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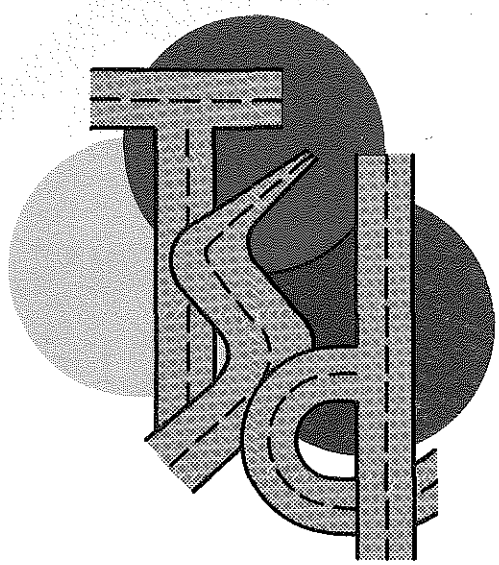
A TRAFFIC ACCIDENT ANALYSIS OF HIGH ACCIDENT LOCATIONS IN THE CITY OF ADRIAN

Report TSD-SS-191-71



TRAFFIC and SAFETY DIVISION

DEPARTMENT OF STATE HIGHWAYS
STATE OF MICHIGAN

65-9109

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A TRAFFIC ACCIDENT ANALYSIS OF HIGH ACCIDENT LOCATIONS IN THE CITY OF ADRIAN

Report TSD-SS-191-71

by

GLEN R. ETELAMAKI

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June, 1972

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Michigan Department of State Highways

in cooperation with

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and
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National Highway Traffic Safety Administration

"The opinions, findings and conclusions expressed in this publication are those of the authors and not necessarily those of the State or U.S. Department of Transportation, National Highway Traffic Safety Administration."

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INTRODUCTION

The Highway Safety Act of 1966 was enacted by the Congress of the United States in order to promote highway safety programs. Subsequently, various highway safety standards were developed to assure the orderly implementation of the Act.

Highway Safety Standard 4.4.9, Identification and Surveillance of Accident Locations, is one of those standards. The purpose of Standard 4.4.9 is to identify specific locations or sections of streets and highways which have high or potentially high accident experience as a basis for establishing priorities for improvement, selective enforcement or other operational practices that will eliminate or reduce the hazards at the location so identified.

The State of Michigan carries out a program of this type on the state trunkline system; however, many of the State's city and county agencies lack the financial and technical prerequisites necessary to pursue similar programs with similarly defined objectives. To insure that this additional Highway Safety Standard is met and to improve the overall evaluation of the accident picture in Michigan, the Michigan Department of State Highways requested and received through the Office of Highway Safety Planning in the Department of State Police a federally funded project entitled, "Traffic Accident Analysis

for Cities and Counties". The intent of this new project is to provide a special traffic engineering field service for cities and counties. In cooperation with participating cities and counties, the proposed service, under the direction of Department personnel, will make a traffic engineering evaluation of the factors causing traffic accidents and will recommend corrections to those conditions which may be contributing to accidents.

SCOPE

The intent of this program is to improve traffic safety on all Michigan streets and roads by expanding the traffic engineering evaluation of factors causing accidents. This should be accomplished by conducting traffic accident analysis of locations which experience high accident frequencies, and summarizing recommendations for corrective action.

STUDY PROCEDURES

The study procedures for the subject project involve several distinct phases. They may be described as follows: basic data collection, identifying and locating high accident locations, an accident analysis of these high accident locations, technical evaluation of previously compiled facts and consequent remedial recommendations.

Since a portion of the data collection phase involves accident records and reports, and since the Michigan Department of State Police is responsible for keeping all accident records in Michigan, the task of identifying and

locating high accident locations in the City of Adrian (and providing an inventory of those locations) was designated as State Police responsibility. Since there is no automated system of locating accidents on the city street system, the high accident locations for the City of Adrian were determined by manually extracting and compiling those locations with the highest number of accidents from the 1968 city accident reports. From this list the 21 highest accident locations were selected. Once the problem locations were identified, additional accident information for the years 1966, 1967, 1969 and 1970 was compiled in order to expand the accident base at each location. Upon completion of this portion of the data collection, the Department of State Police documented and transmitted to the Traffic & Safety Division of the Department of State Highways a list, along with the accident reports, of the high accident locations for the City of Adrian.

The second portion of the data collection phase, which is the responsibility of the Department of State Highways, involves data collection utilizing the following basic steps: 1) preparation of collision diagrams, and if necessary, physical condition diagrams for each selected location, 2) obtaining traffic counts where necessary.

The accident analysis phase involves the analysis of the summarized facts and field data from the viewpoint of a highway traffic engineer with special attention focused on the

effect which the highway environment may have had on the accident. Thus, at each high accident location, individual accident reports were reviewed in detail and the accident factors were tabulated and grouped in various tables. Collision diagrams were prepared for each location in order to identify accident patterns and to locate the accident in relation to the intersection or approaches to the intersection.

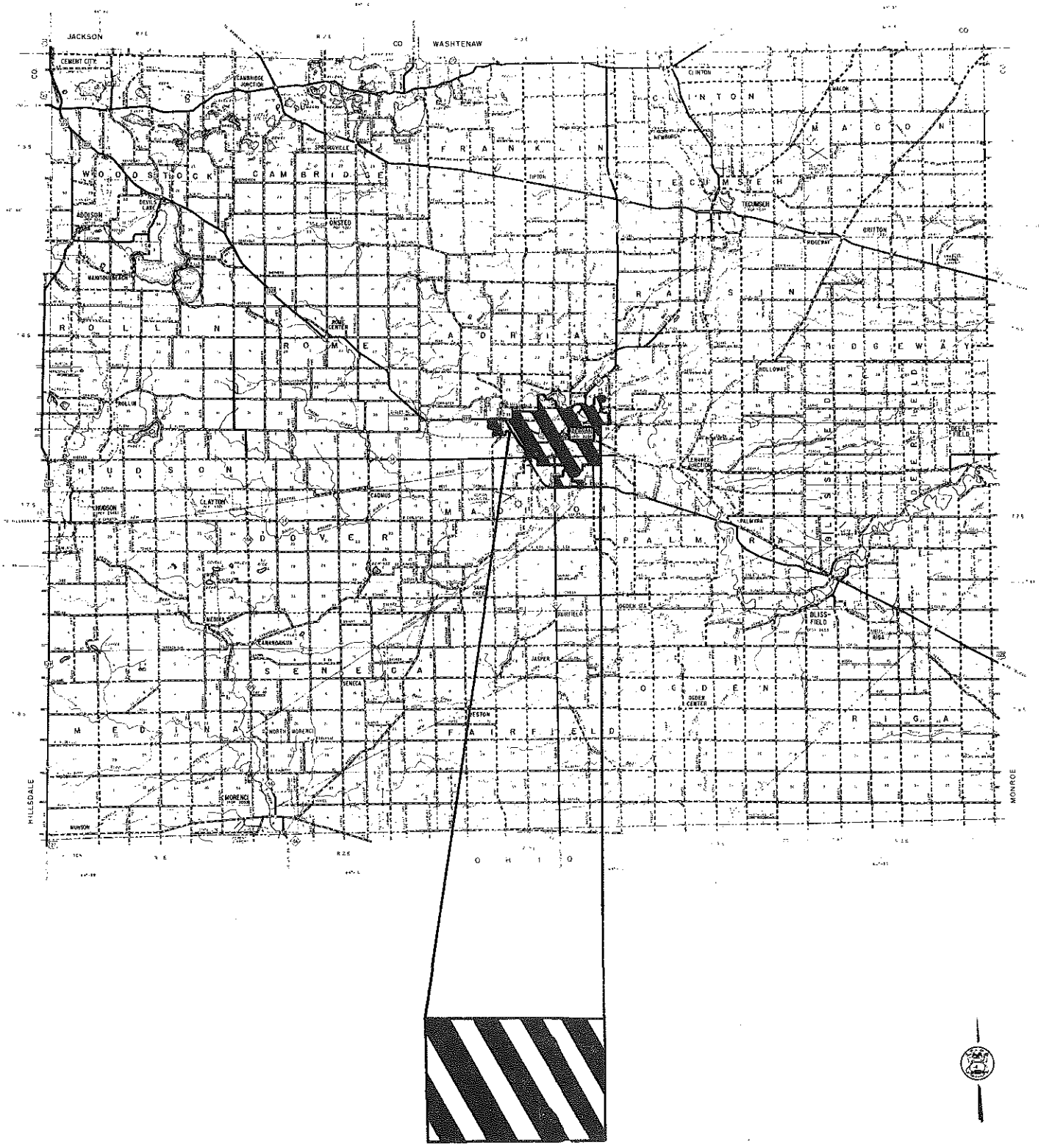
The traffic engineering analysis phase involved evaluating the summarized facts and field data and prescribing the proper remedial treatment.

STUDY AREA

The City of Adrian is located near the geographic center of Lenawee County in southeastern Michigan (See Figure 1, p. 5). It is 60 miles southwest of Detroit and 35 miles northwest of Toledo. Adrian is the largest city and also the county seat of Lenawee County.

Adrian is the intersecting point of three state trunkline routes; M-34, M-52 and US-223. M-34 is an east-west route from Adrian to the City of Hillsdale, M-52 is a north-south route from the Ohio border to the City of Saginaw, and US-223 extends northwesterly from Toledo to its termination at US-127 ten miles south of the City of Jackson. Three railway systems also serve Adrian with a total of 16 daily freight trains. The systems included are Norfolk and Western; New York Central; and Detroit, Toledo and Ironton. The Norfolk and Western Railroad also has daily passenger service. Lenawee County's Airport is located two miles south of Adrian

FIGURE 1



STUDY AREA
CITY OF ADRIAN

GENERAL HIGHWAY MAP
LENAWEE COUNTY
MICHIGAN
STATE HIGHWAY COMMISSION
DEPARTMENT OF STATE HIGHWAYS

and serves as the base for a number of charter and private aircraft.

Population tends to be active and dynamic, and Adrian's population is no exception. Adrian's population doubled from 1900 to 1960, with the largest growth between 1940 and 1950 (See Figure 2). From 1960 to 1970 Adrian experienced its smallest growth in nearly a century. However, the surrounding townships experienced a substantial growth, reflecting the national trend toward suburban growth. Adrian's population will continue to grow, but at a lesser rate as evidenced by Figure 2.

Providing Adrian with a stable economic base are the agricultural, industrial and tourism businesses. Lenawee County is one of Michigan's principle agricultural counties; thus, Adrian is the center of a rich agricultural and dairy area. Approximately 86% of the total land area in Lenawee County is in farms; a larger percentage than any other county in Michigan. For selected crops, Lenawee County ranks first in corn; second in soybeans; third in oats; and fifth in winter wheat production in Michigan. The net value of crops produced in Lenawee County is $12,500,000.

The Adrian area has 59 industries employing approximately 4,000 persons. The principle industries in aluminum, auto parts, paper products, laboratory equipment, woodworking, and plating provide an average total weekly wage of nearly $555,000. The community looks favorably to new industry of all types and offers industrial sites from 1 to 300 acres in

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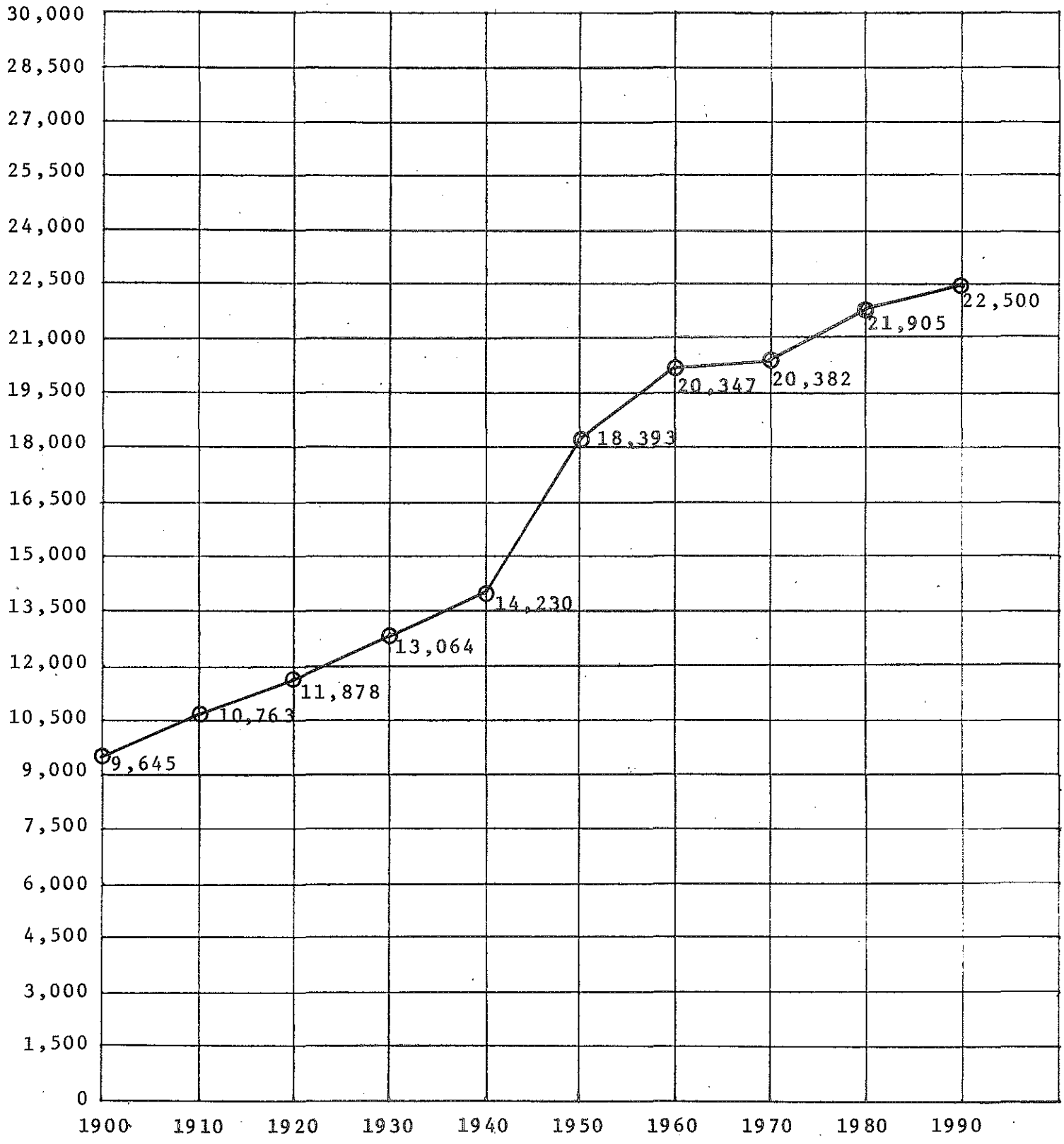
FIGURE 2

CITY OF ADRIAN

POPULATION CHART



area. Adrian also offers an adequate supply of skilled and production workers which further enhance future industrial growth in the area.

There are two fine four-year colleges in Adrian. Adrian College, which is a Methodist sponsored school, has an enrollment of about 1,600 students; while Siena Heights College, which is a Catholic sponsored school, has an enrollment of about 800 students.

Surrounded by more than 55 lakes in the county, Adrian is also the center of a summertime tourist industry. The City of Adrian has two large municipal parks of 28 and 25 acres, as well as five minor parks of two acres each. The Lenawee Country Club provides residents and visitors with some of the finest golfing in Michigan. Two other public golf courses are within easy driving range of Adrian.

The Nineteenth Annual Progress Report compiled by the Local Government Division of the Michigan Department of State Highways shows that the City of Adrian has a total of 69.76 miles of streets. This includes 4.65 miles of state trunkline, 24.27 miles of major streets, and 40.84 miles of local streets (See Figure 3).

STATE OF MICHIGAN

DEPARTMENT OF STATE HIGHWAYS

CITY OF ADRIAN

ROAD SYSTEM

- STATE TRUNK LINE
- COUNTY PRIMARY
- COUNTY LOCAL
- ADJACENT COUNTY OR CITY
- CITY OR VILLAGE MAJOR ST.
- CITY OR VILLAGE LOCAL ST.
- CITY OR VILLAGE OFFICES

FIGURE 3

TRAFFIC ENGINEERING ANALYSIS

The traffic engineering phase of any accident analysis study involves the evaluation of facts which are summarized from each accident report as well as data obtained from field investigation, and from these sets of data recommend proper remedial treatment. One of the primary tools used in this type of analysis is a graphic representation of accidents on either a spot collision diagram or a strip map which is used to locate the accident and determine definite accident patterns. Another useful tool the traffic engineer uses in the analysis of accident data is the summarization of accidents by types, wet or dry pavement and dark or light conditions. These tools are the engineering techniques used in trying to eliminate the causes of accidents.

There are, however, cases where an accident pattern does not exist, and often these collisions are caused by one or more driving hazards such as inclimate weather, drinking drivers, defective equipment or excessive speed. In these cases the accident causes lie outside the jurisdiction of the traffic engineer and fall within the area of enforcement. In this instance the traffic engineer can offer specific information to the enforcing agency and request their cooperation in increasing the safety of problem areas.

The traffic engineering analysis for the City of Adrian began when the Michigan Department of State Police, after compiling the accident data for the city streets in Adrian,

transmitted to the Michigan Department of State Highways 21 high accident locations (See Figure 4). A review of these locations shows that 11 of the locations were signalized, two had flashers and the remaining eight were controlled by "Stop" signs.

Four of the 11 signalized locations have only one signal head, while the remaining seven had dual signal heads. The MICHIGAN MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES states that a minimum of one overhead vehicular signal face per approach is required at any signalized location. However, it is strongly recommended that at least two vehicular signal faces be provided per approach for the following reasons:

1) Two (or more) properly located overhead faces will in almost all cases provide drivers with a signal indication even though trucks or buses may momentarily obscure one signal face.
2) Multiple faces provide a safety factor where the signals must compete with a brilliant background such as advertising signs or the sun.
3) The occasional lamp failure in one face will not leave an approach without any signal indication.

(See Part IV, Section B, pp. 326-327 of the MICHIGAN MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES, Appendix II, pp. 146 and 147.)

The cost of extra signal heads may not be economically feasible at this time, but it would be advantageous to employ dual signal heads as funds become available.

STATE OF MICHIGAN

DEPARTMENT OF STATE HIGHWAYS

CITY

OF

ADRIAN

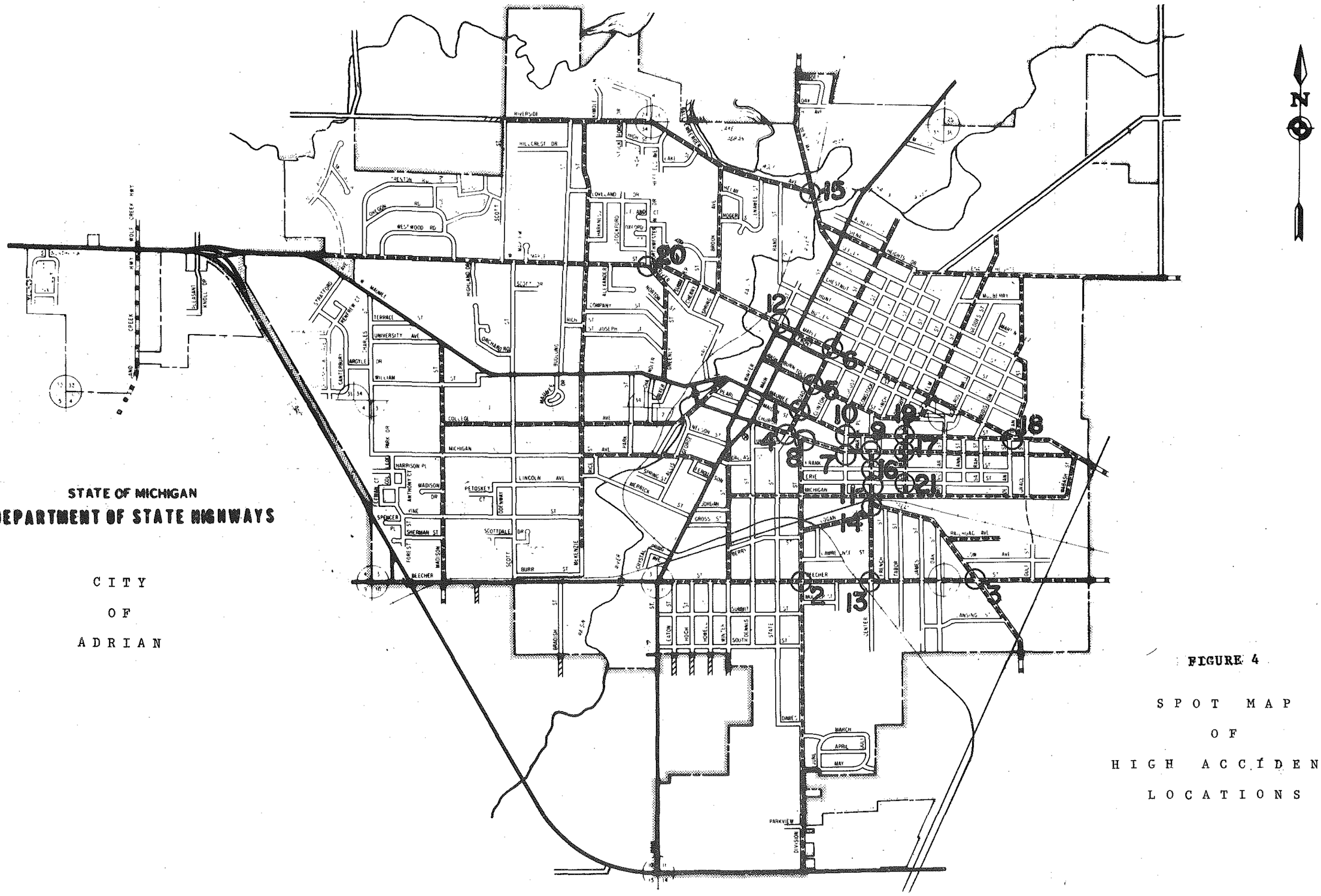


FIGURE 4

SPOT MAP

OF

HIGH ACCIDEN

LOCATIONS

To improve capacity and possibly reduce the incidence of rear end accidents at all the signalized intersections, it is recommended that at least three parking spots be removed on both sides of each leg of the intersection.

