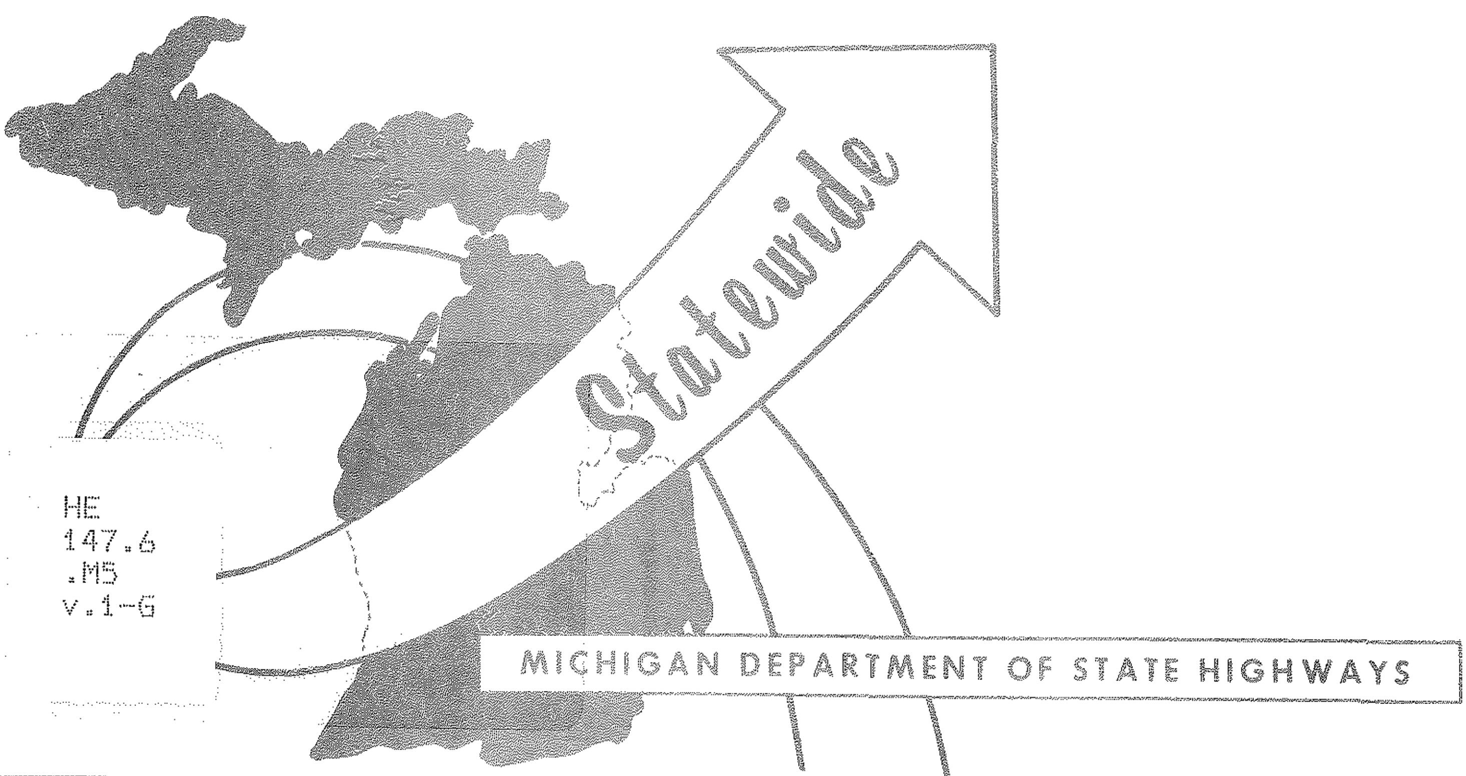
Statewide Transportation Analysis & Research

Michigan's
Statewide Traffic Forecasting
Model

Volume I-G
Transportation Planning
Psychological Impact Model

July 20, 1973



Michigan's Statewide Traffic Forecasting Model

Volume I-G
Transportation Planning Psychological Impact Model

July 20, 1973

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

TABLE OF CONTENTS

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

July 27, 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 very pleased to present Volume I-G in a series of reports dealing with "Michigan's Statewide Traffic Forecasting Model". Volume I-G documents the creation and application of the Statewide Studies Unit "Psychological Impact Model".

The Psychological Impact Model is an integrated series of computer programs which output an annoyance or "Hassle" factor (Highway Annoyance Scale of Selected Logical Elements) for each designated link within the Statewide Model Network.

This factor provides an indices of the effect of highway construction and improvement upon the psychological comfort of motorists traversing the routes prior to their actual modification. This can be accomplished for any design year.

The Psychological Impact Model may provide a partial answer to the improvement of communications between the public and highway officials concerning corridor location questions and general travel information.

The model systems work, HASSLE computer programs, and subsequent report were written and prepared by Mr. Lawrence J. Swick of the Statewide Studies Unit under the supervision of Mr. Richard E. Esch. Any comments you might have would be appreciated.

