Statewide Transportation Analysis & Research

MICHIGAN'S STATEWIDE
TRANSPORTATION MODELING SYSTEM

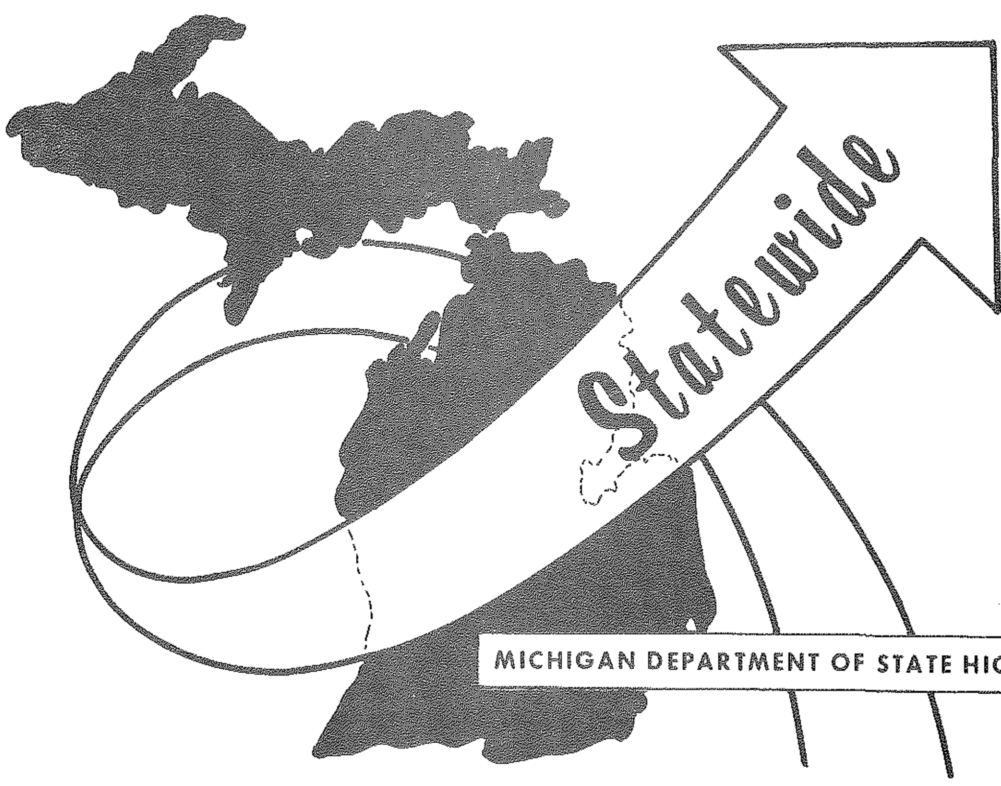
APPLICATION REPORT NO. 15

**I-69 IMPACT ON THE ACCESSIBILITY
OF HEALTH, FIRE, AND AMBULANCE
SERVICES TO RESIDENTIAL AREAS**

Report 15

STATEWIDE RESEARCH & DEVELOPMENT

MARCH, 1976



MICHIGAN DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION

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BUREAU OF TRANSPORTATION PLANNING

MICHIGAN'S STATEWIDE
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MARCH, 1976

STATE OF MICHIGAN

WILLIAM G. MILLIKEN, GOVERNOR

DEPARTMENT OF STATE HIGHWAYS AND TRANSPORTATION

STATE HIGHWAYS BUILDING, 425 WEST OTTAWA PHONE 517-373-2090
POST OFFICE DRAWER K, LANSING, MICHIGAN 48904

JOHN P. WOODFORD, DIRECTOR

April 6, 1976

Mr. Sam F. Cryderman, Deputy Director
Bureau of Transportation Planning
Michigan Department of State Highways
and Transportation
State Highways Building, 425 West Ottawa
Post Office Drawer K
Lansing, Michigan 48904

Dear Mr. Cryderman:

Until recently, the Statewide Transportation Modeling System has found its greatest application in the area of social, economic, and travel impact measurement at the statewide and regional planning levels. This report presents a suggested methodology in which elements of the Statewide process have been modified so as to permit the quantification of project-level social impacts. While this study focuses upon one, very specific type of social impact, it is believed that the logic employed herein is applicable to the measurement of a broad range of impacts which have been, in the past, all too frequently left to subjective analysis. It is believed, further, that the adoption of this methodology in conjunction with the utilization of the many Statewide data files already available will greatly improve this Department's ability to objectively evaluate project-level alternate transportation plans.

This report was written by Mr. Terrence G. Frake, Engineer-Trainee, while on assignment to the Statewide Transportation Planning Procedures Section. Mr. Richard E. Esch supervised its presentation.

Sincerely,

R. J. Lilly

R. J. Lilly, Administrator
Highway Planning Division

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**I-69 IMPACT ON THE ACCESSIBILITY
OF HEALTH, FIRE, AND AMBULANCE
SERVICES TO RESIDENTIAL AREAS**

by

TERRENCE G. FRAKE

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PREFACE

The application of a social disruption analysis process such as the one described in this report will hopefully allow the department to quantify an area that, in the past, has often caused many hours of very subjective debate. The Federal-Aid Highway Act of 1970 requires that state highway departments consider fully the economic, social, and environmental impacts of new road alternatives and Michigan's Statewide Transportation Modeling System has been applied to perform many of these tasks. Previous reports have been published documenting assorted modeling impact techniques. A current listing of reports dealing with the Statewide Model's development and application is presented on the following page for your convenience. This report, however, deals with an actual road construction project, and the social impacts this project will have on the surrounding area. By using an actual project, this publication will show system application rather than system development. Therefore, the work presented here should be of special interest to those wishing to use a system of social impact analysis measurements of their own.

STATEWIDE TRAVEL MODELING SERIES

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
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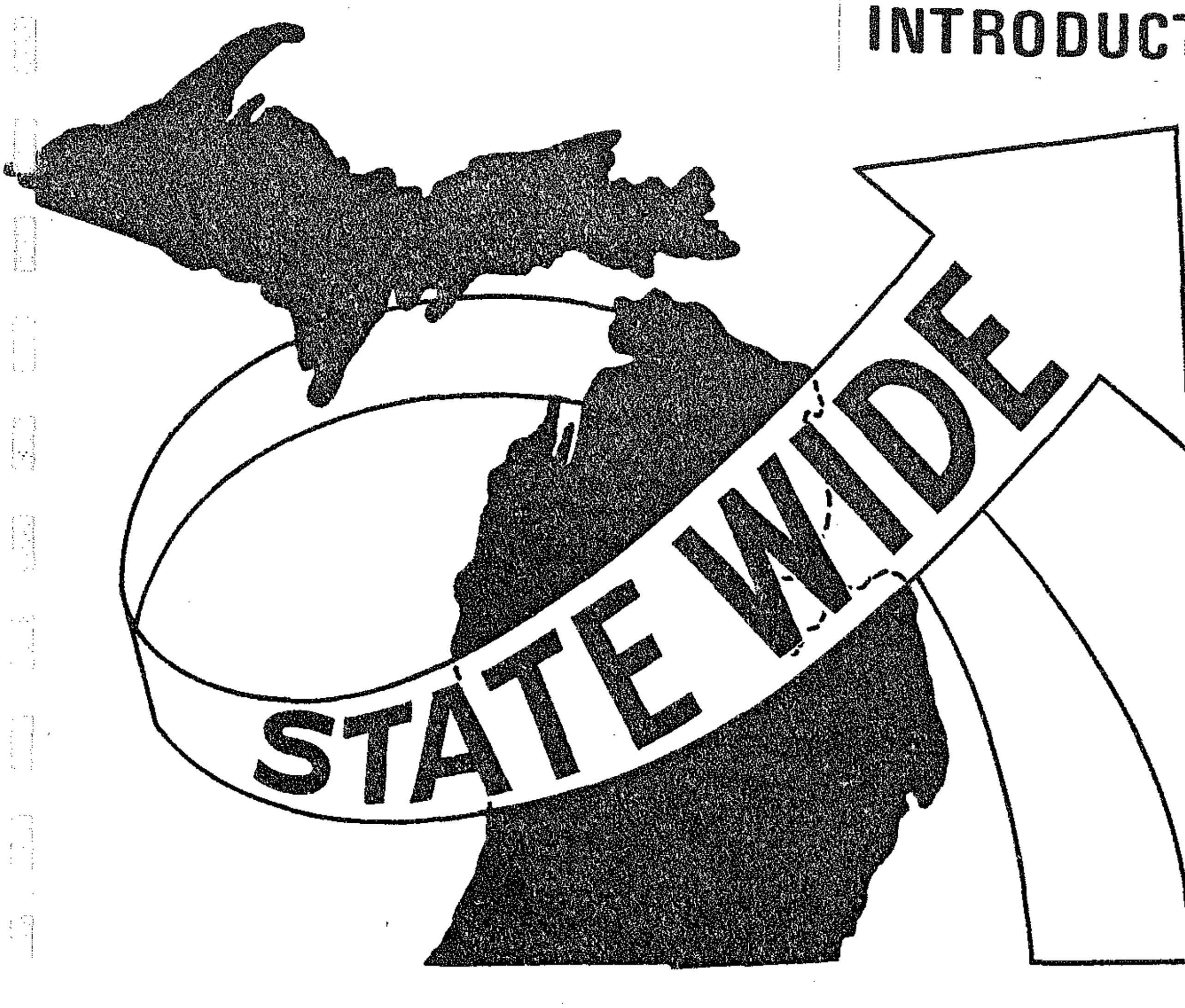
Volume	III-A--	Semi-Automatic Network Genator Using a "Digitizer"
Volume	V --	Part A -- Travel Model Development: Reformation-Trip Data Bank Preparation
Volume	V --	Part B -- Development of the Statewide Socio-Economic Data Bank for Trip Generation-Distribution
Volume	VI --	Corridor Location Dynamics
Volume	VI-A--	Environmental Sensitivity Computer Mapping
Volume	VII --	Design Hour Volume Model Development
Volume	VII-A--	Capacity Adequacy Forecasting Model
Volume	VII-B--	Modeling Major Facility Opening Impact on DHV
Volume	VIII --	Statewide Public and Private Facility File
Volume	IX --	Statewide Socio-Economic Data File
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
Volume	XIII --	Michigan Goes Multi-Modal
Volume	XIII-A--	Multi-Modal Mobility and Accessibility Analysis
Volume	XIV-A--	Commodity Flow Matrix - Ann Arbor Railroad
Volume	XIV-B--	Commodity Flow Matrix - Penn Central Railroad
Volume	XIV-C--	Commodity Flow Matrix Michigan Railroads 1% Sample
Volume	XV-A--	Railroad Financial Impact Analysis
Volume	XV-B--	Railroad Community Impact Analysis
Volume	XV-C--	Railroad Environmental Impact Analysis
Volume	XVI --	Multi-Modal Analysis: Dial-a-Ride
Volume	XVII --	Intermodal Impact Analysis - Truck and Railroad

INTRODUCTION



INTRODUCTION

The construction and utilization of a transportation corridor has been recognized as having a tremendous effect upon a region's political, economic, social, psychological, and environmental framework. In compliance with section (109h) of Title 23, U.S. Code, state departments of transportation are now required to study fully the economic, social and environmental impacts of new road alternatives in relation to the existing road system. This report deals with the application of statewide transportation modeling system concepts as related to social impact analysis. The process developed in this document deals with the measurement of change on accessibility to public services a proposed construction project may have on residential areas.

As previously mentioned, the Statewide Model has been used to predict these impacts based on statewide and regional transportation plans. Even though this report will deal more specifically with a project area, rather than a regional corridor, the principles and concepts used in the Statewide Model can also be used here; therefore, a short description of the system follows.

The Statewide Transportation Modeling System is dependent upon three information files which represent society as defined in Figure 1. The first of these files contains data descriptive of man's natural environment, or elements of the real world which are not physically created by man himself. A sample of the items which appear in this file are shown in Figure 2. The

SOCIETY

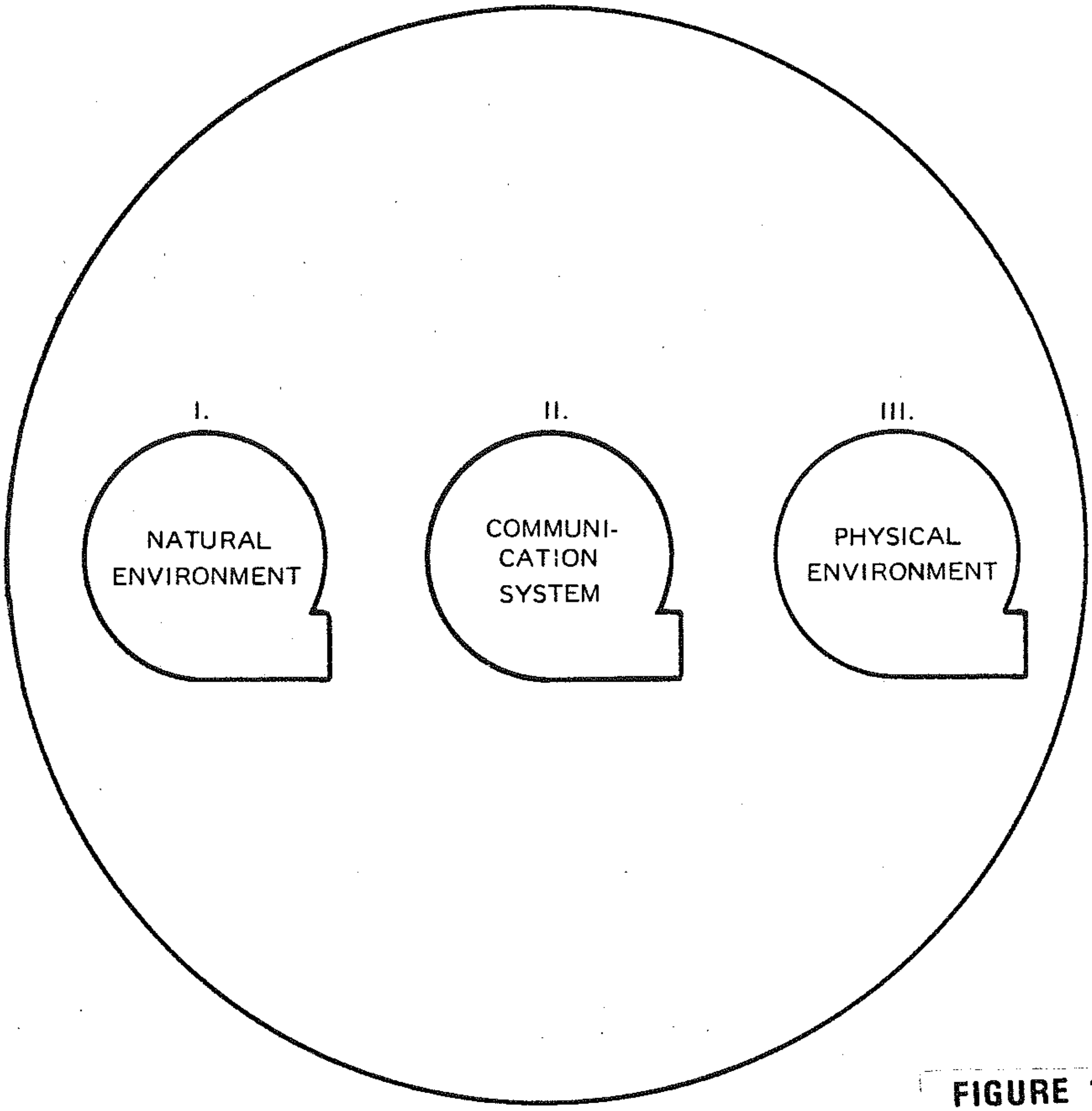


FIGURE 1

I. STATEWIDE SOCIO-ECONOMIC DATA FILE

II. STATEWIDE TRANSPORTATION NETWORK

III. STATEWIDE PUBLIC & PRIVATE FACILITY FILE

STATEWIDE SOCIO-ECONOMIC DATA FILE

GENERAL CHARACTERISTICS OF POPULATION

- SCHOOL ENROLLMENT BY TYPE OF SCHOOL
- YEARS OF SCHOOL COMPLETED
- CITIZENSHIP BY AGE

INCOME CHARACTERISTICS OF POPULATION

- FAMILY INCOME
- INCOME BY OCCUPATION AND SEX
- RATIO OF FAMILY INCOME TO POVERTY LEVEL

LABOR FORCE CHARACTERISTICS OF POPULATION

- EMPLOYMENT BY AGE
- EMPLOYMENT BY OCCUPATION AND SEX
- EMPLOYMENT BY INDUSTRY AND SEX

SOCIAL CHARACTERISTICS OF POPULATION

- AGE BY SEX
- TYPE OF FAMILY
- MARITAL STATUS

STRUCTURAL CHARACTERISTICS OF HOUSING

- YEAR STRUCTURE BUILT
- UNITS IN STRUCTURE
- STORIES IN STRUCTURE

EQUIPMENT CHARACTERISTICS OF HOUSING

- AIR CONDITIONING
- TYPE OF HEATING FUEL
- SOURCE OF WATER

OCCUPANCY CHARACTERISTICS OF HOUSING

- OCCUPANCY / VACANCY STATUS
- NUMBER OF PERSONS IN UNIT
- NUMBER OF PERSONS PER ROOM

FIGURE 2

AREA CHARACTERISTICS

- LAKE FRONTAGE
- ASSESSED VALUATION
- WATER AREA

*THOSE ITEMS LISTED HERE ARE SAMPLES TAKEN FROM THE COMPLETE FILE WHICH CONTAINS 76 CATEGORIES WITH OVER 800 ITEMS third file known as the "Statewide Public and Private Facility File" contains information pertinent to the man-made, physical aspects of the human environment. A complete listing of the categories currently being utilized within the modeling process are presented in Figure 3. Man's communication system provides, in both the real and simulated world, a logical connection between these two environments. The second file is critical in that it is a definition of the transportation planning networks. The type of data stored in that file appears in Figure 4. This same file also contains air, rail and bus network information. The true utility of the three basic information files lies not in the amount or type of data which they store, but rather in the user's ability to rapidly add and delete information as needed. This feature allows the modeling process to employ only that information which is most currently available.