From the Spot Map (See Figure 4, p. 12) it is evident that nine of the 21 high accident locations are on the paralleling east-west streets, Church and Maumee. These streets serve as access routes from the east side of the city and beyond, to the Central Business District. From Main Street, Church Street is one-way eastbound one block to Broad Street and Maumee Street is one-way westbound from Broad Street to Main Street. Considering these facts, it appears to be advantageous to extend the one-way system on Church and Maumee Streets to their intersection at the east city limits. This change could be made with relative ease, as the eastern terminus of the two streets is a "Y" intersection which is the most functional beginning or ending to a one-way system.

Some advantages of such a system are:

1) Increased capacity,
2) Increased overall travel speed,
3) Reduction of accidents (a typical two two-way intersection has 16 intersecting conflicts while the same intersection operating as one one-way and one two-way has only 7 intersecting conflicts), and
4) Relatively minor change-over costs.

Some disadvantages of such a system are:

1) Farther travel for some motorists to reach certain locations,

2) Confusion to unfamiliar drivers,

3) Additional signing required, and

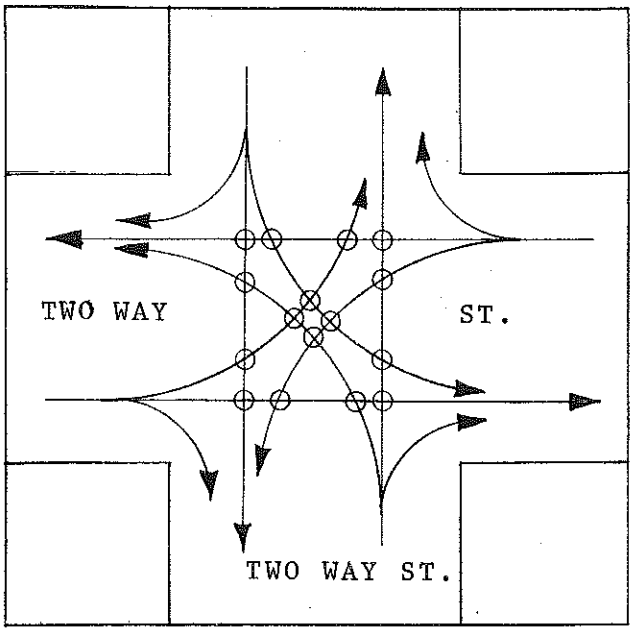
4) Increased weaving.

Figures 5 and 6 show the reduction in intersecting conflicts when one street at an intersection is changed to one-way operation. A typical four-legged intersection has a reduction from 16 to 7 conflicts and a "T" intersection has a reduction from 3 conflicts to one conflict. On Church and Maumee Streets there are 14 four-legged intersections and 12 "T" intersections; therefore, the number of conflicts would be reduced from 260 to 110 by converting to a one-way system.

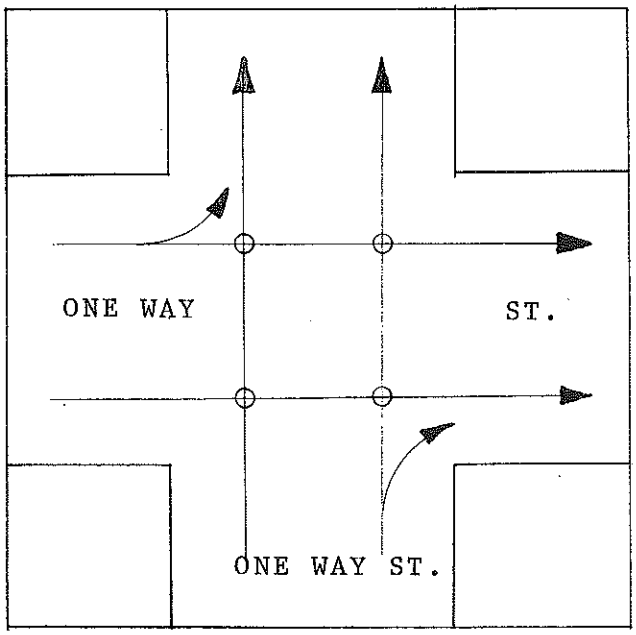
At the nine locations on this proposed system, there may have been 81 fewer accidents had they been one-way during the five-year study period. This is 23% of the total 352 accidents at these locations.

The new MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES has revised pavement markings as shown in Appendix II, pp.144 and 145. To comply with these changes the city should, on the next application of pavement markings, follow the guidelines set forth in the new MANUAL and illustrated in Appendix II.

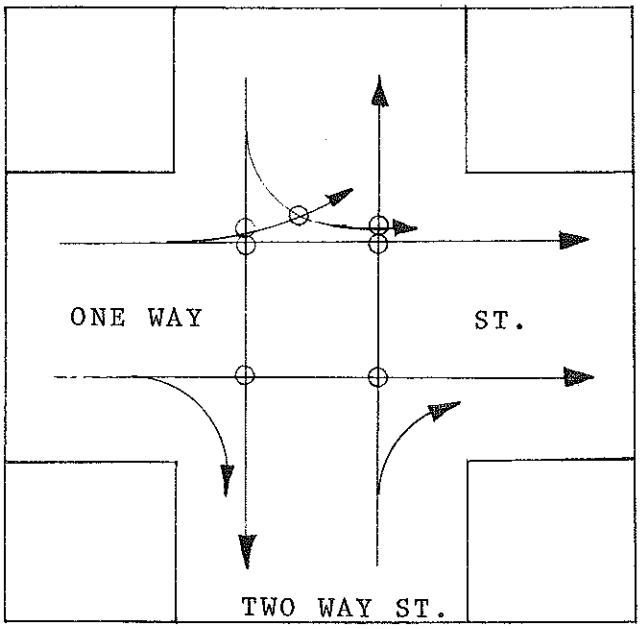
Further analysis of the 21 high accident locations in the city revealed that no recommendations could be made for four locations. There were no accident patterns at these four locations and no present or potential serious driving hazards which could be eliminated or controlled by traffic engineering. This report will discuss in detail only the remaining 17 locations. The collision diagrams and pictures for each of these



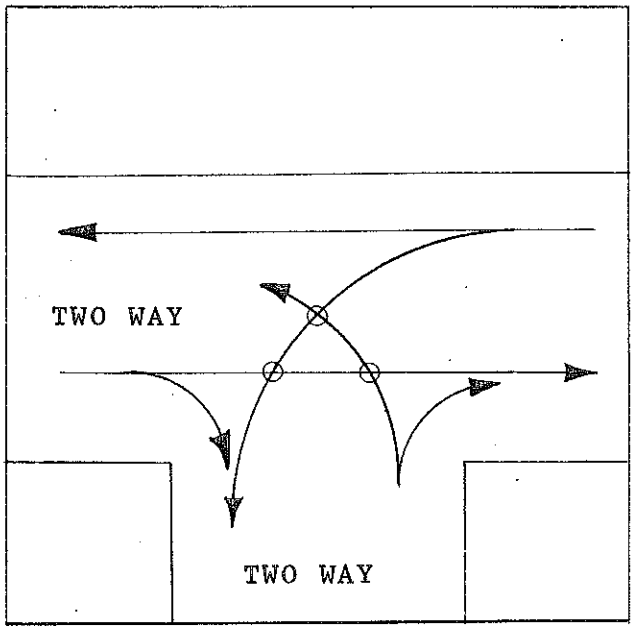
2 "TWO-WAY" STREETS
12 BASIC MOVEMENTS-16 INTERCEPTING CONFLICTS



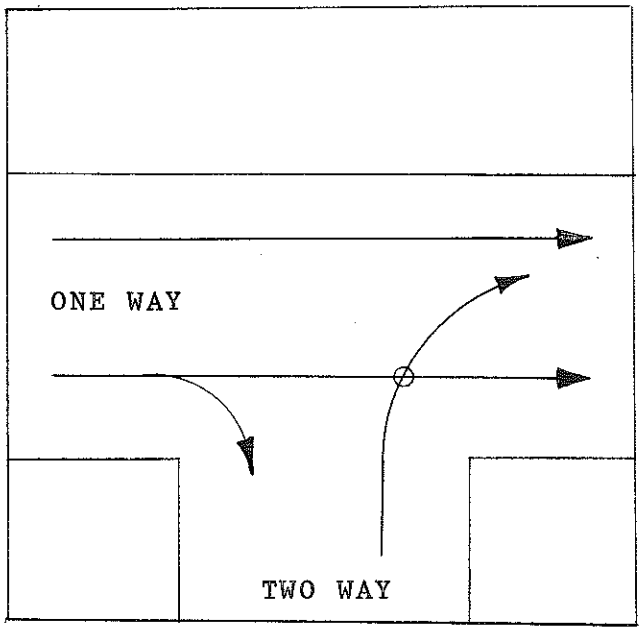
2 "ONE-WAY" STREETS
4 BASIC MOVEMENTS-4 INTERCEPTING CONFLICTS



1 "ONE-WAY" AND 1 "TWO-WAY" STREET
7 BASIC MOVEMENTS-7 INTERCEPTING CONFLICTS



2 - "TWO-WAY" STREETS
6 Basic Movements - 3 Intercepting Conflicts



1 - "ONE-WAY" and 1 - "TWO-WAY" STREETS
3 Basic Movements - 1 Intercepting Conflict

will be found on the page following the discussion. The collision diagrams and pictures for the remaining four locations will be found in Appendix I.

Additional statistical information was collected on traffic accidents in the City of Adrian for the period 1966 through 1970. This information, which may be a valuable tool in selective enforcement, is contained in Tables 1 through 8.

Table 1 shows that there was a total of 5,865 accidents in the city during the five-year study period. City streets accounted for 3,850 of the accidents; while the 21 study locations had 739 accidents during the five-year study period.

The information summarized in Table 2 shows that the peak accident month was December at the 21 study locations. Table 2 also shows that the peak accident day was Friday and that approximately 48% of the accidents occurred during the weekend period; Friday, Saturday, and Sunday.

Table 3 indicates that there were two fatal accidents, 171 personal injury accidents, and 566 property damage accidents, during the five-year study period, at the 21 study locations. It also shows that 29.1% (215) of the accidents occurred at night.

Table 4 shows that the peak accident hour was 3:00 to 4:00 P.M. (9.61%) while the next highest hour was 4:00 to 5:00 P.M. (9.34%). Tables 5 and 6 show the age and residence of drivers; while Tables 7 and 8 show the weather and pavement conditions at the 21 study locations.

TABLE 1

Reported Traffic Accidents in the City of Adrian

Year	Total	City Street	Property Damage	Injury	Fatal	Persons Injured	Persons Killed
1966	1,229	864	953	273	3	379	3
1967	1,072	734	857	215	0	337	0
1968	1,224	839	961	260	3	379	3
1969	1,231	770	956	274	1	406	1
1970	1,109	643	872	237	0	349	0

COMPARISON OF ACCIDENT FREQUENCY

Year	Adrian City Streets	Lenawee County Roads	Total Accidents State of Mich.
1966	864	824	302,880
1967	734	678	299,004
1968	839	904	305,495
1969	770	964	331,223
1970	643	950	313,715

PERCENTAGE CHANGE FOR ABOVE TOTALS

Year	Adrian City Streets	Lenawee County Roads	Total Accidents State of Mich.
1966-67	-15.1	-17.7	-1.3
1967-68	14.3	33.3	2.2
1968-69	-8.2	6.6	8.4
1969-70	-16.5	-1.4	-5.6

ACCIDENT ANALYSIS

Table 2

MONTHLY AND DAILY ACCIDENT OCCURRENCE

TWENTY ONE HIGH ACCIDENT LOCATIONS

IN THE CITY OF ADRIAN

Period Studied: 1966 through 1970

Month	Day of the Week							Monthly Total	% Of Total
	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.		
January	9	6	8	7	18	13	9	70	9.47
February	8	11	7	8	14	14	7	69	9.34
March	9	12	3	7	9	10	4	54	7.31
April	9	4	8	8	12	15	5	61	8.25
May	7	6	4	14	14	8	12	65	8.80
June	6	7	4	5	10	7	5	44	5.95
July	9	11	8	6	12	11	4	61	8.25
August	7	5	3	4	10	8	3	40	5.41
September	9	9	8	7	7	8	8	56	7.58
October	8	6	11	6	16	8	12	67	9.07
November	11	10	14	9	11	9	5	69	9.34
December	10	13	11	11	15	14	9	83	11.23
Day Total	102	100	89	92	148	125	83	739	100.00
% of Total	13.80	13.53	12.04	12.45	20.03	16.92	11.23	100.00	

Peak Accident Day: Friday

Peak Accident Month: December

ACCIDENT ANALYSIS

Table 3

ANNUAL ACCIDENT SUMMARY

TWENTY ONE HIGH ACCIDENT LOCATIONS

IN THE CITY OF ADRIAN

Period Studied: 1966 through 1970

Accident Type	Day	Night	Total
Fatal Accident	0	2	2
Personal Injury Acc.	116	55	171
Property Damage Acc.	408	158	566
Total	524	215	739

* * * * * * * *

Month	Fatal		Injury		Prop. Damage		Sub. Total		Total
	Day	Night	Day	Night	Day	Night	Day	Night	
January	-	1	8	3	45	13	53	17	70
February	-	1	9	10	31	18	40	29	69
March	-	-	7	2	35	10	42	12	54
April	-	-	7	4	32	18	39	22	61
May	-	-	18	3	39	5	57	8	65
June	-	-	7	4	26	7	33	11	44
July	-	-	12	7	29	13	41	20	61
August	-	-	10	1	20	9	30	10	40
September	-	-	11	3	30	12	41	15	56
October	-	-	9	4	38	16	47	20	67
November	-	-	7	7	34	21	41	28	69
December	-	-	11	7	49	16	60	23	83
S. Total	-	2	116	55	408	158	524	215	739
Total	2		171		566		739		

ACCIDENT ANALYSIS

Table 4

DAILY AND HOURLY ACCIDENT OCCURRENCE

TWENTY ONE HIGH ACCIDENT LOCATIONS

IN THE CITY OF ADRIAN

Period Studied: 1966 through 1970

Hour	Day of the Week							Hour Total	% of Total
	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.		
12-1 a.m.	-	1	1	1	3	-	5	11	1.49
1-2 a.m.	-	2	1	1	1	2	2	9	1.22
2-3 a.m.	-	1	-	-	1	4		6	.81
3-4 a.m.	-	-	-	1	-	2	2	5	.68
4-5 a.m.	1	-	-	-	-	-	-	1	.14
5-6 a.m.	1	-	-	1	-	-	-	2	.27
6-7 a.m.	1	2	3	1	2	1	-	10	1.35
7-8 a.m.	3	5	4	6	6	1	1	26	3.52
8-9 a.m.	4	5	6	1	4	4	2	26	3.52
9-10 a.m.	2	6	4	3	2	5	-	22	2.98
10-11 a.m.	4	4	2	5	9	5	1	30	4.06
11-12 a.m.	3	3	10	4	7	8	2	37	5.00
12-1 p.m.	8	4	9	11	5	13	10	60	8.12
1-2 p.m.	9	6	9	8	9	8	6	55	7.44
2-3 p.m.	10	10	5	7	13	10	4	59	7.98
3-4 p.m.	12	8	9	11	21	5	5	71	9.61
4-5 p.m.	14	12	4	10	18	5	6	69	9.34
5-6 p.m.	10	11	4	5	10	7	5	52	7.04
6-7 p.m.	3	4	3	4	5	7	13	39	5.27
7-8 p.m.	4	4	3	5	8	10	6	40	5.41
8-9 p.m.	3	3	6	2	7	6	3	30	4.06
9-10 p.m.	5	3	2	3	7	7	2	29	3.92
10-11 p.m.	2	4	4	1	7	12	4	34	4.60
11-12 p.m.	3	2		1	2	3	4	15	2.03
Not Stated	-	-	-	-	1	-	-	1	.14
Day Total	102	100	89	92	148	125	83	739	100.00
% of Total	13.80	13.53	12.04	12.45	20.03	16.92	11.23	100.00	

Peak Accident Hour: 3 - 4 p.m.

Peak Accident Day: Friday

Table 5

AGE OF DRIVERS INVOLVED IN ACCIDENTS

TWENTY ONE HIGH ACCIDENT LOCATIONS

IN THE CITY OF ADRIAN

Period Studied: 1966 through 1970

Age Group	Number of Drivers Involved in				Percent
	Fatal	Injury	Property Damage	Total	
Under 16	-	-	1	1	.07
16 - 19	-	19	264	283	19.94
20 - 24	-	26	187	213	15.01
25 - 34	-	36	210	246	17.34
35 - 44	-	22	188	210	14.80
45 - 54	-	21	177	198	13.95
55 - 64	1	11	108	120	8.46
65 - 74	-	3	44	47	3.31
75 & Over	1 Ped.	1	27	29	2.04
Not Stated	-	-	72	72	5.08
TOTAL	2	139	1278	1419	100.00

Table 6

RESIDENCE OF DRIVERS INVOLVED IN ACCIDENTS

Residence	Number of Drivers Involved in				Percent
	Fatal	Injury	Property Damage	Total	
Local	2	105	928	1035	72.94
Michigan	-	24	264	288	20.30
Out of State	-	10	40	50	3.52
Not Stated	-	-	46	46	3.24
TOTAL	2	139	1278	1419	100.00

ACCIDENT ANALYSIS

Table 7

WEATHER CONDITIONS AT SCENE OF ACCIDENTS

TWENTY ONE HIGH ACCIDENT LOCATIONS

IN THE CITY OF ADRIAN

Period Studied: 1966 through 1970

Weather	Severity of Accident				Percent
	Fatal	Injury	Property Damage	Total	
Clear or Cloudy	2	134	448	584	79.03
Rain	-	30	78	108	14.61
Fog	-	-	-	0	0.00
Snow or Sleet	-	7	39	46	6.22
Not Stated	-	-	1	1	.14
TOTAL	2	171	566	739	100.00

TABLE 8

PAVEMENT CONDITIONS AT SCENE OF ACCIDENTS

Pavement	Severity of Accident				Percent
	Fatal	Injury	Property Damage	Total	
Dry	1	104	361	466	63.06
Wet	1	53	163	217	29.36
Snowy/Icy	-	12	36	48	6.50
Icy	-	2	6	8	1.08
Not Stated	-	-	-	-	-
TOTAL	2	171	566	739	100.00

LOCATION 1 BROAD STREET AT MAUMEE STREET

(This intersection is part of the proposed one-way system, see TRAFFIC ENGINEERING ANALYSIS.)

Broad Street and Maumee Street form a right-angle intersection in the central part of the city, one block east of the Central Business District. Broad Street has a 50ft. wide bituminous pavement, with curb and gutter, on both sides of the intersection; while Maumee Street has a 40ft. wide bituminous pavement, with curb and gutter, east of the intersection and west of the intersection it has a 50ft. wide bituminous pavement with curb and gutter. West of the intersection Maumee Street is one-way westbound.

Broad Street serves as a north-south bypass of the Central Business District, and Maumee Street is a major east-west access from the east side of the city.

Traffic is controlled by pretimed dual head signals, with eight inch lenses and a red flashing arrow for northbound to westbound vehicles. The signal operates on a 70 second cycle with a 50-50 split. The amber time is 6% of the total cycle. The red flashing arrow is supplemented by a "Left On Red After Stop" sign. Two overhead Lane Use Control signs located 195 feet south of the intersection indicate "Left Turn Lane" and "Thru And Right Turn Lane".

On either side of the intersection, Broad Street is three lanes with a center left turn lane and parallel parking on both sides. Maumee Street has two lanes, with parallel parking on

both sides, east of the intersection; and the west leg has three lanes, one-way westbound, with parallel parking on both sides.

During the five-year study period, 1966 through 1970, there were a total of 95 reported accidents at this intersection. Rear end accidents, with 42, constituted the largest amount by type. There were also 16 angle, 14 sideswipe same direction, 8 backing, and 8 left turn head-on accidents. The 7 remaining accidents formed no significant pattern.

It was noted from the accident reports that, of the 42 rear end accidents, 14 were caused by vehicles which had already stopped, but the driver either let his foot off the brake pedal or said he thought the signal had changed. These accidents are very minor in nature and tend to distort the criticality of this type accident. If these accidents are subtracted from the total rear end accidents, there would be 28 rear end accidents which can't be considered too serious as this is a high volume* signalized location.

The accident reports also revealed that 12 of the 16 angle accidents were caused by vehicles attempting the left turn from northbound Broad Street to westbound Maumee Street on the red flashing arrow.

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*Figures obtained from the Michigan Highway Needs Study show 1968 A.D.T.'s of 9,800 on Broad Street south of the intersection, 7,400 north of the intersection; Maumee Street had 10,500 west of the intersection and 3,600 east of the intersection.

Recommendations

Field investigation revealed a definite need for a separate phase for the northbound to westbound movement, as there is a heavy left turn volume in this direction. It is, therefore, recommended that the flashing red arrow be removed and a delayed left turn phase be added to facilitate this movement. Traffic counts will be necessary to determine the proper timing of the left turn phase.

If the one-way system is implemented it is recommended that the pavement be marked as shown on page 30; however, should the present system be retained, the pavement should be marked as shown on page 31. These changes are reflected in the new National Manual on Uniform Traffic Control Devices.

The overhead "Left Turn Lane" and "Thru and Right Turn Lane" signs, south of the intersection, should be replaced by symbol signs. These are Lane Use Control signs (R3-8-30, Appendix II, p.130). If the one-way system is adopted the signs should indicate a center left turn lane and the through lane. If the one-way system is not implemented, the sign over the right lane should be a "Thru and Right Turn" Lane Use Control sign (R3-9-30, Appendix II, p.130).

A final recommendation would be to obtain skidometer tests, as there were 27 accidents (28.4%) on wet pavement. Several policing officers also indicated on the accident reports that the pavement was slippery when wet. This service is available from the Testing and Research Division of the Michigan Department of State Highways. Arrangements should be made with Mr. Max N. Clyde, Engineer of Testing and Research.