Respectfully Submitted,

Keith E. Bushnell

Keith E. Bushnell
Engineer of Transportation
Survey and Analysis Section

MICHIGAN THE GREAT LAKE STATE

PREFACE

PREFACE

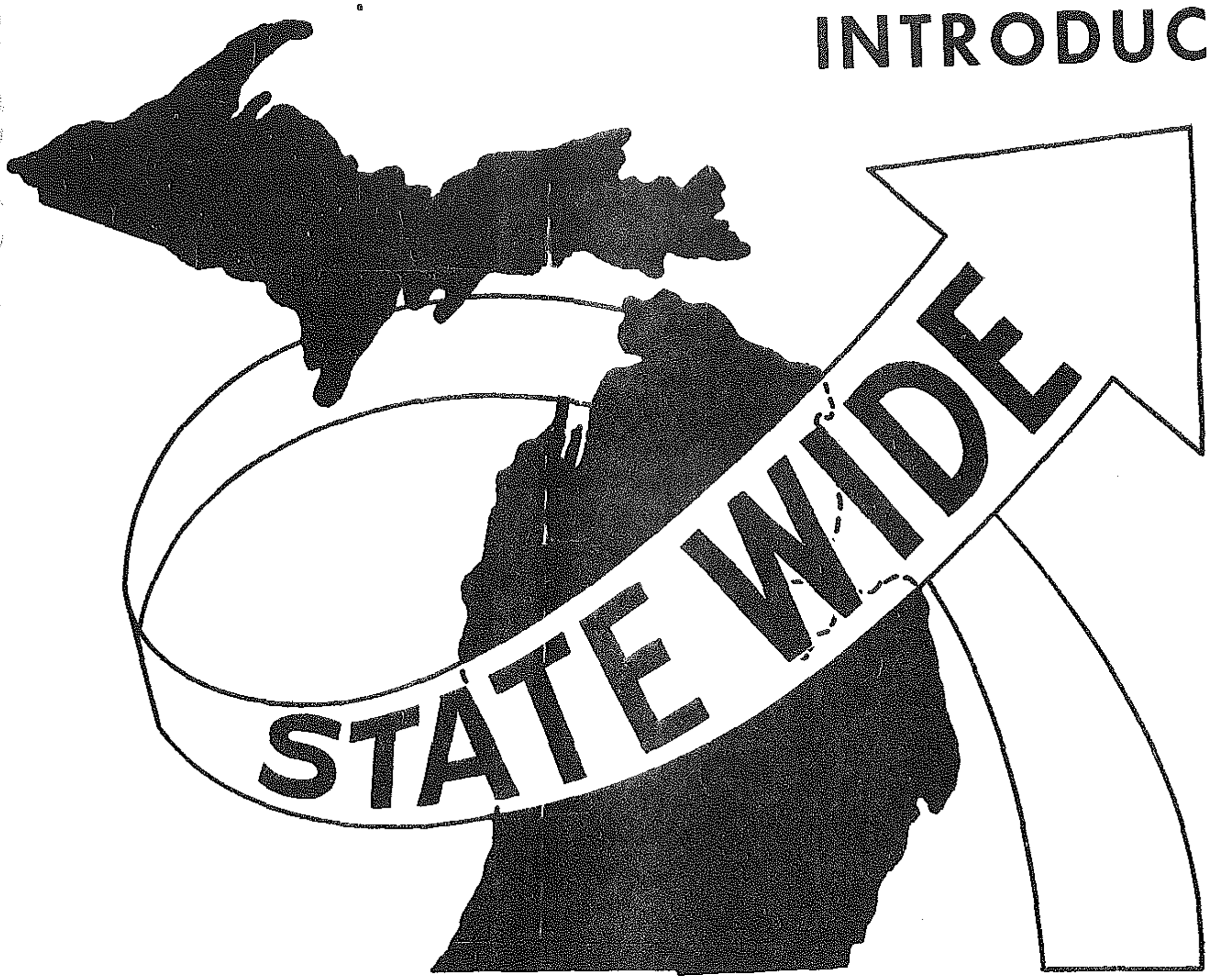
The Statewide Traffic Forecasting Model was designed to provide a means of measuring the impact of highway improvements and additions prior to their actual construction and inclusion within the trunkline system. Subsequent system refinements have added to the total applications of the model and expanded its impact on the planning process.

This report documents the creation of one of these refinements and its test application within the highway planning structure. The Michigan Department of State Highways hopes the presentation of this information can add to the understanding of this modeling improvement and possible application within other areas of concern.

Other reports in Michigan's series of Statewide Modeling appear on the following page.

I	Objectives and Work Program
I-A	Proceedings of the Statewide Traffic Forecasting Model Workshop
I-B	Traffic Forecasting Applications, Single and Multiple Corridor Travel
I-C	Trunkline Turnbacks Analysis
I-D	Proximity Analysis: Social Impacts of Alternate Highway Plans on Public Facilities
I-E	Cost-Benefit Analysis
I-G	Transportation Analysis Psychological Impact Model
II	Development of Network Models
III	Multi-level Highway Network Generator Segmental Model
III-A	Semi-Automatic Network Generator Using a "Digitizer"
IV	Total Model Calibration - 547 Zone Process
V-A	Travel Model Development Reformation -- Trip Data Bank Preparation
V-B	Development of the Statewide Socio-Economic Data Bank for Trip Generation-Distribution
VI	Corridor Location Dynamics
VII	Design Hour Volume Model Development
VIII	Statewide Public & Private Facility File
IX	Statewide Socio-Economic Data File

INTRODUCTION



INTRODUCTION

Many research efforts and much attention have been directed to the effects of new highways and improvements on the environment. Little concern, however, has been directed to the impact of new highways or improvements on one of the most important elements within the highway-ecological system . . . man.

