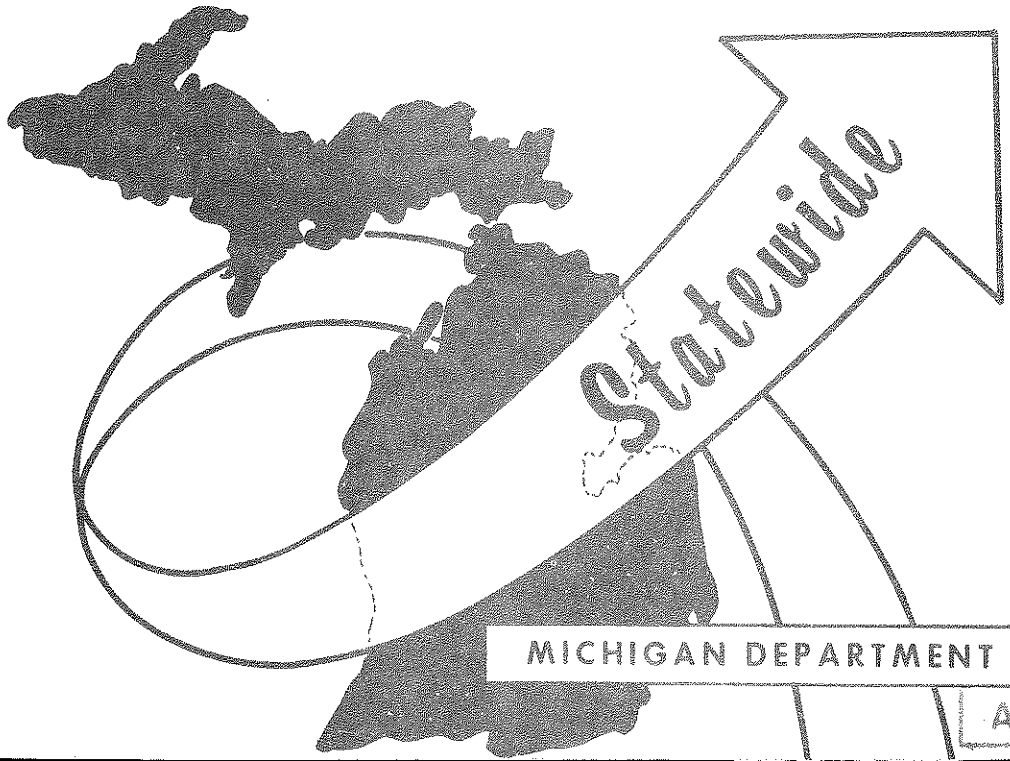
Statewide Transportation Analysis & Research

MICHIGAN'S STATEWIDE
TRANSPORTATION MODELING
SYSTEM
VOL. I-L

**SYSTEM IMPACT ANALYSIS
GRAPHIC DISPLAY**

STATEWIDE STUDIES

MAY 1974



MICHIGAN DEPARTMENT OF STATE HIGHWAYS
AND TRANSPORTATION

MICHIGAN DEPARTMENT

OF

STATE HIGHWAYS AND TRANSPORTATION

BUREAU OF TRANSPORTATION PLANNING

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SYSTEM IMPACT ANALYSIS
GRAPHIC DISPLAY

STATEWIDE STUDIES

MAY 1974

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, GOVERNOR

DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION

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

JOHN P. WOODFORD, DIRECTOR

May 21, 1974

Mr. Sam F. Cryderman, Deputy Director
Bureau of Transportation Planning
Department of State Highways and Transportation
State Highways Building
Post Office Drawer K
Lansing, Michigan 48904

Dear Mr. Cryderman:

The Highway Planning Division is pleased to present Volume I-L in the Statewide Transportation Modeling System series. It documents the graphic display of system impact analysis which was developed for use in the Northwest Region US-31 and 131 study and will be available for future planning and analysis studies.

The process described condenses the extensive impact analysis output for a given alternate into a concise summary of selected impacts. These summaries are further condensed to produce graphic comparisons of a particular impact for any or all of the alternates. The information may be viewed at statewide, regional, and county (within the region) levels for several types of highways.

This report was prepared by Mr. Lawrence G. Scott of the Statewide Interagency Procedures Research and Development Section, under the supervision of Mr. Richard E. Esch.

Sincerely,

R. J. Lilly

R. J. Lilly, Administrator
Highway Planning Division

SYSTEM IMPACT ANALYSIS GRAPHIC DISPLAY

By

Lawrence G. Scott

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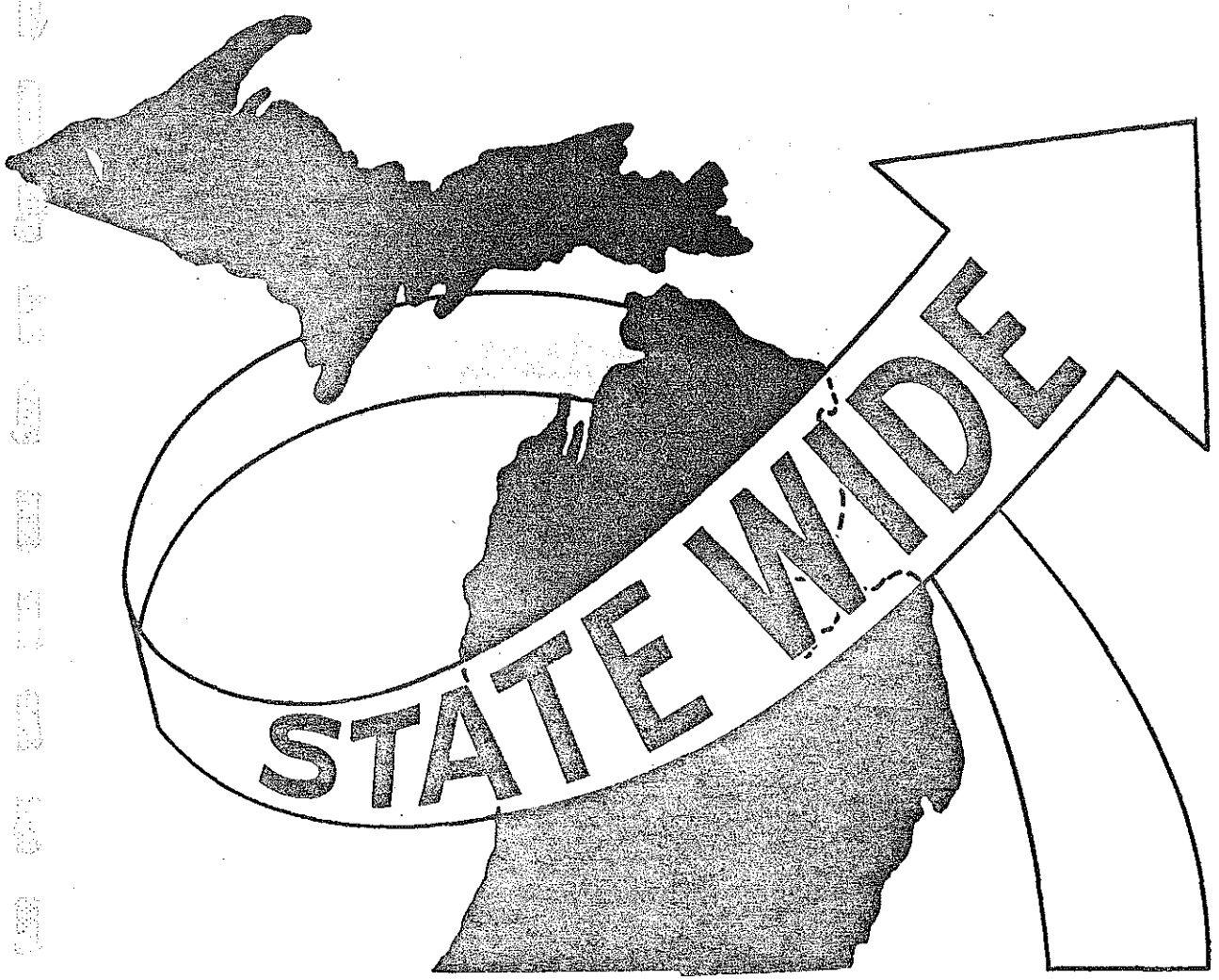

PREFACE

An integral part of any computer modeling system is the component which transforms data from magnetic bits on a computer tape into readable, printed matter. Only in the latter form is information useable for management analysis and public viewing. This component in the Statewide Transportation Modeling System is the graphics display battery, of which the tool described herein is a part.

