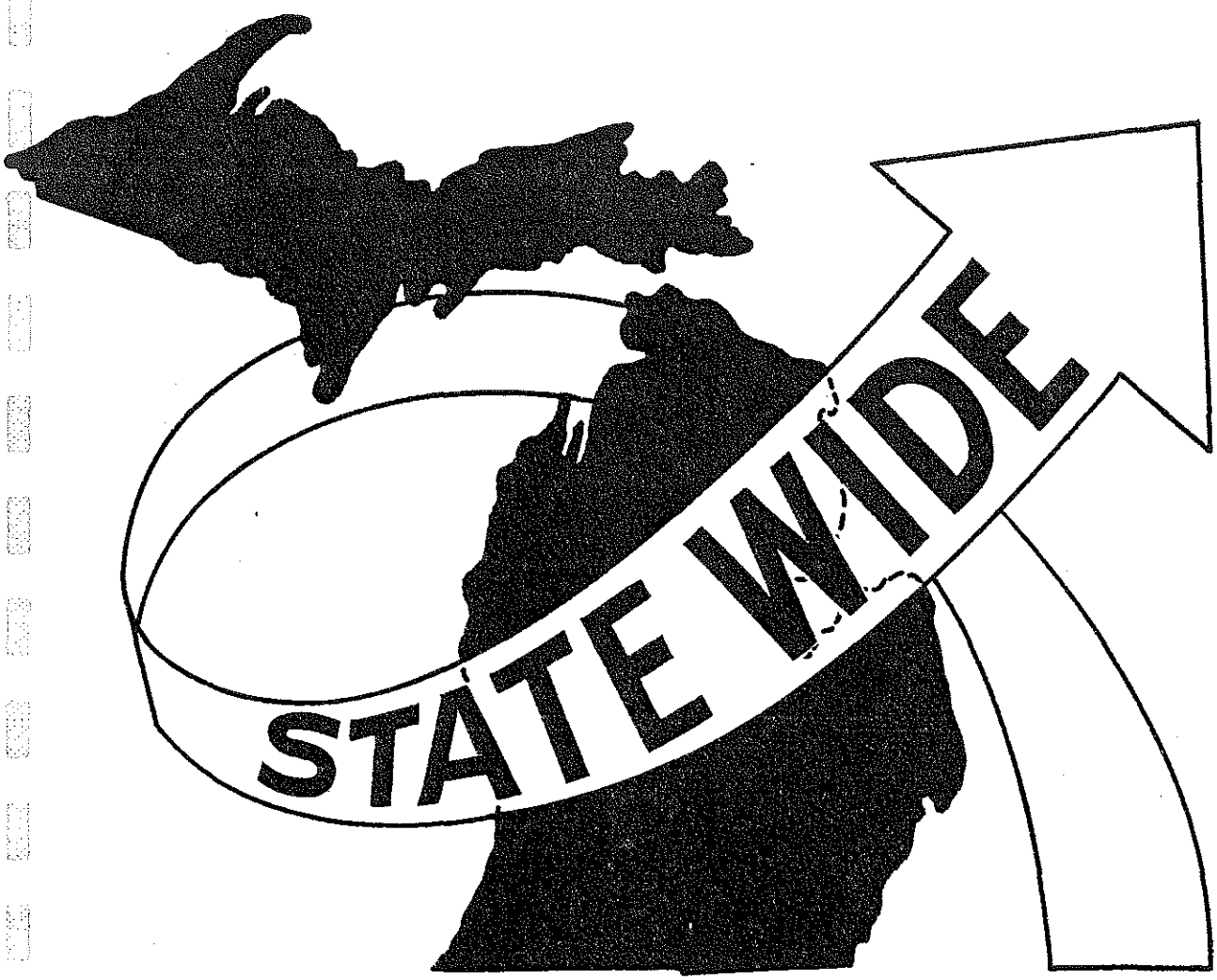
Driving comfort and convenience data was obtained in conjunction with the soon-to-be-published Statewide Traffic Forecasting Model Report I-G, entitled "Transportation Planning Analysis Psychological Impact Model". Briefly, the report explains the process by which relative values are assigned to each link with regards to factors that limit driving comfort and convenience.

Data on operating costs was acquired from two sources. The first source was the Highway Research Board's Report #111, "Running Costs of Motor Vehicles as Affected by Road Design and Traffic". The second source was a text by Robley Winfrey entitled "Economic Analysis for Highways". Both outline methods of obtaining overall vehicle operating costs based on formulas and breakdowns of running costs on individual items such as gasoline and oil consumption, tire wear, etc.

Data pertaining to safety is being collected with the help of the Accident Analysis Unit of the Traffic and Safety Division, Michigan Department of State Highways. Now, safety as a factor related to level of service is being based on accident rates throughout the state. A program written within the Statewide Studies Unit summarizes this data from the accident master tape according to control section and reformats it for use with the highway network link file. Another program, also written by Statewide personnel, enables a user to access information on the Michigan Highways Yearly Sufficiency Rating File. Included on this file is a safety rating.

In the near future, revisions of the level of service program will be written incorporating this additional data and a subsequent report will follow.

CONCLUSION



CONCLUSION

The object of this report has been to explain what Statewide Studies believes to be a beneficial factor in relating to the public what affects and impacts alternate highway routes have on society. Because of this objective, the details of the level of service program itself have many times been skimmed over to give the reader insight into the basic overall concept of community involvement using this approach. A revised edition of the current program, incorporating the additional factors mentioned in the previous section, will warrant another report dealing with the actual procedures used in measuring and weighing this additional information.

The key to good public relations does not of course stop with the level of service program. It is rather a beginning, or base, to which additions can be made to strengthen communications between the citizen and the Highway Department.