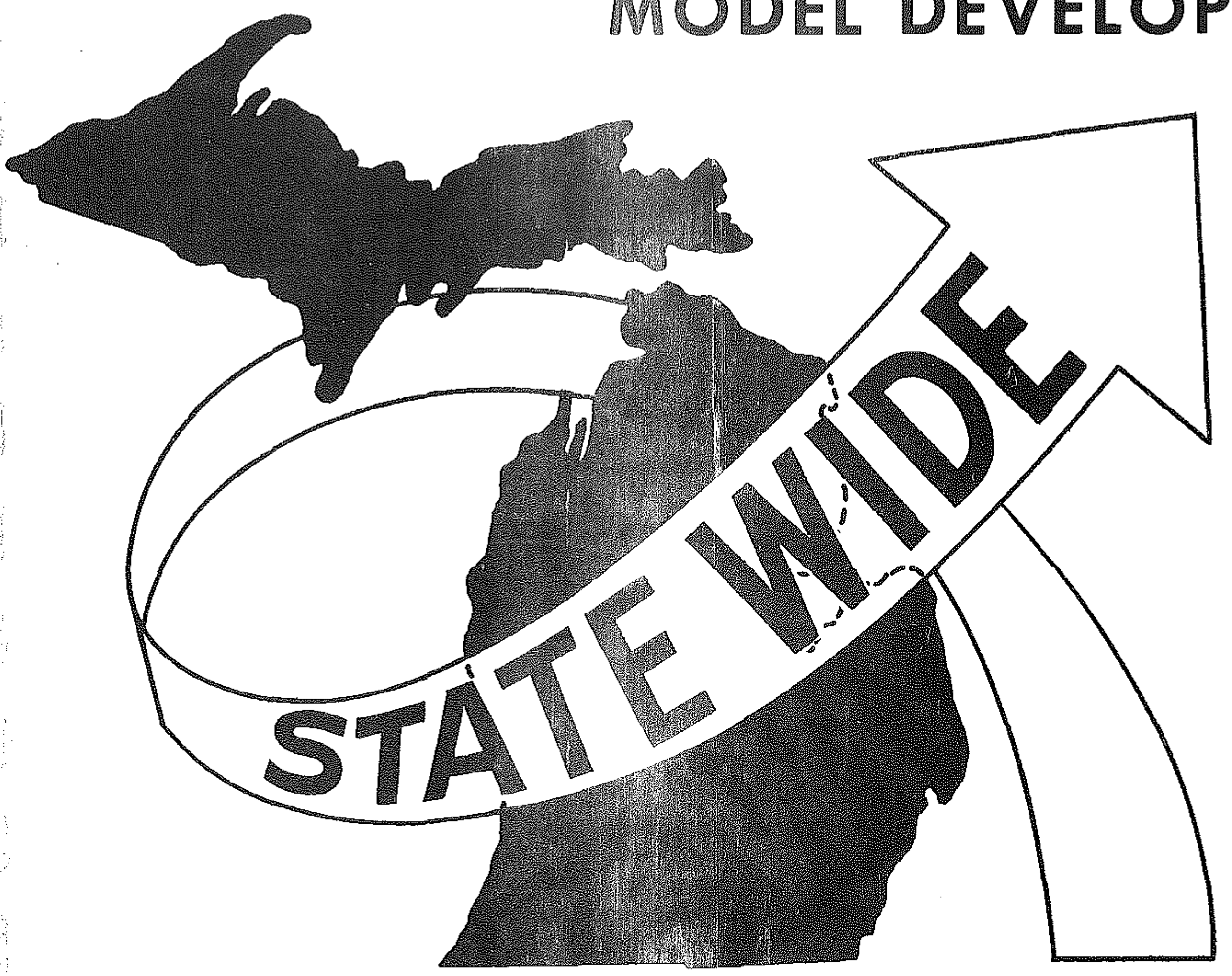
Not only does the mind of man influence highways but highways also influence the mind of man - or more specifically the relative driving comfort or condition of highways affect the psychological comfort of man. Highways with wide lanes, minor traffic congestion, and smooth surfaces provide means of motoring that are a comfort to us all. Highways with narrow lanes, major congestion, and a rough ride in turn provide the public with a considerable degree of discomfort and anxiety. How then do we best improve our highway network to provide more ease of travel to more motorists and yet remain within the financial means available?

This brings us to the context of this report. The Statewide Studies Unit has developed a means of measuring the relative "driving comfort" of its trunkline system or any route or combinations of routes therein. The Department can also measure the psychological impact of these improvements or new highways prior to their inclusion within the trunkline system. This gives the Department another valuable point of reference when considering the best possible combinations of trunkline improvements or additions to be considered.

Michigan's index system for measuring the psychological impact of highway improvements has been labeled the HASSLE factor. (HIGHWAY ANNOYANCE SCALE OF SELECTED LOGICAL ELEMENTS.) The HASSLE factor, as it is called throughout the report, was derived from original efforts in this field by the Stanford Research Institute (SRI). SRI developed a scale that measured the relative congestion of a route by dividing the capacity of a route by its actual or anticipated traffic volume (V/C ratio). Michigan's effort goes several steps further and began with a survey of driver annoyance factors and their weighted use within a driver comfort formula.

The HASSLE factor rating system is quite simple and easily adaptable to other statewide monitoring systems. The weighted factors and the scaling levels used were not designed to be absolutes for any study agency. These items can be easily rearranged within the computer program which measures the HASSLE factor to accommodate modified study results or purposes. The basic idea was to develop a computer program which, when fed available or projected highway data, could respond with a logical and sound comfort rating for each link within the total network system. By varying the input according to projected figures, future comfort indices could also be studied for scheduled improvements or test corridors of new freeways. This is explained in the following section.

MODEL DEVELOPMENT



MODEL DEVELOPMENT

The first step in developing the Hassle Index began with the selection of highway variables which:

(1) Annoyed people or interfered with their driving comfort.

(2) Could be readily obtained from network data files.

(3) Could be reasonable measured on a sliding scale.

Five items were chosen which matched these conditions. (Any individual user can modify this list as circumstances demand.)

(1) Traffic volume to capacity ratio (V/C ratio)

(2) Lane width

(3) Percent of commercial traffic (trucks)

(4) Sight Distance (Percent Restriction)

(5) Surface condition of highway (General quality of ride)

Each item was then rated subjectively from one to five with a one rating signifying very comfortable to a five rating meaning very uncomfortable. The range or parameters of each item were arranged as follows. (Note the weighting factor to the right of the Hassle items).

PERCENT COMMERCIAL:

(% of Trucks Within Total)	SCALE	WEIGHTING FACTOR
1 - 5%	1	10
6 - 10%	2	
11 - 15%	3	
16 - 20%	4	
Over 20%	5	

LANE WIDTH:	SCALE	WEIGHTING FACTOR
Over 12 Ft	1	15
11 Ft	2	
10 Ft	3	
9 Ft	4	
8 Ft	5	

SURFACE CONDITION RATING	SCALE	WEIGHTING FACTOR
1	1	20
2	2	
3	3	
4	4	
5	5	

SIGHT DISTANCE % RESTRICTION	SCALE	WEIGHTING FACTOR
1 - 20%	1	17
21 - 40%	2	
41 - 60%	3	
61 - 80%	4	
Over 80%	5	

VOLUME - CAPACITY RATIO % OF CAPACITY	SCALE	WEIGHTING FACTOR
1 - 49%	1	38
50% - 79%	2	
80% - 109%	3	
110% - 139%	4	
Over 140%	5	

The highway characteristic weighting factors shown in the previous examples were derived from results of a sample survey of 100 highway employees. The sample was of a stratified nature and contained 75 men and 25 women (the same ratio of drivers on the road as evidenced by field studies) . . . This was a small sample and can be modified to accommodate larger study results.

Each person interviewed was simply asked to identify the highway or traffic characteristic which annoyed him or her the most while driving.

The five factors and results are listed as follows:

			No. of Choices
F_1	(1)	High Volume of Truck Traffic	10
F_2	(2)	Inability to see Ahead (Hills and Curves)	17
F_3	(3)	Narrow Lanes	15
F_4	(4)	High Traffic Congestion on Route	38
F_5	(5)	Poor Surface Conditions of Highway	20
			100

The Hassle index formula was then constructed to weight the scale level of each indicator as follows.