This report, which documents the development of graphic display of system level impact analysis, is Volume I-L in the Statewide series of publications. Previous reports in the series are:

Volume I -- Objectives and Work Program
Volume I-A -- Region 4 Workshop Topic Summaries
Volume I-B -- Single and Multiple Corridor Analysis
Volume I-C -- Model Applications: Turnbacks
Volume I-D -- Proximity Analysis: Social Impacts of Alternate Highway Plans on Public Facilities
Volume I-E -- Model Applications: Cost-Benefit Analysis
Volume I-F -- Air and Noise Pollution System Analysis Model
Volume I-G -- Transportation Planning Psychological Impact Model
Volume I-H -- Level of Service Systems Analysis Model: A Public Interaction Application
Volume I-J -- Service-Area Model
Volume I-K -- Effective Speed Model; A Public Interaction Tool
Volume II -- Development of Network Models
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Volume VIII -- Statewide Public and Private Facility File
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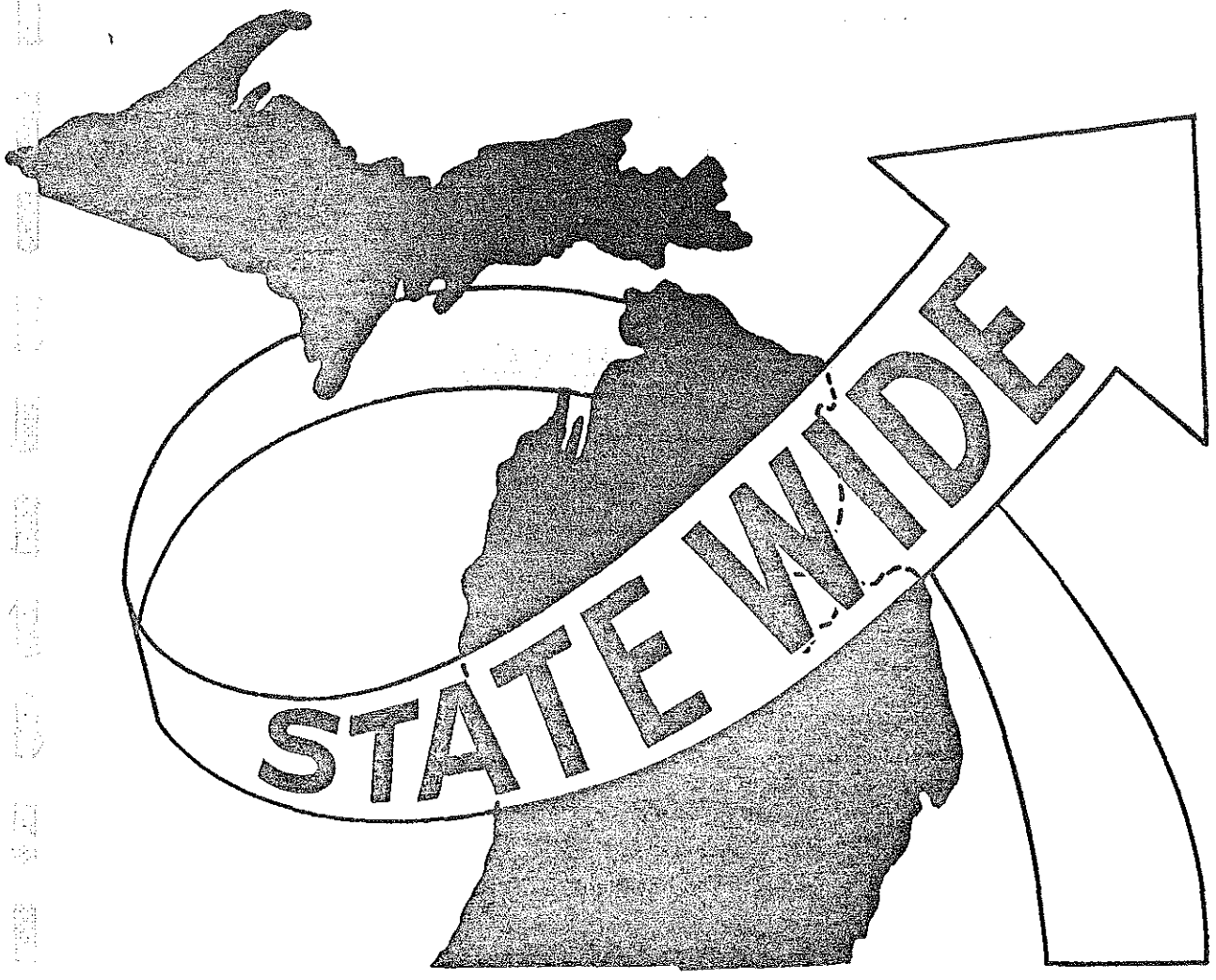
Volume X-A -- Statewide Travel Impact Analysis Procedures
Volume X-B -- Statewide Social Impact Analysis Procedures
Volume X-C -- Statewide Economic Impact Analysis Procedures
Volume XI -- Computer Run Times - An Aid in Selecting Statewide Travel Model System Size

INTRODUCTION



INTRODUCTION

One function of a Statewide Transportation Modeling System is the evaluation of the impacts of alternate highway systems in the following areas:

(1) travel

(2) social

(3) economic

The result of the impact analysis process is a computerized highway network file which contains impact analysis information on a link by link basis for each alternate. With more than 3,500 links in a network, (see Figure 1) this scale is obviously too detailed to permit the meaningful regional or statewide alternate systems comparison currently required by federal legislation.

This report documents the steps to obtain graphic comparisons of system impact analysis. Included are an annotated flow chart and examples of system level summary tables and graphic comparisons.