All information is related to geographical areas in the state through a zone system. The state and contiguous areas outside the state are broken into 547 zones of which 508 are instate. Zone sites and boundaries have been determined on the basis of population, land area, political boundaries and other relevant factors. The information for all zones is linked together and inter-related through the use of a highway network of Michigan trunklines and county roads. This level of zone detail is typically used to measure statewide and regional transportation impacts. The zone concept was redefined to represent singular public service facilities or residential neighborhoods in the I-69 project area. The same network modeling concepts were used to create the I-69 project area study network.

STATEWIDE FACILITY FILE

AIRPORTS
AMBULANCE SERVICE
BANKS
BUS TERMINALS
CAMP GROUNDS, PUBLIC AND PRIVATE
CERTIFIED INDUSTRIAL PARKS
CITIES OVER 5,000 POPULATION AND 30,000 POPULATION
CIVIL DEFENSE TERMINALS
COLLEGES, PUBLIC COMMUNITY
COLLEGES AND UNIVERSITIES, PUBLIC AND PRIVATE
COMMERCIAL CENTERS, MAJOR
CONVENTION CENTERS
DENTISTS
ELECTRICAL GENERATING PLANTS
GAME AREAS
GOLF COURSES
GRAIN ELEVATORS
HEALTH SCREENING CLINICS, EPSDT
HIGH SCHOOLS
HISTORIC SITES
HOMES FOR THE AGED
HORSEBACK ENTERPRISES
HOSPITALS
ICE ARENAS
MANUFACTURERS
MARINAS
MENTAL HEALTH CENTERS
NEWSPAPERS, DAILY
NEWSPAPERS, WEEKLY AND BIWEEKLY
NURSING HOMES
OIL PROCESSING AND STORAGE PLANTS
PHARMACIES
PHYSICIANS
POLICE DEPT'S, STATE AND LOCAL
PORTS
RAIL TERMINALS
SECRETARY OF THE STATE OFFICES
SEWAGE TREATMENT FACILITIES
SKI RESORTS
SNOWMOBILE TRAILS
SOCIAL SERVICES OFFICES
STATE PARKS
STATE POLICE POSTS
TOURIST ATTRACTIONS
TRAILER ON FLAT CAR TERMINALS
TRANSIT SYSTEMS, BUS
TREASURY OFFICES
TRUCK TERMINALS
UNEMPLOYMENT OFFICES
WEATHER SERVICE STATIONS–NATIONAL
WHOLESALE TRADE CENTERS

FIGURE 3

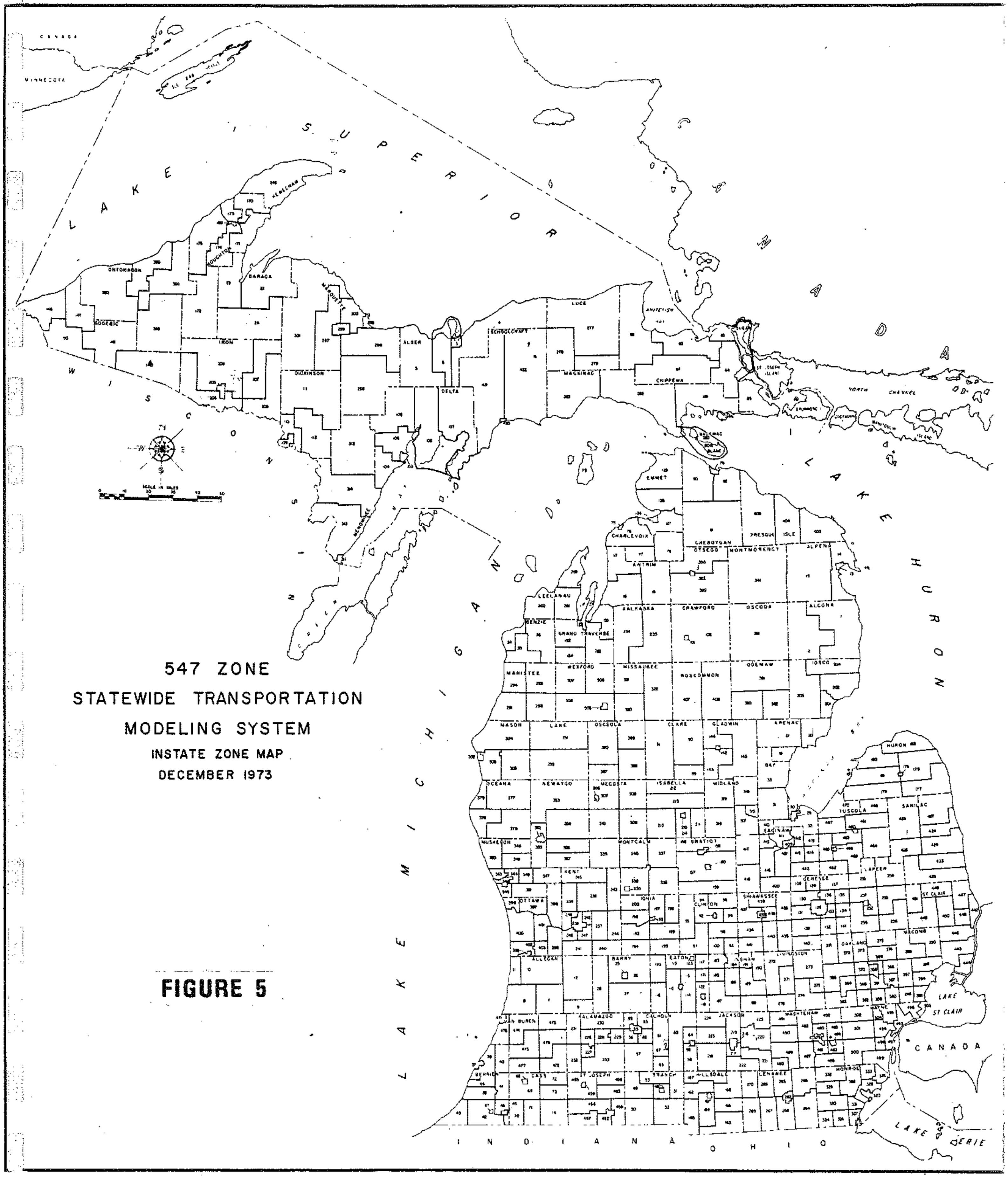
STATEWIDE HIGHWAY NETWORK

LINK FILE

CONTENTS OF EACH HIGHWAY SEGMENT OR LINK

- AVERAGE SPEED
- DISTANCE
- URBAN-RURAL DESIGNATION
- TYPE OF ROUTE
- TRAFFIC VOLUME CAPACITY
- AVERAGE ANNUAL DAILY TRAFFIC VOLUME
- COMMERCIAL TRAFFIC VOLUME
- DESIGN HOUR VOLUME
- ACCIDENT FATAL RATE
- ACCIDENT INJURY RATE
- ACCIDENT RATE
- NUMBER OF LANES
- LANE WIDTH
- SURFACE CONDITION
- RIGHT OF WAY
- SIGHT RESTRICTION

FIGURE 4



547 ZONE
STATEWIDE TRANSPORTATION
MODELING SYSTEM
INSTATE ZONE MAP
DECEMBER 1973

FIGURE 5

The present statewide transportation modeling system has been designed to measure a number of impacts that can be used to illustrate clearly the effect a new road might have on the accessibility to health, safety, and general public services. Figure 6 is a list of typical social impact analysis measurements used for statewide and regional planning impact analysis.

This report will deal exclusively with the social impact analysis area related to health services. This is often an issue with many highway construction projects. Therefore, the department is faced with the problem of choosing specific measures that will indicate to what extent alternative road networks will disrupt the residential areas. In dealing with the area of health services, the measure chosen was the accessibility of persons to hospitals and ambulance facilities within certain travel times in the I-69 corridor.

In the past, it was difficult to effectively measure the impact a specific road construction project such as I-69 would have on the accessibility of citizens to ambulance and public health services. Thus, lengthy debates have been carried on as to whether or not a certain project would have impact on a specific area and to what extent. This report hopefully will demonstrate the basis by which a department can actually measure these impacts using modeling techniques typically applied at the statewide or regional planning level.

SOCIAL IMPACT MEASUREMENTS

PEOPLE ACCESSIBLE TO HEALTH CARE *

PEOPLE ACCESSIBLE TO RECREATIONAL ACTIVITIES *

PEOPLE ACCESSIBLE TO EDUCATIONAL OPPORTUNITIES *

PEOPLE ACCESSIBLE TO PUBLIC SERVICES *

AIR POLLUTION

NOISE POLLUTION

SAFETY

SOCIAL DISRUPTION

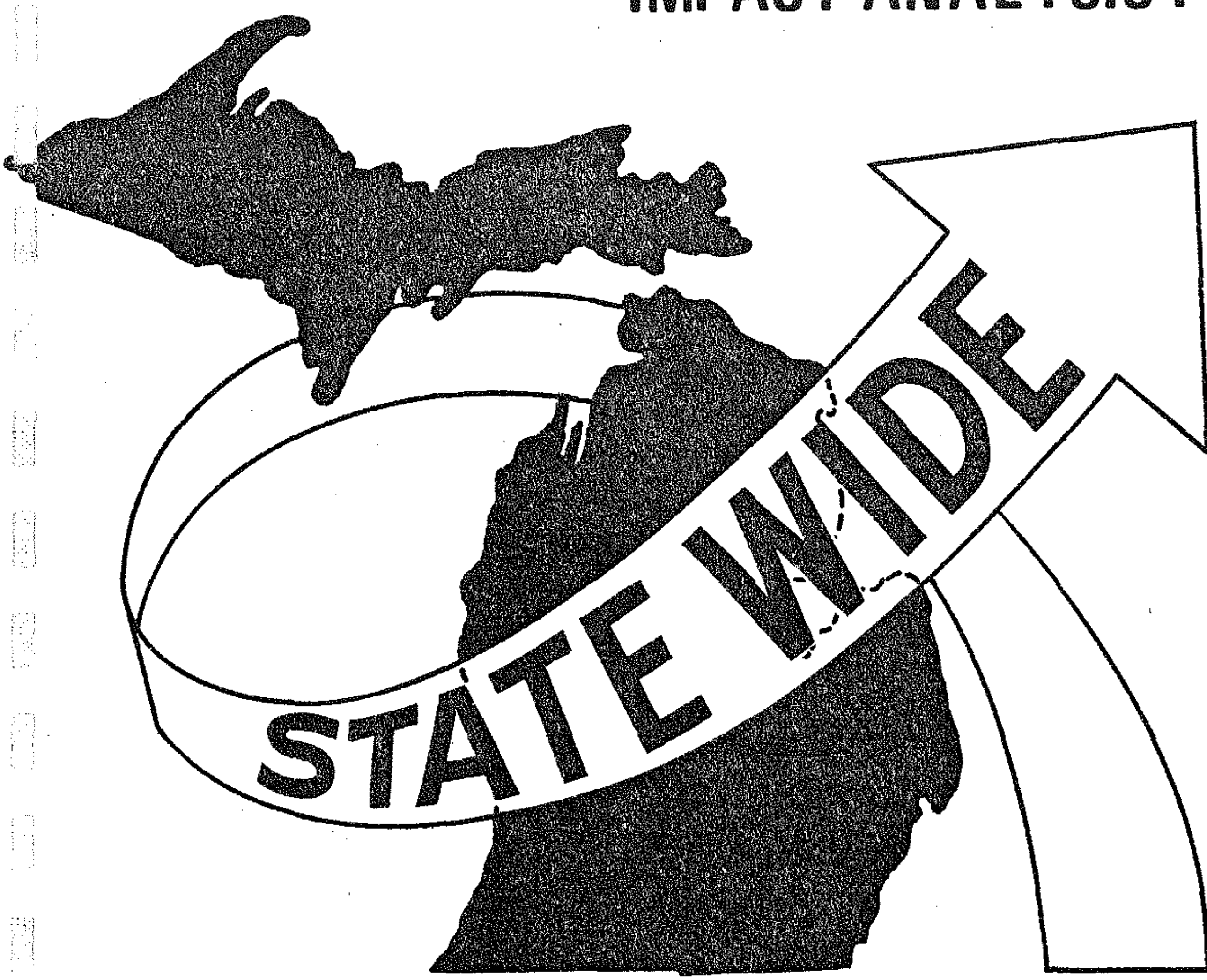
PSYCHOLOGIAL IMPACT

DRIVING TIME CONSUMPTION

FIGURE 6

* AVAILABLE BY AGE, INCOME, RACE

IMPACT ANALYSIS PROCESS



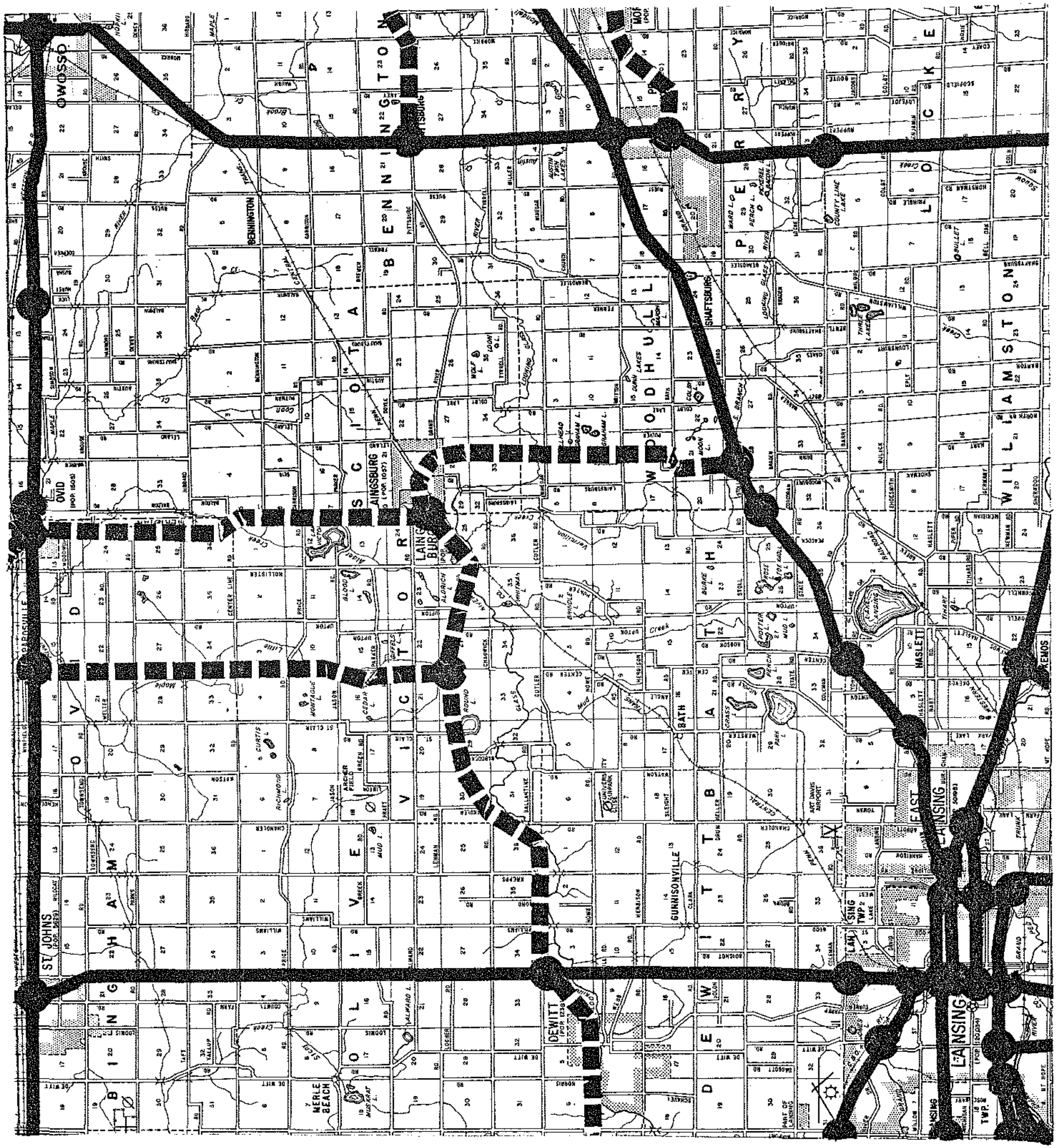
IMPACT ANALYSIS PROCESS

Figure 7 is a diagram of the Michigan Statewide Model highway network for the I-69 project area northeast of Lansing. It can be seen that only major state trunklines and county roads have been incorporated into the system. Since the detail of this network is not fine enough for a specific project alignment study and its impact on accessibility, a new network was coded which included all roads in the vicinity of the project which have an effect on the accessibility of the area to health services. Figure 8 is a computer plot of the total road network in the I-69 corridor.