F = Scale of Annoyance for Factor (1-5)

$$10(F_1) + 17\ (F_2) + 15\ (F_3) + 38\ (F_4) + 20\ (F_5)$$

= Hassle Factor Per Link

OR: if the five characteristics of a sample highway were rated as follows, the hassle index would be completed as shown.

Scale Rating 1 thru 5

1 = Good → 5 = Poor

Truck Traffic- - - - - - - - - 2

Inability to See Ahead- - - 3

Narrow Lanes - - - - - - - - - 5

Traffic Congestion on- - - - 2
Route

Surface Condition- - - - - - 1

H.I. = 10(2) + 17(3) + 15(5) + 38(2) + 20(1) =

H.I. = 20 + 15 + 75 + 76 + 20 =

Hassle Index=242

The Hassle index can range from an excellent rating of 100 to a poor rating of 500. These indexes may be associated directly with pictorial examples of existing situations for each index. A Cal-Comp plot of Hassle indexes for a sample region of highways can be seen in Figure 1. The five factors listed were ascribed to each link of the highway network through computer programs which took the needed information from the following sources.

Lane Width - Highway Sufficiency Record Tapes

Surface Condition - Highway Sufficiency Record Tapes

% Commercial - Traffic Vehicle Miles Record Tapes

Sight Distance - Highway Sufficiency File Tapes

V/C Ratio - Highway Sufficiency Record and Statewide Model Assignments.

This information was then stored behind each link record on a network tape in specific volume fields. The network tape was reformated and then fed into the Hassle program. The program computed the factors for each characteristic and ran them through the annoyance formula. The output tape contained the A node and B node of each link plus the Hassle factors.