MICHIGAN STATEWIDE 1970 NETWORK

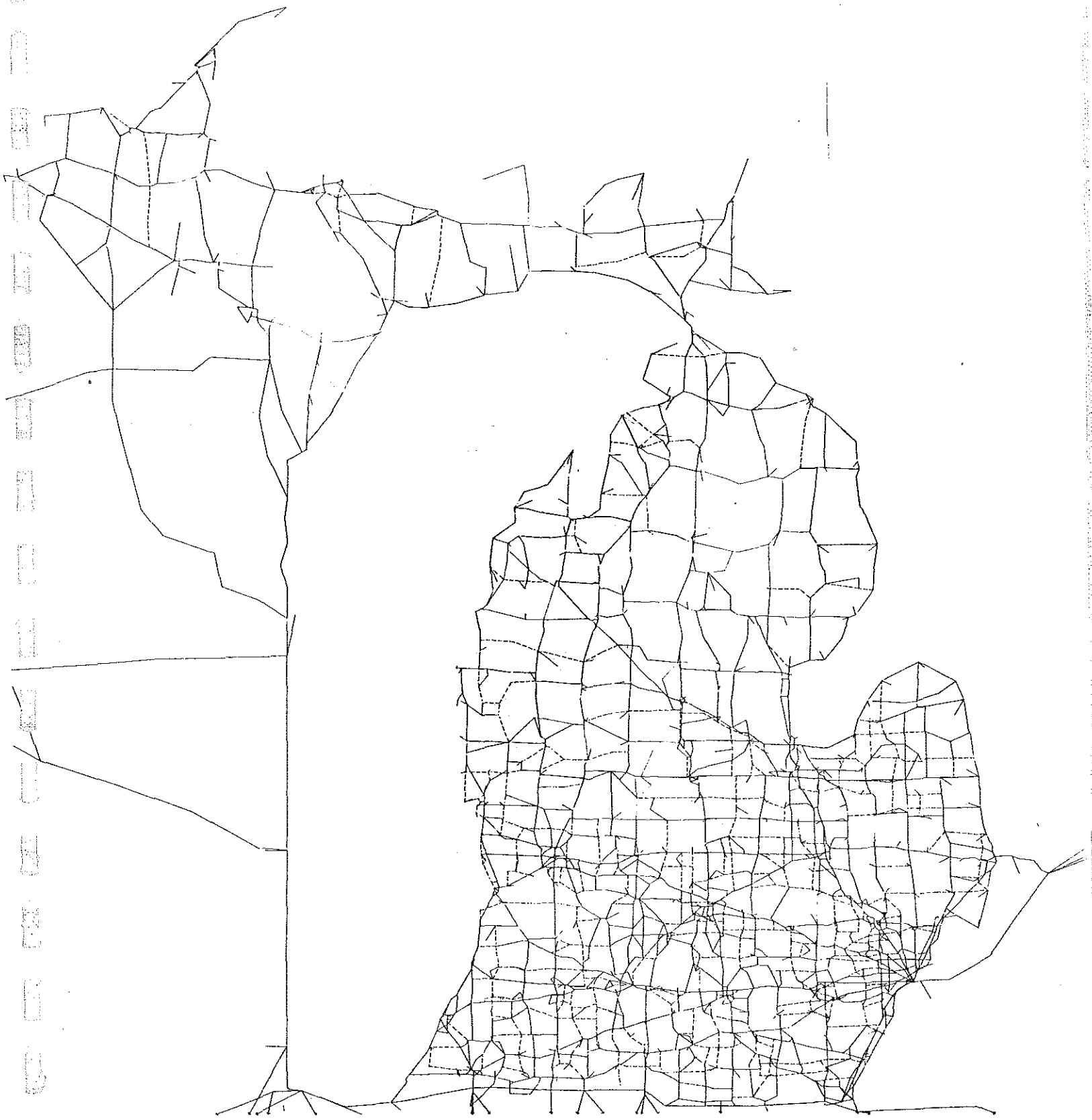
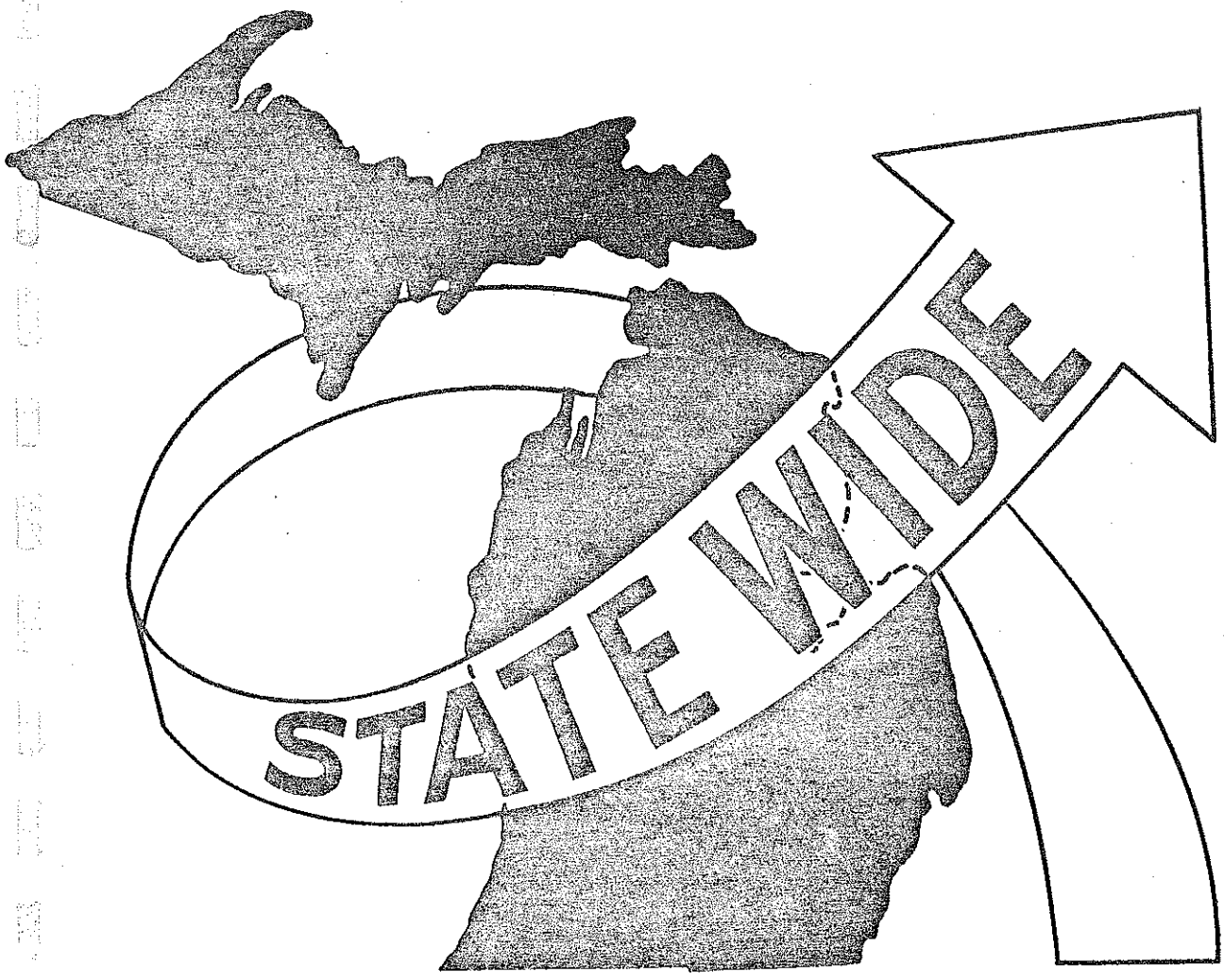


FIGURE 1

SYSTEM IMPACT ANALYSIS

GRAPHIC DISPLAY



SYSTEM IMPACT ANALYSIS GRAPHIC DISPLAY SYSTEM OPERATION

Appreciation of graphic comparisons of system impact analysis requires an understanding of the basics of the Michigan Statewide Transportation Modeling System. The simplest component of the system is the "link" - - a representation of a section of the highway network. A link is named by its end points, the "A-node" and the "B-node"; thus the link with A-node 1475 and B-node 1505 is link 1475-1505. Nodes are delineated at highway intersections and at zone boundaries. See Figure 2 for a diagram of links and nodes.

SAMPLE NETWORK

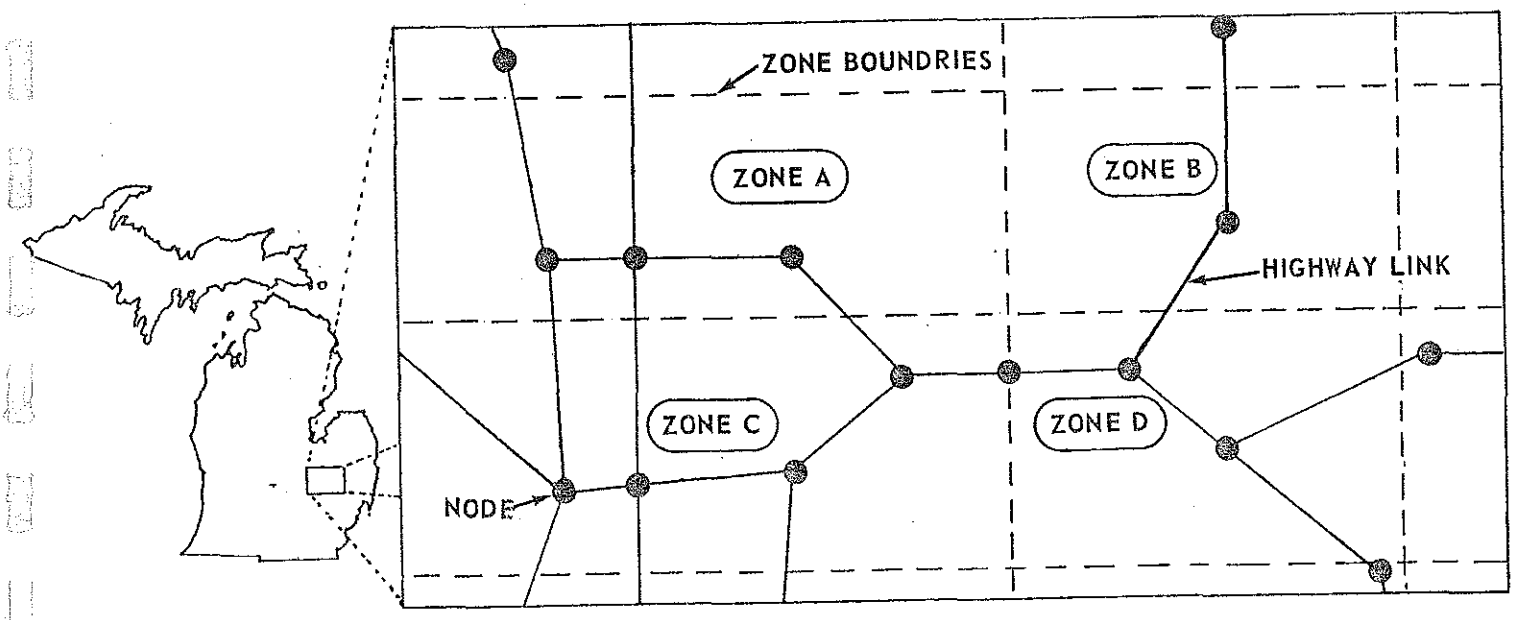


FIGURE 2

Each link in the highway network has information associated with it. Such information as link type, annual average daily traffic, design hour volume, lane width, and many others for that section of highway are stored in "volume fields" on magnetic tape records associated with the link's A-node and B-node. A volume field is nothing more than a descriptive way of referencing a physical space on a computer tape in which information is stored.