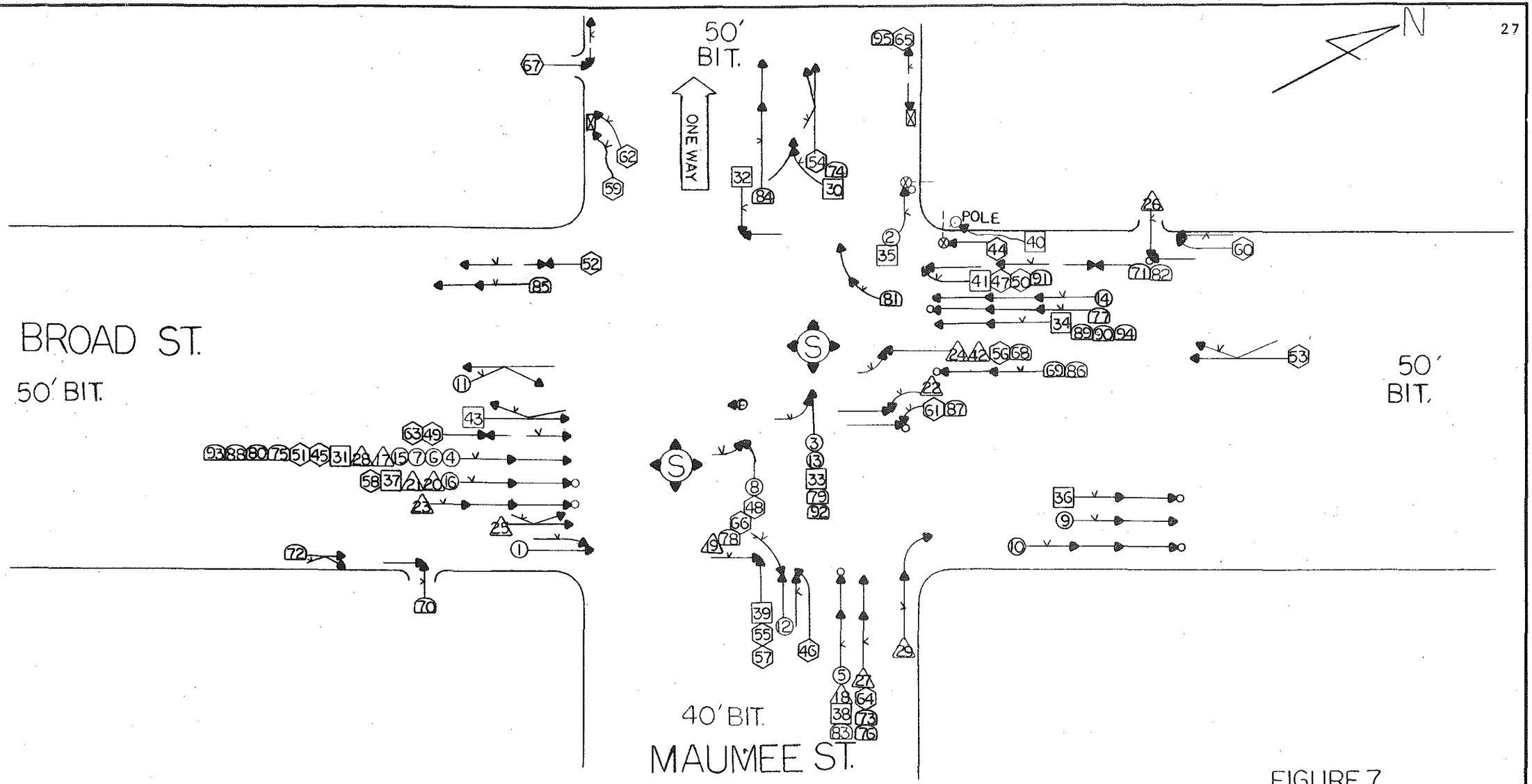


FIGURE 7

REMARKS

- ○ 1966 (16)
- △ 1967 (13)
- □ 1968 (14)
- ⬡ 1969 (24)
- ⌓ 1970 (28)

⊠ PARKED VEH.
⊙ POLE

LEGEND

Stop & Go Signal (S, R, Y, F, Y)
Flashing Beacon
Stop Sign S
Yield Sign Y
Fatal
Injury
Skidding
Jackknife
Overturned
Backing
Pedestrian (X)
Tree
Out of Control
Driver Intent
Deer (V)
Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1970
Accidents – Total 95
P.D. 72
Injury 23 (31)
Fatal 0 ( )
ADT
Rate /100 mvm
Rate / mv

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location BROAD AT MAUMEE
CITY OF ADRIAN
LENAWEE CO.

C.S. Miles
Drawn DJM Date 5-3-71
Plan No. LOCATION # 1

Form 1547 (Rev. 5/69) Sheet of

NORTHBOUND
BROAD STREET

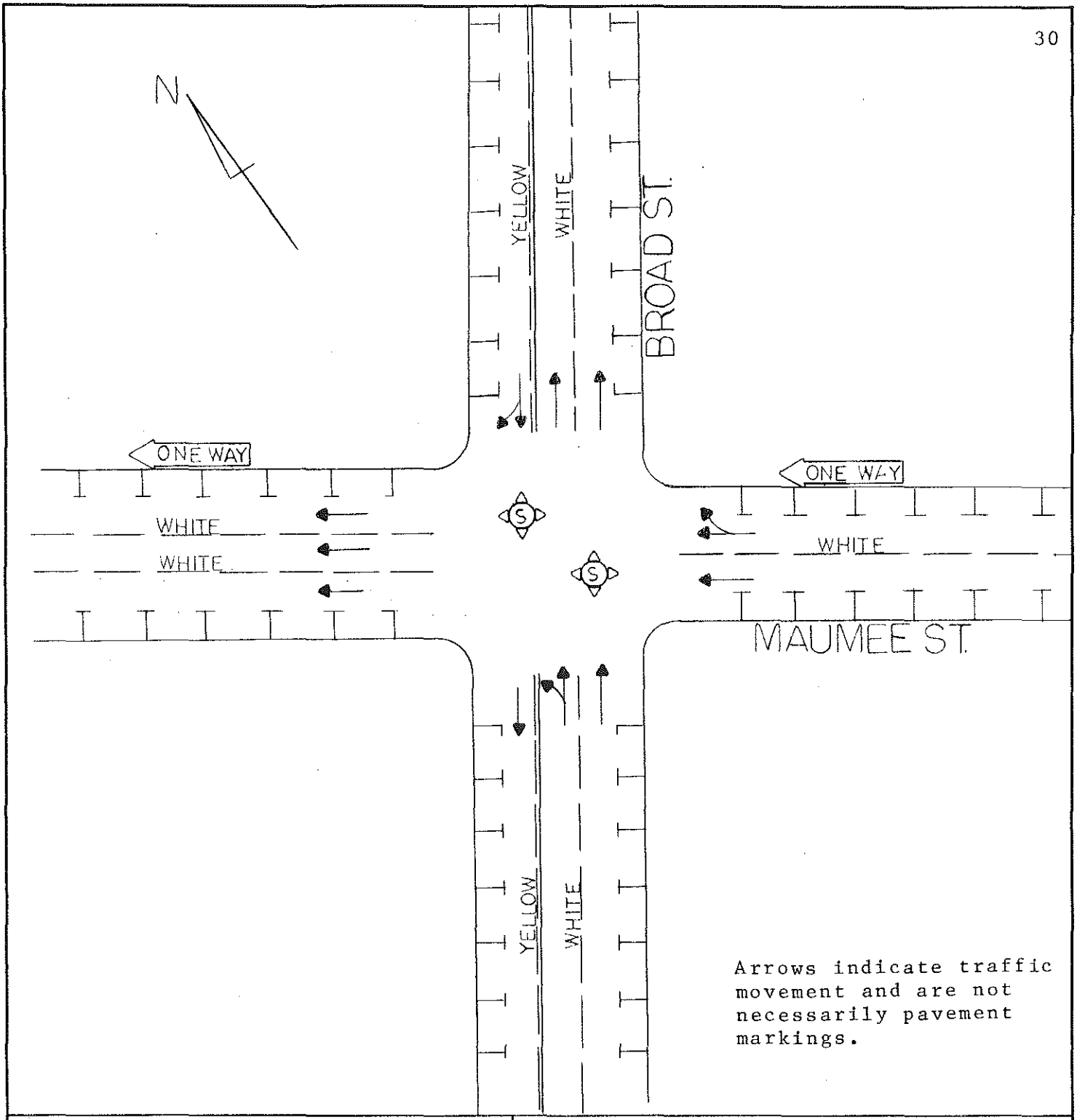
SOUTHBOUND
BROAD STREET

Figure 7A

EASTBOUND
MAUMEE STREET

WESTBOUND
MAUMEE STREET

Figure 7B



LEGEND

Stop & Go Signal — Stop Sign S
Flashing Beacon — Yield Sign Y

Fatal
Injury
Skidding
Jackknife
Overturned
Backing
Pedestrian
Tree
Out of Control
Driver Intent
Deer
Violator

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location BROAD ST. AT MAUMEE ST.
PAVEMENT MARKING IF ONE WAY SYSTEM IS IMPLEMENTED

Period: _____

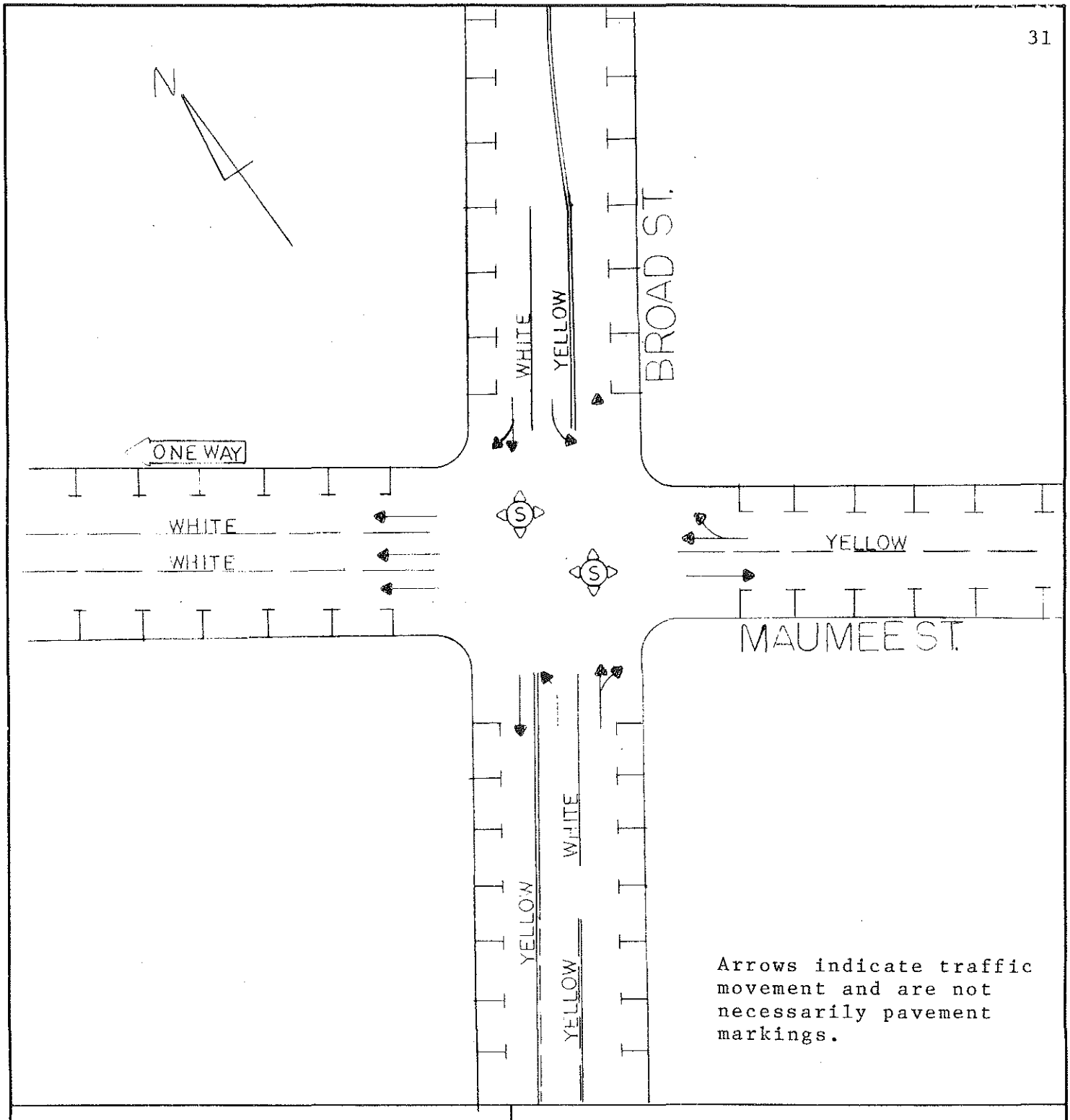
Accidents – Total _____ P.D. _____

Injury _____ ( ) Fatal _____ ( )

C.S. _____ Miles _____ Drawn DJM

Plan No. _____ Date 5-11-72

Form 1547 B (Rev. 11/70)



LEGEND

Stop & Go Signal — Flashing Beacon

Stop Sign S

Yield Sign Y

Fatal

Injury

Skidding

Jackknife

Overturned

Backing

Pedestrian

Tree

Out of Control

Driver Intent

Deer

Violator

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location BROAD AT MAUMEE
PAVEMEN MARKING IF PRESENT
SYSTEM IS RETAINED

Period:

Accidents – Total P.D.

Injury ( ) Fatal ( )

C.S. Miles Drawn DJM

Plan No. Date 5-15-72

Form 1547 B (Rev. 11/70)

LOCATION 2 BEECHER STREET AT DIVISION STREET

Located in the south-central part of the city, a light commercial-residential area, Beecher Street and Division Street form a right-angle intersection. Beecher Street has a 44ft. wide bituminous pavement with curb and gutter on both sides, and Division Street has a 40ft. wide bituminous pavement with curb and gutter on both sides.

Traffic is controlled by pretimed dual head signals with eight inch lenses, which operate on a 60 second cycle with a 50-50 split. The amber time is 5% of the total cycle length.

Parking is permitted on all legs of the intersection except for 40 feet on the south side of Beecher Street east of Division Street. Laneage is assigned by white centerlines on both streets.

During the five-year study period, 1966 through 1970, there were a total of 64 reported accidents at this intersection. The most significant accident patterns formed during the study period were right-angles, with 21, and rear ends, with 21.

Recommendations

Traffic signals when installed, and obeyed by drivers or pedestrians, can be expected to substantially reduce angle accidents, and in many cases increase rear end accidents. Since 32.8% of the accidents were angles, it is evident that full benefit is not being received from the signal. It is felt that the 5% amber time may be a contributing factor in the high per-

centage of angle accidents; and it is, therefore, recommended that the amber time be increased to 7% of the total cycle length.

It is also recommended that separate left turn lanes be provided on all four legs of the intersection. Parking should be prohibited on both sides of all legs of the intersection for 175 feet. This will provide room for a center left turn lane 100 feet long with a 75 foot taper. The pavement should be marked as shown on page 35.

A final recommendation would be to obtain skidometer tests, because 39% or 25 of the accidents occurred on wet pavement. This service is available from the Testing and Research Division of the Michigan Department of State Highways (See p. 26).

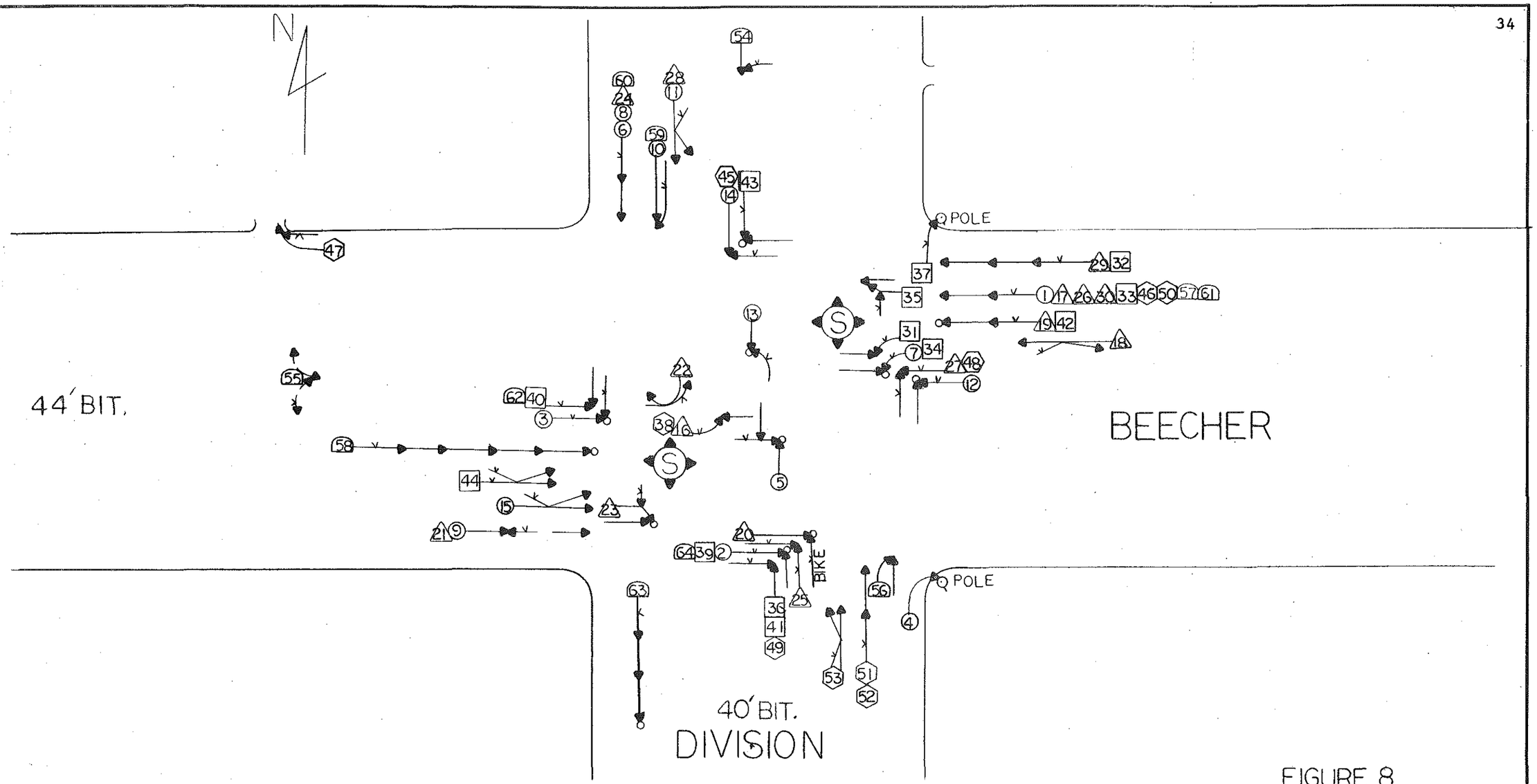


FIGURE 8

REMARKS

- ○ 1966 (15)
- △ 1967 (15)
- □ 1968 (14)
- ⬡ 1969 (9)
- ⬠ 1970 (11)

LEGEND

Stop & Go Signal (S, R, F, Y) — Stop Sign S — Yield Sign Y — Flashing Beacon

Fatal — Injury — Skidding — Jackknife — Overturned — Backing

Pedestrian (X) — Tree — Out of Control — Driver Intent — Deer (V) — Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1970

Accidents – Total 64

P.D. 48 — ADT

Injury 16 (34) — Rate /100 mvm

Fatal 0 ( ) — Rate / mv

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

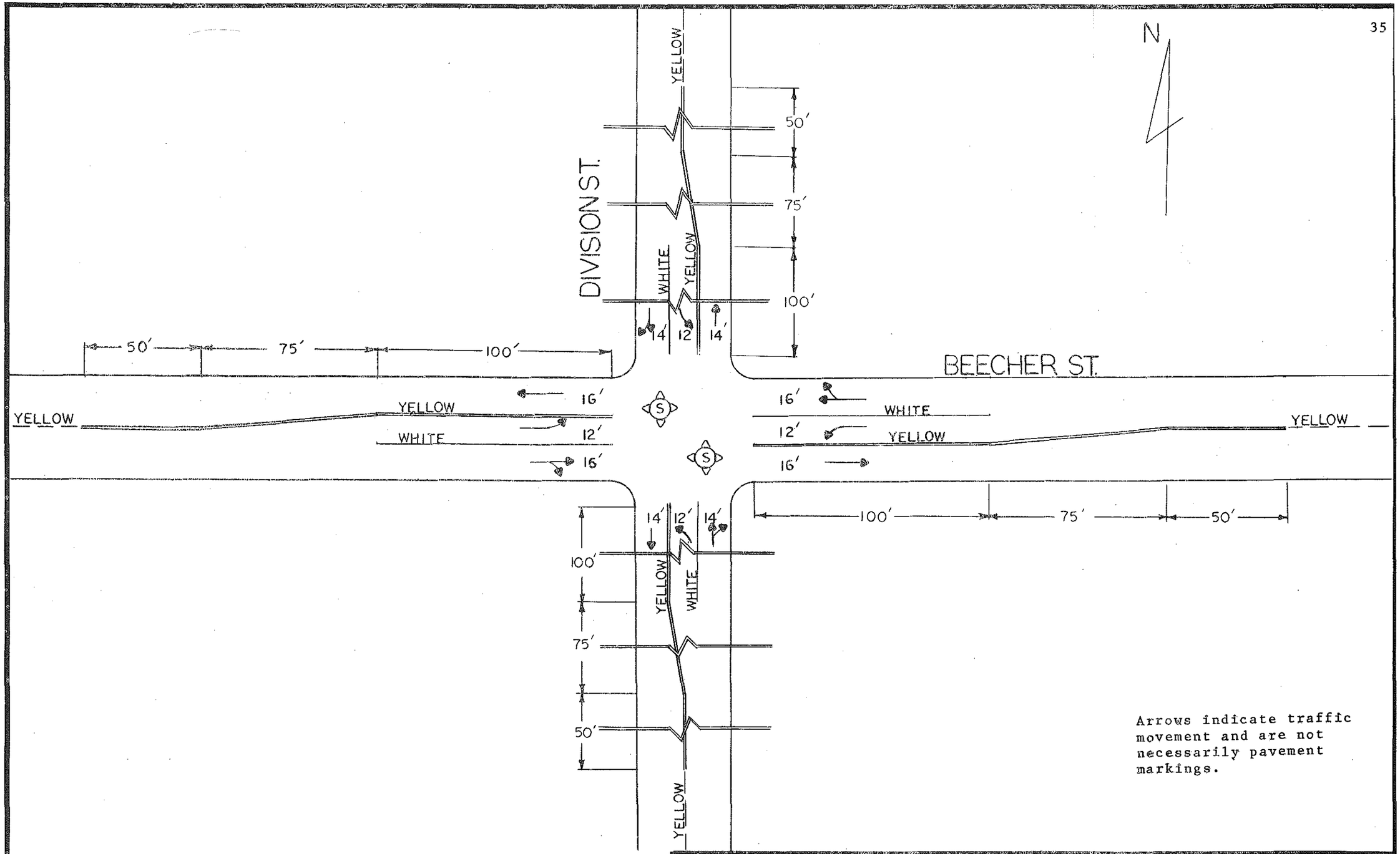
Location BEECHER AT DIVISION
CITY OF ADRIAN
LENAWEE CO.