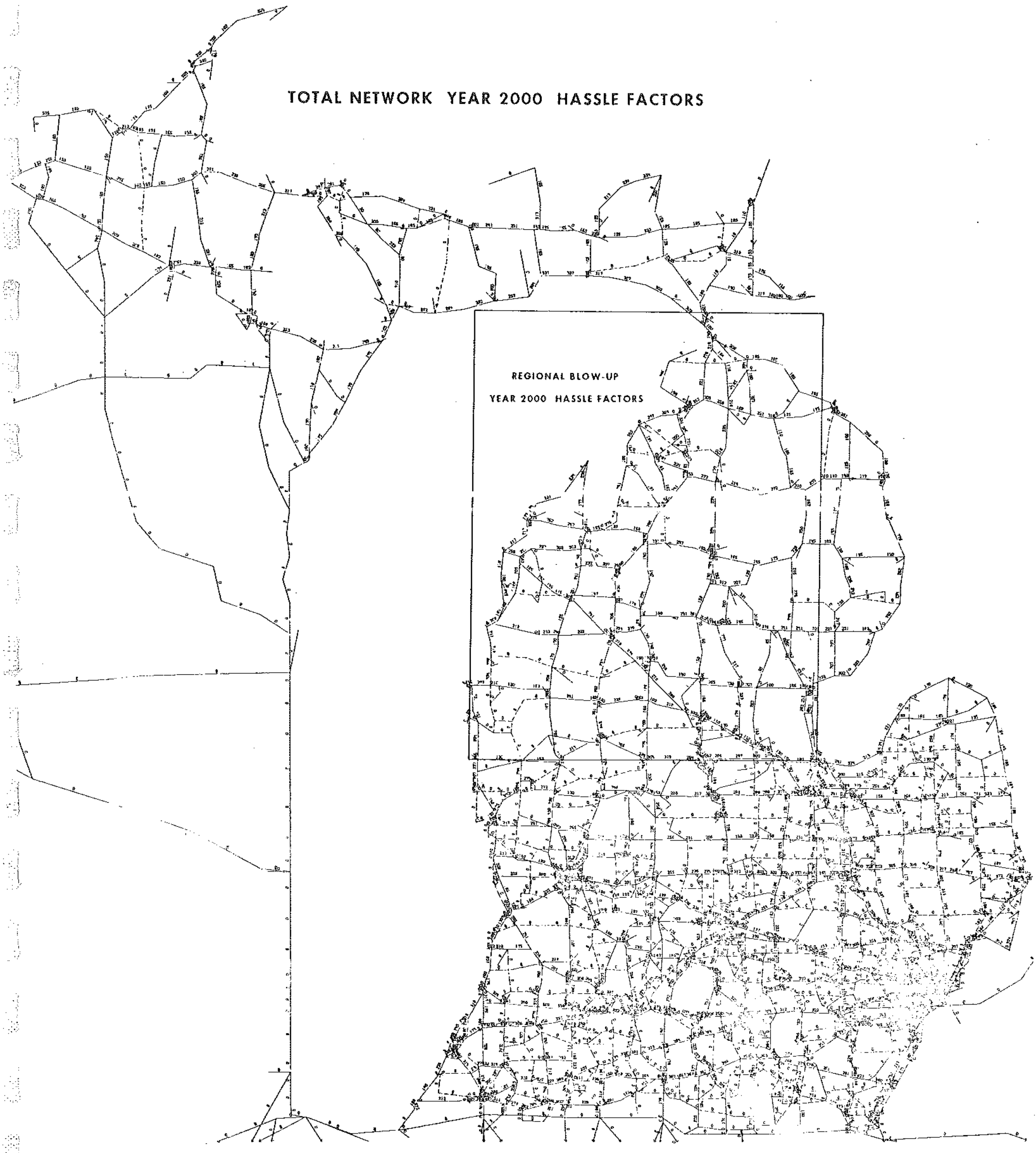

TOTAL NETWORK YEAR 2000 HASSLE FACTORS
REGIONAL BLOW-UP
YEAR 2000 HASSLE FACTORS

FIGURE 1

COMPUTED HASSLE FACTORS

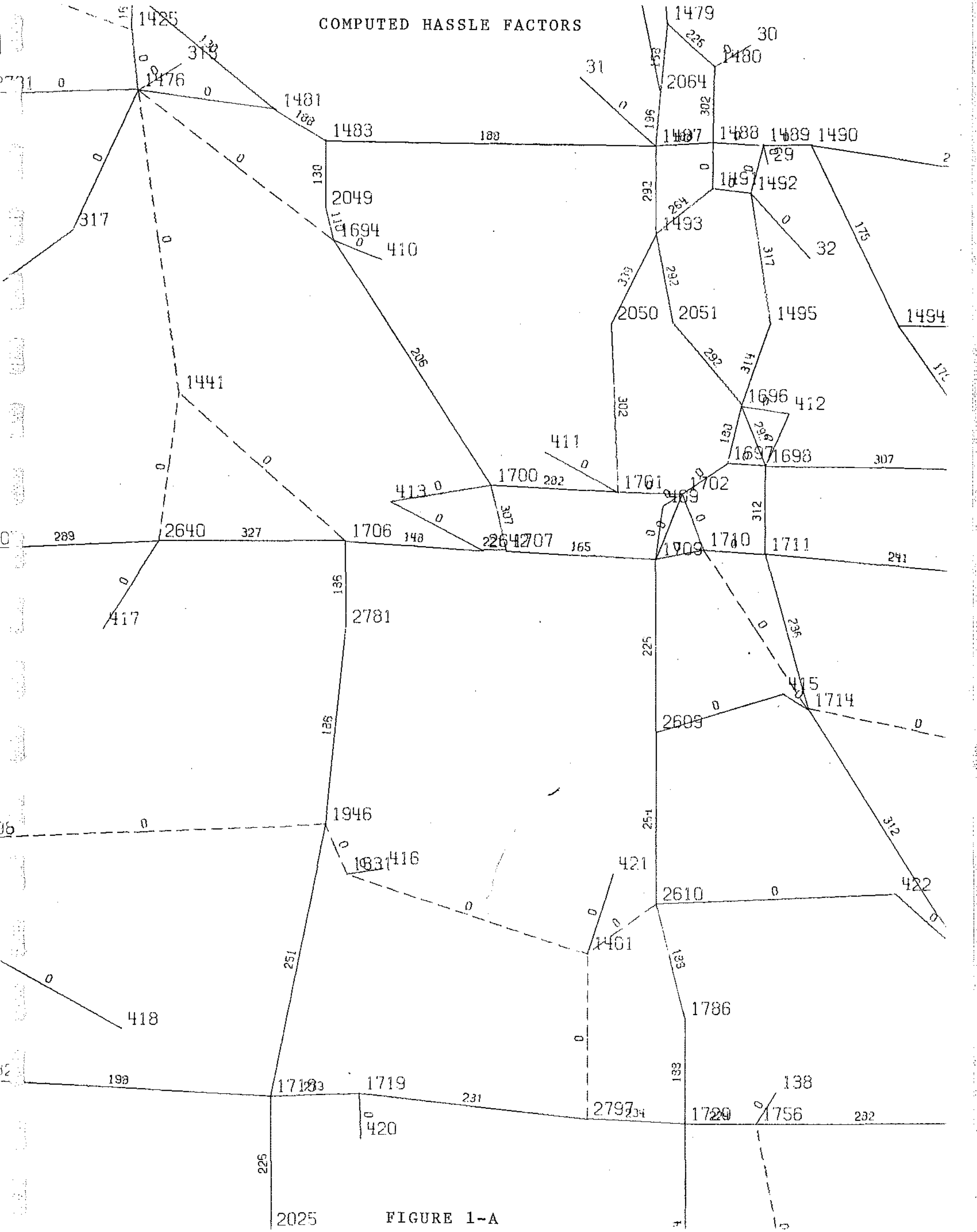


FIGURE 1-A

This tape was then run through a VOLA Q01433 which placed the Hassle factors back in a data field of the original net tape. The factors within the net were then plotted as shown in the previous illustration. See Figure 2 for schematic of Psychological Impact Model.