The other basic component of the modeling system is the "zone". Michigan has been divided for modeling purposes into 508 zones, displayed in Figure 3. Two large data files, the socio-economic file and the facilities file, are organized into this zone system.

To evaluate alternate highway system proposals, new links and nodes are coded into the existing highway network to produce hypothetical alternates. The Transportation Modeling System is then run on each alternate to assess the alternate's impacts. The result is large computer printouts and a computer tape containing information on travel, social, and economic impacts for each alternate highway proposal at the system level, but broken down link by link.

The graphic comparisons component transforms the link by link system results into a system-oriented display. (The reader may refer to the flow chart in Figure 4 as an aid in following this discussion.) The final network tape for an alternate is designed to put desired impacts into the proper volume fields for system level accumulation. Another preparatory routine "unpacks" the tape -- puts it into a form so that it can be accessed by the summary program. The summary program reads the unpacked network tape link by link, accumulating desired impact information for each county, for a pre-selected multi-county region, and

508 INSTATE ZONES

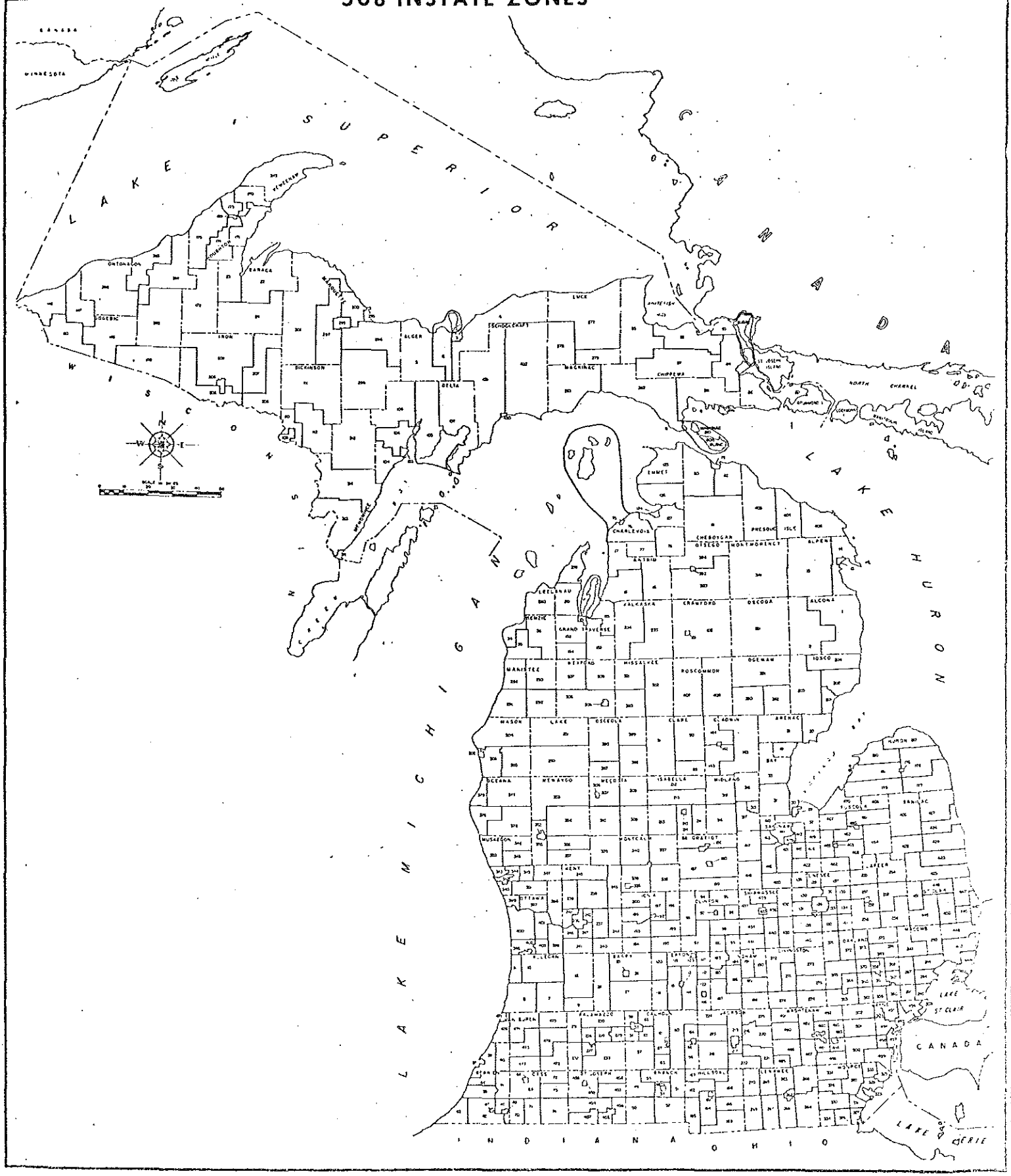


FIGURE 3

for the state. The output of this program is printed and also written to a master vehicle summary tape. The process is repeated for as many alternates as are being studied.

The master vehicle summary tape is the input to the graphic comparison routine. One impact is selected from the volume fields of the summary tape for any or all alternates. The routine then displays in bar graph form a comparison of that impact for the desired alternates, providing a systems comparison of the impact. Actual examples are provided in the following section.