C.S. ____ Miles ____

Drawn DJM Date 5-3-71

Plan No. LOCATION #2

Form 1547 (Rev. 5/69) Sheet ____ of ____



STATE OF MICHIGAN DEPARTMENT OF STATE HIGHWAYS TRAFFIC & SAFETY DIVISION	AUTH. NO.	DRAWN D.J.M.	PROPOSED PAVEMENT MARKING
	CONT. SEC.	DATE 5-17-72	
	REF.	SCALE	
	SHEET OF	PLAN	

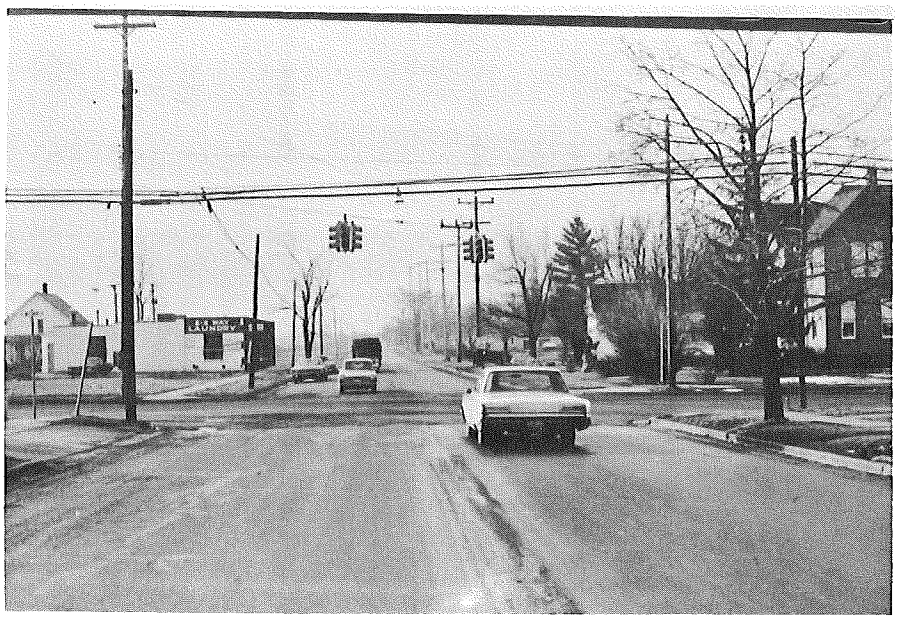
FORM 1595A (REV. 10-68)

EASTBOUND
BEECHER STREET

WESTBOUND
BEECHER STREET

Figure 8A

NORTHBOUND
DIVISION STREET



SOUTHBOUND
DIVISION STREET

Figure 8B

LOCATION 3 BEECHER STREET AT TREAT STREET

This skewed intersection is located in the southeast industrial-commercial part of the city. There are service stations in the northwest and southwest quadrants of the intersection, a vacant car lot in the northeast quadrant, and a bar-restaurant in the southeast quadrant. West of the intersection Beecher Street has a 43ft. wide bituminous pavement, with curb and gutter, and a 38ft. wide concrete pavement, with curb and gutter, east of the intersection. North of the intersection Treat Street has a 30ft. wide bituminous pavement, with curb and gutter, and a 36ft. wide bituminous pavement, with curb and gutter, south of the intersection.

Traffic controls at the intersection consist of pretimed dual signal heads with eight inch lenses, and a red flashing arrow for eastbound Beecher Street to southbound Treat Street. The signal operates on a 60 second cycle with a 60%-40% split, Beecher Street - Treat Street. The amber time is 6% of the total cycle.

There is a "Curve" sign (W1-2-30, Appendix II, p. 139) for northbound Treat Street located 360 feet south of the intersection. Parking is permitted on all legs of the intersection, except for the north side of Beecher Street, east of the intersection.

There was a total of 49 reported accidents at this location for the five-year study period, 1966 through 1970. Backing accidents constituted 37% or 18 of the total accidents at the intersection. Thirteen of the backing accidents involved parked

cars on the south leg of the intersection. There were also 11 sideswipe and 10 rear end accidents during the study period.

Recommendations

In view of the fact that 13 accidents involved parked cars on the south leg of the intersection, it is recommended that parking be removed on both sides of Treat Street, south of Beecher Street for a distance of 175 feet. This will increase the sight distance and alleviate the conflict between vehicles which would normally park on the east side of Treat Street. This will require the installation of two "No Parking At Any Time" signs (R4-1-12, Appendix II, p.134) on each side of Treat Street.

The amber time should also be increased to 7% of the total cycle length. This change will allow a greater clearance interval through the intersection.

A final recommendation would be to mark all legs of the intersection as shown on p. 43. In conjunction with this pavement marking, two "Right Lane Must Turn Right" signs (R3-7-30, Appendix II, p.129) should be installed on the south side of Beecher Street. One should be installed at the intersection, and the other at the beginning of the right turn lane for eastbound to southbound traffic.

It is also recommended that the "Curve" sign be moved north of the intersection, 250 feet south of the curve (See Appendix II, p.139). It should also be replaced as it is in poor condition.

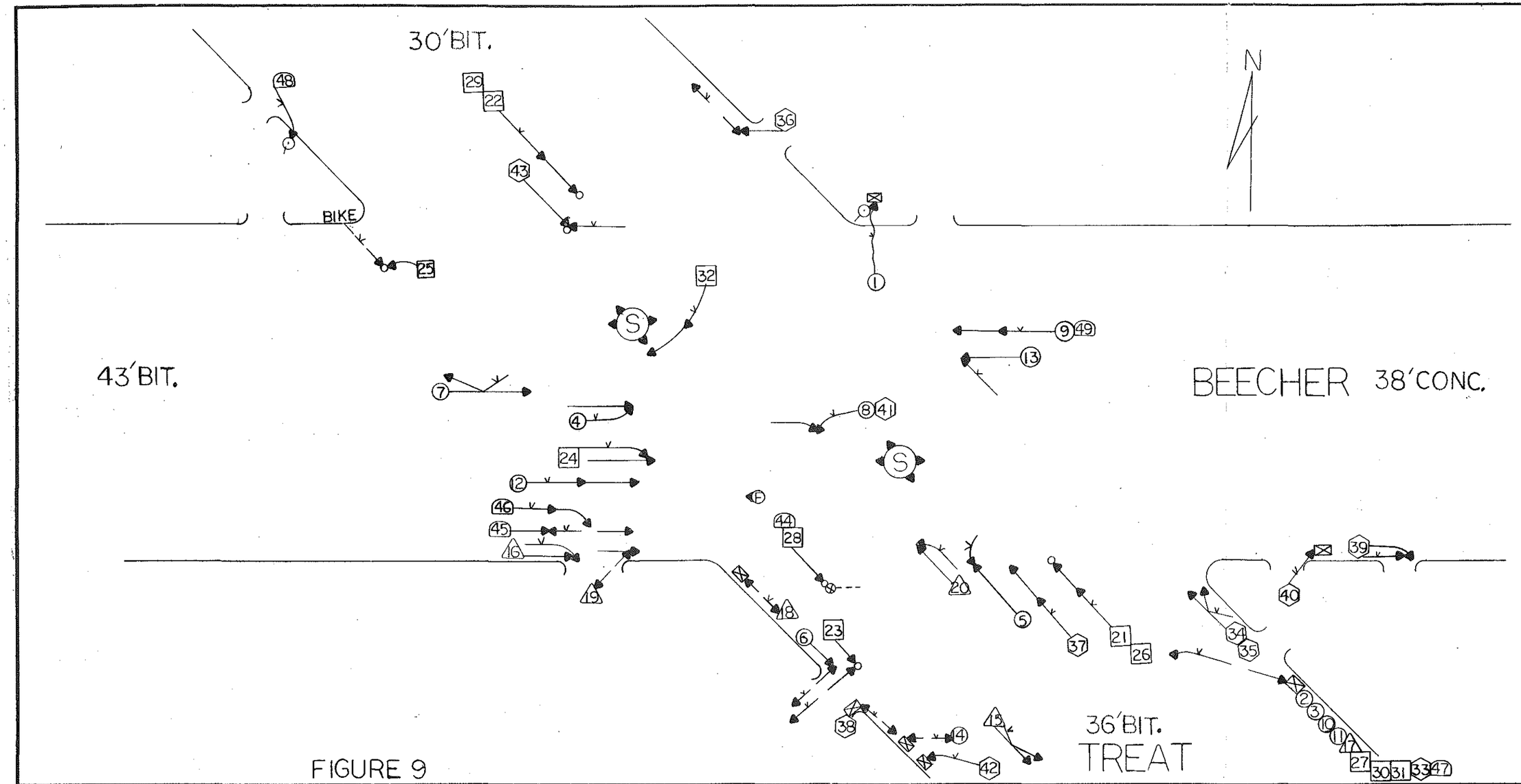


FIGURE 9

REMARKS ⊠ PARKED VEH. ⊙ POLE

- ○ 1966 (14)
- △ 1967 (6)
- □ 1968 (12)
- ⬡ 1969 (11)
- ⌓ 1970 (6)

LEGEND

Stop & Go Signal (S, R, Y, F, Y) — Stop Sign S — Yield Sign Y
Flashing Beacon

Fatal
Injury
Skidding
Jackknife
Overturned
Backing
Pedestrian (X)
Tree
Out of Control
Driver Intent
Deer
Violator (V)

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1970
Accidents – Total 49
P.D. 38
Injury 11 (15)
Fatal 0 ( )
ADT
Rate /100 mvm
Rate / mv

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location BEECHER AT TREAT
CITY OF ADRIAN
LENAWEE CO.

C.S. Miles
Drawn DJM Date 5-3-71
Plan No. LOCATION #3

Form 1547 (Rev. 5/69) Sheet of

EASTBOUND
BEECHER STREET

WESTBOUND
BEECHER STREET

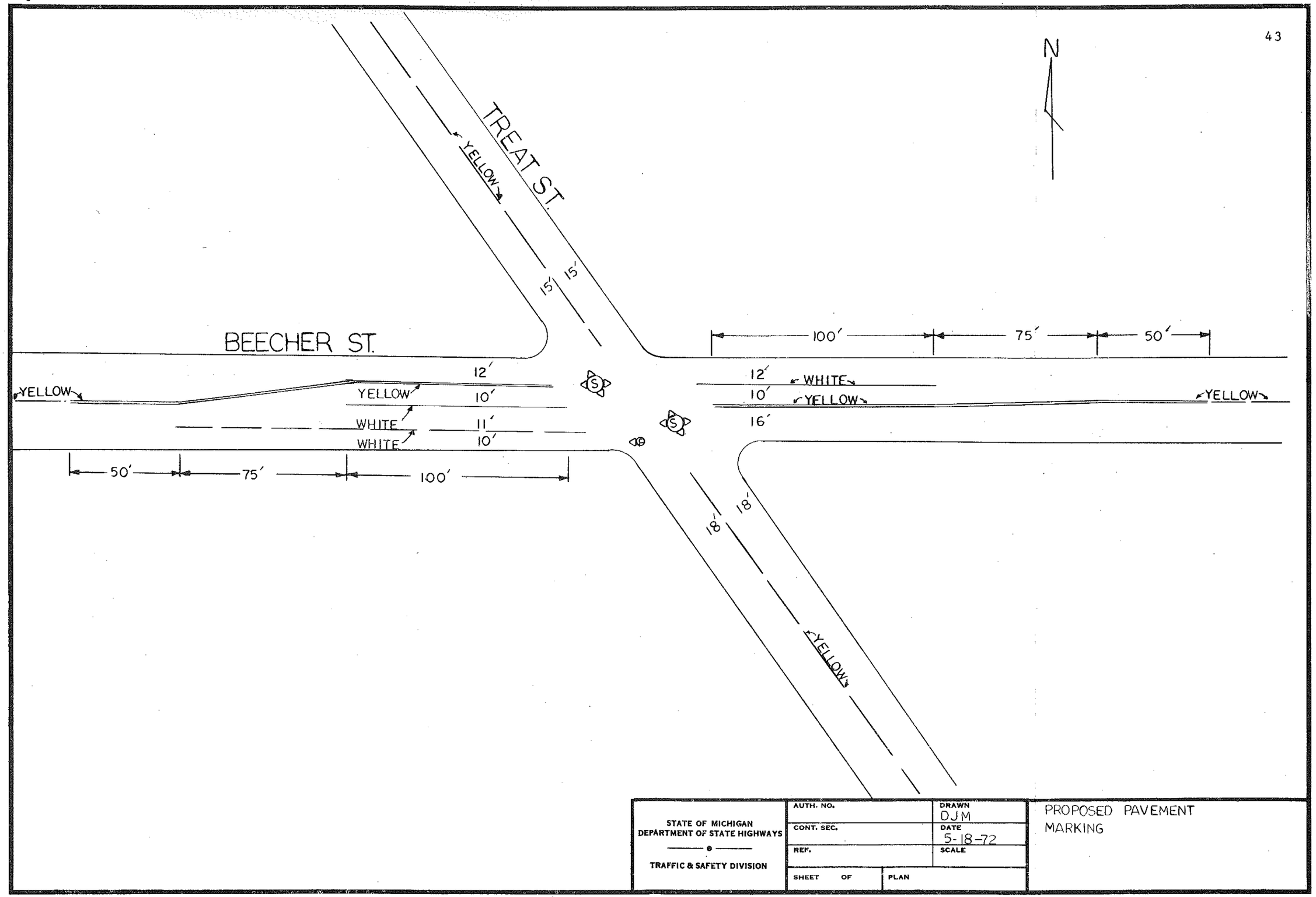
LIBRARY
michigan department of
state highways
LANSING

Figure 9A

NORTHBOUND
TREAT STREET

SOUTHBOUND
TREAT STREET

Figure 9B



STATE OF MICHIGAN DEPARTMENT OF STATE HIGHWAYS TRAFFIC & SAFETY DIVISION	AUTH. NO.	DRAWN DJM
	CONT. SEC.	DATE 5-18-72
	REF.	SCALE
	SHEET OF	PLAN

PROPOSED PAVEMENT MARKING

FORM 1595A (REV. 10-68)

LOCATION 4 CHURCH STREET AT BROAD STREET AND STATE STREET

(This intersection is part of the proposed one-way system, see TRAFFIC ENGINEERING ANALYSIS.)

Church Street at Broad and State Streets intersect in the central part of the city. This intersection is one block east of the Central Business District in a light-commercial type development. To the west of the intersection Church Street is one-way eastbound, while the remaining legs of the intersection are two-way. To the west, Church Street has a 43ft. wide bituminous pavement, with curb and gutter, and a 41ft. wide bituminous pavement, with curb and gutter, to the east. There is a small traffic island to channel eastbound vehicles wishing to turn northbound on Broad Street. Broad Street has a 50ft. wide bituminous pavement, with curb and gutter, while State Street has a 64ft. wide opening at the intersection which tapers back to a 28ft. wide bituminous pavement, with curb and gutter. Parallel parking is only permitted on the south side of Church Street west of the intersection and on the west side of State Street.

The basic traffic control at the intersection is a pretimed dual head signal, with eight inch lenses, operating on a 70 second cycle with a 50-50 split. The amber time is 6% of the total cycle time. The dual head signals are supplemented by a single face signal head for eastbound to northbound vehicles. There is also a red flashing arrow for westbound to northbound vehicles. The green lenses on the northbound and southbound signal faces of both signal heads, have the green arrow configuration as shown on the collision diagram (See p. 48).

Eastbound vehicles must stop at the crosswalk located 65 feet west of Broad Street. There are two, 18 inch x 24 inch, "Stop Here For Red Light" signs at the crosswalk. There is a 12 inch x 18 inch "No Left Turn" sign for northbound vehicles on State Street and an 18 inch x 30 inch "No Right Turn" sign for southbound vehicles on Broad Street. A 24 inch x 30 inch "Do Not Enter" sign (R3-27-24, Appendix II, p. 132) is located on the east end of the traffic island for westbound vehicles. The red flashing arrow is supplemented by a "Right Turn On Red After Stop" sign.

East of the intersection Church Street has a solid white centerline and west of the intersection there are two broken white lines for three lanes of traffic. Broad Street is divided into three lanes (two northbound) by a solid white line and a broken white line. State Street has no pavement markings.

This intersection was the scene of 50 reported accidents during the five-year study period. The most significant type of accident was the rear end, which constituted 46% (23) of the total accidents. Five of the rear ends occurred on snowy or icy pavement, while eight of the remaining 18 rear end accidents occurred on wet pavement. There were also seven other wet pavement accidents for a total of 15 of 50, or 30%. Sideswipe accidents constituted the next high type accident with 11 accidents and the remaining 16 accidents formed no significant patterns.

Recommendations

The first recommendation would be to obtain skidometer tests (See p. 26) as there was a high percentage of wet pavement accidents.

A second recommendation would be to replace the double green arrow lenses with solid green lenses. There was only one accident attributable to these lenses but there is a potential hazard. As an example, a southbound Broad Street driver turning left to eastbound Church Street would be in conflict with northbound drivers, because each driver has the green arrow indications simultaneously for his direction of travel. These green arrows mean that the driver can make the indicated move unrestricted and thus have no expected conflict.

It is also recommended that the following signing changes be made on Church Street, west of the intersection:

1. Install a "Left Turn Lane" sign (G3-26-30, Appendix II, p. 136) on the north side of Church Street 250 feet from the intersection.
2. Install a "Left Lane Must Turn Left" sign (R3-7-30, Appendix II, p. 129) at the intersection.
3. Install two "Stop Here For Signal" signs (R6-19-30, Appendix II, p.131) at the crosswalk to replace the existing nonstandard signs.
4. Install two "Do Not Enter" signs (R5-1, Appendix II, p. 133), as revised, on both sides of Church Street west of the intersection, facing east.

It is also recommended that the nonstandard 12 inch x 18 inch "No Left Turn" sign on northbound State Street be replaced with a "No Left Turn" sign (R3-1-24, Appendix II, p.127) and the nonstandard 18 inch x 30 inch "No Right Turn" sign on southbound Broad Street be replaced with a "No Right Turn" sign (R3-2-24, Appendix II, p.128).

A final recommendation would be to remove the traffic island and mark all pavements as suggested by the new MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (See Figures 3-1 to 3-4, Appendix II, pp. 144 and 145).

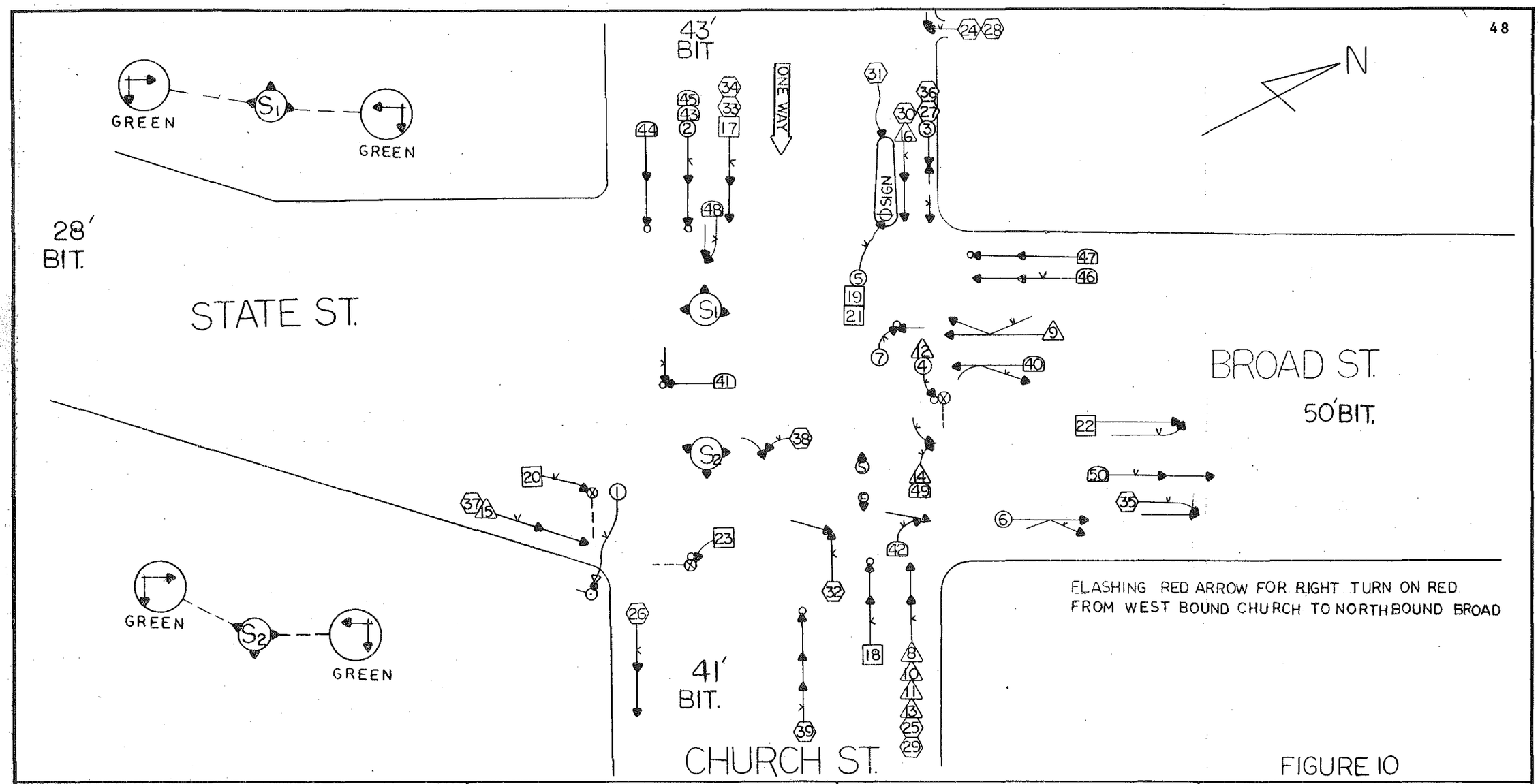


FIGURE 10

REMARKS

⊙ POLE

- ○ 1966 (7)
- △ 1967 (9)
- □ 1968 (7)
- ⬡ 1969 (16)
- ⌓ 1970 (11)

LEGEND

Stop & Go Signal — Stop Sign S
Flashing Beacon — Yield Sign Y
Fatal
Injury
Skidding
Jackknife
Overturned
Backing
Pedestrian
Tree
Out of Control
Driver Intent
Deer
Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1970
Accidents – Total 50
P.D. 37
Injury 12 (16)
Fatal 1 (1)
ADT
Rate /100 mvm
Rate / mv

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location BROAD AT CHURCH ST. AND STATE ST.
CITY OF ADRIAN
LENAWEE CO

C.S. ____ Miles ____
Drawn DJM Date 5-4-71
Plan No. LOCATION #4

Form 1547 (Rev. 5/69) Sheet ____ of ____

EASTBOUND
CHURCH STREET

WESTBOUND
CHURCH STREET

Figure 10A

NORTHBOUND
STATE STREET

SOUTHBOUND
BROAD STREET

Figure 10B

LOCATION 5 BROAD STREET AT TOLEDO STREET
(See Appendix I, p. 115)

Total	P.D.	Inj.	Fatal
40	34	6	0

LOCATION 6 BROAD STREET AT MAPLE STREET

Broad Street and Maple Street form a right-angle intersection in the central part of the city. This light commercial-residential area is located one block east of the Central Business District. Broad Street serves as a north-south bypass of the downtown area and Maple Street tends to serve as an east-west bypass of the downtown area. Broad Street has a 50ft. wide bituminous pavement south of the intersection and a 36ft. wide bituminous pavement north of the intersection. Maple Street has a 40ft. wide bituminous pavement on both sides of the intersection. All four legs of the intersection have curb and gutter on both sides.