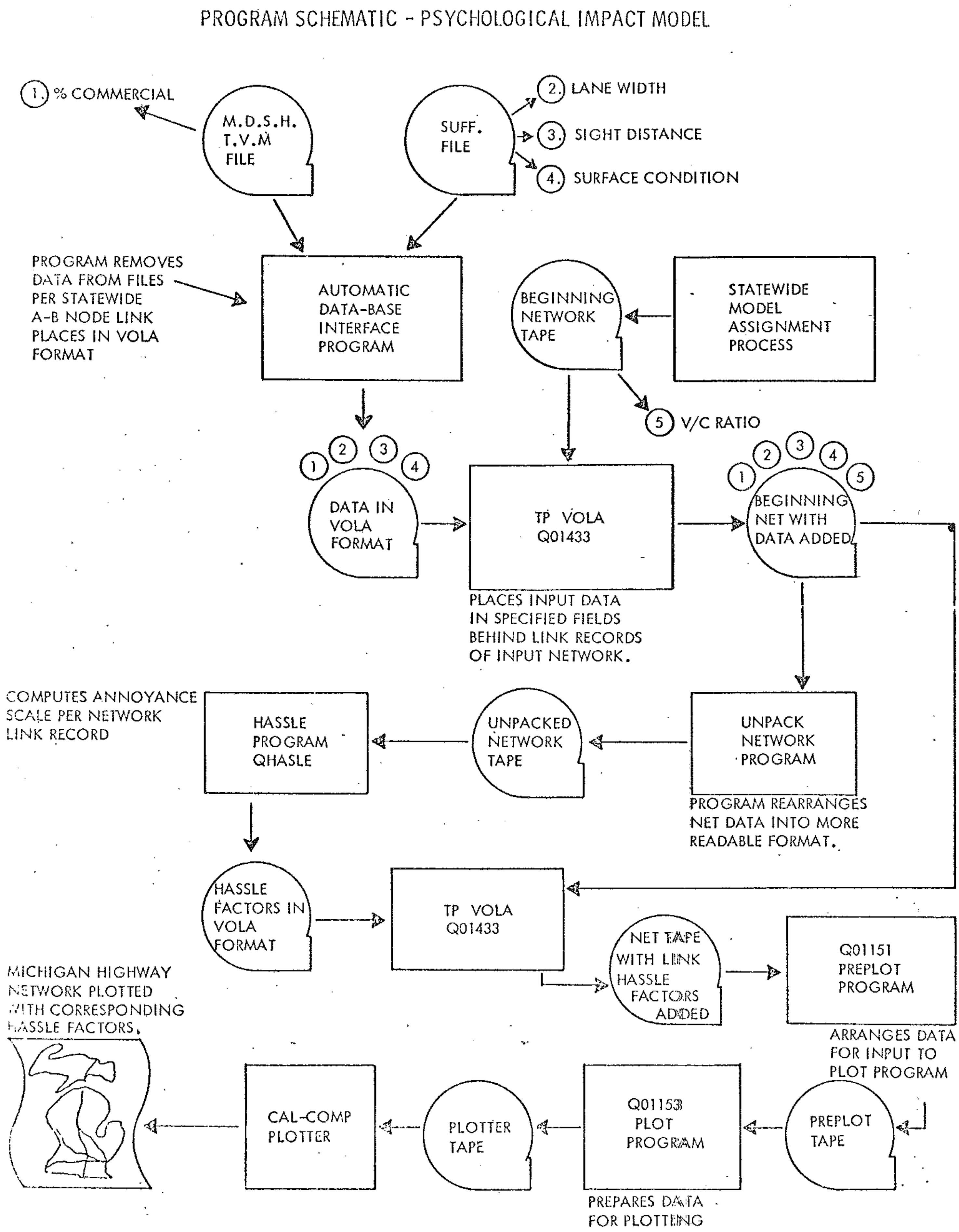

PROGRAM SCHEMATIC - PSYCHOLOGICAL IMPACT MODEL
1. % COMMERCIAL
M.D.S.H. T.V.M FILE
SUFF. FILE
2. LANE WIDTH
3. SIGHT DISTANCE
4. SURFACE CONDITION
PROGRAM REMOVES DATA FROM FILES PER STATEWIDE A-B NODE LINK PLACES IN VOLA FORMAT
AUTOMATIC DATA-BASE INTERFACE PROGRAM
BEGINNING NETWORK TAPE
STATEWIDE MODEL ASSIGNMENT PROCESS
5 V/C RATIO
1 2 3 4
DATA IN VOLA FORMAT
TP VOLA Q01433
PLACES INPUT DATA IN SPECIFIED FIELDS BEHIND LINK RECORDS OF INPUT NETWORK.
1 2 3 4 5
BEGINNING NET WITH DATA ADDED
COMPUTES ANNOYANCE SCALE PER NETWORK LINK RECORD
HASSLE PROGRAM QHASLE
UNPACKED NETWORK TAPE
UNPACK NETWORK PROGRAM
PROGRAM REARRANGES NET DATA INTO MORE READABLE FORMAT.
HASSLE FACTORS IN VOLA FORMAT
TP VOLA Q01433
NET TAPE WITH LINK HASSLE FACTORS ADDED
Q01151 PREPLOT PROGRAM
ARRANGES DATA FOR INPUT TO PLOT PROGRAM
MICHIGAN HIGHWAY NETWORK PLOTTED WITH CORRESPONDING HASSLE FACTORS.
CAL-COMP PLOTTER
PLOTTER TAPE
Q01153 PLOT PROGRAM
PREPARES DATA FOR PLOTTING
PREPLOT TAPE

FIGURE 2

MODEL APPLICATIONS

STATE WIDE

MODEL APPLICATIONS

The psychological impact model is not a comprehensive solution to highway planning problems, but it could be an effective tool in the often grueling highway decision-making process. The Hassle index is merely one more point of reference to be considered by highway analysts in their attempt to provide safe and efficient highways with the least amount of expenditure.

The Federal Highway Administration could use the concept of the Psychological Impact Model (or something similar to it) to appraise the effectiveness of highway networks for various states or Interstate systems which incorporate the use of a Statewide Model.

Individual analyses of specific types of highways within a total network can also be evaluated through the use of an auxiliary program called GPSP (General Purpose Summary Program). GPSP summarizes input link data by specified jurisdiction or type. For example GPSP could summarize the total Hassle factors for all selected federal-aid secondary routes within Michigan. In addition, the effects of new freeways or improvements on the total system could be measured prior to their actual construction. The Hassle index could be plotted on the neutral network and compared to a revised network which included proposed new additions or improvements and the subsequent traffic variations. This, as implied by the name of the model, would provide indices of the psychological impact of a highway network modification.

It is generally known that the construction of a new freeway normally adds to the total effectiveness and comfort of the total highway system, but the critical question is "How much?" By providing a means of measuring "how much" (Hassle Index), the question of "which corridor should be built?" may also be answered. In other words, by providing a means of measuring the psychological impact of a new freeway prior to its construction, the process of the selection of the most effective corridor is augmented by the analysis of relative Hassle indices.

See Figures 3 and 4 for a band width plot of Hassle factors. A narrow band indicates a low or acceptable Hassle index and a wide band indicates a high or unacceptable Hassle level. Note that these band width plots show projected year 2000 traffic assigned to a 1970 network - an abundance of wide band widths, therefore, would not appear unusual.

Figures 5, 6 and 7 show selected traffic and highway conditions and their corresponding simulated Hassle factor. Through the use of these photos, it was hoped that the range of Hassle indices could more readily be identified and associated with common driving situations. We feel the Hassle Index can provide highway officials and the public with a more meaningful description of highway situations as compared to more technical presentations such as DHV volume and peak movement analysis.