This new base network was used to code three new proposed road systems which appear in Figure 9. These networks are defined as a set of links and nodes. The numbered nodes in Figure 8 represent link intersections and also zone centroids (1-40). The centroid links are used to connect the residential neighborhoods with the road system. The location of a link is described by a paired set of nodes - i.e., a link is defined by its connection of two specific network nodes. Figure 10 shows a conceptual drawing of a portion of the road network as used within the system.

The user of the network model must also differentiate between types of road links according to certain physical and travel characteristics when analyzing accessibility impacts. Though the physical characteristics may vary from link to link, each discrete "piece" of descriptive data is stored on magnetic tape in what is known as "volume fields". The primary function of such fields is to organize the storage of the link data by appropriately numbering the area of tape in which particular information is contained - thus facilitating user access.

STATEWIDE MODEL BASE NETWORK



STATE ROAD ——— **COUNTY ROAD** - - - **NODE** ●

FIGURE 7

TOTAL ROAD NETWORK I-69 CORRIDOR

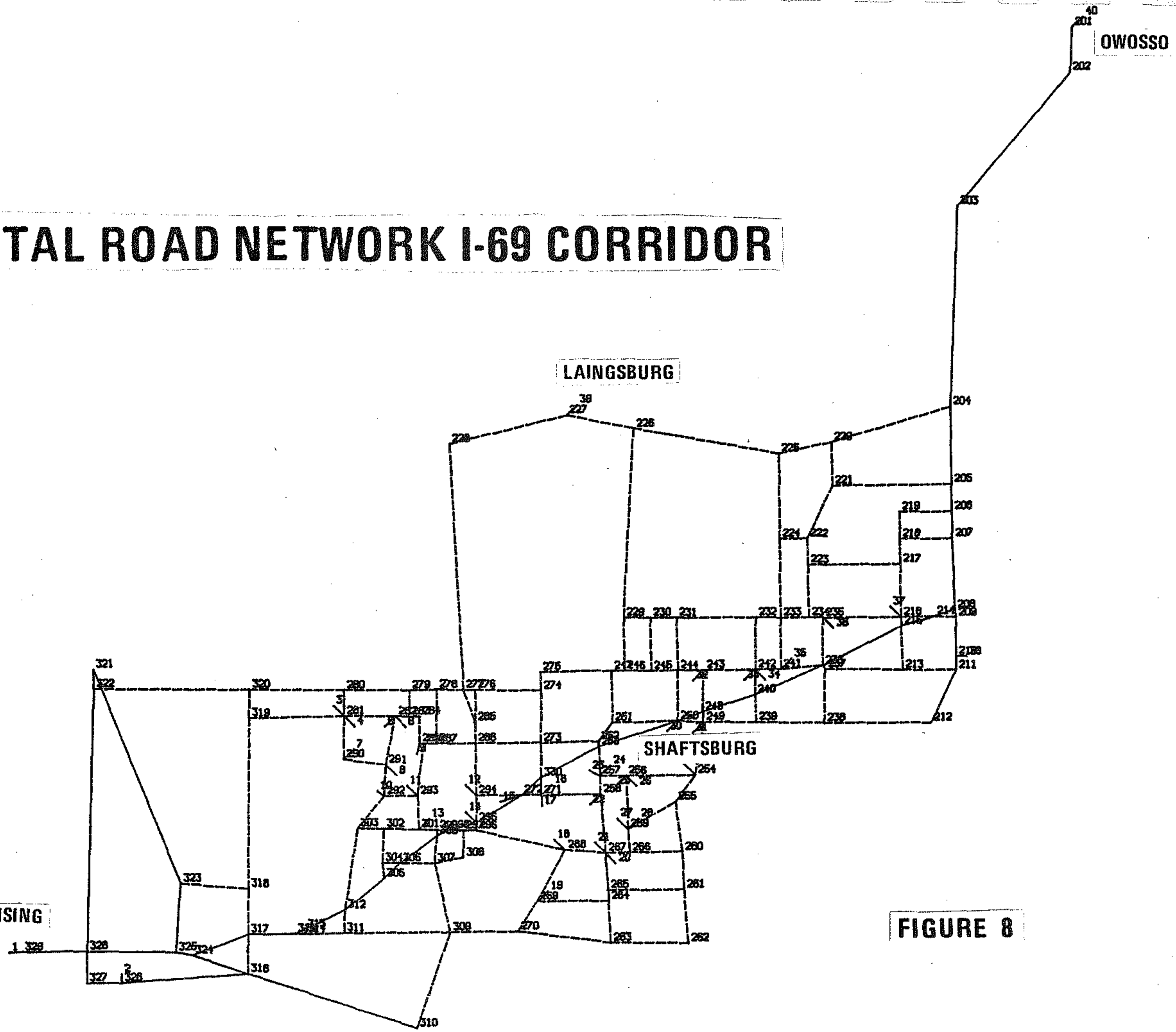
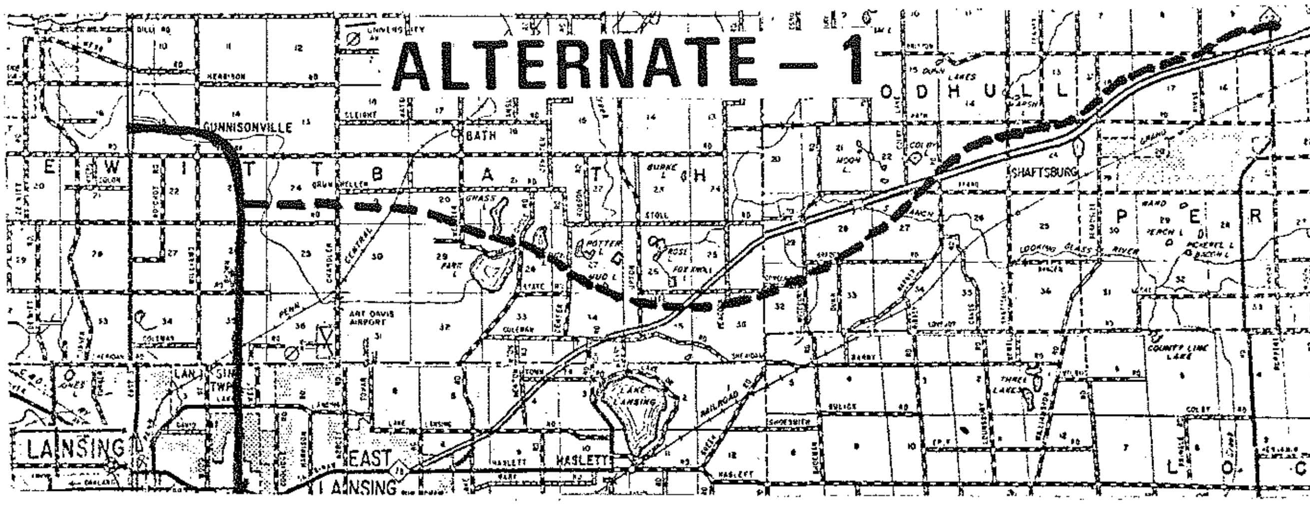
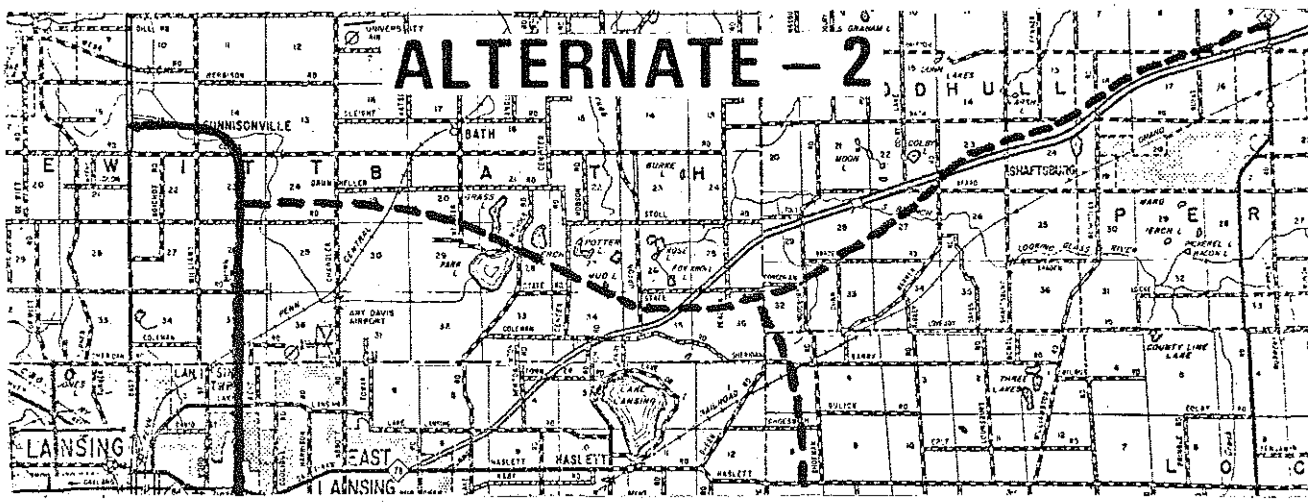


FIGURE 8



I-69



I-69 & VANATTA

I-69 & VANATTA & CLOSED ROADS

FIGURE 9

NETWORK DESCRIPTION

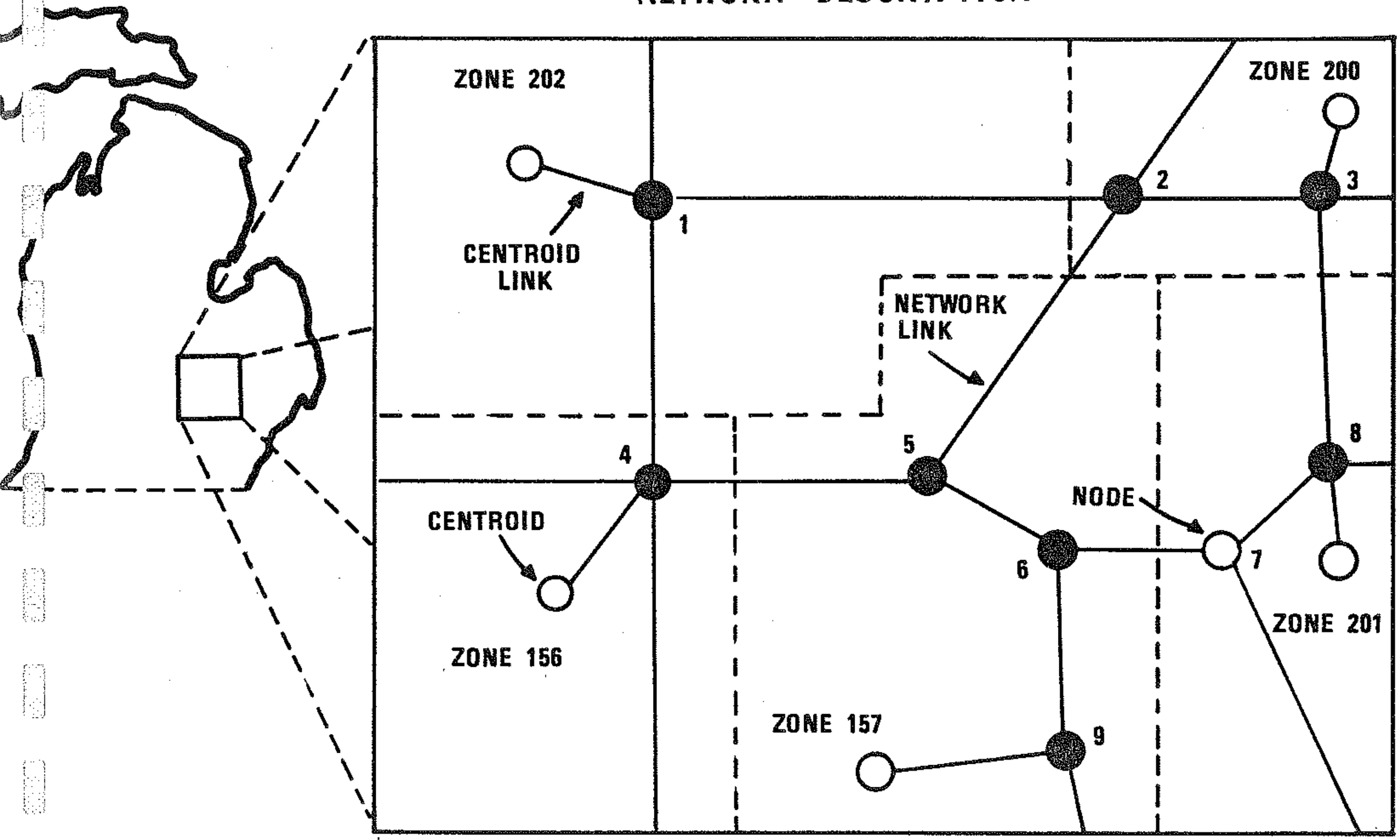
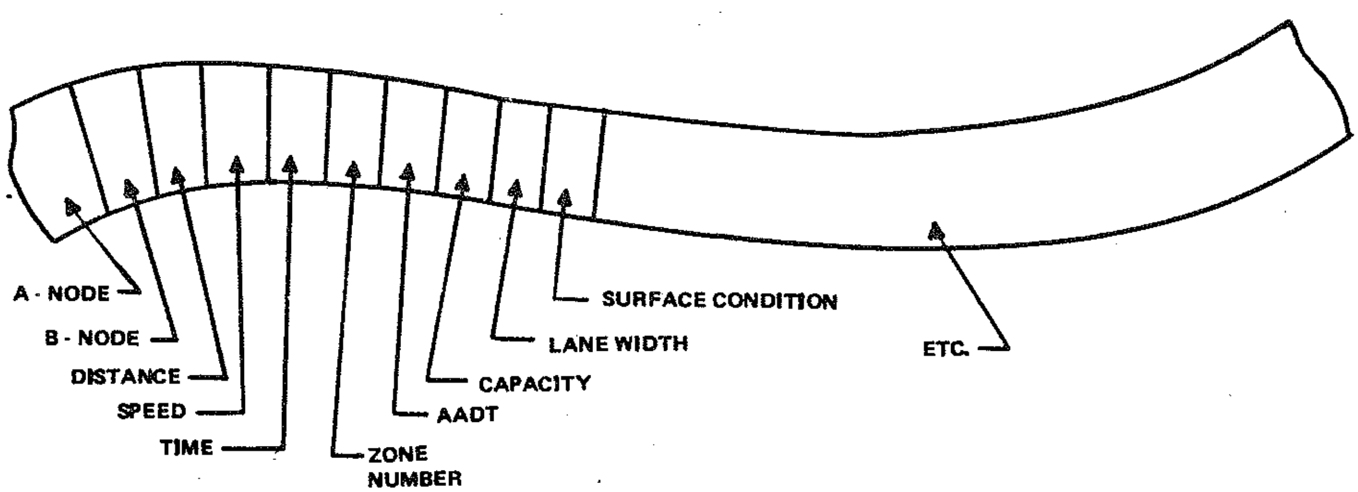


FIGURE 10

LINK DESCRIPTION



Appreciation of the "volume field" concept is critical to one's comprehension of the modeling system for it is consistently employed throughout the process. Figure 10 illustrates how a link's descriptive data might appear on a segment of magnetic tape if it were visible to the human eye. When defining a network, all the nodes are numbered to distinguish each one from others within the network. The distance from node A to node B is measured in tenths of a mile and speed at the safe rate for emergency vehicles. Each link is assumed to be symmetrical - that is, as a two-way link, all data applicable to one direction is applicable to the other. Therefore, direction is always entered as a "2". The initial portion of a link's data file also contains a description of road type (4-lane limited access, 4-lane free access, 2-lane paved, gravel). All of the above information for each road or link in the I-69 area was coded on sheets such as the one in Figure 11.