Traffic is controlled by pretimed dual head traffic signals, with eight inch lenses, operating on a 55 second cycle with a 50-50 split. The amber time is 5% of the total cycle.

There are also solid white centerlines and pedestrian crosswalks marked on all legs of the intersection. Parallel parking is permitted on both sides of all legs of the intersection.

The most significant incidence of accidents at this location were right-angles, where 16 of the total 39 reported accidents were of this type. There were also ten sideswipes, nine rear ends, three head-on left turns, and one pedestrian accident.

Recommendations

It is felt that the 5% amber time is the contributing factor to the angle accidents occurring at this location. It is, therefore, recommended that the signal be changed to a 70 second cycle with 6% amber time. This change will coincide with the cycle lengths of the signals on Broad Street to the south and aid the progression which was lacking between this intersection and the signal at Broad Street and Toledo Street.

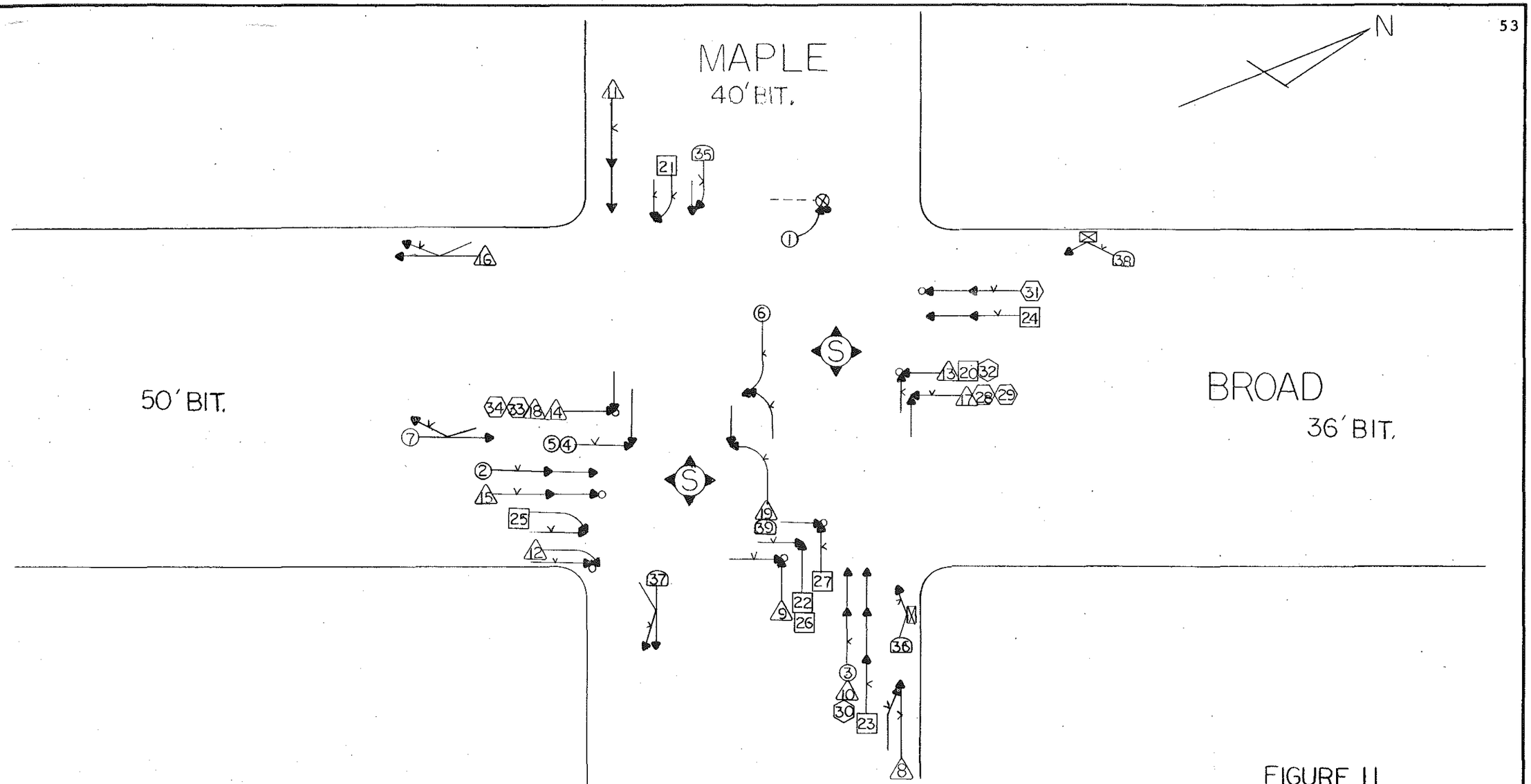


FIGURE 11

REMARKS

- ○ 1966 (7)
- △ 1967 (12)
- □ 1968 (8)
- ⬡ 1969 (7)
- ⌓ 1970 (5)

LEGEND

Stop & Go Signal — Stop Sign S
Flashing Beacon — Yield Sign Y
Fatal
Injury
Skidding
Jackknife
Overturned
Backing
Pedestrian
Tree
Out of Control
Driver Intent
Deer
Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1970
Accidents – Total 39
P.D. 25 — ADT
Injury 13 (27) — Rate /100 mvm
Fatal 1 (1) — Rate / mv

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location BROAD AT MAPLE
CITY OF ADRIAN
LENAWEE CO.

C.S. — Miles
Drawn DJM — Date 6-16-71
Plan No. LOCATION # 6

Form 1547 (Rev. 5/69) Sheet ____ of ____

NORTHBOUND
BROAD STREET

SOUTHBOUND
BROAD STREET

Figure 11A

EASTBOUND
MAPLE STREET

WESTBOUND
MAPLE STREET

Figure 11B

LOCATION 7 CHURCH STREET AT LOCUST STREET

(This intersection is part of the proposed one-way system see TRAFFIC ENGINEERING ANALYSIS.)

Church Street and Locust Street form a skewed intersection in the east-central part of the city, which is basically a residential area with some light commercial development. Church Street has a 42ft. wide bituminous pavement west of the intersection and a 39ft. wide bituminous pavement east of the intersection; while Locust Street has a 36ft. wide bituminous pavement north of the intersection and a 29ft. wide bituminous pavement south of the intersection. There is curb and gutter on both sides of all legs of the intersection.

Vision is severely obscured, to the east for southbound drivers on Locust Street by a church in the northeast quadrant of the intersection. The southeast quadrant is a school playground, and the remaining quadrants are occupied by private residences.

Traffic is controlled by 24 inch "Stop" signs (R1-1-24, Appendix II, p.125) on Locust Street. Supplementing the "Stop" signs is a flashing beacon with the red stop lenses for Locust Street and the amber caution lenses for Church Street. Church Street is divided by a solid white centerline at the intersection, but Locust Street has no pavement markings. Parking is prohibited on the south side of Church Street west of the intersection, and on the west side of Locust Street south of the intersection.

This intersection was the scene of 37 reported accidents during the five-year study period. Right-angle accidents ac-

counted for 54% (20) of the total; while the next high, rear ends, only accounted for 18.9% (7) of the total accidents at this location.

Recommendations

Warrant #5, "Accident Experience", in the MICHIGAN MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES (Appendix II, p. 154) requires a minimum of five angle accidents a year to justify the installation of a traffic signal. Since the average number of angle accidents for the five-year study period was four, signal installation is not justified; however, there are several recommendations which may alleviate the incidence of angle accidents at this intersection.

The first would be the implementation of the proposed one-way system. This would eliminate nine conflicts, thus a potential number of angle accidents.

It is also recommended that the flasher lenses be increased to 12 inches. This will increase the effectiveness of the flasher as a traffic control.

A final recommendation would be to replace the 24 inch "Stop" signs with 30 inch "Stop" signs (R1-1-30, Appendix II, p. 125). The "No Parking Here To Corner" sign located adjacent to the existing "Stop" sign on the south leg of Locust Street should be removed or relocated.

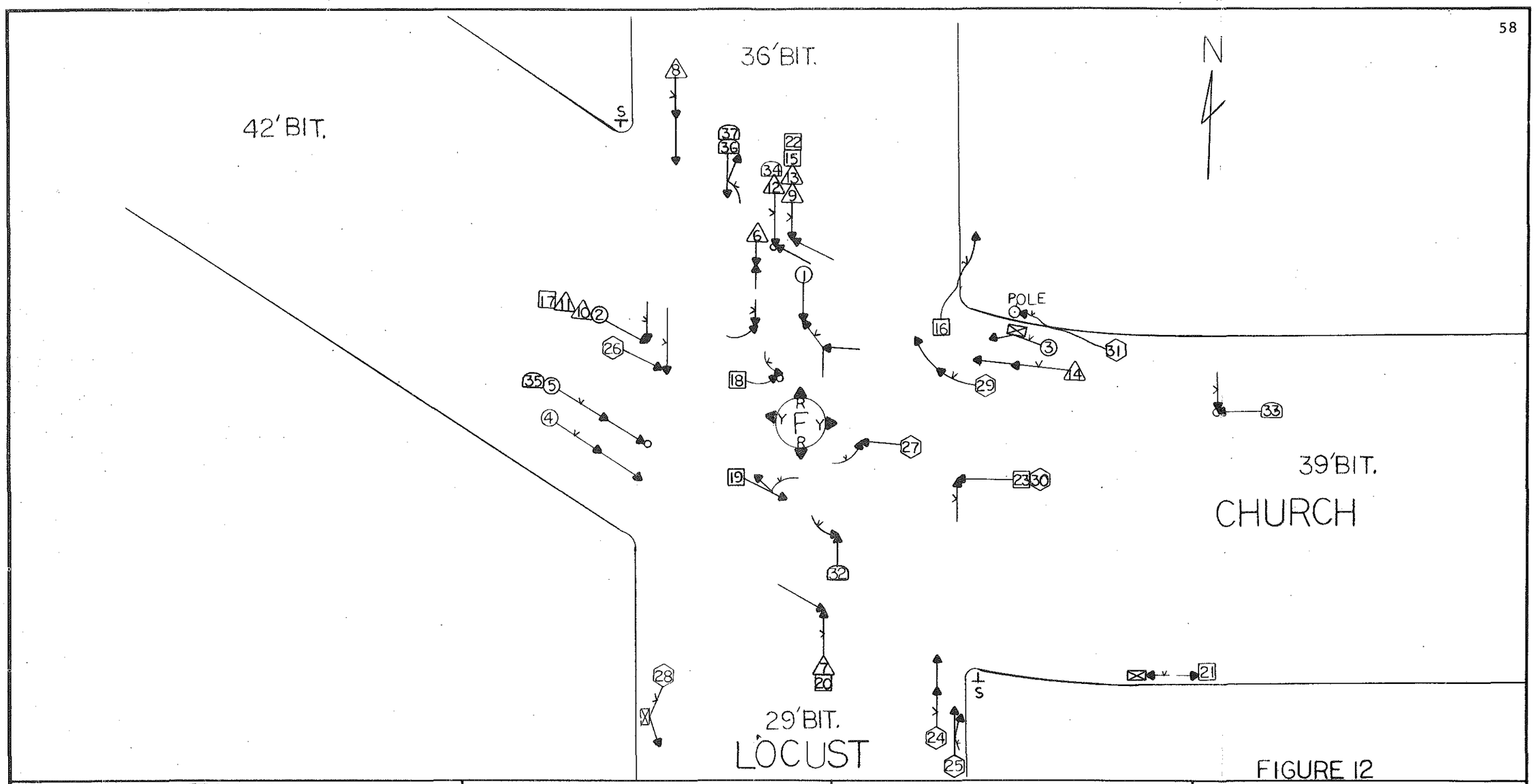


FIGURE 12

PARKED VEH.

REMARKS

- ○ 1966 (5)
- △ 1967 (9)
- □ 1968 (9)
- ⬠ 1969 (8)
- ⬭ 1970 (6)

LEGEND

Stop & Go Signal — Stop Sign S
Flashing Beacon — Yield Sign Y
Fatal
Injury
Skidding
Jackknife
Overturned
Backing
Pedestrian
Tree
Out of Control
Driver Intent
Deer
Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1970
Accidents – Total 37
P.D. 30
Injury 7 (9)
Fatal 0 ( )
ADT
Rate /100 mvm
Rate / mv

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location CHURCH AT LOCUST
CITY OF ADRIAN
LENAWEE CO.

C.S. Miles
Drawn DJM Date 5-17-71
Plan No. LOCATION #7

Form 1547 (Rev. 5/69) Sheet of

NORTHBOUND
LOCUST STREET

SOUTHBOUND
LOCUST STREET

Figure 12A

EASTBOUND
CHURCH STREET

WESTBOUND
CHURCH STREET

Figure 12B

LOCATION 8 CHURCH STREET AT DIVISION STREET

(This intersection is part of the proposed one-way system, see TRAFFIC ENGINEERING ANALYSIS.)

Church Street and Division Street form a skewed "T" intersection in the central part of the city two blocks east of the Central Business District. Church Street, the through street, has a 41ft. wide bituminous pavement with curb and gutter west of the intersection and east of the intersection there is a 38ft. wide bituminous pavement with curb and gutter. Division Street, the stop street, has a 40ft. wide bituminous pavement with curb and gutter.

Traffic is controlled by a 24 inch "Stop" sign for northbound Division Street. Parking is prohibited on the north side of Church Street opposite Division Street and on the south side of Church Street, both east and west of the intersection. Parallel parking is allowed on both sides of Division Street. Division Street and Church Street are also striped with solid white centerlines.

This location was the scene of 36 reported accidents during the five-year study period. Rear end accidents, with 12, and angle accidents, with 11, constituted 63.8% of the total accidents, while the remaining 13 accidents formed no significant patterns.

Recommendations

Since there is only a 24 inch "Stop" sign at the intersection, it is recommended that it be replaced by a 36 inch

"Stop" sign (R1-1-36, Appendix II, p. 125). It is also recommended that a 48 inch x 24 inch Bi-directional Target Arrow sign (W1-7-48, Appendix II, p. 140) be installed in target position, opposite Division Street. These changes will give advance warning of the impending stop and help reduce the incidence of angle and rear end accidents at this location.

It is also recommended that the city seek the removal of the shrubbery located in the southwest quadrant of the intersection. This shrubbery causes a sight restriction which may have contributed to several of the right-angle accidents occurring at the intersection.

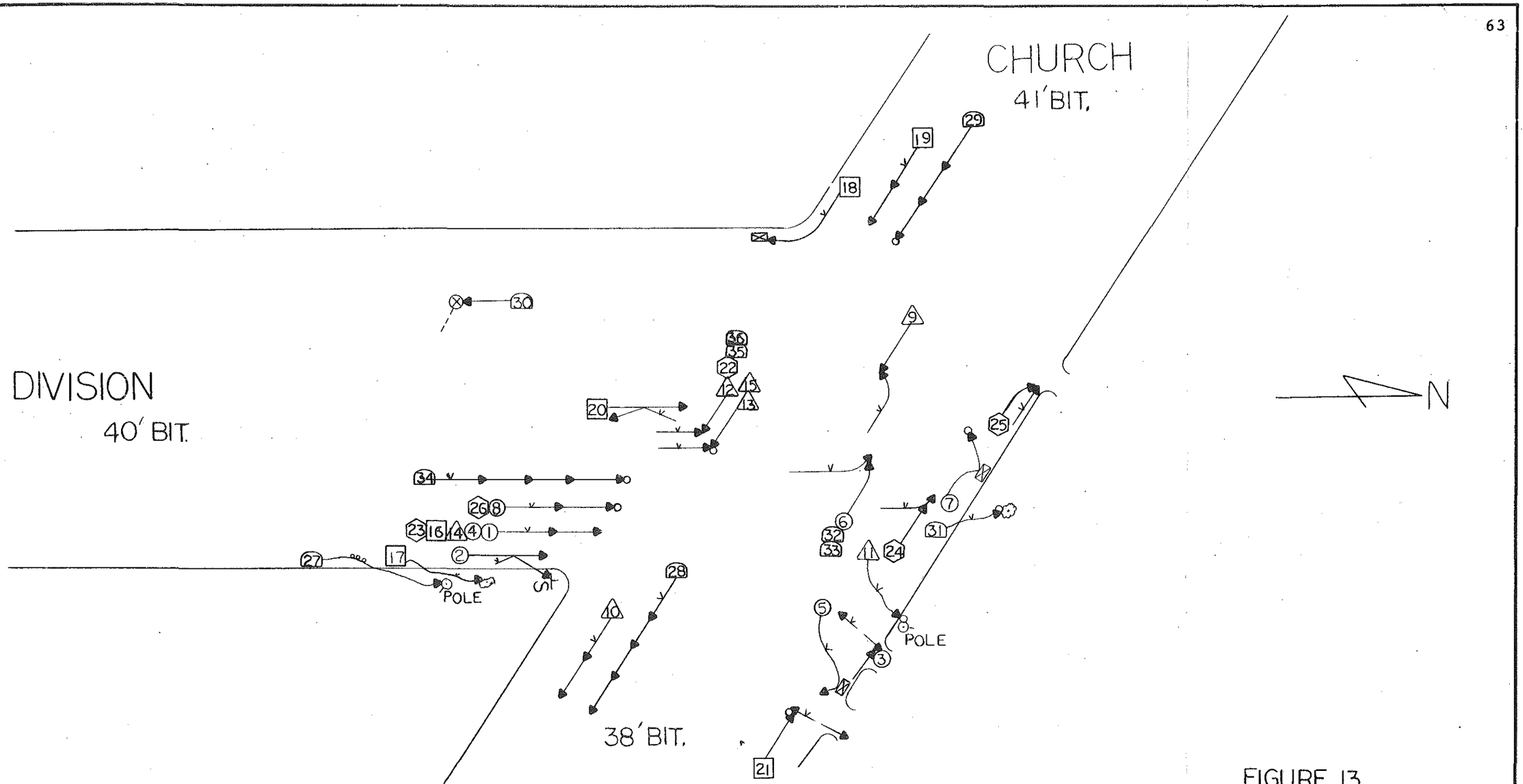


FIGURE 13

REMARKS ⊠ PARKED VEH.

- ○ 1966 (8)
- △ 1967 (7)
- □ 1968 (6)
- ⬡ 1969 (5)
- ⌓ 1970 (10)

LEGEND

Stop & Go Signal — Stop Sign S
Flashing Beacon — Yield Sign Y
Fatal
Injury
Skidding
Jackknife
Overturned
Backing
Pedestrian
Tree
Out of Control
Driver Intent
Deer
Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1970
Accidents – Total 36
P.D. 26
Injury 10 (16)
Fatal 0 ( )
ADT
Rate /100 mvm
Rate / mv

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location CHURCH AT DIVISION
CITY OF ADRIAN
LENAWEE CO.

C.S. Miles
Drawn DJM Date 5-11-71
Plan No. LOCATION #8

Form 1547 (Rev. 5/69) Sheet of

SOUTHEASTBOUND
CHURCH STREET

NORTHBOUND
DIVISION STREET

NORTHWESTBOUND
CHURCH STREET

Figure I3A

LOCATION 9 CHURCH STREET AT CENTER STREET

(This intersection is part of the proposed one-way system, see TRAFFIC ENGINEERING ANALYSIS.)

Located in the east-central part of the city, a commercial area, Church Street and Center Street form a "T" intersection. Church Street, the through street, has a 36ft. wide bituminous pavement with curb and gutter. Center Street also has a 36ft. wide bituminous pavement with curb and gutter.

Traffic is controlled at the intersection by a pretimed single head signal with eight inch lenses, operating on a 60 second cycle and a 50-50 split. The amber time is 5% of the total cycle. There is also a red flashing arrow for eastbound Church Street to southbound Center Street.

Parking is prohibited on the north side of Church Street and on the east side of Center Street; while parallel parking is permitted on the south side of Church Street and the west side of Center Street. Each leg of the intersection has a solid white centerline.