FLOW CHART OF GRAPHIC DISPLAY PROCEDURES

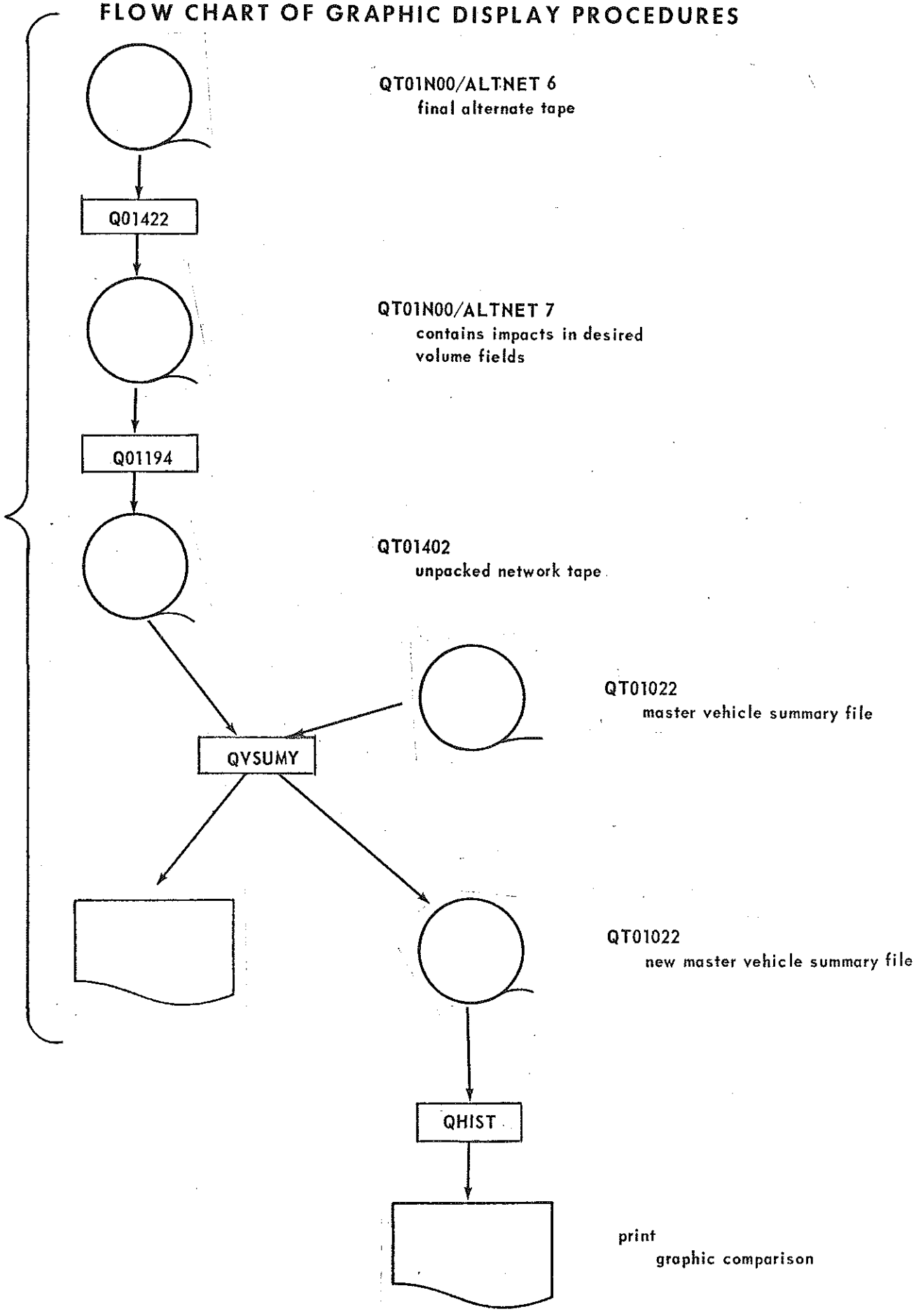
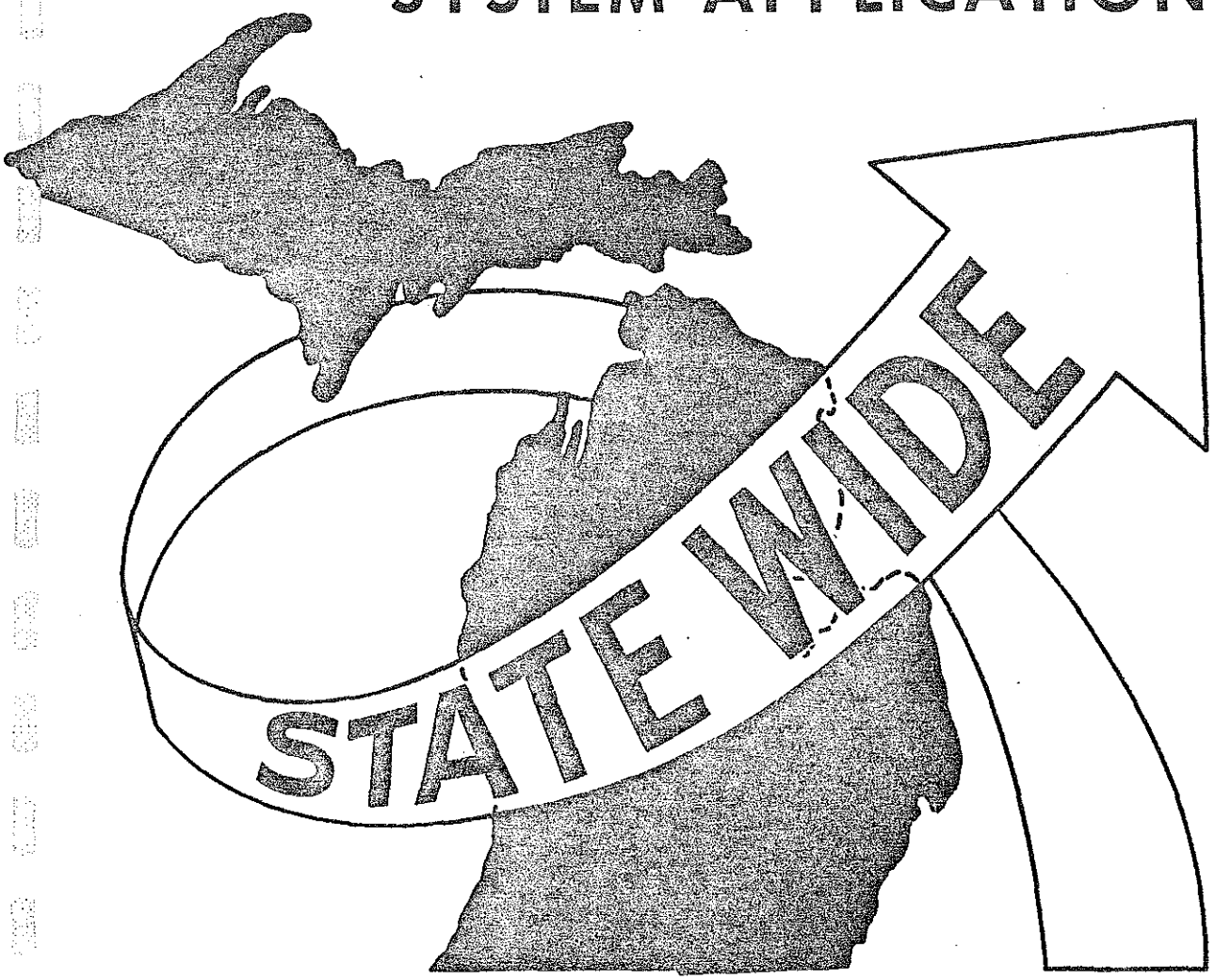


FIGURE 4

SYSTEM APPLICATION



SYSTEM APPLICATION

It is possible with previous graphics techniques to display link information on a plot of part or all of the state highway network. In Figure 5, the links with higher accident rates are signified by more lines or "band widths" than those with lower rates. Alternatively to band widths, the actual values in the volume field may be printed along the link.

Previous techniques also enable information to be pulled from the socio-economic and facilities data files and to be displayed on a zonal basis. Figure 6 illustrates the number of hospitals in each zone.

Bulky computer printouts are obviously not the best management tool for analyzing the vast amounts of impact information generated by a series of highway alternate runs. Even graphically displaying the information, as in Figures 5 and 6, does not completely solve the problem. Just to analyze three impacts, say, for each of ten alternates, would require 30 different plots. Since a typical analysis might emphasize 10 or 15 impacts, on 3 or 4 different classes of highways, for as many as twenty alternates, a broader perspective than the link level or zone level is needed.

An intermediate step in achieving systems comparison is the vehicle summary table, which allows the analyst to view several important factors at a glance. Figures 7, 8, and 9 illustrate vehicle summaries for three alternate highway proposals in Michigan's northwest region (shown in Figure 10). Vehicle summary tables are useful for analyzing the impacts of one alternate at a glance, but comparing several alternates