The x and y coordinates for each separate node was also coded so that the output can be mechanically platted similar to the network in Figure 8. A detailed network of this type may also be created by digitizing with a cathode-ray-tube ("CRT") computer terminal and a graphics tablet (shown in Figure 11A). To do this a map of the area that is to be digitized is placed on the graphics tablet. Then with the use of a crosshair cursor or light pen each node is entered into the computer. A computer program finds the coordinates of each node and builds the links between nodes. The physical characteristics for each link are not coded by hand but entered directly into the CRT as the link is built. The I-69 project area was coded by hand because of its small size. Figure 11B shows a portion of a network that has been digitized for the Metro area.

Once the base network tape is defined through standard coding procedures or digitized and created by running computer programs, it may be modified, in any number of ways, to simulate alternate highway proposals in Figure 9.

DEPARTMENT OF STATE HIGHWAYS

B-5500 LINK DATA CARD

Form 1720

TYPICAL NETWORK CODING SHEET

FIGURE 11

CARD TYPE	A NODE	B NODE	DISTANCE XX.XX	T OR S	A → B TIME OR SPEED X.XX XX.X AM	PM	OFF	CAPACITY IN 10'S	COUNT	DIRECTION	T OR S	B → A TIME OR SPEED X.XX XX.X AM	PM	OFF	CAPACITY IN 10'S	COUNT	PATTERN FACTOR	SEQUENCE NUMBER	LINK TYPE	LINK JURISDICTION	CAPACITY CLASS	CONTROL SECTION	DELETE
2	0201	0202	0090	S			550			2	S								03				
2	0202	0203	0340	S			550			2	S								03				
2	0203	0204	0390	S			550			2	S								03				
2	0204	0205	0150	S			550			2	S								03				
2	0205	0206	0050	S			550			2	S								03				
2	0206	0207	0050	S			550			2	S								03				
2	0207	0208	0140	S			550			2	S								03				
2	0208	0209	0010	S			550			2	S								03				
2	0204	0220	0240	S			500			2	S								04				
2	0205	0221	0230	S			350			2	S								05				
2	0220	0221	0090	S			350			2	S								05				
2	0206	0219	0100	S			350			2	S								05				
2	0207	0218	0100	S			350			2	S								05				
2	0218	0219	0050	S			350			2	S								05				
2	0217	0218	0050	S			350			2	S								05				
2	0216	0217	0100	S			350			2	S								05				
2	0214	0216	0060	S			500			2	S								04				
2	0215	0216	0020	S			350			2	S								05				
2	0214	0215	0060	S			650			2	S								02				
2	0208	0214	0040	S			650			2	S								02				
2	0209	0214	0040	S			500			2	S								04				
2	0209	0210	0070	S			550			2	S								03				
2	0210	0211	0030	S			550			2	S								03				
2	0211	0212	0120	S			550			2	S								03				
2	0211	0213	0100	S			500			2	S								04				
2	0212	0238	0200	S			500			2	S								04				
2	0213	0237	0150	S			500			2	S								04				
2	0237	0238	0100	S			350			2	S								05				
2	0213	0215	0090	S			350			2	S								05				
2	0236	0237	0010	S			500			2	S								04				
2	0215	0236	0170	S			650			2	S								02				
2	0235	0236	0090	S			350			2	S								05				
2	0216	0235	0150	S			500			2	S								04				
2	0234	0235	0030	S			500			2	S								04				
2	0233	0234	0050	S			500			2	S								04				

FIGURE 11A

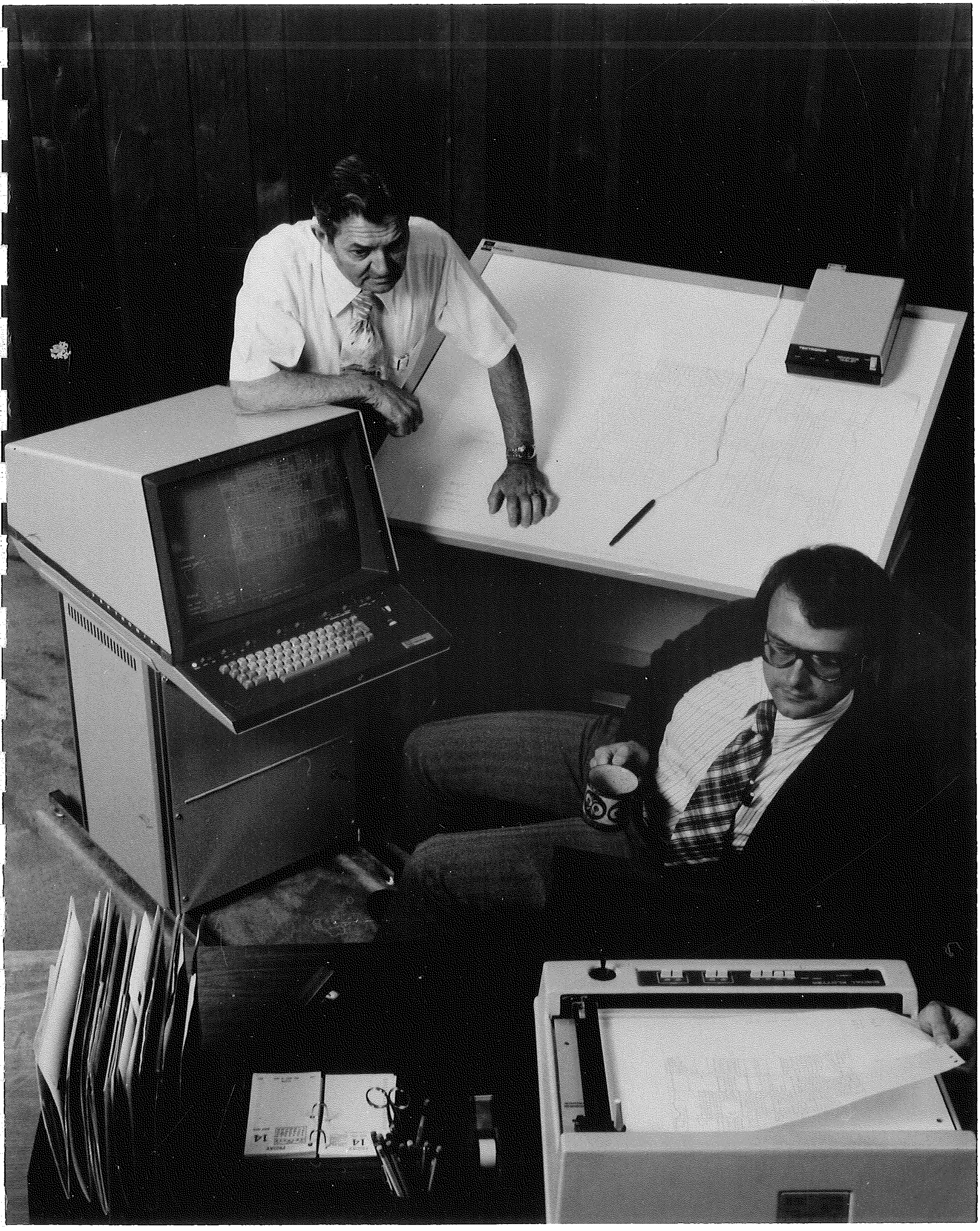
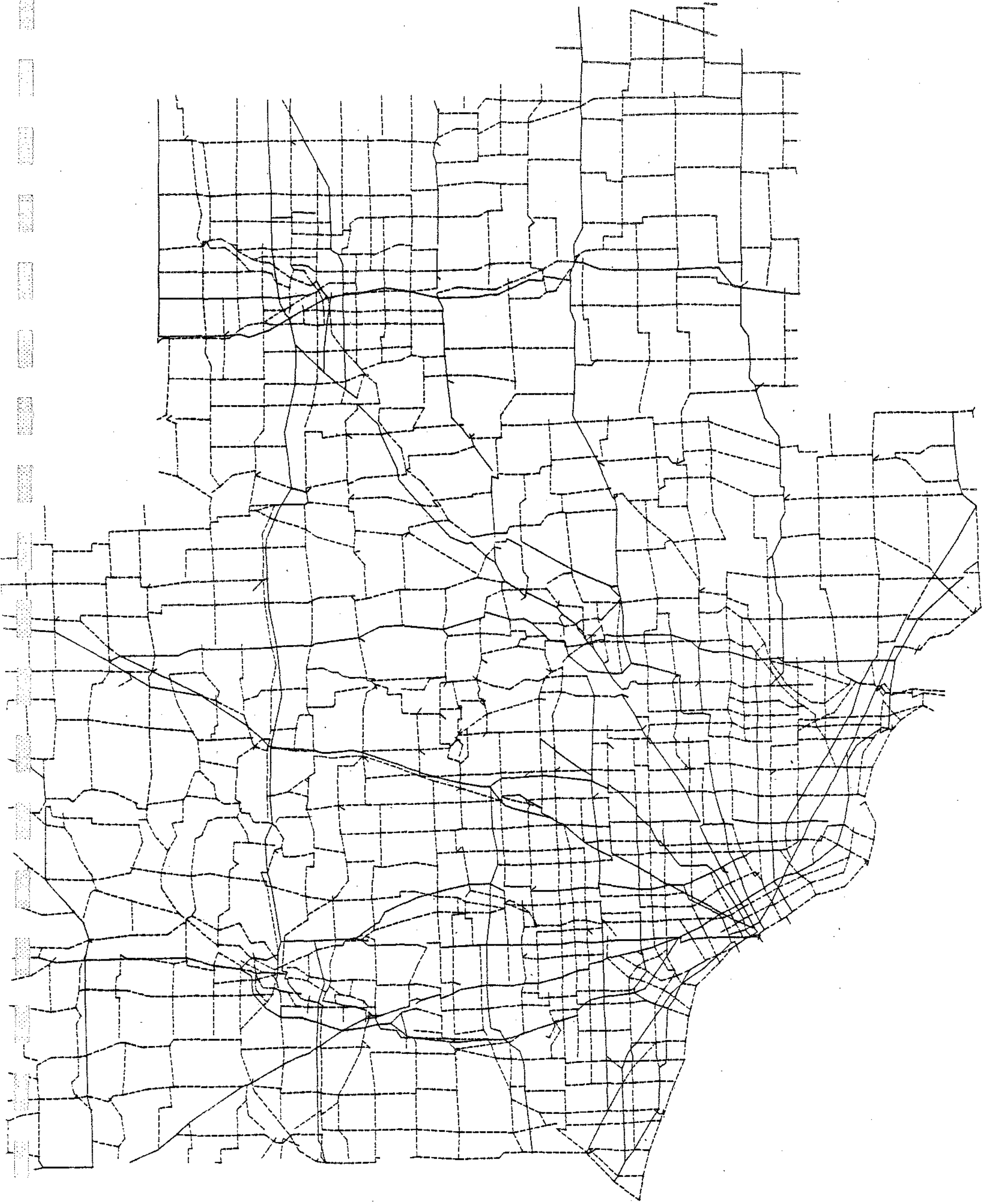


FIGURE 11B



The TP TREE and TP SKIM are the next computer programs in the Transportation Planning Battery, which provide the nucleus around which the accessibility analysis process has been built. The TP TREE program determines, using any network configuration, "the path of least resistance" from each zone to every other zone according to some user specified variable such as time or distance. Since this process stresses the accessibility of public health services to residential areas, it is possible to build a minimum path from each of the health service zones to all other residential zones. The TP SKIM program runs the actual driving time along the minimum path for each zone to zone pair - in effect "skimming" the selected tree. When these minimum paths are graphically displayed, they are similar to branches of a tree - thus the function of "building trees" is illustrated in Figures 12 and 13.

When the minimum paths between all zones are calculated, a driving time matrix can be created that allows the user to determine the driving time from each residential zone to all public health services, which accounts for all simulated trips between zones. The trip table does not indicate which links within the road network are utilized in determining the traffic interchange between zones. If the user creates this time table for each highway proposal and subtracts the base times for each of the alternate networks, a new matrix table is generated which gives travel time lost or gained between each and every zone of the individual networks. This type of information appears in Figure 14 where each cell indicates the amount of time lost or gained in accessibility.

In the next section of this report, the model process just described above will be applied to three alternate highway proposals for I-69. This type of analysis will allow the department to systematically determine the extent and location of major impacts on accessibility.