During the five-year study period there was a total of 36 reported accidents at this intersection. The highest number, by type, was rear end accidents with 11, which can be expected at a signalized location. There were also eight accidents involving vehicles parked or parking, six ran off roadway accidents, five angle accidents, four sideswipe accidents, and two miscellaneous accidents.

Recommendations

With these facts in mind, it is recommended that a Bi-directional Target Arrow sign (W1-7-48, Appendix II, p. 140) be installed opposite Center Street on the north side of Church Street. Installing the Bi-directional Target Arrow sign should help reduce the ran off roadway type accidents and possibly some rear end accidents by giving warning of the impending direction change.

It is further recommended that the cycle length be changed from 60 to 70 seconds and the amber time increased to 6%. The latter change should help reduce the angle accidents by increasing the clearance interval.

It is also recommended that parking be prohibited on the south side of Church Street for 75 feet from the crosswalk at Center Street. Removal of this parking will provide storage for several vehicles wishing to turn right. Should the one-way system be implemented, this change would not be necessary. Parking should also be removed on the west side of Center Street, 75 feet south of the Church Street crosswalk. This will provide lateral clearance for eastbound and westbound vehicles turning to southbound Center Street. The "No Parking Here To Corner" sign (R4-5-12, Appendix II, p. 135) on Church Street should then be moved 25 feet to the south, thus eliminating only one parking spot. A "No Parking Here To Corner" sign should also be installed on the south side of Church Street, 75 feet east of the intersection, if the one-way system is not implemented.

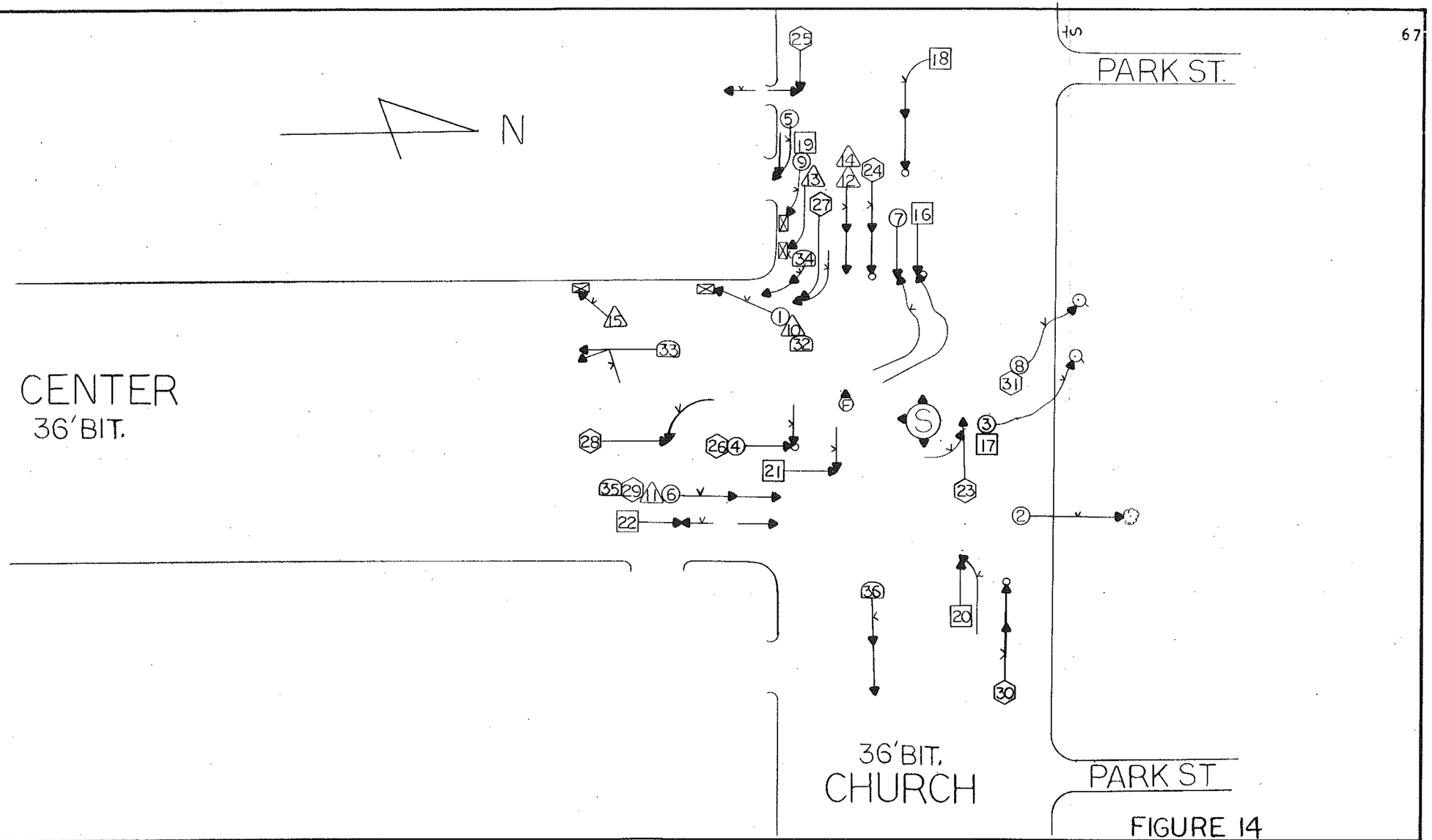


FIGURE 14

REMARKS ⊠ PARKED VEH. ⊙ POLE

- ○ 1966 (9)
- △ 1967 (6)
- □ 1968 (7)
- ⬡ 1969 (9)
- ⌓ 1970 (5)

LEGEND

Stop & Go Signal (S, R, Y, F, Y) — Stop Sign S ⊢ — Yield Sign Y ⊢ — Flashing Beacon

Fatal — Injury — Skidding — Jackknife — Overturned — Backing — Pedestrian (X) — Tree — Out of Control — Driver Intent — Deer (V) — Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1970

Accidents – Total 36

P.D. 30 — ADT

Injury 6 (9) — Rate /100 mvm

Fatal 0 ( ) — Rate / mv

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location CHURCH AT CENTER
CITY OF ADRIAN
LENAWEE CO.

C.S. ____ Miles ____

Drawn DJM Date 6-18-71

Plan No. LOCATION #9

Form 1547 (Rev. 5/69) Sheet ____ of ____

EASTBOUND
CHURCH STREET

NORTHBOUND
CENTER STREET

WESTBOUND
CHURCH STREET

Figure 14A

LOCATION 10 MAUMEE STREET AT LOCUST STREET

(This intersection is part of the proposed one-way system, see TRAFFIC ENGINEERING ANALYSIS.)

Maumee Street and Locust Street form a skewed intersection in the east-central part of the city; a light commercial-residential area. Maumee Street, east of the intersection, has a 46ft. wide bituminous pavement with curb and gutter; while west of the intersection it has a 42ft. wide bituminous pavement with curb and gutter. North of the intersection, Locust Street has a 40ft. wide bituminous pavement with curb and gutter and a 36ft. wide bituminous pavement with curb and gutter south of the intersection.

Traffic is controlled at the intersection by a pretimed single head signal with eight inch lenses, operating on a 60 second cycle with a 50-50 split. The amber time is 5% of the total cycle time.

Maumee Street has solid white centerlines on both sides of the intersection, while Locust Street has a solid white centerline north of the intersection. Parallel parking is permitted on both sides of all legs of the intersection.

During the five-year study period there was a total of 36 reported accidents at this intersection. Vehicles parked or parking were involved in 15 accidents; 12 of which were on the north side of Maumee Street east of the intersection in front of the Post Office. Angle and rear end accidents, with 7 each, constituted the next high types of accidents at this intersection. The remaining 7 accidents formed no significant pattern.

Recommendations

It is recommended that the cycle length be changed to 70 seconds and the amber time be changed to 6% of the total cycle time. The latter change should help reduce the right-angle accidents by giving a greater clearance time through the intersection.

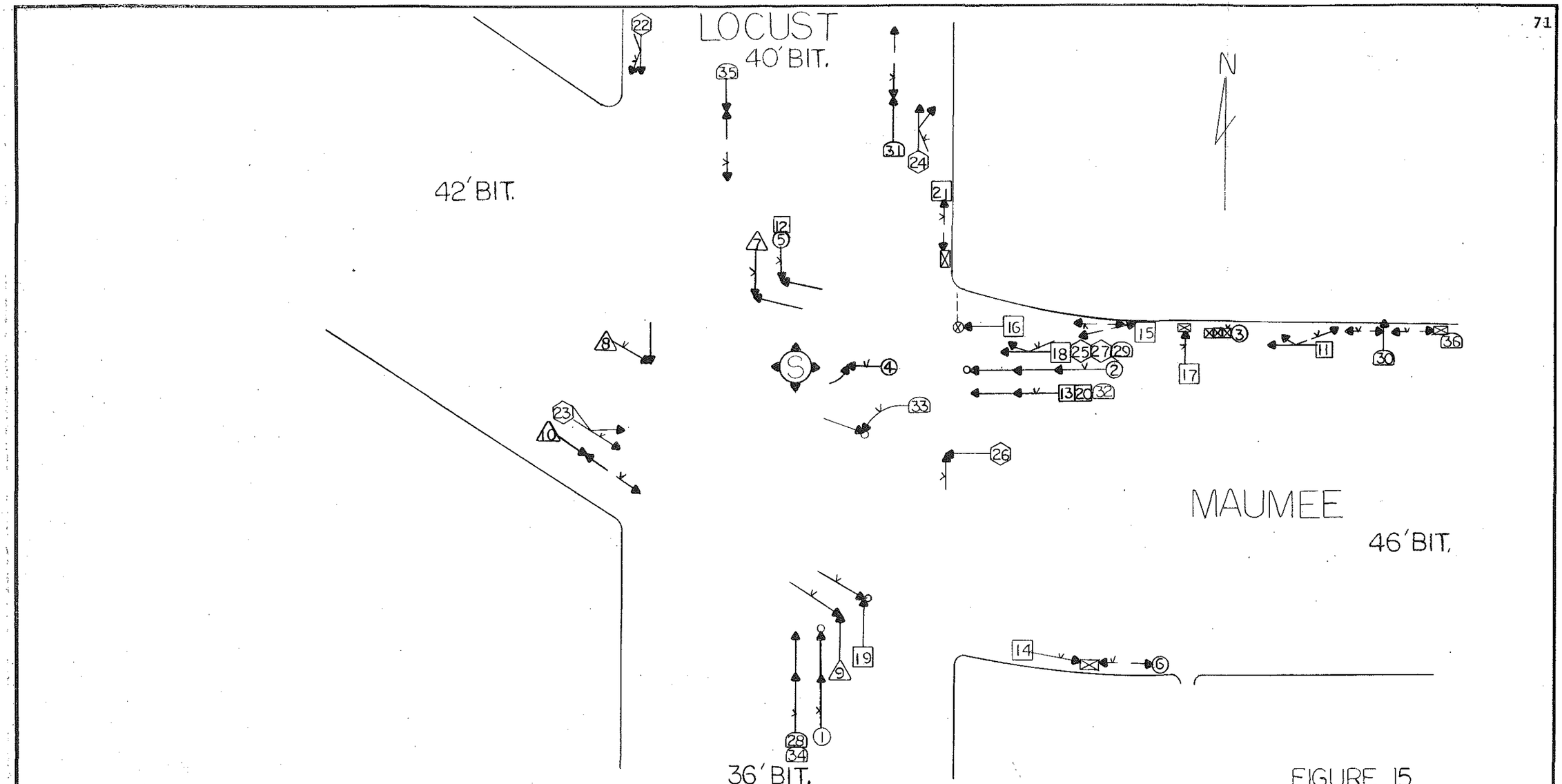


FIGURE 15

REMARKS

⊠ PARKED VEH.

○ 1966 (6)
△ 1967 (4)
□ 1968 (11)
⬡ 1969 (6)
⌓ 1970 (9)

LEGEND

Stop & Go Signal — Stop Sign S
Flashing Beacon — Yield Sign Y
Fatal
Injury
Skidding
Jackknife
Overturned
Backing
Pedestrian
Tree
Out of Control
Driver Intent
Deer
Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1970
Accidents – Total 36
P.D. 31
Injury 5 (9)
Fatal 0 ( )
ADT
Rate /100 mvm
Rate / mv

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location MAUMEE AT LOCUST
CITY OF ADRIAN
LENAWEE CO.

C.S. Miles
Drawn DJM Date 5-24-71
Plan No. LOCATION #10

Form 1547 (Rev. 5/69) Sheet of

NORTHBOUND
LOCUST STREET

SOUTHBOUND
LOCUST STREET

Figure 15A

EASTBOUND
MAUMEE STREET

WESTBOUND
MAUMEE STREET

Figure 15B

LOCATION 11 CENTER STREET AT ERIE STREET

Center Street and Erie Street form a right-angle intersection in the southeast part of the city. The area surrounding the intersection is basically a light commercial-residential area. North of the intersection, Center Street has a 36ft. wide bituminous pavement with curb and gutter. The south leg of the intersection has a 50ft. wide bituminous pavement. This leg serves as an approach to a bituminous covered, wooden, hump-back highway-railroad grade separation located south of the intersection. There is also a one-way northbound connector to Michigan Street which passes under the structure, south of the intersection. The east leg of the intersection (Erie Street) has a 36ft. wide bituminous pavement with curb and gutter, while the west leg has a 28ft. wide bituminous pavement with curb and gutter.

Traffic is controlled on Erie Street by 24 inch "Stop" signs (R1-1-24, Appendix II, p.125). Parking is restricted on the north side of Erie Street on both sides of the intersection. On the south side of Erie Street west of the intersection there is angle parking for a grocery store located in the southwest quadrant of the intersection. North of the intersection, on Center Street, 2 hour parallel parking is permitted; while south of the intersection parallel parking is unrestricted.

On the north end of the east bridge railing there is a "Do Not Enter" sign (R3-27-24, Appendix II, p.132) for the northbound one-way connector.

During the five-year study period there were a total of 33 reported accidents at this location. Parked or parking vehicles were involved in 16, or 48.5%, of the total accidents. Twelve of the 16 parking accidents occurred on the southwest corner near the store. Angle accidents with 21.2% of the total, or 7, and rear end accidents with 18.2% of the total, or 6, constituted the majority of the remaining accidents.

Recommendations

Based on the accident experience, it is recommended that the angle parking on the south side of Erie Street west of the intersection be prohibited and that a "No Parking Here To Corner" sign (R4-5-12, Appendix II, p.135) be installed 68 feet from the crosswalk. It is also recommended that the parallel parking be prohibited on the west side of Center Street south of the intersection to the bridge. The "No Parking Here To Corner" sign would have to be removed and replaced with a "No Parking At Any Time" sign (R4-1-12, Appendix II, p.134).

Removal of this parking should not be detrimental to business of the grocery store, as there is a large paved parking lot south of the store.

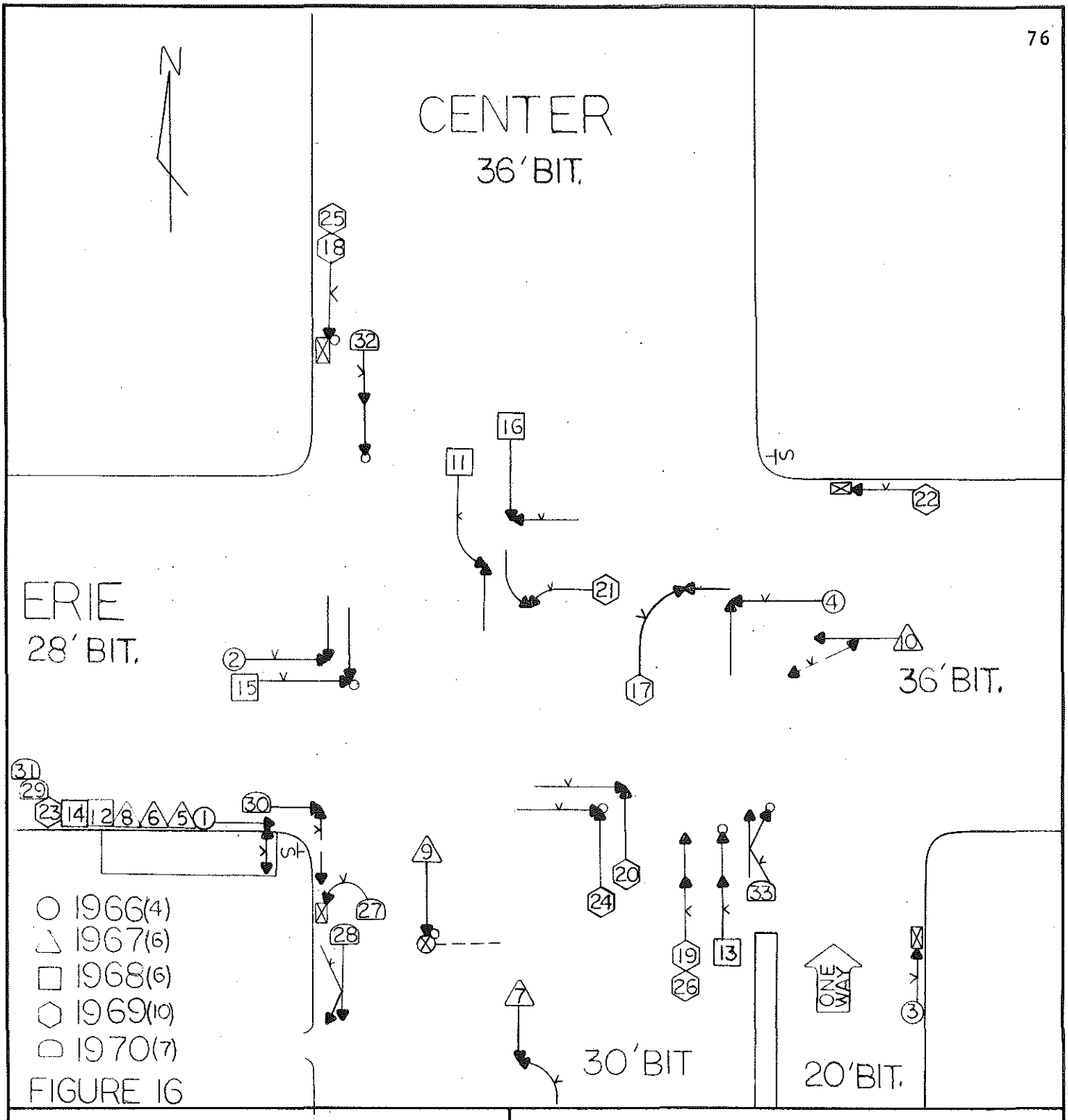


FIGURE 16

LEGEND

Stop & Go Signal — Flashing Beacon

Stop Sign S — Yield Sign Y

Fatal — Injury — Skidding — Jackknife — Overturned — Backing

Pedestrian — Tree — Out of Control — Driver Intent — Deer — Violator

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location ERIE AT CENTER
CITY OF ADRIAN
LENAWEE CO.

⊠ PARKED VEH.

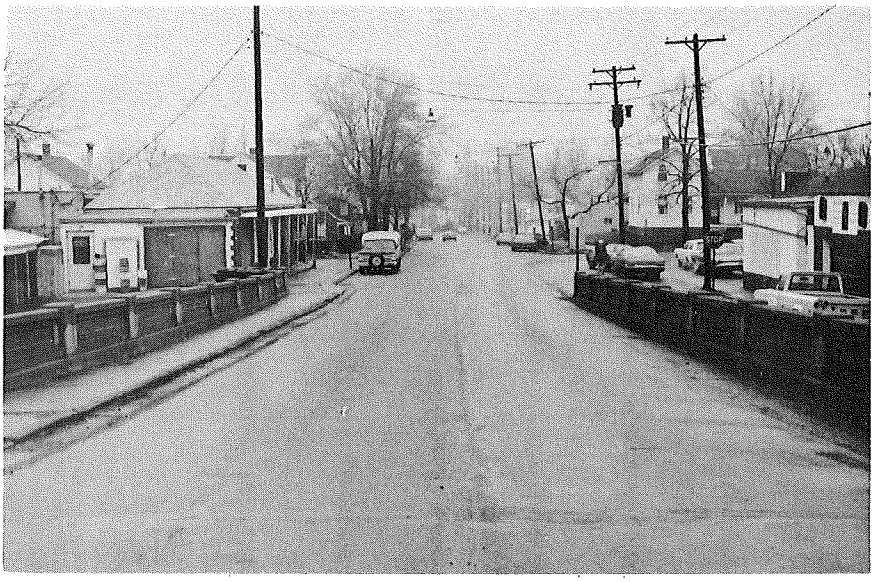
Period: 1966 THRU 1970

Accidents – Total 33 **P.D.** 26

Injury 7 (10) **Fatal** 0 ( )

C.S. _____ **Miles** _____ **Drawn** DJM

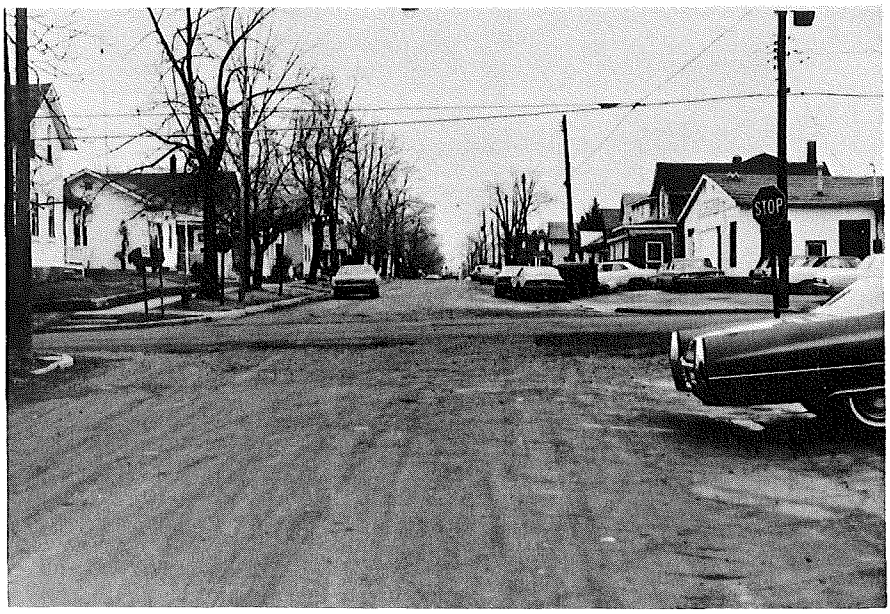
Plan No. LOCATION #11 **Date** 6-22-71



NORTHBOUND
CENTER STREET

SOUTHBOUND
CENTER STREET

Figure 16A



EASTBOUND
ERIE STREET

WESTBOUND
ERIE STREET

Figure 16B

LOCATION 12 MAPLE STREET AT WINTER STREET

Maple Street and Winter Street form a right-angle intersection in the central part of the city near the Central Business District. Maple Street has a 36ft. wide bituminous pavement with curb and gutter west of the intersection. There is also a 16ft. wide parking area on the north side of this leg. East of the intersection Maple Street has a 35ft. wide bituminous pavement with curb and gutter. The north leg of Winter Street has a 34ft. wide bituminous pavement with curb and gutter; while the south leg has a 36ft. wide bituminous pavement with curb and gutter.