ACCIDENT RATE PER LINK

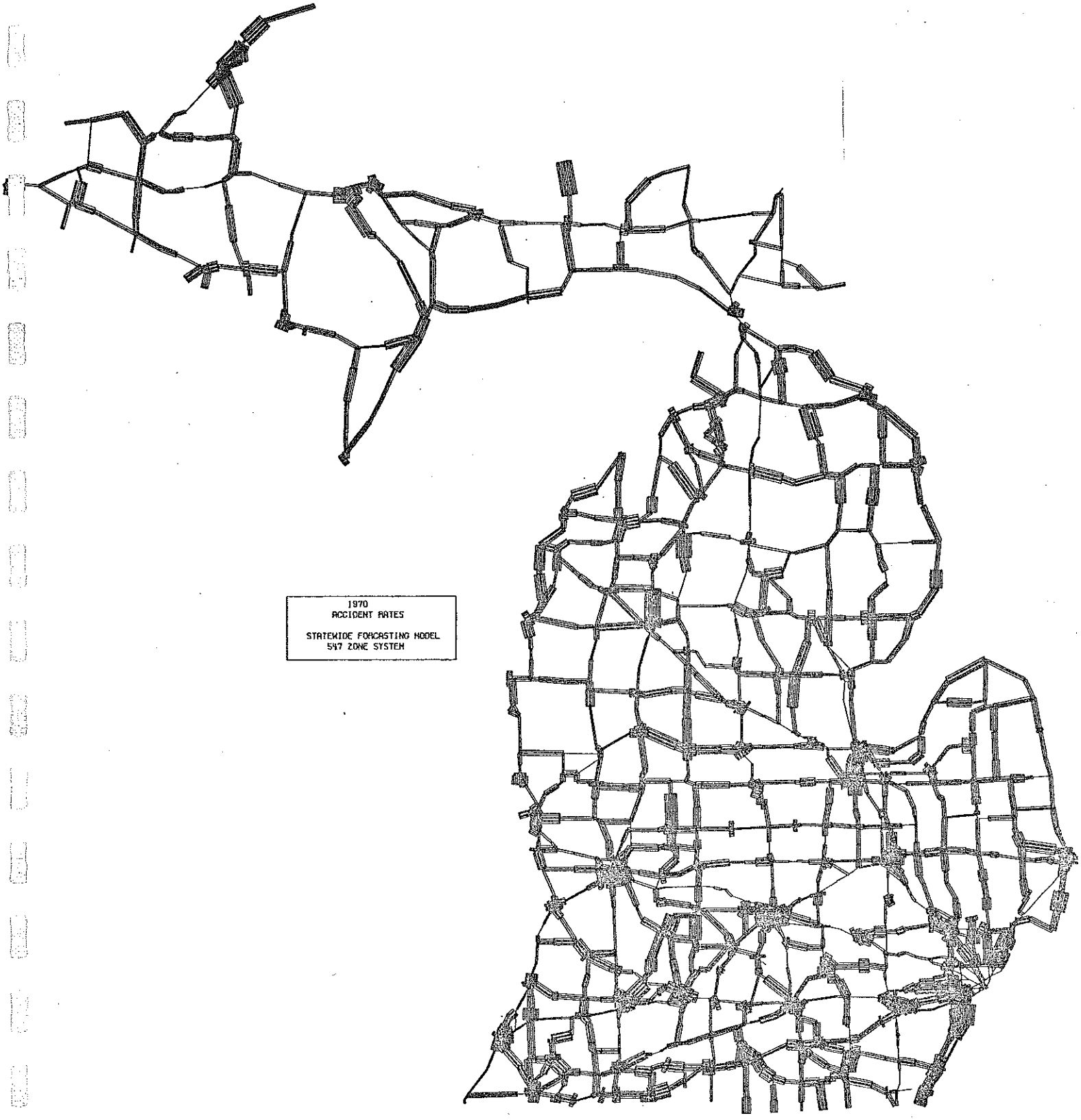


FIGURE 5

NUMBER OF HOSPITALS PER ZONE

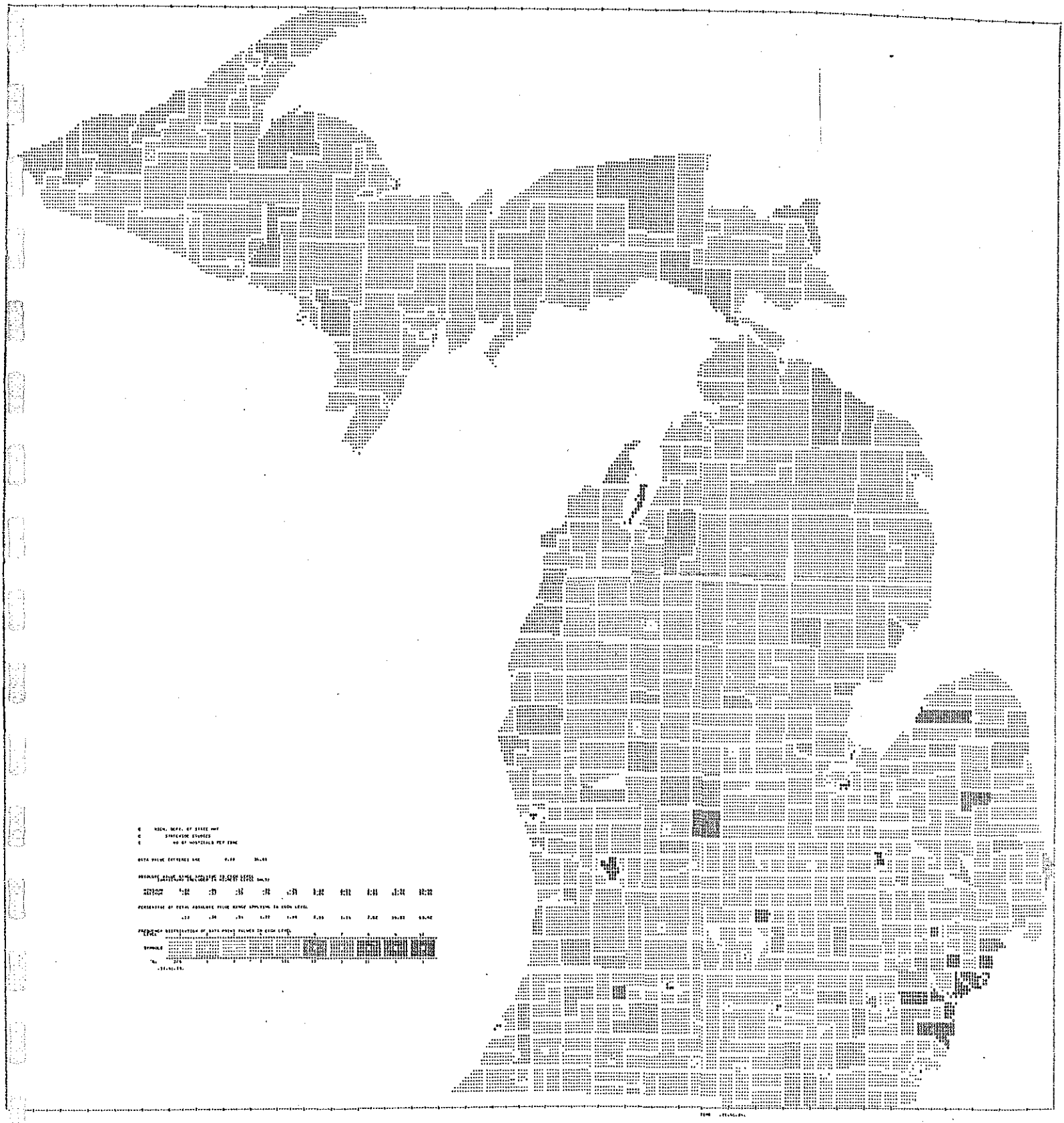


FIGURE 6

REGIONAL VEHICLE SUMMARY, ALTERNATE 23
INCLUDES COUNTIES NOS 51, 83, 57, 10, 45, 28, 40, 5, 15, 24
RUN 3/28/74 W/ OUTPUT TO TAPE

	INTER STATE	FAP FWY	FAP NON-FWY	FAS	TOTAL
TOTAL MILES	0	3	453	309	765
ANNUAL VEHICLE-MILES (THOUSANDS)	0	14921	973502	239618	1228041
ANNUAL VEHICLE-HOURS (THOUSANDS)	0	15689	1266955	338560	1621204
ANNUAL ACCIDENTS	0	16	3903	965	4884
A.ACCS./A.V.M. (TIMES 1000000)	0.00	1.07	4.01	4.03	3.98
A.ACCS./A.V.H. (TIMES 1000000)	0.00	1.02	3.08	2.85	3.01
ANNUAL GASOLINE CONSUMPTION (THOUSAND GALS.)	0	825	46463	11033	58321
MILES LS=1	0	0	0	15	15
MILES LS=2	0	3	30	206	239
MILES LS=3	0	0	134	63	197
MILES LS=4	0	0	134	13	147
MILES LS=5	0	0	40	6	46
MILES LS=6	0	0	115	6	121