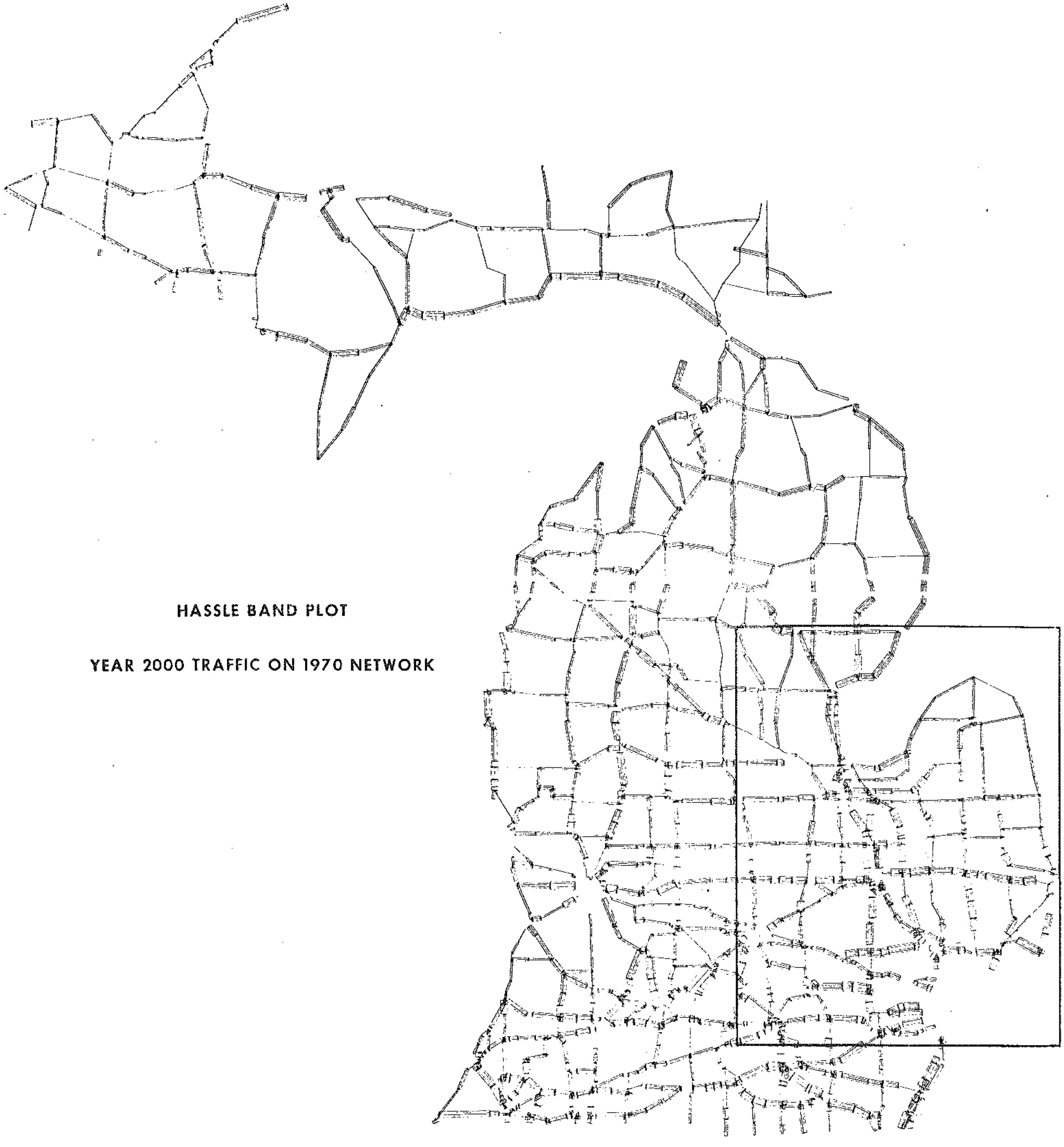


FIGURE 3

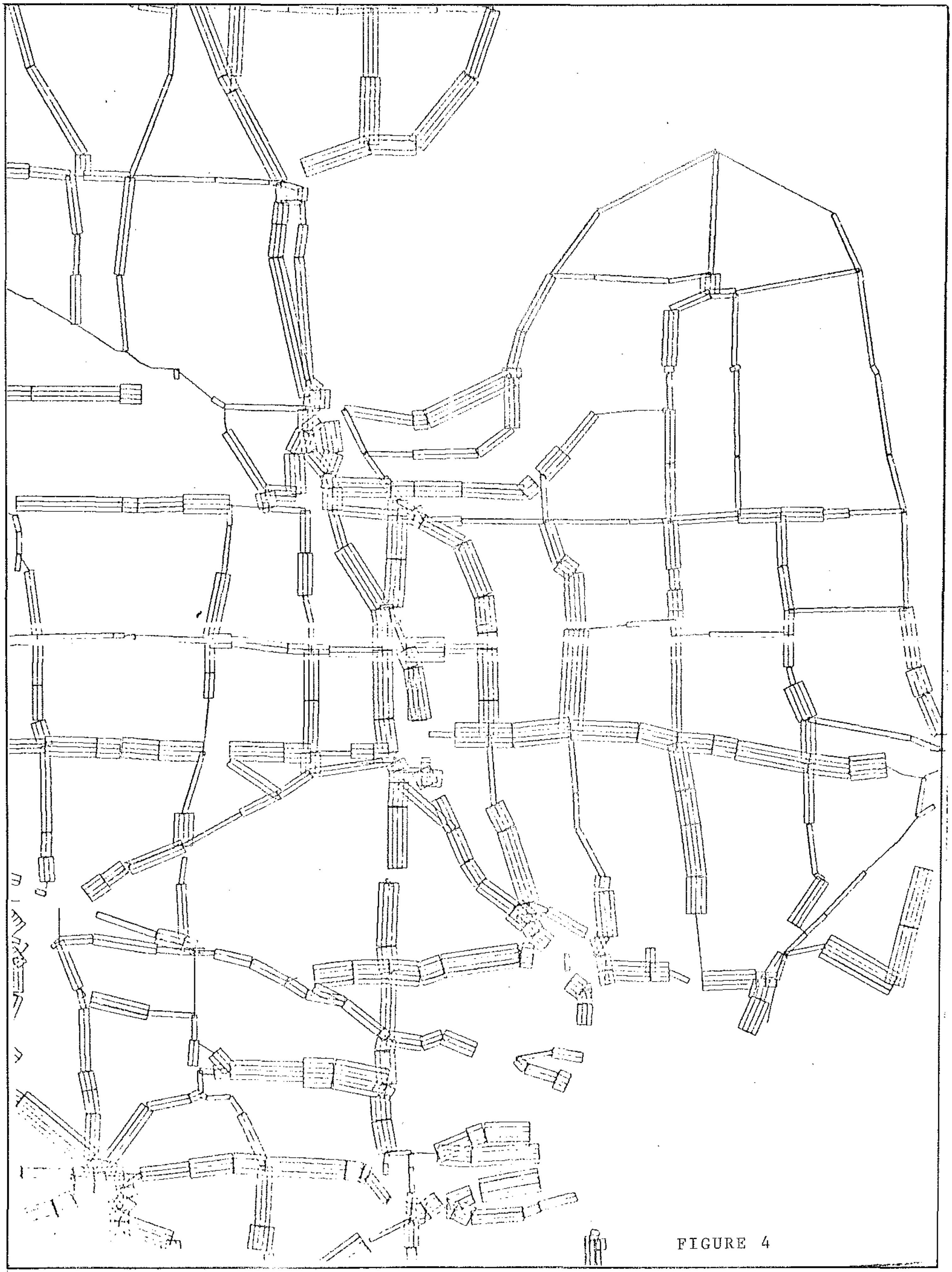
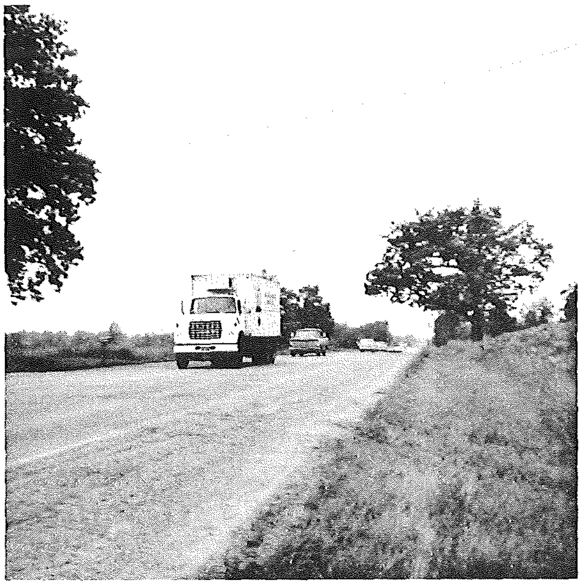
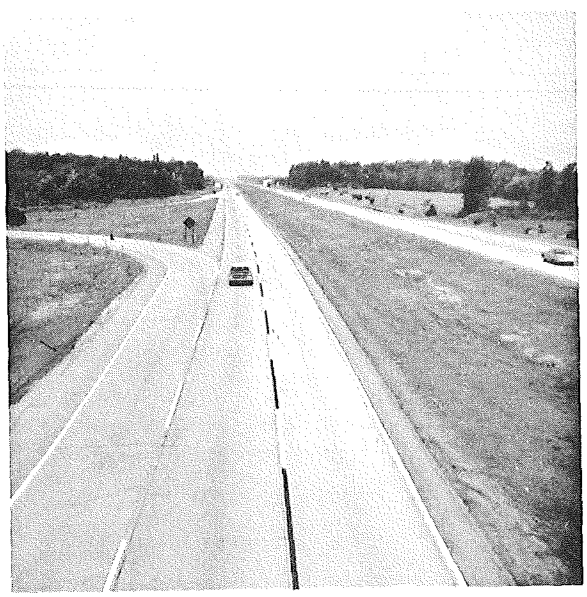