BASE NETWORK – ACCESS FROM ZONE 1

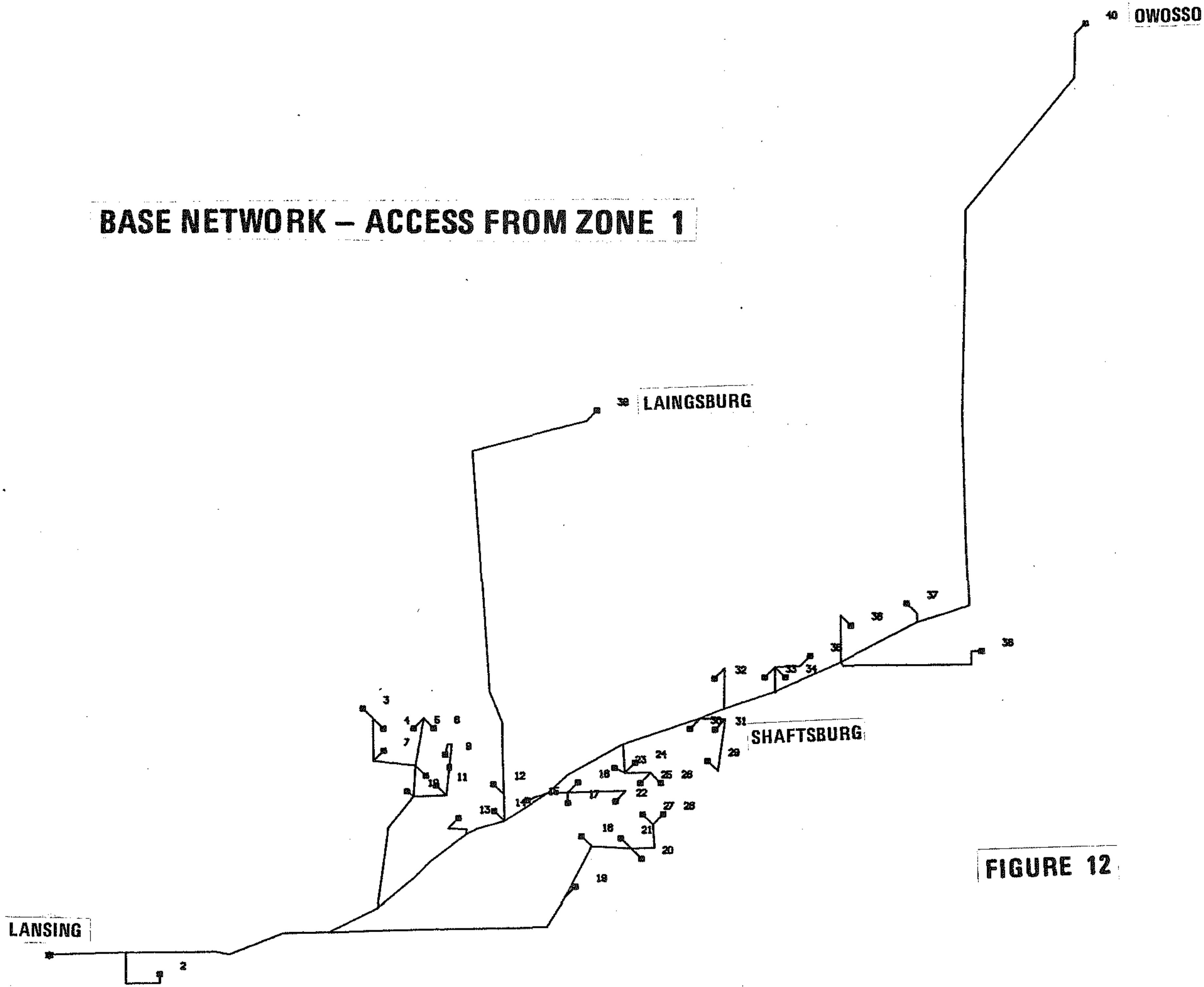


FIGURE 12

BASE NETWORK - ACCESS FROM ZONE 39

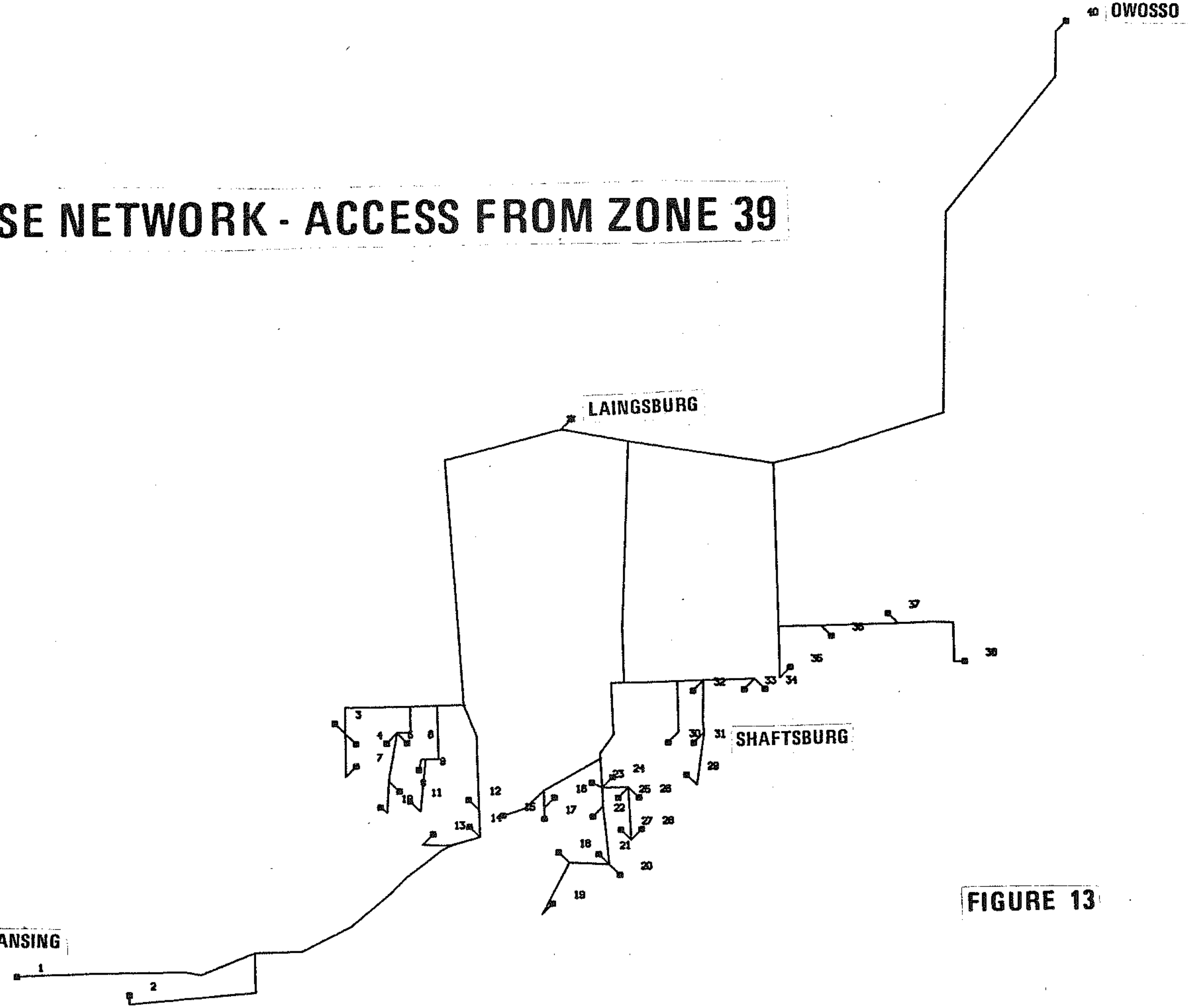


FIGURE 13

INTER-ZONAL DIRIVING TIME MATRIX - ZONE 1

ST. LAWRENCE HOSPITAL

20MAR76 ZONE MATRIX TIME SAVED I69 BYPASS & VAN ATTA VS DO NOTHING ROADS CLOSED PAGE 2

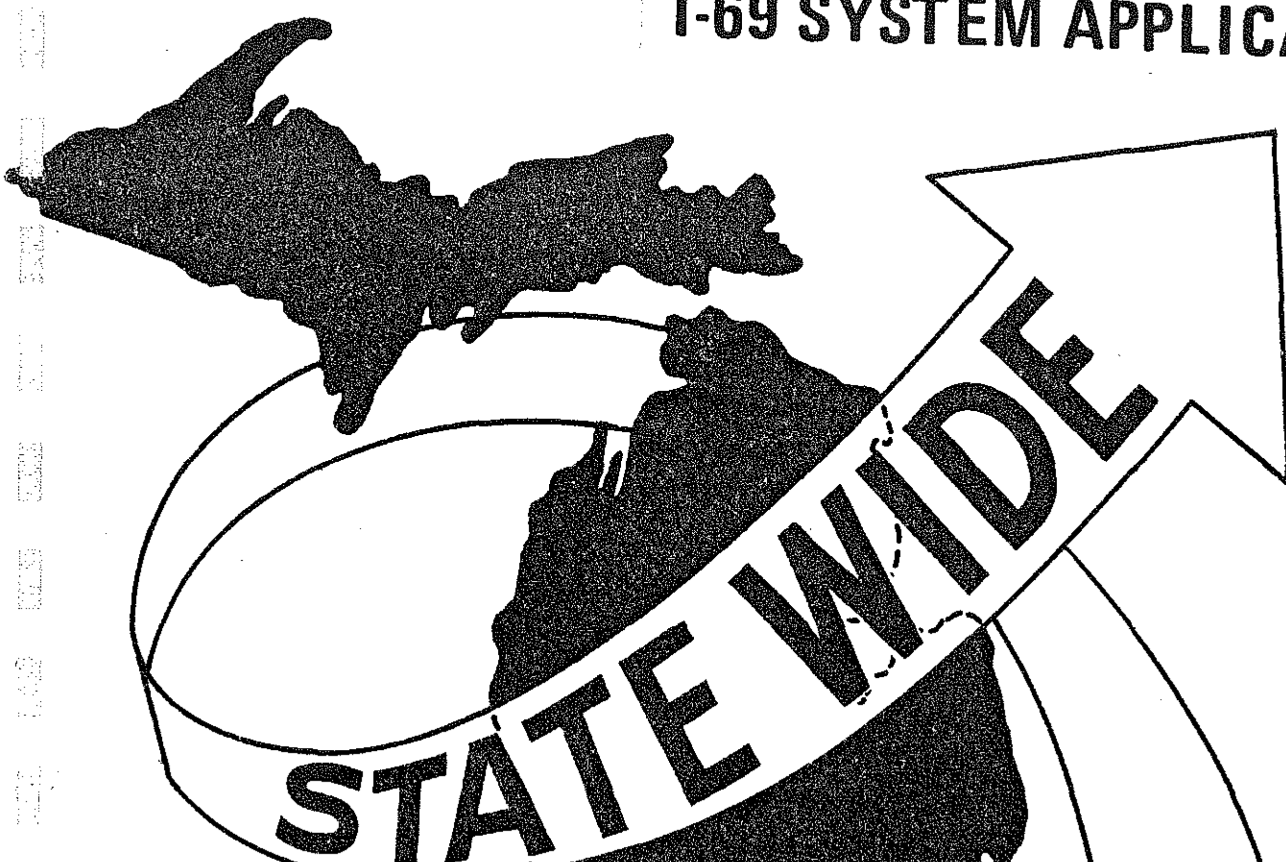
INTERCHANGE VALUES FROM ZONE 1 TO ALL OTHER ZONES TABLES NUMBER 101

	0	1	2	3	4	5	6	7	8	9
0		1	0	2	2	0	0	2	0	-1
1	0	0	-2	0	0	0	0	0	0	0
2	0	0	-2	0	0	-3	-3	0	0	0
3	0	0	-1	0	0	0	0	-788	0	0

TOTAL = -793 MEAN = -19.825

FIGURE 14

I-69 SYSTEM APPLICATION



I-69 SYSTEM APPLICATION

With the growing congestion on temporary I-69 from East Lansing to Perry, concern has mounted for investigation into various highway alternates in this area. One of the issues identified was the impact this new road might have on the residential community in the area. Using the impact analysis process discussed in the previous section, a detailed look at accessibility impacts for three alternates was completed: 1) I-69 bypass east and west between US-27 and M-52, 2) I-69 bypass east and west with a north-south connection to the proposed VanAtta Expressway as far south as Haslett Road, and 3) same as 2) except with extensive county road closings. These alternates are illustrated in Figure 9 on the area base map, and also graphically plotted in Figures 15, 16, and 17 as the result of network coding.

Accessibility is typically defined as the ease with which a person or agency can travel from a zone of origin to other zones called destination zones. For the purposes of this analysis, accessibility was measured in travel time minutes between zones using the distance and speed coded in each link to calculate time.

Since the study dealt exclusively with the impact on accessibility of health services to residential neighborhoods in the I-69 corridor, the analysis zones were chosen to be hospitals and fire and ambulance facilities in the vicinity of the project area, with destination zones picked as residential areas immediately adjacent to the I-69 project. The health service analysis zones are: Zone 1 - St. Lawrence Hospital, Zone 2 - Sparrow Hospital, Zone 3 - Bath Township Fire Department, Zone 38 - Perry Fire