Maple Street has a distinct negative gradient to the west on the west leg of the intersection. This gradient creates a poor vision problem in this direction.

Traffic is controlled by 24 inch "Stop" signs (R1-1-24, Appendix II, p.125) on Winter Street for northbound and southbound vehicles. Parking is restricted on both sides of Maple Street east of the intersection, and for 83 feet on the south side of Maple Street west of the intersection. Maple Street parking is restricted on both sides of the north leg of the intersection.

This intersection was the scene of 32 reported accidents during the five-year study period. The most significant type of accidents were right-angles with 17, or 53%, of the total. Rear end and sideswipe in the same direction constituted another 31% of the accidents; and the remaining accidents formed no significant patterns.

Recommendations

The MICHIGAN MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES, on p. 399, states that a flashing beacon is warranted when either:

1. A serious concentration of accidents (four or more over a two year period) which are susceptible of correction by the cautioning or stopping of traffic exists, or
2. Sight distance is extremely limited or where other conditions make it especially desirable to emphasize the need for stopping one street and for cautioning the other. (See Appendix II, p.157)

Since this intersection meets both warrants it is recommended that a flashing beacon be installed maintaining Winter Street as the stop street. The 24 inch "Stop" signs should also be replaced with 36 inch "Stop" signs (R1-1-36, Appendix II, p.125), as they are in poor condition and have lost their reflectivity.

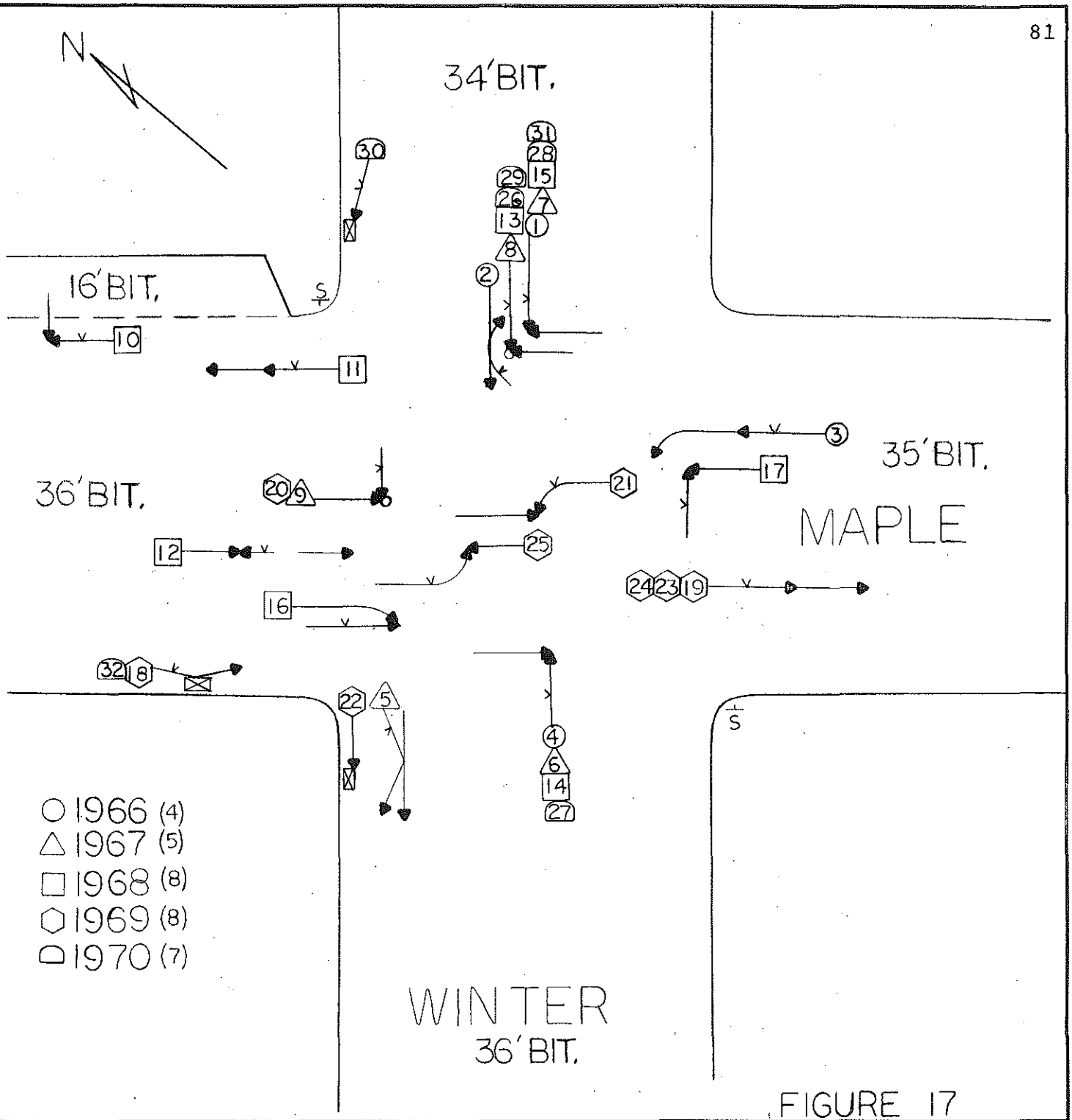


FIGURE 17

LEGEND

Stop & Go Signal — S, R
Flashing Beacon — F, Y
Stop Sign — S
Yield Sign — Y
Fatal
Injury
Skidding
Jackknife
Overturned
Backing
Pedestrian — X
Tree
Out of Control
Driver Intent
Deer
Violator — V

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location WINTER AT MAPLE
CITY OF ADRIAN
LENAWEE CO.

PARKED VEH.

Period: 1966 THRU 1970

Accidents – Total 32 **P.D.** 24

Injury 8 (17) **Fatal** 0 ( )

C.S. _____ **Miles** _____ **Drawn** DJM

Plan No. LOCATION # 12 **Date** 6-23-71

NORTHEASTBOUND
WINTER STREET

SOUTHWESTBOUND
WINTER STREET

Figure 17A

NORTHWESTBOUND
MAPLE STREET

SOUTHEASTBOUND
MAPLE STREET

Figure 17B

LOCATION 13 BEECHER STREET AT CENTER STREET

Beecher Street and Center Street form a right-angle intersection located in the southeast part of the city. This area is a light commercial-residential type of development. Beecher Street has a 44ft. wide bituminous pavement with curb and gutter on both sides, while Center Street has a 30ft. wide bituminous pavement with curb and gutter north of the intersection and a 44ft. wide bituminous pavement south of the intersection. There is a pair of railroad tracks crossing Beecher Street 100 feet west of the intersection and Center Street 130 feet south of the intersection.

Controlling traffic at the intersection are pretimed dual head signals with eight inch lenses, operating on a 60 second cycle and a 50-50 split. The amber time is 5% of the total cycle time.

Parking is prohibited only on the south side of Beecher Street, east of the intersection. Laneage is assigned by solid white centerlines on all legs of the intersection. The existing protection for the grade crossing on Beecher Street consists of a Railroad Advance Warning sign (W10-1-36, Appendix II, p. 142) 250 feet east and 250 feet west of the crossing, and "Railroad Crossing" signs (W10-2, Appendix II, p. 143) with red flashing lights. These signs are supplemented by a legend indicating "2 Tracks".

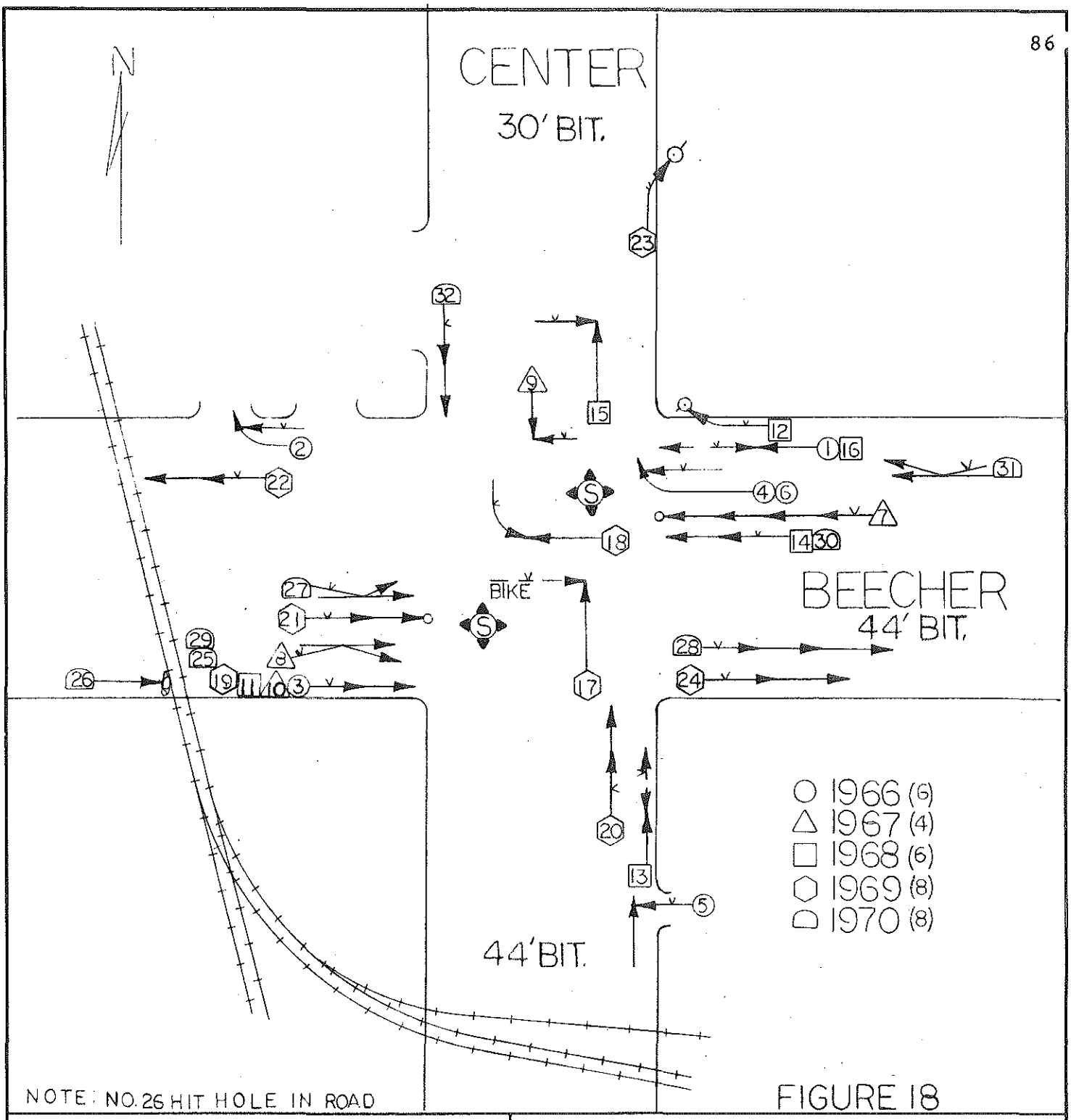
The protection for the grade crossing on Center Street consists of "Railroad Crossing" signs on both sides of the crossing.

During the five-year study period there were 32 reported accidents at this intersection. The most significant pattern of accidents, with 15, or 46.9% of the total being rear ends. The remaining 17 accidents consisted of five angle, five side-swipes (same direction), three backing, two ran off roadway and two miscellaneous accidents.

Recommendations

With the speed limit 30MPH on Beecher Street, it is felt that the amber time should be increased to 7% of the total cycle time. This change will allow more time to clear the intersection and will coincide with timing changes made at Location #2 to the west (See p. 32) and Location #3 to the east (See p. 38) improving progression.

Statute #257.615, Sec. 615a, in the MICHIGAN VEHICLE CODE prohibits the use of commercial advertising signs which resemble traffic control devices. It is, therefore, recommended that the cross-bucks, located in the southwest quadrant, with the legend "DONUTS" be removed as they are in violation of the Code.



NOTE: NO. 26 HIT HOLE IN ROAD

FIGURE 18

LEGEND

Stop & Go Signal — S, R
Flashing Beacon — F, Y
Stop Sign — S
Yield Sign — Y

Fatal
Injury
Skidding
Jackknife
Overturned
Backing
Pedestrian — X
Tree
Out of Control
Driver Intent
Deer
Violator — V

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location CENTER AT BEECHER ⌀ POLE
CITY OF ADRIAN
LENAWEE CO.

Period: 1966 THRU 1970

Accidents – Total 32 **P.D.** 30

Injury 2 (8) **Fatal** 0 ( )

C.S. _____ **Miles** _____ **Drawn** DJM

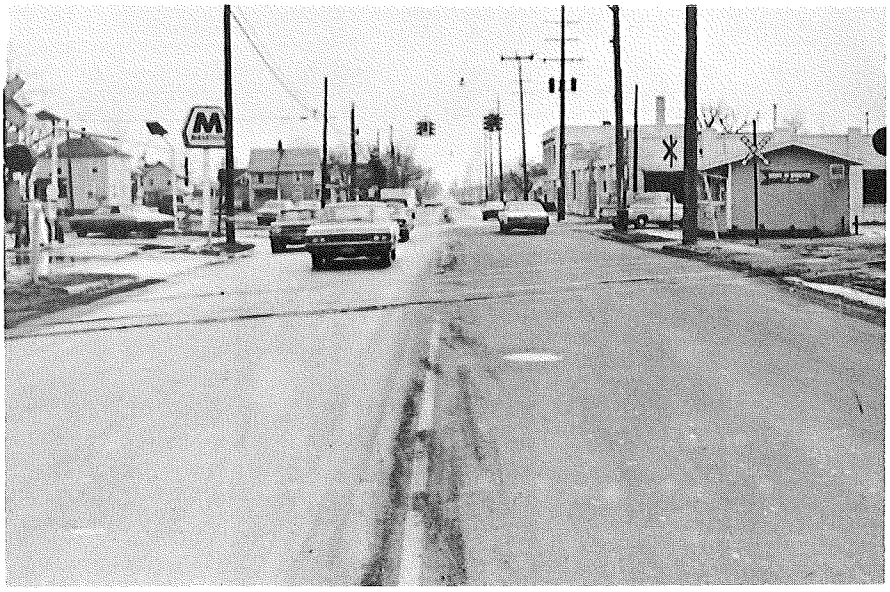
Plan No. LOCATION # 13 **Date** 6-24-71

Form 1547 B (Rev. 11/70)

NORTHBOUND
CENTER STREET

SOUTHBOUND
CENTER STREET

Figure 18A



EASTBOUND
BEECHER STREET

WESTBOUND
BEECHER STREET

Figure 18B

LOCATION 14 CENTER STREET AT TREAT STREET

Center Street and Treat Street form a "T" intersection in the southeast part of the city, which is an industrially developed area. A single track railroad grade crossing spur crosses the intersection diagonally from the northeast to the southwest. The north leg of the intersection, Center Street, is a 28ft. wide, bituminous covered, wooden, hump-back structure over a main line railroad and Michigan Street to the north. Center Street south of the intersection has a 40ft. wide bituminous pavement with curb and gutter. At the intersection Treat Street has an opening of 74 feet, which tapers toward the east for 74 feet where Treat Street is a 30ft. wide bituminous pavement with curb and gutter.

There are two severe sight restrictions at this intersection. The first sight restriction occurs on southbound Center Street north of the intersection where the intersection is obscured by the hump in the bridge. The second sight restriction occurs for westbound vehicles at the intersection where vision is obscured to the north by a three foot high concrete wall.

Traffic is controlled by a 24 inch "Stop" sign (R1-1-24, Appendix II, p.125) for westbound vehicles on Treat Street. Center Street is divided by a solid white centerline. There are no existing controls at either grade crossing, except for a Railroad Advance Warning sign (W10-1-36, Appendix II, p.142) on Center Street south of the crossing.

During the five-year study period there were a total of 24 reported accidents at this intersection. Eight, or 33%, of the

accidents were rear ends with five of these occurring when vehicles attempted a left turn from southbound Center Street to eastbound Treat Street. There were also five accidents involving trains moving through the intersection. The remaining 11 accidents formed no significant pattern.

Recommendations

The obvious solution to the problem at this location would be the reconstruction of the wooden overpass, but the availability of funds at this time may be prohibitive. Therefore, the only recommendation would be to install the necessary signing to warn motorists of the railroad grade crossing as there were five car-train accidents, and no signing currently exists. The signing would consist of a "Railroad Crossing" sign (W10-2, Appendix II, p.143) on both sides of each crossing. Railroad Advance Warning signs (W10-1-36, Appendix II, p.142) should be installed on southbound Center Street and westbound Treat Street.

Centerlines should also be painted on all legs of the intersection (Appendix II, p.144, Figure 3-2a).

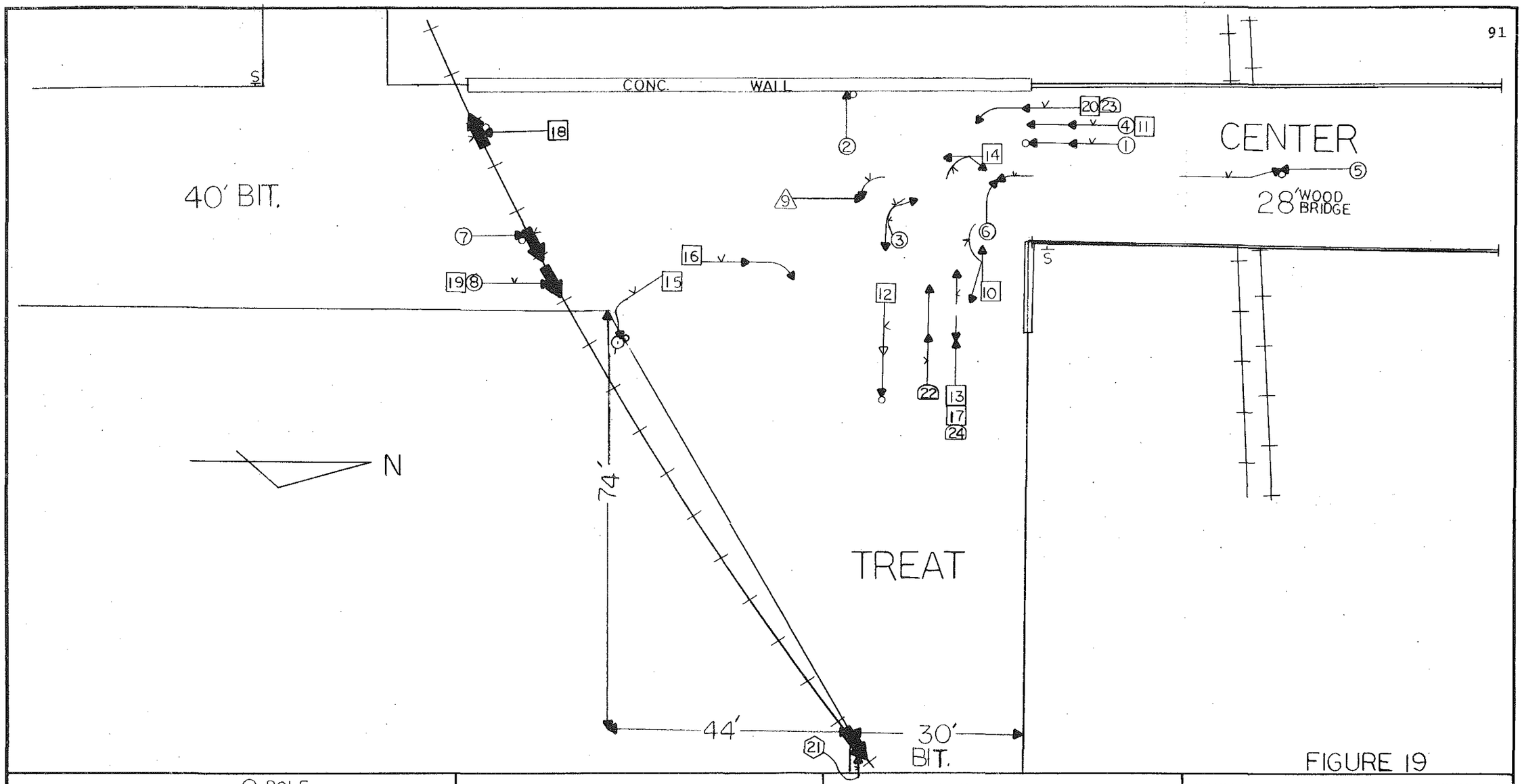


FIGURE 19

REMARKS

○ 1966 (8)
△ 1967 (1)
□ 1968 (11)
⬡ 1969 (1)
⬭ 1970 (3)

Q POLE
TRAIN

LEGEND

Stop & Go Signal — Stop Sign S
Flashing Beacon — Yield Sign Y
Fatal
Injury
Skidding
Jackknife
Overturned
Backing
Pedestrian
Tree
Out of Control
Driver Intent
Deer
Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1970
Accidents – Total 24
P.D. 16
Injury 8 (14)
Fatal 0 ( )
ADT
Rate /100 mvm
Rate / mv

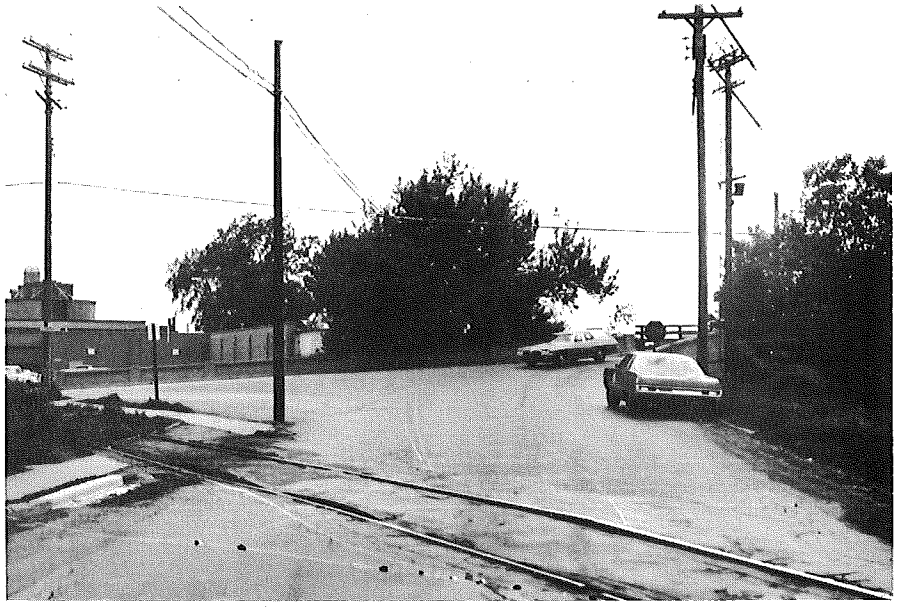
MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location CENTER AT TREAT
CITY OF ADRIAN
LENAWEE CO.