FIGURE 4

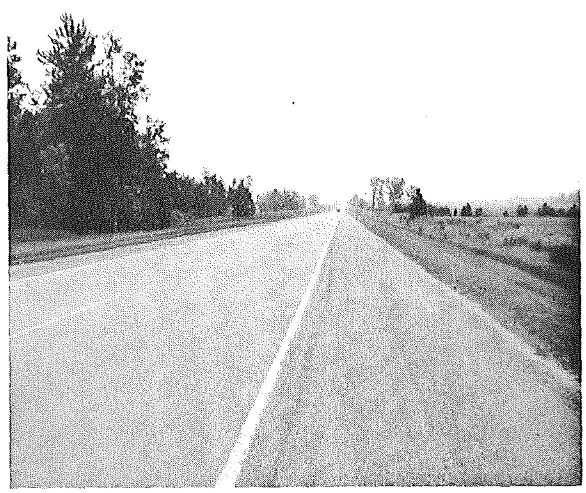


HASSLE FACTOR = 316

HASSLE FACTOR = 359



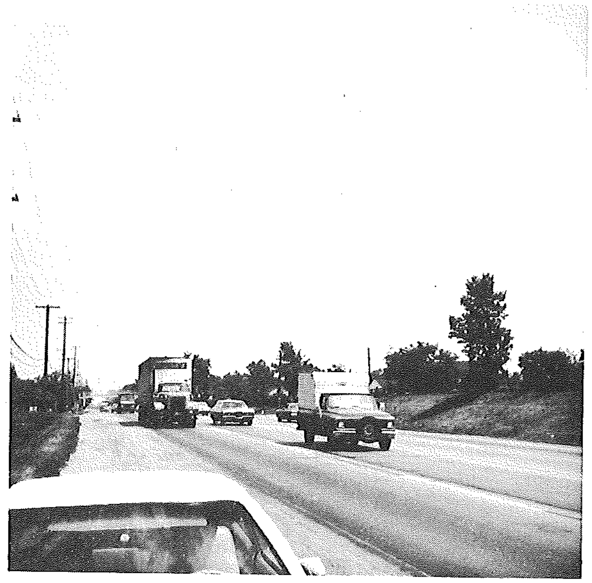
HASSLE FACTOR = 124



HASSLE FACTOR - 104

Figure 5

HASSLE FACTOR - 271



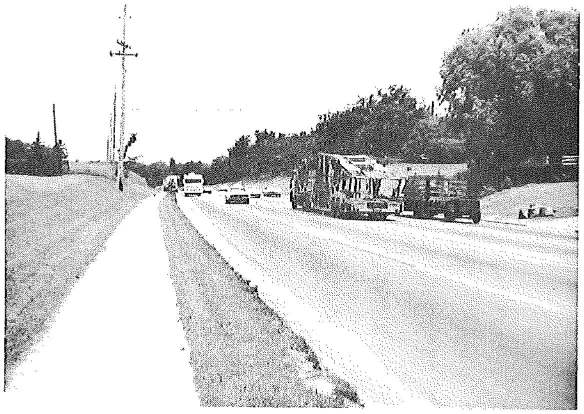
HASSLE FACTOR = 341

HASSLE FACTOR = 137

HASSLE FACTOR = 154

Figure 6

HASSLE FACTOR = 245



HASSLE FACTOR = 311

HASSLE FACTOR = 372

HASSLE FACTOR = 352

Figure 7

CONCLUSION

CONCLUSION

The Psychological Impact Model and resulting Hassle Index is a relatively simple but useful highway improvement impact indicator. This tool places its importance on the effects of highways upon man and can be used to supplement the "total picture" of highway-ecological studies.

The concept and programming of the model lend themselves to modification and diverse application within any statewide planning situation.

If a set of weighting factors and item ranges were decided upon, the statewide average Hassle index could be used to measure the relative efficiency of highway networks for different states who apply total system planning techniques.

This is only speculation and the true value of the techniques should be decided from the viewpoint of individual users. We hope this report aids in that effort.