BASE NETWORK I-69

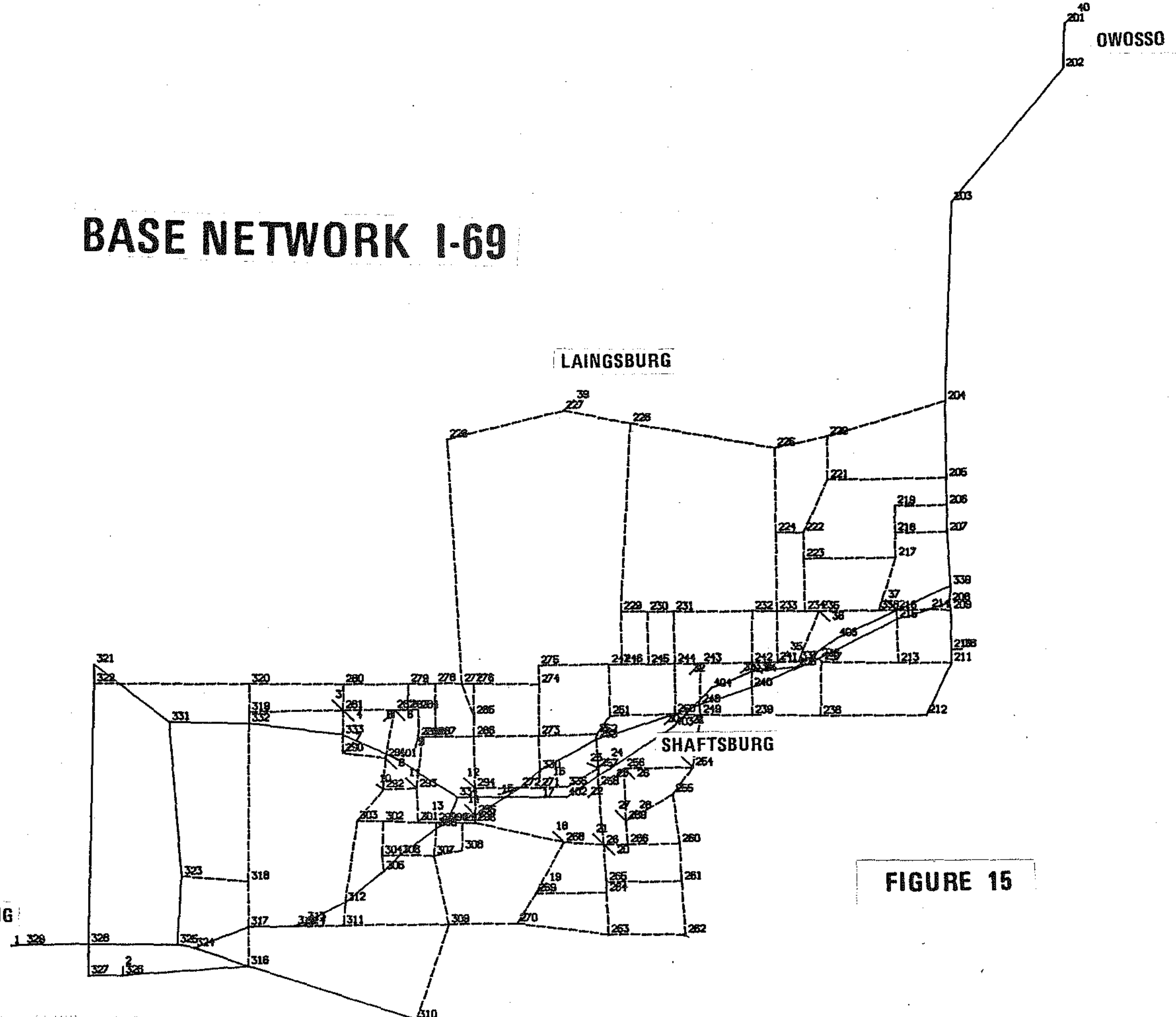


FIGURE 15

BASE NETWORK I-69 & VANATTA

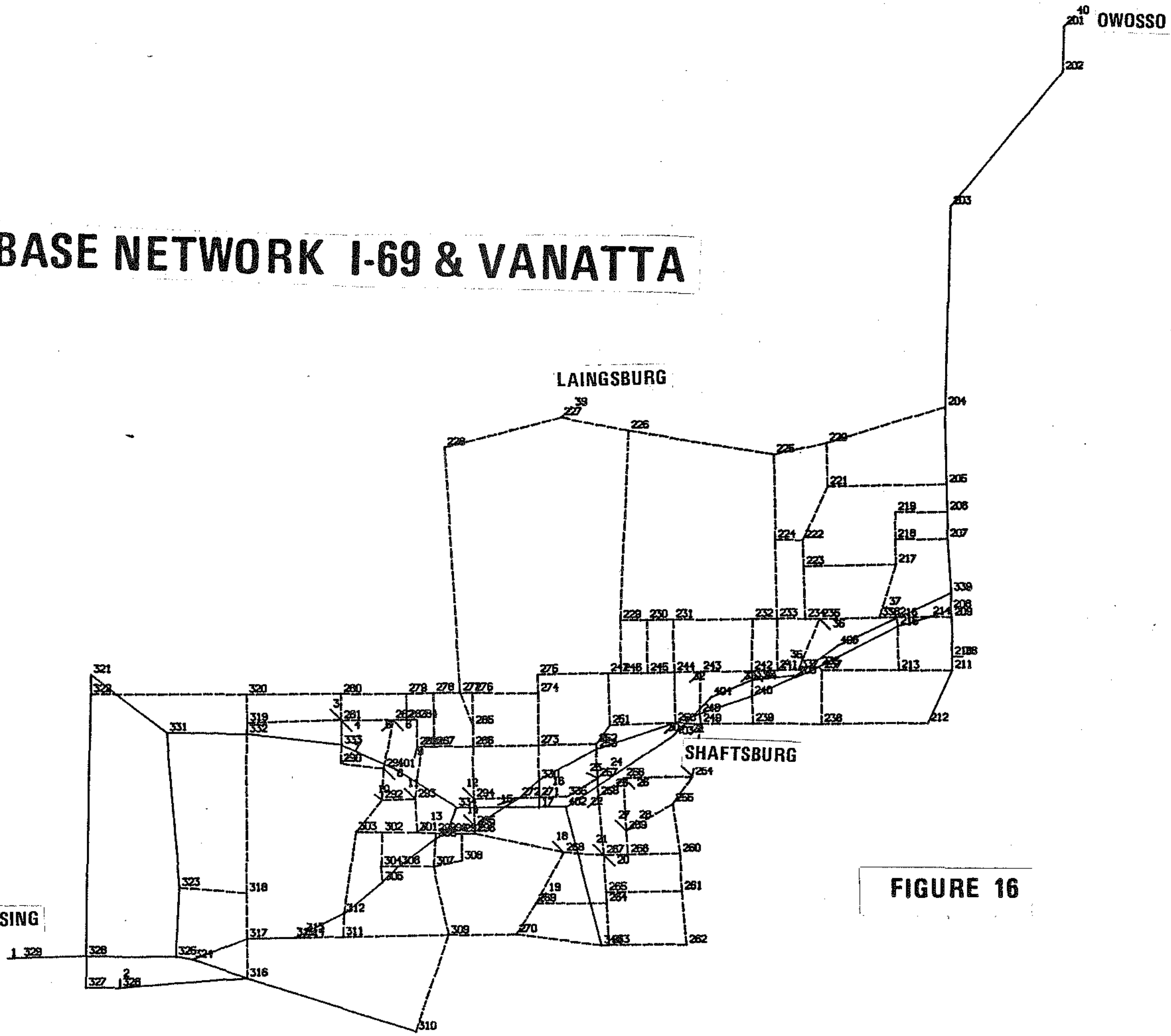


FIGURE 16

BASE NETWORK I-69 & VANATTA & ROADS CLOSED

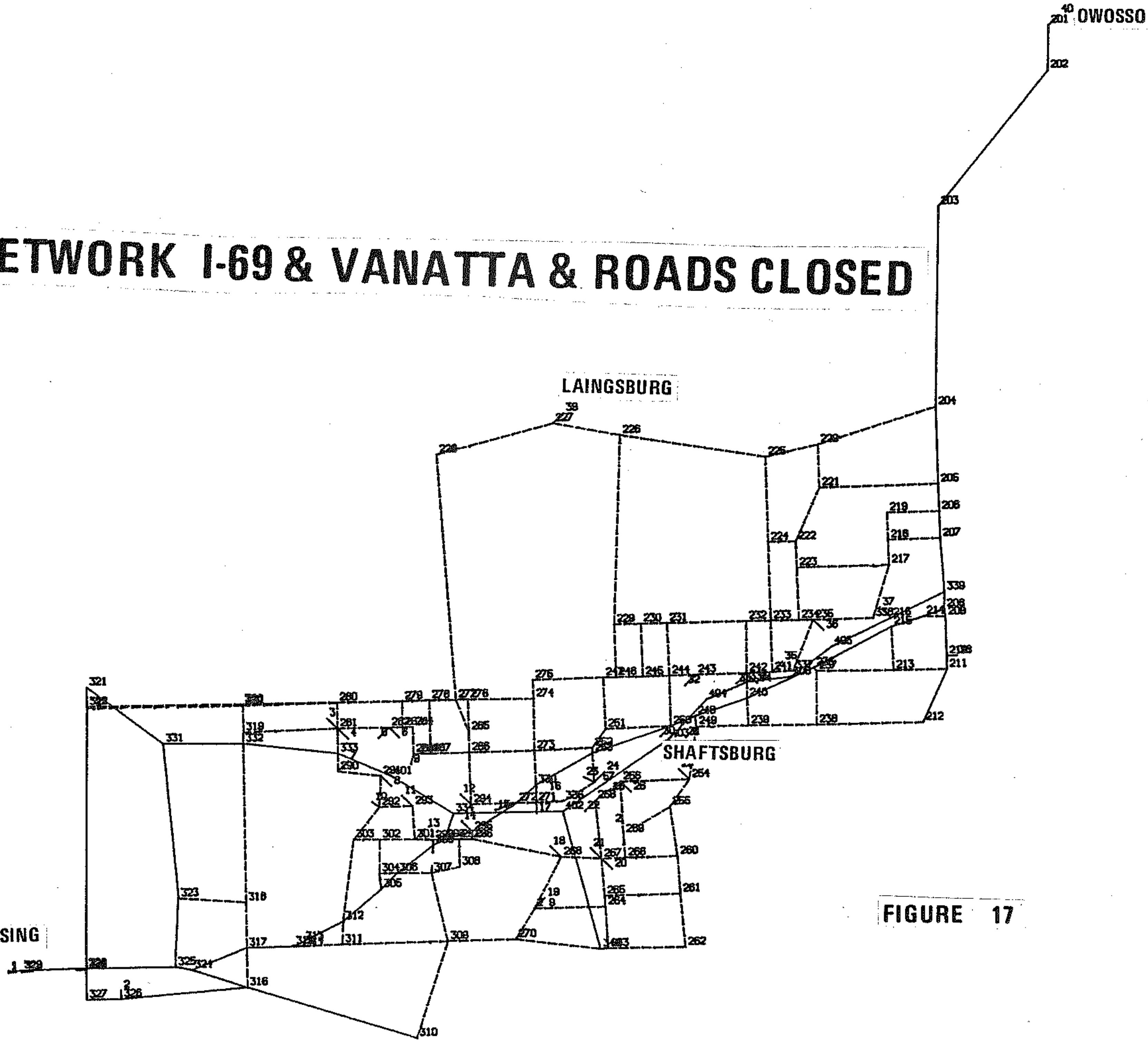


FIGURE 17

Department, Zone 39 - Laingsburg Fire Department, and Zone 40 - Owosso Memorial Hospital. Public health service locations appear in Figure 18.

Analysis of accessibility to residential neighborhoods (Zones 4-37) from the public service locations can be studied by plotting the shortest driving path from each of the service zones. The driving path from St. Lawrence Hospital (Zone 1) using all three alternate highway networks, to the residential zones adjacent to the proposed project alignments, appear in Figures 19, 20, and 21. Note that the path to Zone 39 changes from Figure 19 to Figure 21.

Tree plots of accessibility from the five other service zones could be accomplished with equal ease. Figures 22, 23, and 24 are plots for the Laingsburg Fire Department in Zone 39. The impact on these driving patterns change more dramatically since I-69 seems to impact north-south movements more than east-west movements as these plots indicate.

After the driving paths have been calculated and the plots completed, it is possible to sum up the actual driving time from each zone to every other using the computer program TP SKIM. This was done for the do nothing or existing network and each of the alternates. Once the driving times for all zones and all alternates was completed, the actual calculation of the accessibility on residential areas can be determined. This was done by subtracting the zone to zone time matrices. This resulted in a zone to zone matrix of the time lost or gained as the result of potential construction. Figure 25 contains this information for Zone 1, 22, and 39. Note that some residential zones become more accessible to public health service whereas others are disrupted as result of possible construction. The type of data appearing in Figure 25 is available for all zones but was not included in this report.