FIGURE 7

REGIONAL VEHICLE SUMMARY, ALTERNATE 24
INCLUDES COUNTIES NOS 51, 83, 57, 10, 45, 28, 40, 5, 15, 24
RUN 3/28/74

	INTER STATE	FAP FWY	FAP NON-FWY	FAS	TOTAL
TOTAL MILES	0	139	383	308	830
ANNUAL VEHICLE-MILES (THOUSANDS)	0	535560	721726	216496	1473782
ANNUAL VEHICLE-HOURS (THOUSANDS)	0	563725	925666	305491	1794882
ANNUAL ACCIDENTS	0	963	2742	847	4552
A.ACCS./A.V.M. (TIMES 1000000)	0.00	1.80	3.80	3.91	3.09
A.ACCS./A.V.H. (TIMES 1000000)	0.00	1.71	2.96	2.77	2.54
ANNUAL GASOLINE CONSUMPTION (THOUSAND GALS.)	0	29613	34776	9972	74361
MILES LS=1	0	92	49	35	176
MILES LS=2	0	33	50	214	297
MILES LS=3	0	12	144	20	176
MILES LS=4	0	0	19	26	45
MILES LS=5	0	2	30	10	42
MILES LS=6	0	0	91	3	94

FIGURE 8

REGIONAL VEHICLE SUMMARY, ALTERNATE 26
INCLUDES COUNTIES NOS 51, 83, 57, 10, 45, 28, 40, 5, 15, 24
RUN 3/28/74

	INTER STATE	FAP FRY	FAP NON-FRY	FAS	TOTAL
TOTAL MILES	0	112	463	309	884
ANNUAL VEHICLE-MILES (THOUSANDS)	0	479143	728730	238394	1446267
ANNUAL VEHICLE-HOURS (THOUSANDS)	0	504315	953168	335604	1793087
ANNUAL ACCIDENTS	0	863	2913	941	4717
A.ACCS./A.V.M. (TIMES 1000000)	0.00	1.80	4.00	3.95	3.26
A.ACCS./A.V.H. (TIMES 1000000)	0.00	1.71	3.06	2.80	2.63
ANNUAL GASOLINE CONSUMPTION (THOUSAND GALS.)	0	26494	34615	10998	72107
MILES LS=1	0	34	78	35	147
MILES LS=2	0	63	74	168	305
MILES LS=3	0	15	177	60	252
MILES LS=4	0	0	45	16	61
MILES LS=5	0	0	42	24	66
MILES LS=6	0	0	47	6	53

FIGURE 9

NORTHWEST REGION

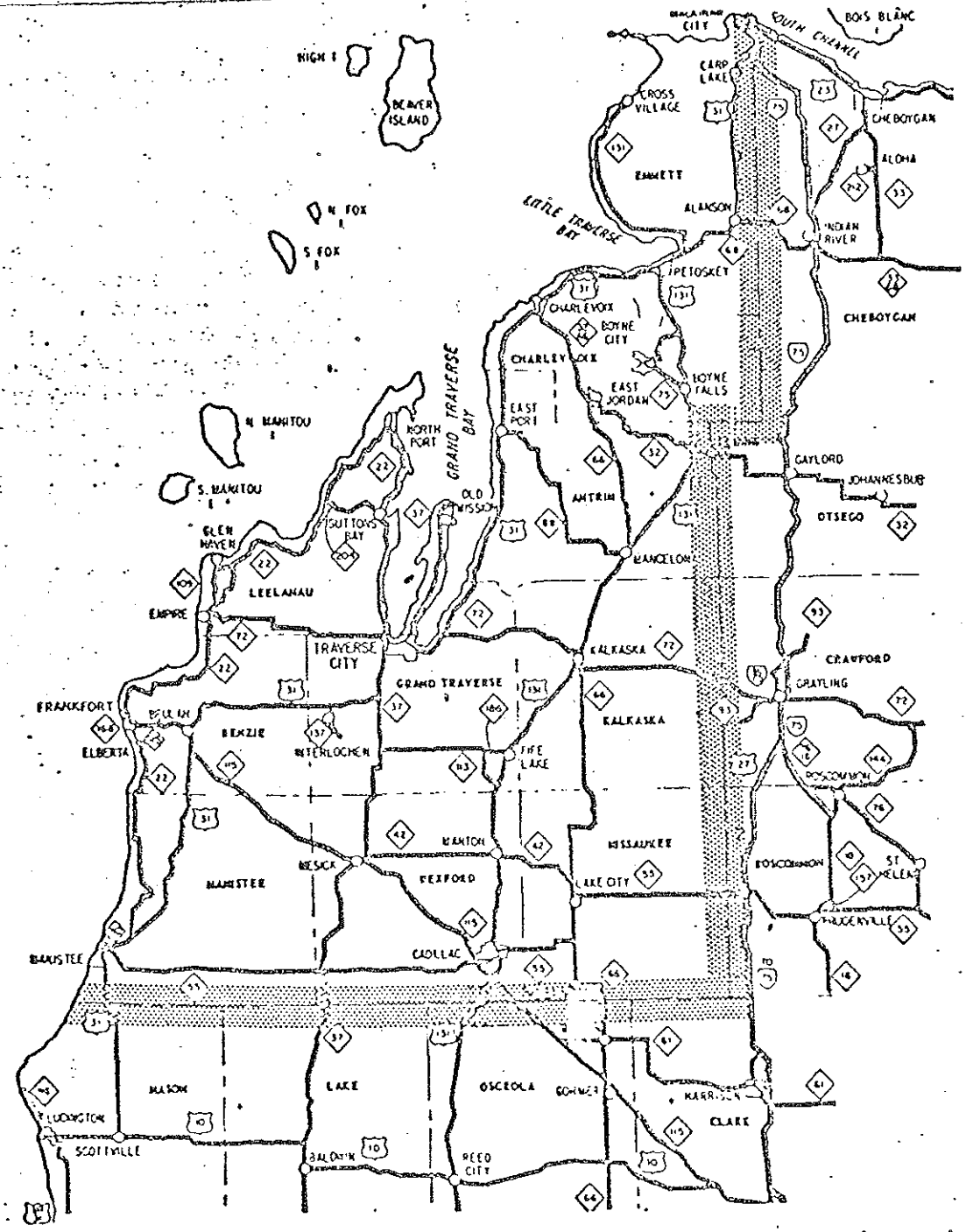


FIGURE 10

requires flipping from printout to printout. Thus, the graphic comparison was developed.

The impacts displayed in Figures 7, 8, and 9 are stored in volume fields on the master vehicle summary tape. The analyst, by specifying a volume field number, can have information displayed on bar graphs for any or all alternates for any county in the region, the entire region, or the state. Figure 11 illustrates a graph for the three alternates shown earlier and Figure 12 is a graph of eighteen alternates. With this tool, several alternates (up to twenty) can be accurately compared for a given impact easily and precisely.

PROJECT NO. 0 SYSTEMS COMPARISON -- MICHIGAN STATEWIDE TRASNPORTATION MO
REGIONAL SUMMARY FOR INTERSTATE, FAP, AND FAS HIGHWAYS