PUBLIC HEALTH SERVICE LOCATION MAP

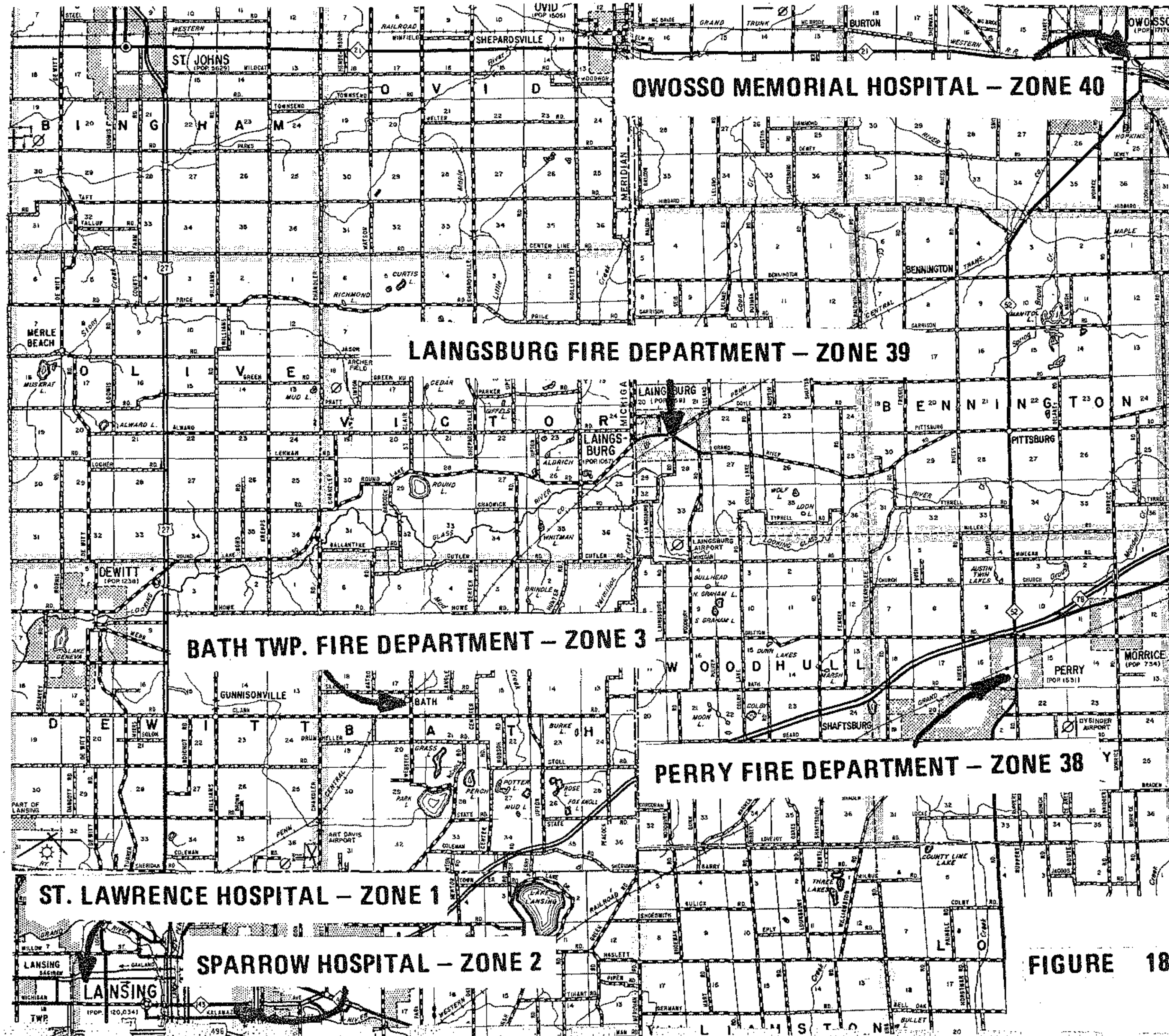


FIGURE 18

I-69 NETWORK – ACCESS FROM ZONE 1
ST. LAWRENCE HOSPITAL

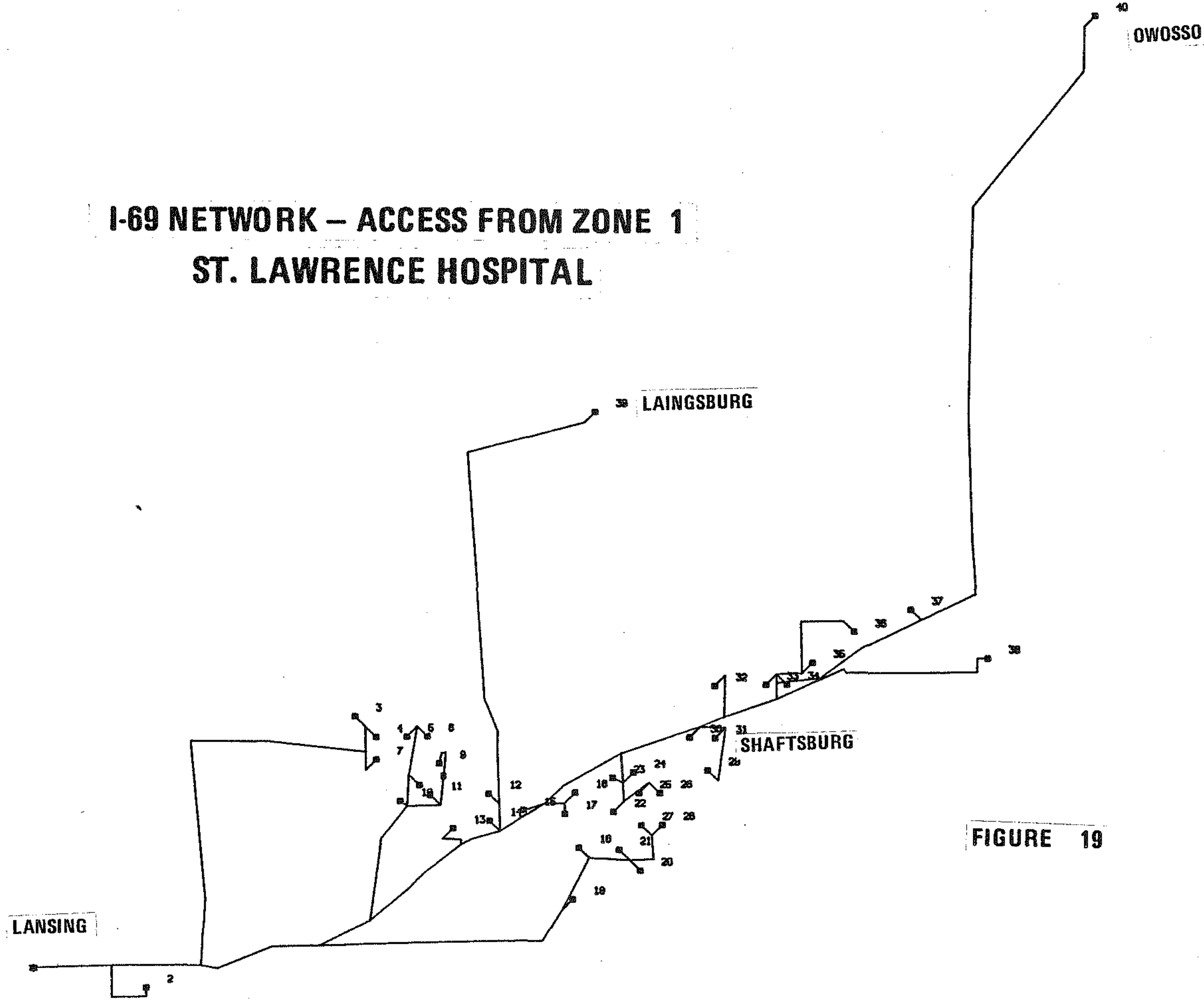


FIGURE 19

I-69 & VANATTA – ACCESS FROM ZONE 1
ST. LAWRENCE HOSPITAL

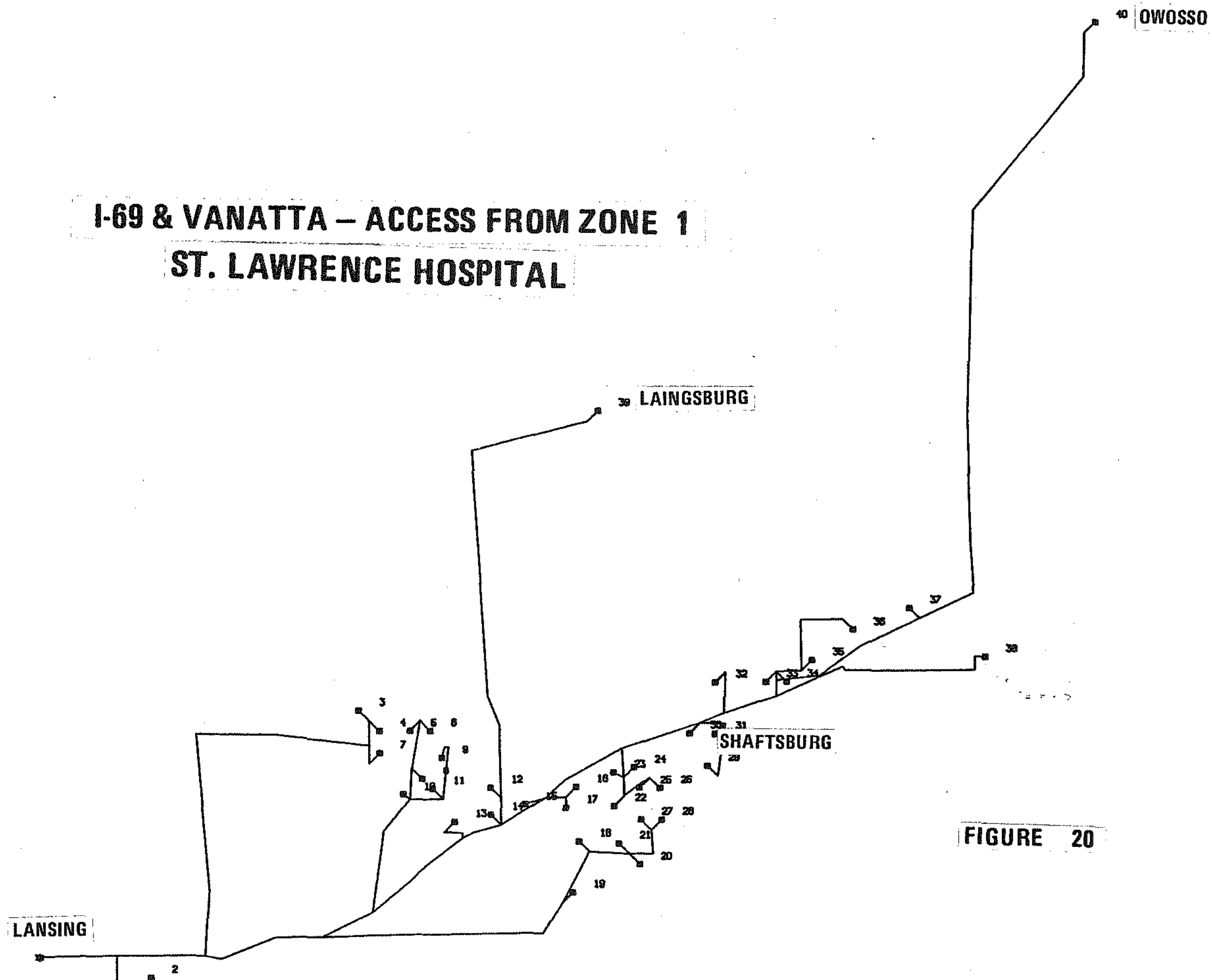


FIGURE 20

I-69 & VANATTA & ROADS CLOSED - ACCESS FROM ZONE 1

ST. LAWRENCE HOSPITAL

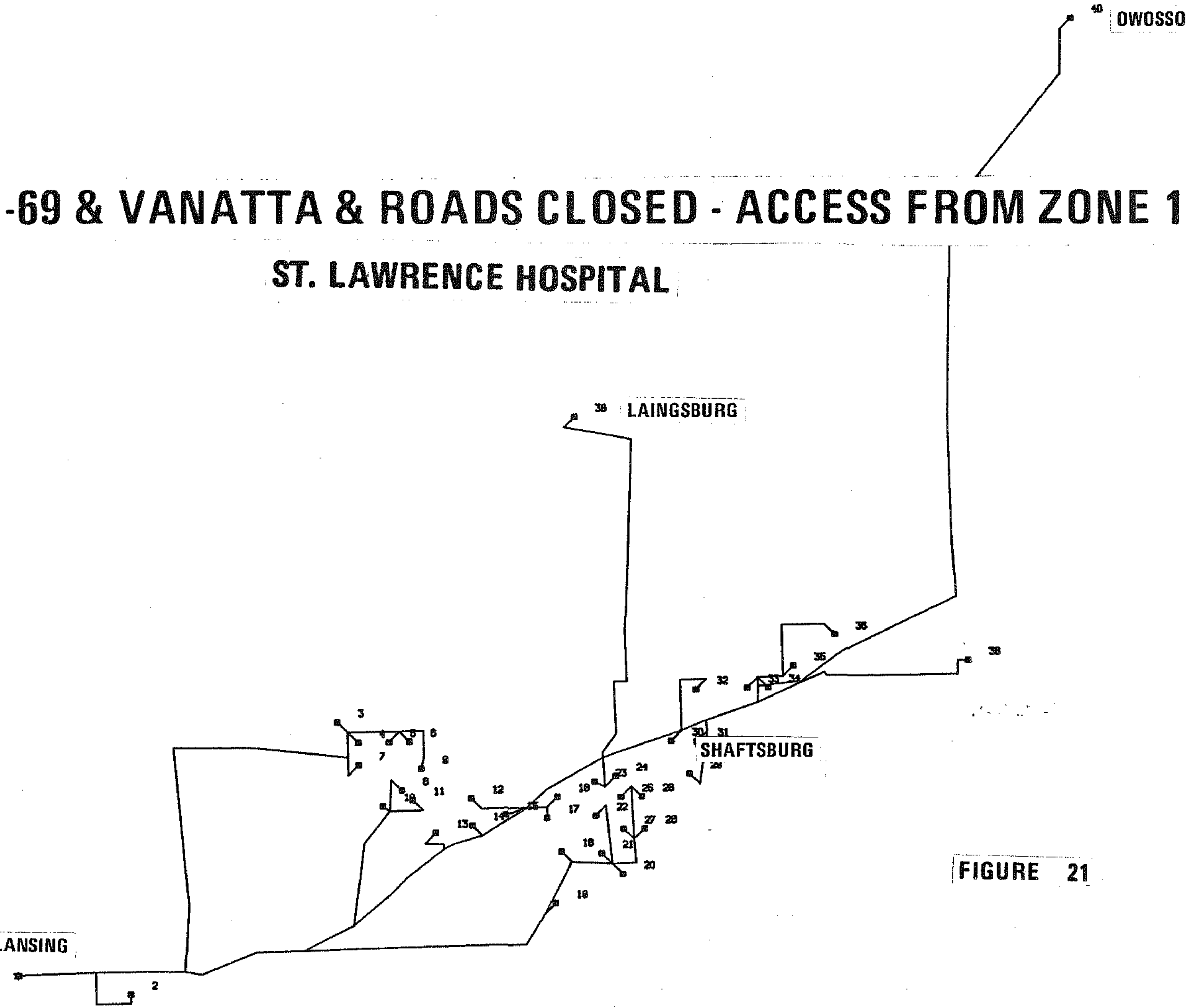


FIGURE 21

I-69-ACCESS FROM ZONE 39

LAINGSBURG FIRE DEPARTMENT

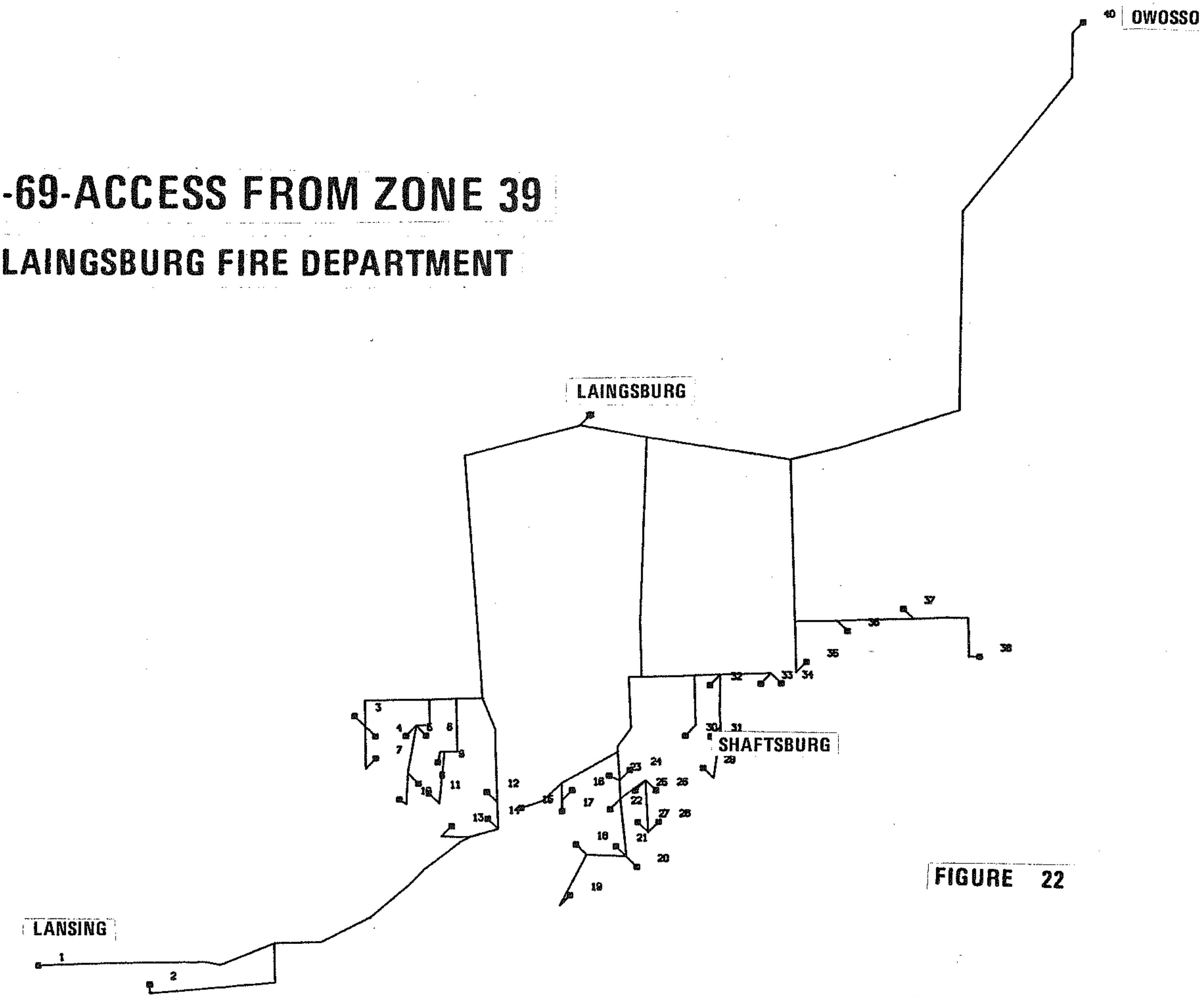


FIGURE 22

I-69 & VANATTA - ACCESS FROM ZONE 39

LAINGSBURG FIRE DEPARTMENT

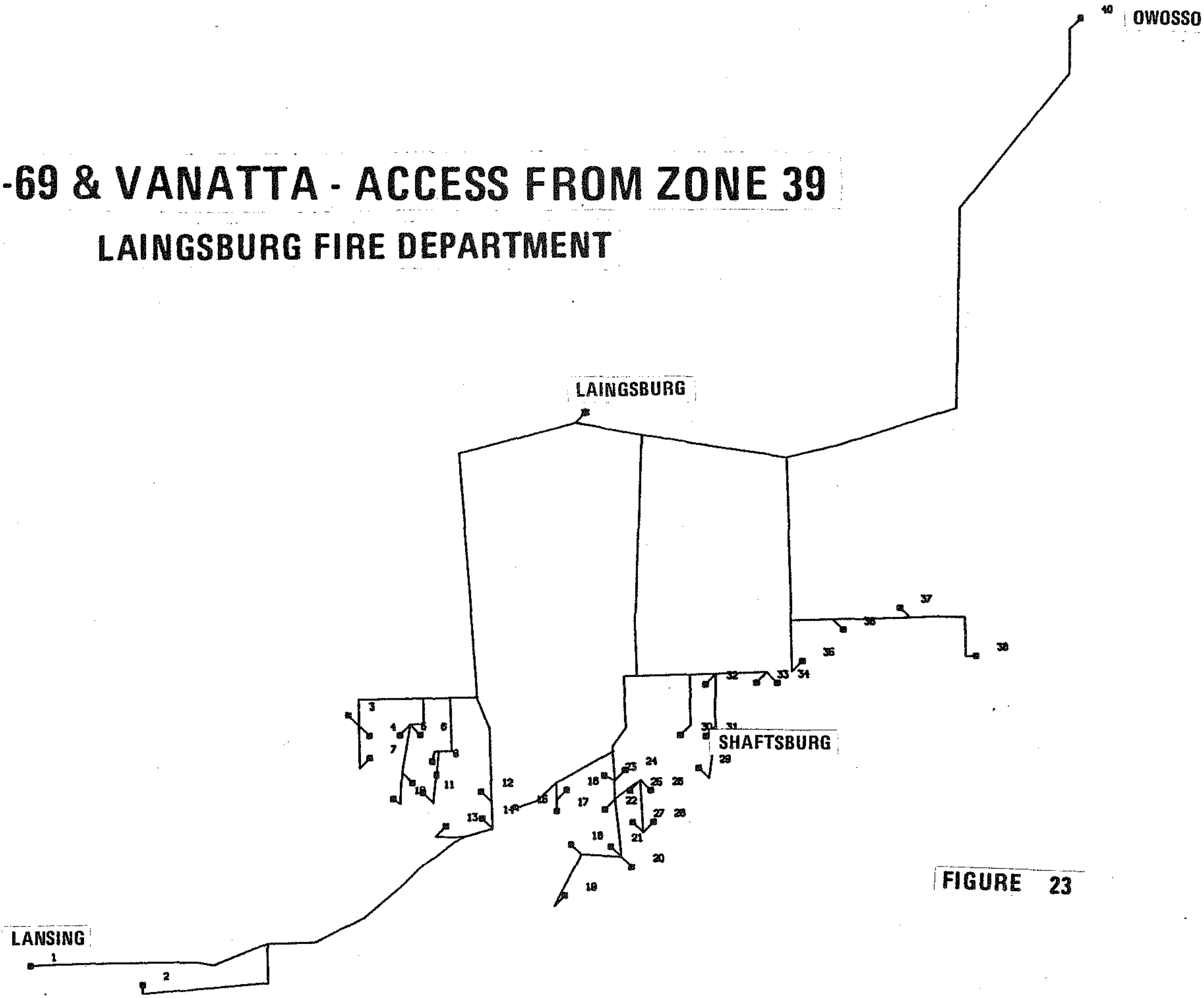


FIGURE 23

I-69 & VANATTA & ROADS CLOSED - ACCESS FROM ZONE 39

LAINGSBURG FIRE DEPARTMENT

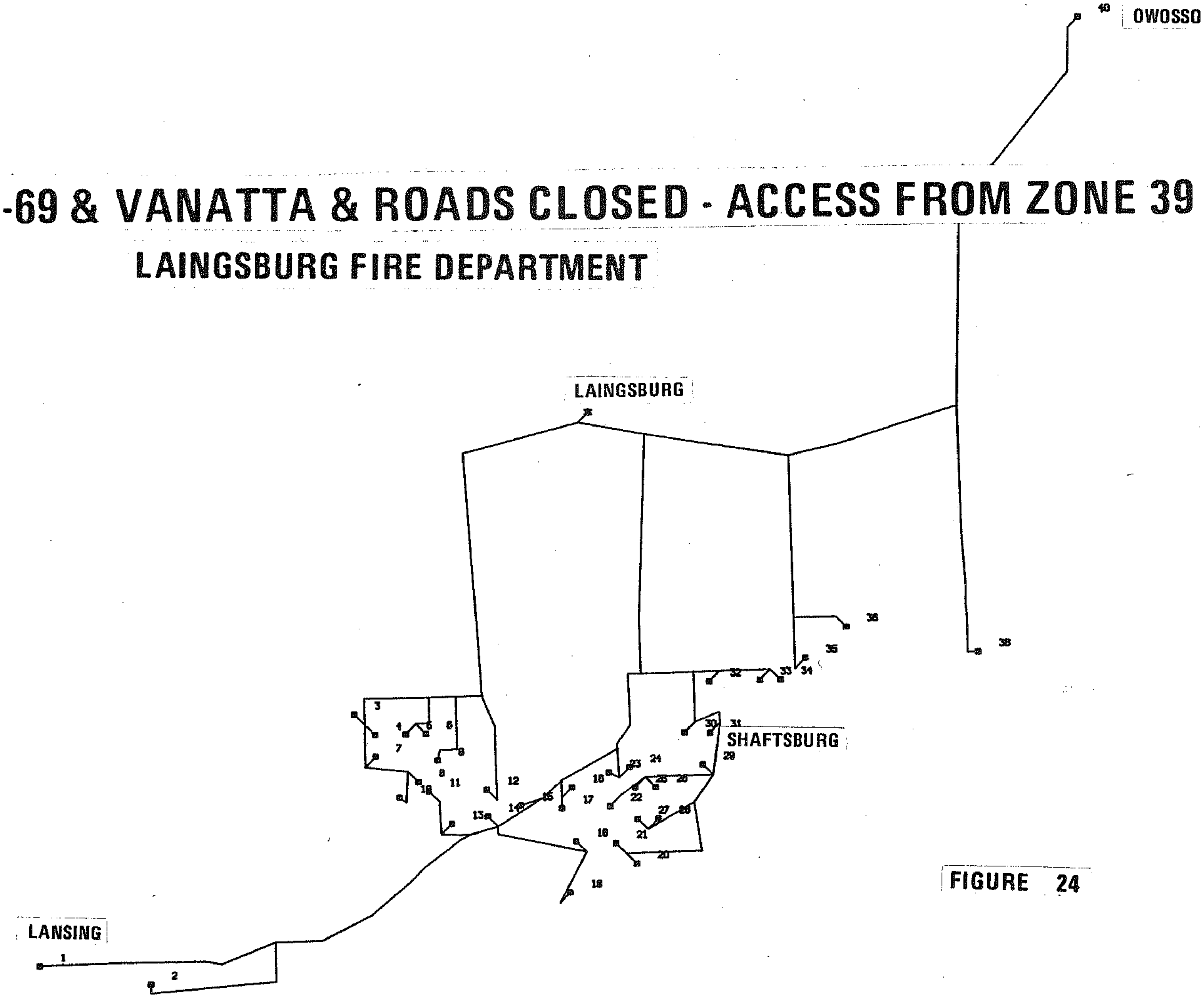


FIGURE 24

TRAVEL TIME SAVED OR LOST

25MAR76 ZONE MATRIX TIME SAVED I69 BYPASS & VAN ATTA VS DO NOTHING ROADS CLOSED PAGE 2

INTERCHANGE VALUES FROM ZONE 1 TO ALL OTHER ZONES TABLES NUMBER 101

	0	1	2	3	4	5	6	7	8	9
0		1	0	2	2	0	0	2	0	-1
1	0	0	-2	0	0	0	0	0	0	0
2	0	0	-2	0	0	-3	-3	0	0	0
3	0	0	-1	0	0	0	0	-2	0	0