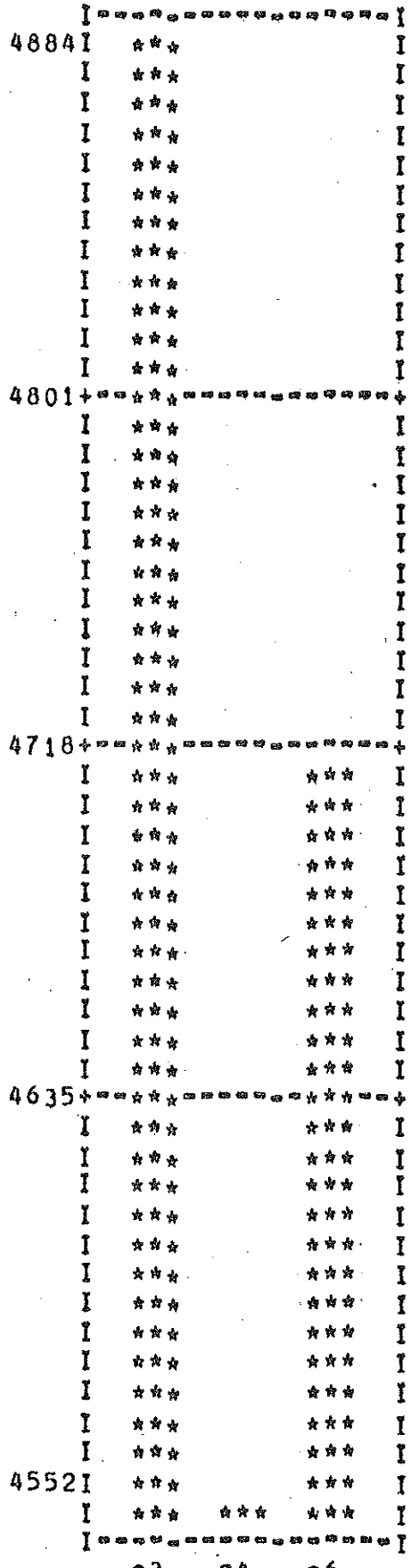


FIGURE 11

GRAPHIC COMPARISON OF REGIONAL VEHICLE-MILES

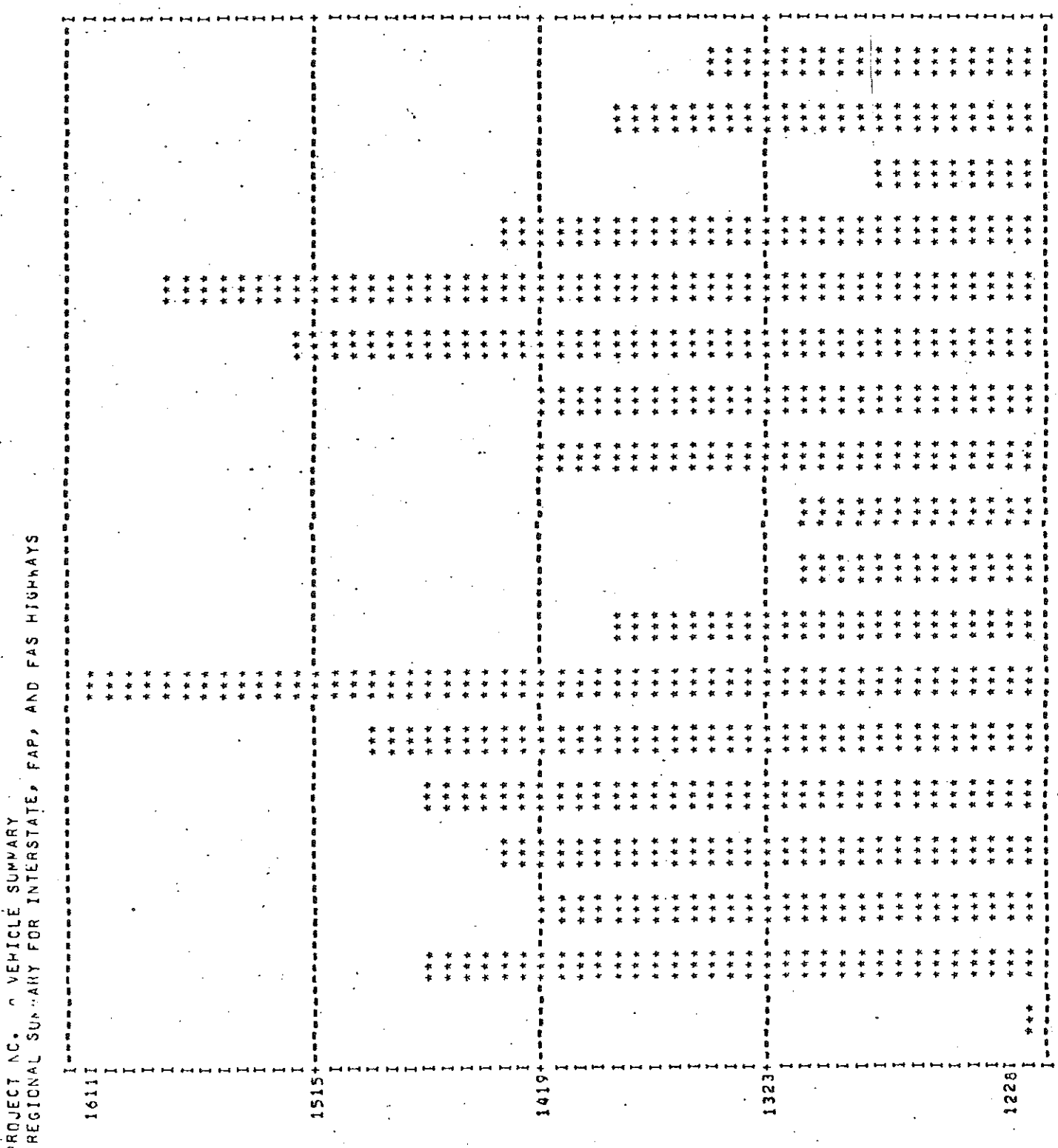
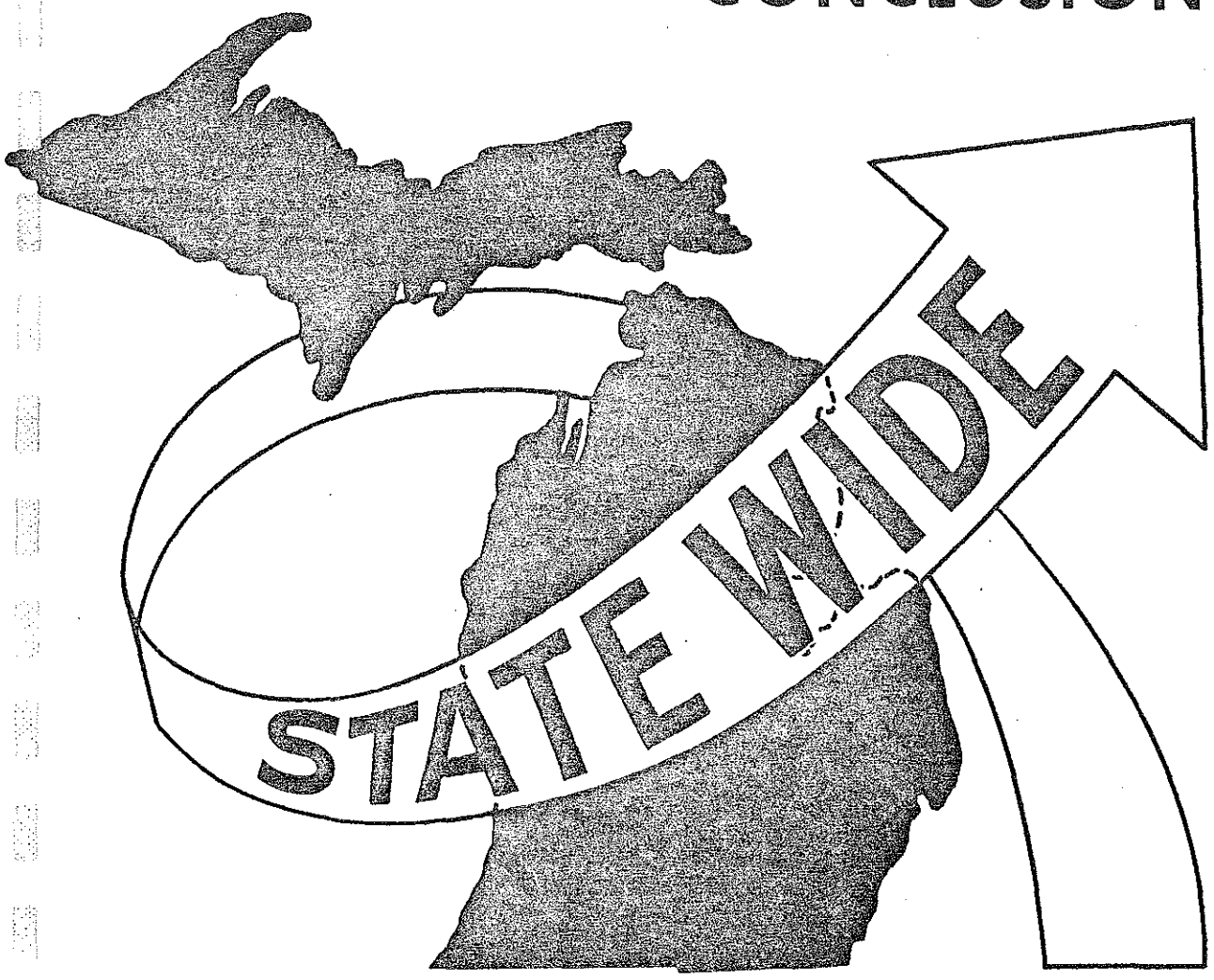


FIGURE 12

CONCLUSION



CONCLUSION

In summary, the graphics display battery now provides a wide range of means to evaluate alternate highway systems. For detailed analysis, plots of link and zonal information are available. For management and for public-oriented uses, the graphic comparison provides a meaningful system overview with easy comprehension and without bulky computer printouts.