TOTAL = -7 MEAN = -0.175

25MAR76 ZONE MATRIX TIME SAVED I69 BYPASS & VAN ATTA VS DO NOTHING ROADS CLOSED PAGE 23

INTERCHANGE VALUES FROM ZONE 22 TO ALL OTHER ZONES TABLES NUMBER 101

	0	1	2	3	4	5	6	7	8	9
0		-2	-2	-1	-1	-3	-3	-1	-2	-4
1	-3	-3	-4	-2	-2	-4	-5	-5	0	0
2	0	0	0	-7	-7	0	0	0	0	0
3	-3	-1	-3	-2	-2	-2	-2	-3	-1	-5
4	-2									

TOTAL = -87 MEAN = -2.175

25MAR76 ZONE MATRIX TIME SAVED I69 BYPASS & VAN ATTA VS DO NOTHING ROADS CLOSED PAGE 40

INTERCHANGE VALUES FROM ZONE 39 TO ALL OTHER ZONES TABLES NUMBER 101

	0	1	2	3	4	5	6	7	8	9
0		0	0	0	0	0	0	0	-1	0
1	-1	-1	0	0	0	0	0	0	-2	-3
2	-4	-4	-5	0	0	-3	-3	-2	-2	0
3	0	-1	0	0	0	0	0	0	-1	0

TOTAL = -33 MEAN = -0.825

FIGURE 25

The time saved or lost from Zone 1 to all other zones when the "do nothing" alternate is compared to the other three proposed alternates may also be plotted for any zone. As an example, the accessibility of St. Lawrence Hospital to all other zones appears in Figures 26, 27, and 28. Looking at these plots, minor impact occurred at Zones 3, 4, 7, 25, and 26 with a few minutes being saved in accessibility from St. Lawrence Hospital to these areas when both the I-69 bypass and the I-69 bypass with the VanAtta connector were compared to the "do nothing" alternate. The alternate with many road closings, also has a positive impact on these zones from Zone 1.

Once the user has acquired all of the impact plots, and driving time matrices, a systematic judgment could be made concerning the extent to which the three proposed highway projects affect the accessibility of the residential neighborhoods to health services. Hopefully, this type of analysis process will allow the department to quantify an impact analysis area which, in the past, has been basically left up to subjective conjecture.

CHANGE IN ACCESSIBILITY IN MINUTES FROM ZONE 1

WITH I-69 CONSTRUCTED

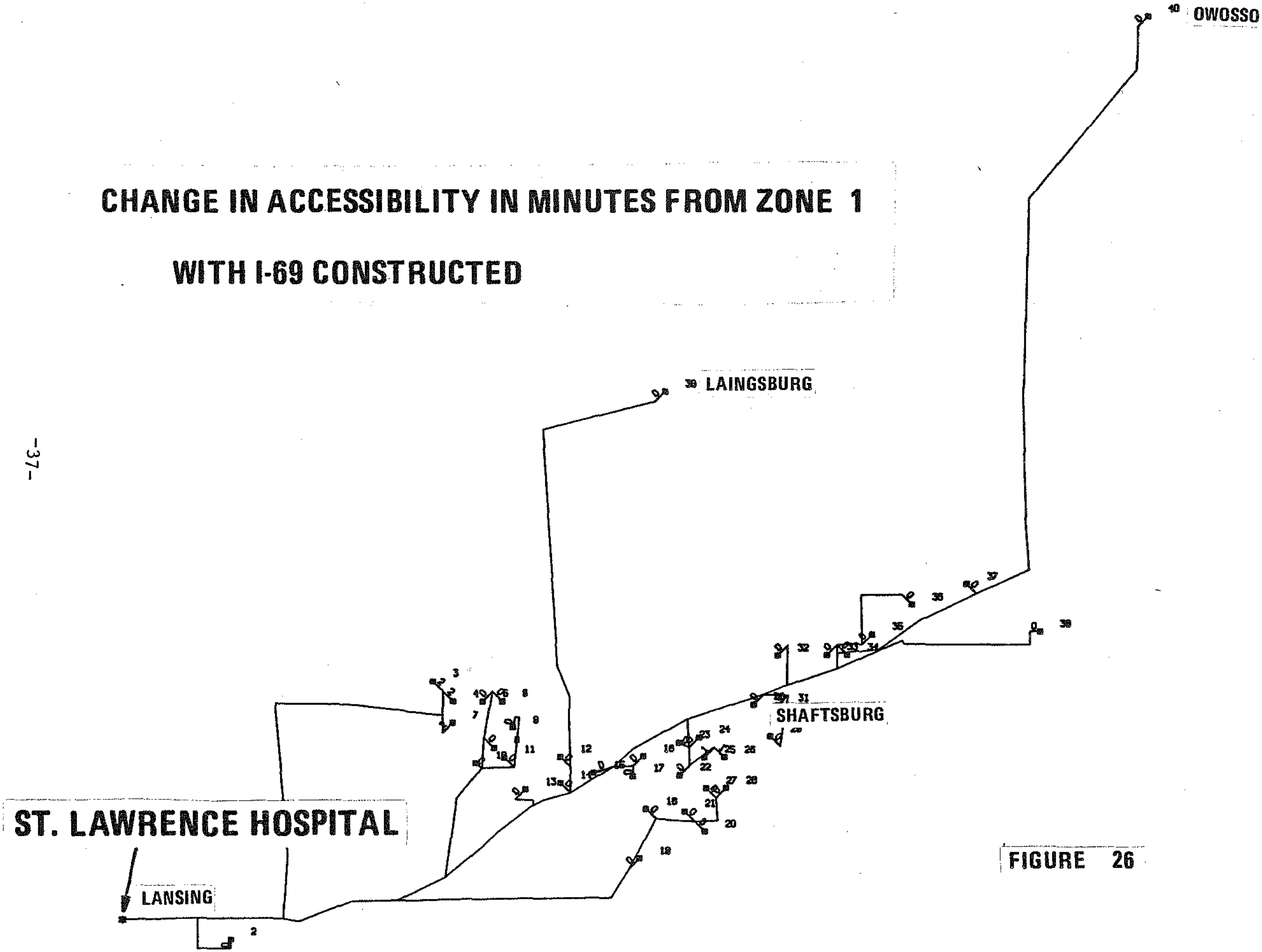


FIGURE 26

CHANGE IN ACCESSIBILITY IN MINUTES FROM ZONE 1

WITH I-69 & VANATTA CONSTRUCTED

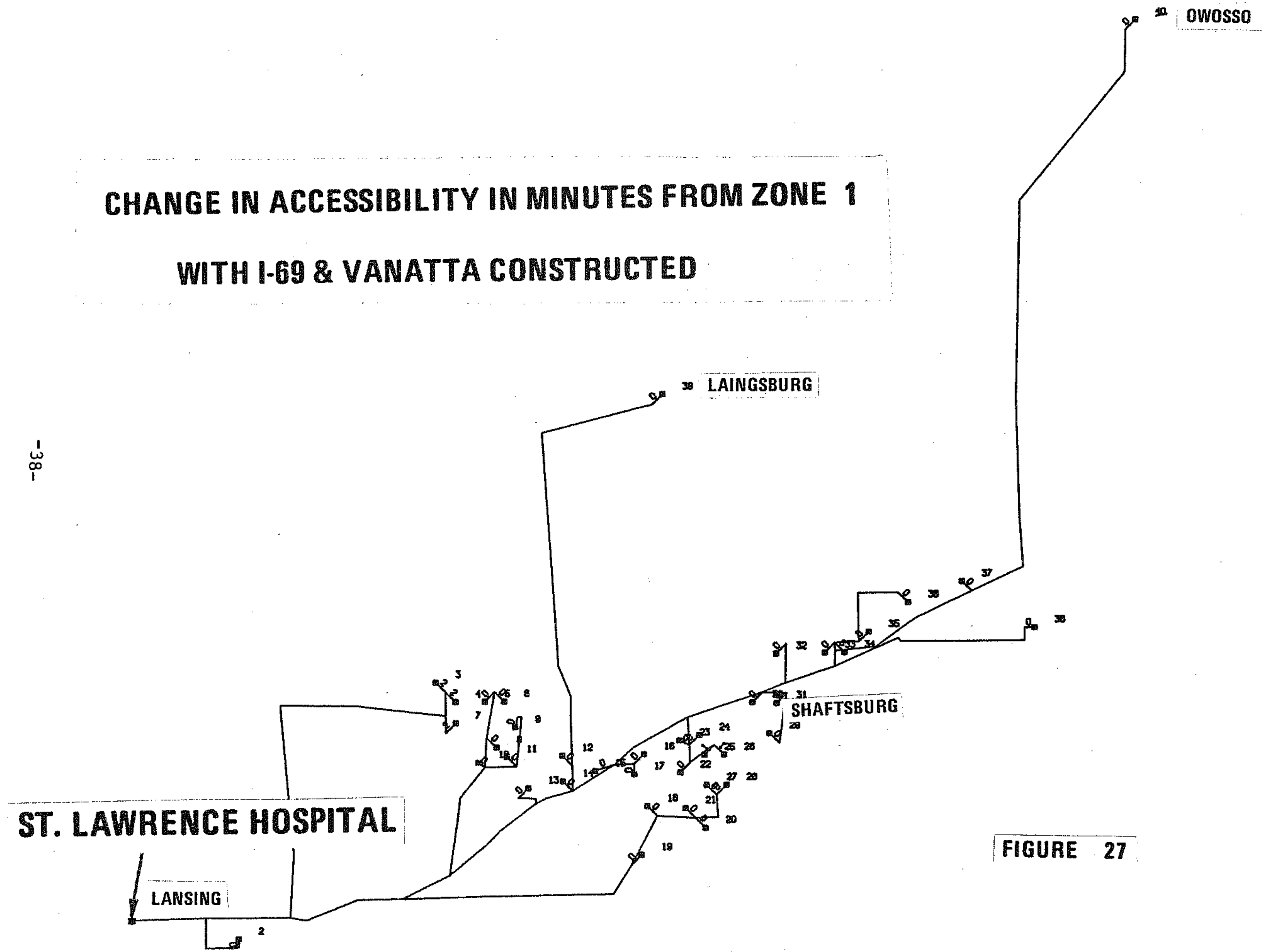


FIGURE 27

CHANGE IN ACCESSIBILITY IN MINUTES FROM ZONE 1 WITH I-69 & VANATTA & ROADS CLOSED CONSTRUCTED

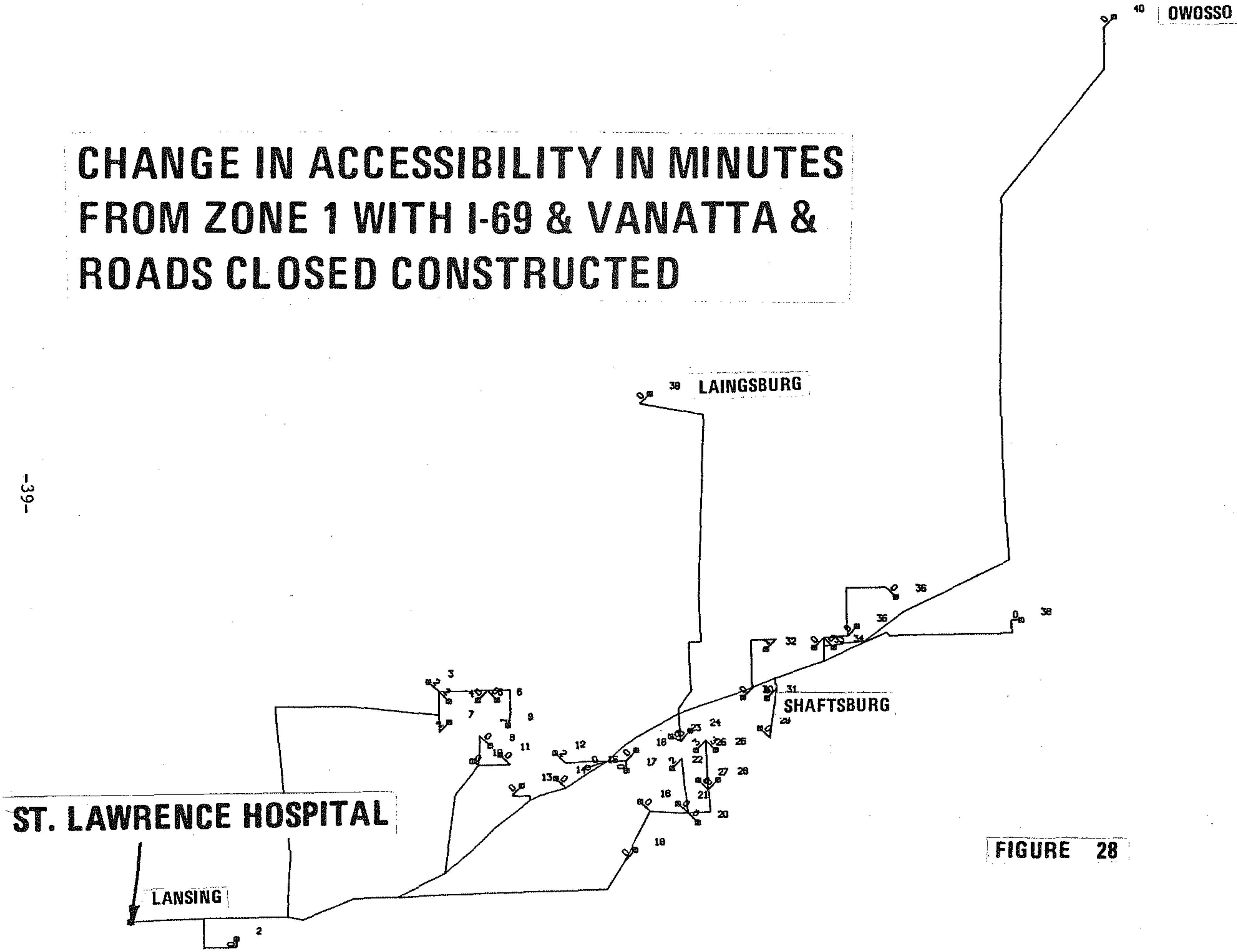


FIGURE 28

CONCLUSION

STATE WIDE

CONCLUSION

The impact a highway construction project might have on a residential neighborhood's accessibility to public services has often been the topic of much discussion. These discussions have frequently been lengthy and usually are centered around very subjective information. The process developed for the I-69 project and its impact on accessibility to public services can eliminate much of the time spent in discussion by quantifying the impact measurements.

The first two alternates in Figure 9 deal with a typical construction situation in rural areas while the third alternate was included to simulate an urban situation where many more cross roads might be closed. This was done to demonstrate the system application under both rural and urban circumstances. Figure 29 is a summary of the driving time gained or lost for each residential zone for all three alternates.

Using this summary information, the engineer responsible for the project can quickly evaluate the impact from the standpoint of which areas are adversely affected and also to what extent. As indicated previously, the impacts under an urban situation such as alternate three are much more extensive as most all zones experience time lost in accessibility to public services. With alternate one and two, some zones gain and others lose, but this is the quantifiable type of information that can shorten up the present decision making process.

TRAVEL TIME SAVED OR LOST

ZONE	ALTERNATE 1 I-69	ALTERNATE 2 I-69 & VANATTA	ALTERNATE 3 ROADS CLOSED
4	42	42	32
5	-1	-1	-26
6	-2	-2	-27
7	36	36	28
8	3	3	-14
9	-3	-3	-49
10	-3	-3	-21
11	-3	-3	-22
12	4	4	-43
13	0	0	-20
14	0	0	-10
15	0	0	-15
16	2	2	-25
17	2	2	-25
18	7	7	-25
19	1	1	-27
20	7	7	-35
21	7	7	-35
22	0	0	-87
23	4	4	-46
24	3	3	-46
25	-8	-8	-66
26	-9	-9	-66
27	-1	-1	-24
28	-1	-1	-24
29	7	7	0
30	7	7	-5
31	2	2	-12
32	0	0	-25
33	5	5	-1
34	5	5	-1
35	10	10	3
36	-5	-5	-14
37	15	15	-45

FIGURE 29