C.S. Miles
Drawn DJM Date 6-28-71
Plan No. LOCATION # 14

Form 1547 (Rev. 5/69) Sheet of

NORTHBOUND
CENTER STREET



WESTBOUND
TREAT STREET

SOUTHBOUND
CENTER STREET

Figure 19A

LOCATION 15 BENT OAK AVENUE AT RIVERSIDE AVENUE

Bent Oak Avenue at Riverside Avenue is a "T" intersection located in the north-central part of the city, which is a residential area. Bent Oak Avenue has a 36ft. wide bituminous pavement with curb and gutter on both sides, and Riverside Avenue is a 40ft. wide bituminous pavement with curb and gutter on both sides. There is a railroad grade crossing which crosses the intersection diagonally from the southwest to northeast.

Traffic is controlled by a 24 inch "Stop" sign (R1-1-24, Appendix II, p. 125) for eastbound Riverside Avenue, and a 30 inch "Stop" sign (R1-1-30, Appendix II, p.125) opposite Riverside Avenue, which functions as a supplement to the 24 inch "Stop" sign. The protection at the railroad crossing consists of "Railroad Crossing" signs (W10-2, Appendix II, p.143) and flashing red beacons.

The posted speed limits are 25MPH on Bent Oak Avenue and 30MPH on Riverside Avenue. Each roadway has a white solid centerline.

During the five-year study period, this location was the scene of 22 reported accidents. Rear end accidents formed the most significant pattern, as there were 12, or 54%, of the total accidents. There were also three angle, three ran off roadway, two head-on left turn, one sideswipe, and one head-on accident.

Recommendations

Since ten of the rear end accidents and two of the ran off roadway accidents occurred on Riverside Avenue at the intersec-

tion, and because the speed limit is 30MPH; it is felt that the 24 inch "Stop" sign should be replaced by a 36 inch "Stop" sign (R1-1-36, Appendix II, p. 125). Because the location of the "Stop" sign appears to be critical it should be placed so as not to obstruct the view of the railroad beacons. A "Stop Ahead" sign (W3-1-36, Appendix II, p. 141) should also be installed 250 feet west of the intersection. The 30 inch "Stop" sign should also be replaced by a 48 inch x 24 inch Bi-directional Target Arrow sign (W1-7-48, Appendix II, p. 140). These recommendations should give eastbound drivers sufficient warning of the impending stop and serve to reduce the number of rear end accidents at this location.

It is also recommended that the Railroad Advance Warning signs (W10-1-36, Appendix II, p. 142) be placed on all legs of the intersection 350 feet from the grade crossing.

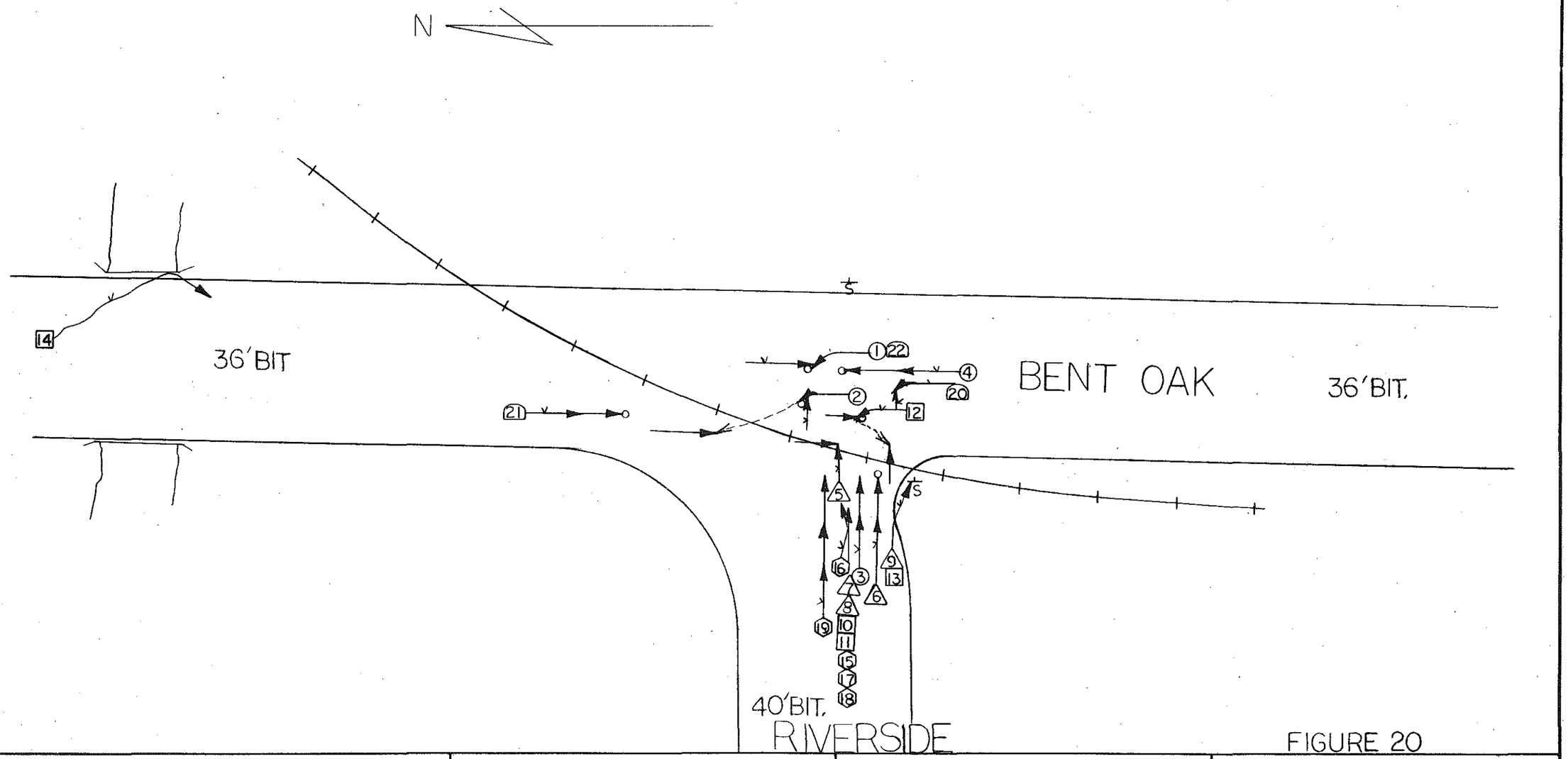


FIGURE 20

REMARKS

○ 1966 (4)
△ 1967 (5)
□ 1968 (5)
⬡ 1969 (5)
⌓ 1970 (3)

LEGEND

Stop & Go Signal — S, R, Y, F, Y
Flashing Beacon
Stop Sign S
Yield Sign Y
Fatal
Injury
Skidding
Jackknife
Overturned
Backing
Pedestrian (X)
Tree
Out of Control
Driver Intent
Deer
Violator (V)

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1970
Accidents – Total 22
P.D. 15
Injury 7 (12)
Fatal 0 ( )
ADT
Rate /100 mvm
Rate / mv

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location BENT OAK AT RIVERSIDE
CITY OF ADRIAN
LENAWEE CO.

C.S. Miles
Drawn DJM Date 6 28 71
Plan No. LOCATION #15

Form 1547 (Rev. 5/69) Sheet of

NORTHBOUND
BENT OAK AVENUE

EASTBOUND
RIVERSIDE AVENUE

SOUTHBOUND
BENT OAK AVENUE

Figure 20A

LOCATION 16 CENTER STREET AT FRANK STREET
(See Appendix I, p.117)

Total	P.D.	Inj.	Fatal
22	16	6	0

LOCATION 17 CHURCH STREET AT TECUMSEH STREET

(This intersection is part of the proposed one-way system, see TRAFFIC ENGINEERING ANALYSIS.)

This right-angle intersection is located in the east-central part of the city, a light commercial-residential area. Church Street has a 36ft. wide bituminous pavement with curb and gutter on both sides, and Tecumseh Street has a 40ft. wide bituminous pavement with curb and gutter on both sides. Parallel parking is permitted on both sides of all legs of the intersection.

Traffic is controlled by a pretimed single signal head with eight inch lenses, operating on a 60 second cycle with a 55%-45% split, Tecumseh - Church. The amber time is 5% of the total cycle time.

There is a solid white centerline on Church Street with pedestrian crosswalks on all four legs of the intersection.

During the five-year study period there were a total of 22 reported accidents at this location, with seven right-angle and six rear end accidents forming the most significant patterns.

Recommendations

Since the amber time is only 5% of the total cycle, it is felt that this is a major contributor to the number of right-

angle accidents at this location. It is, therefore, recommended that the amber time be increased to 6% of the total cycle time and the cycle length changed from 60 to 70 seconds.

A further recommendation would be to obtain skidometer tests, because 54.5%, or 12, of the accidents occurred on wet pavement (See p. 26).

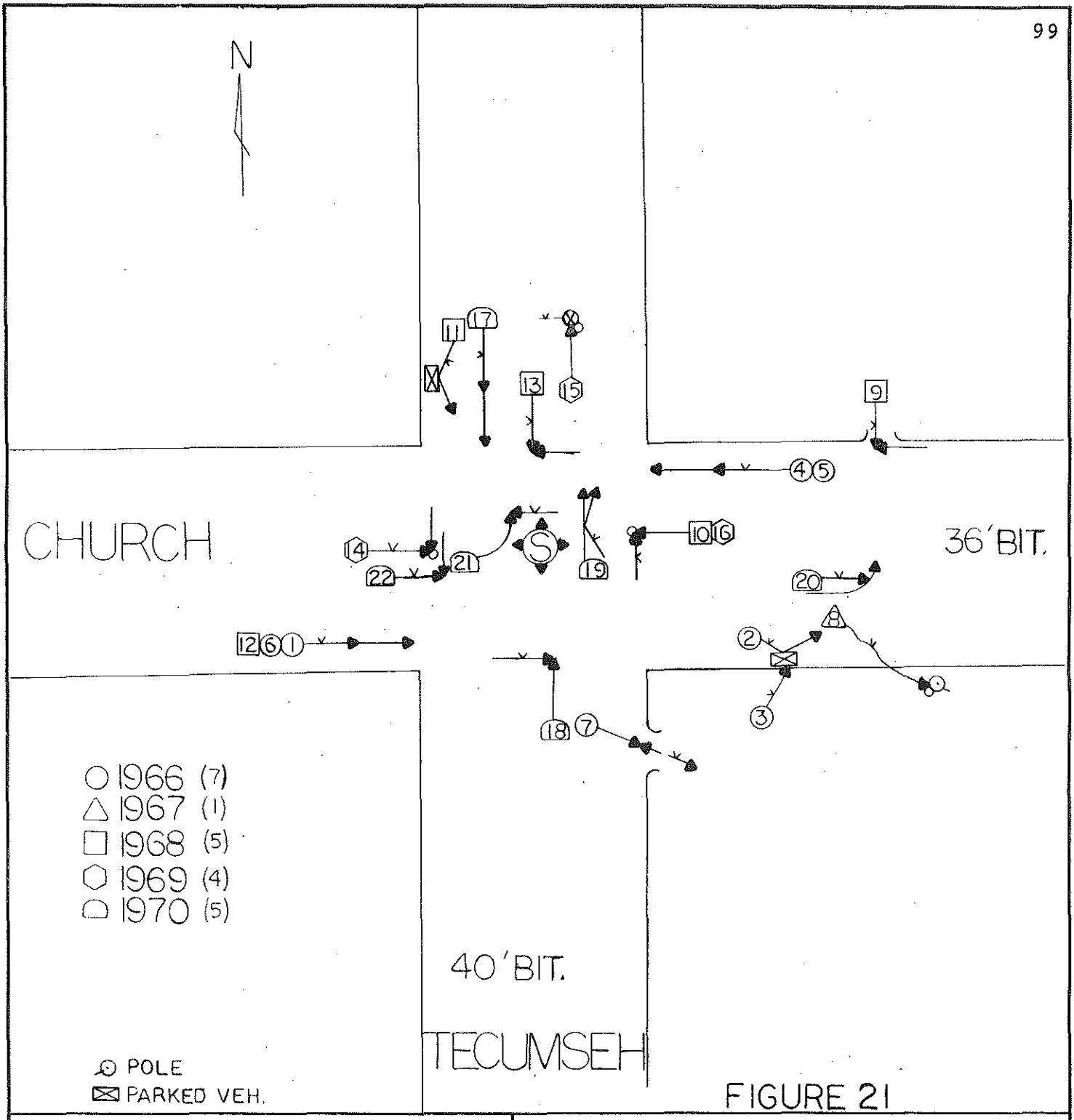


FIGURE 21

LEGEND

Stop & Go Signal — Stop Sign S
Flashing Beacon — Yield Sign Y

Fatal
Injury
Skidding
Jackknife
Overturned
Backing
Pedestrian
Tree
Out of Control
Driver Intent
Deer
Violator

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location CHURCH AT TECUMSEH
CITY OF ADRIAN
LENAWEE CO.

Period: 1966 THRU 1970
Accidents – Total 22 **P.D.** 17
Injury 5 (11) **Fatal** 0 ( )
C.S. _____ **Miles** _____ **Drawn** DJM
Plan No. LOCATION #17 **Date** 6-30-71

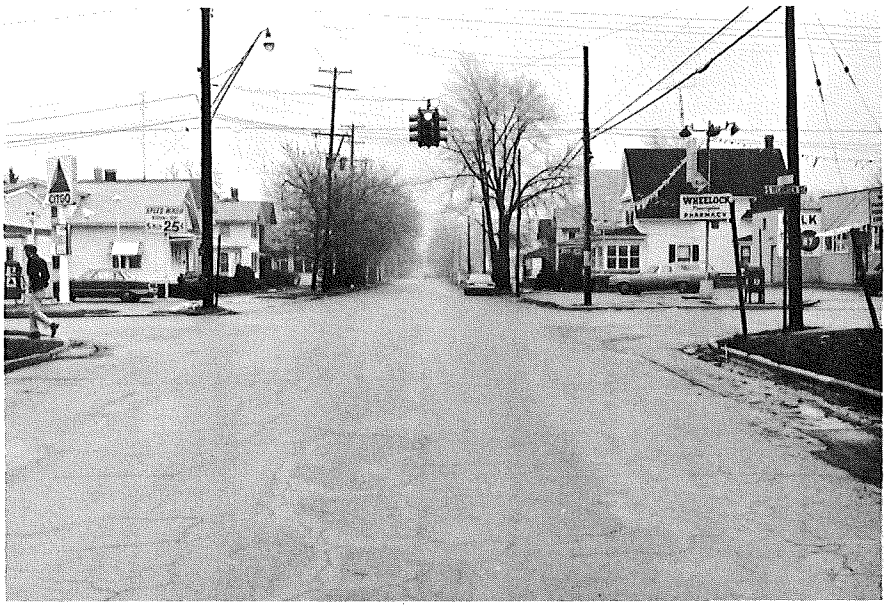
Form 1547 B (Rev. 11/70)

NORTHBOUND
TECUMSEH STREET

SOUTHBOUND
TECUMSEH STREET

LIBRARY
michigan department of
state highways
LANSING

Figure 21A



EASTBOUND
CHURCH STREET

WESTBOUND
CHURCH STREET

Figure 21B

LOCATION 18 MAUMEE STREET AT DEAN STREET AND MAPLE STREET

(This intersection is part of the proposed one-way system, see TRAFFIC ENGINEERING ANALYSIS.)

Located in the east-central part of the city, a light commercial-residential area, this five-legged intersection is formed by the intersection of three streets. Maumee Street is a major east-west street intersected on the north by Maple Street. Dean Street intersects Maumee Street, at a right-angle on the south, directly opposite Maple Street. On the north side of Maumee Street, Dean Street is offset 85 feet to the east and intersects Maumee Street at a right-angle (See Collision Diagram, p.104).

Maumee Street has a 34ft. wide bituminous pavement with curb and gutter, while Maple Street has a 40ft. wide bituminous pavement with curb and gutter. Dean Street, south of Maumee Street, has a 32ft. wide bituminous pavement with curb and gutter, and north of Maumee Street, Dean Street has a 28ft. wide bituminous pavement with curb and gutter.

Traffic is controlled on the south leg of Dean Street and on Maple Street, at Maumee Street, by 24 inch "Stop" signs (R1-1-24, Appendix II, p.125) in conjunction with a flashing beacon. The north leg of Dean Street at Maumee Street has a 24 inch "Stop" sign controlling traffic. Maumee Street and Maple Street are divided by solid white centerlines, while Dean Street has no centerline markings.

During the five-year study period there were a total of 20 reported accidents at this location. The predominant type of

accident occurring were right-angles with 10, or 50% of the total. The accident patterns are not significant enough to warrant major changes at this location, but field investigation revealed two possible corrections.

Recommendations

The first recommendation would be to change the amber lenses on the flashing beacon, as they have the word "Caution" on them. On p. 323 of the MICHIGAN MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES it is stated that, "Lettering shall in no case be used on the visible part of vehicular signal lenses".

The second recommendation would be to replace the 24 inch "Stop" sign on Maple Street, as it is in poor condition and its effectiveness has decreased.

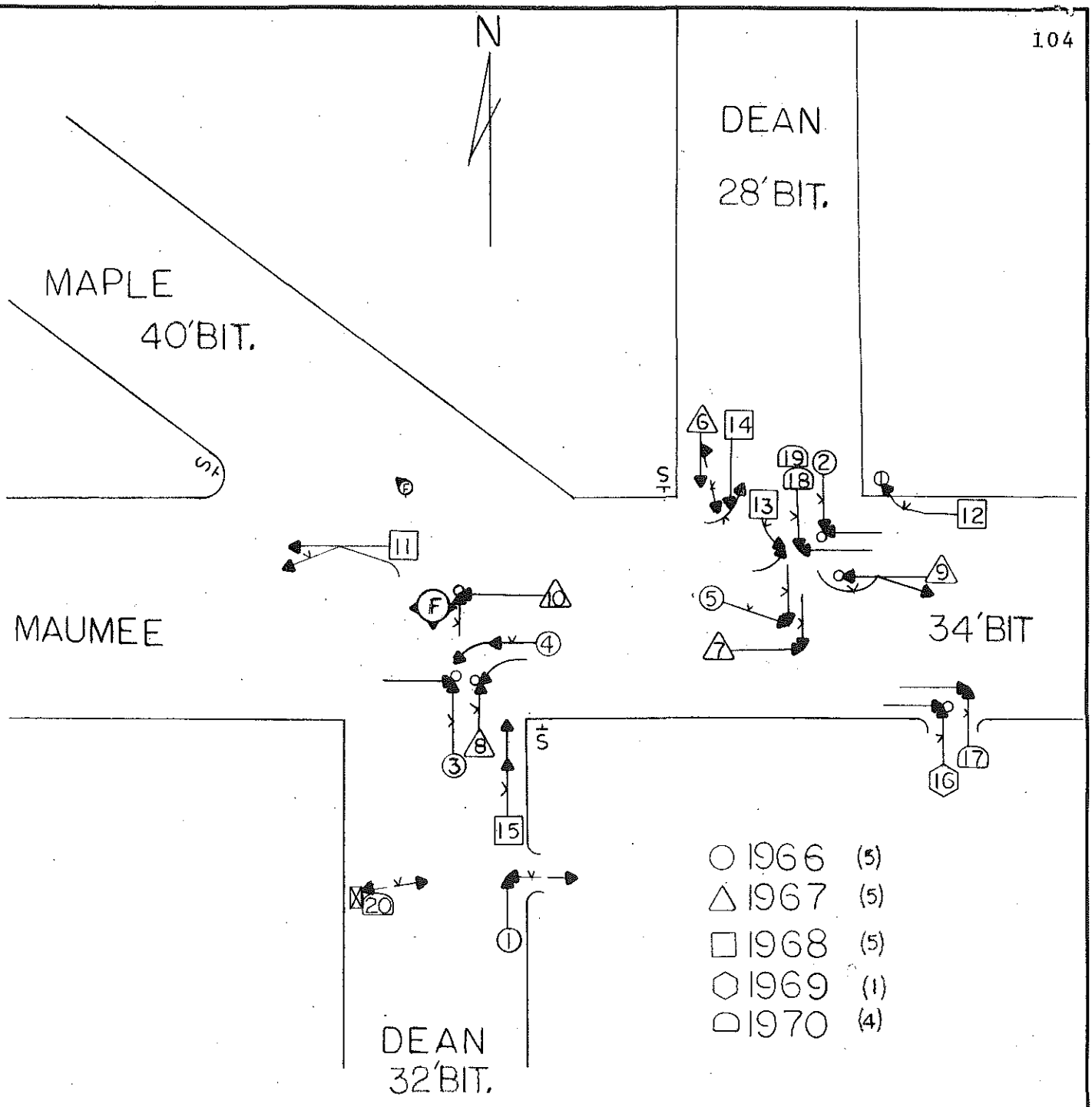
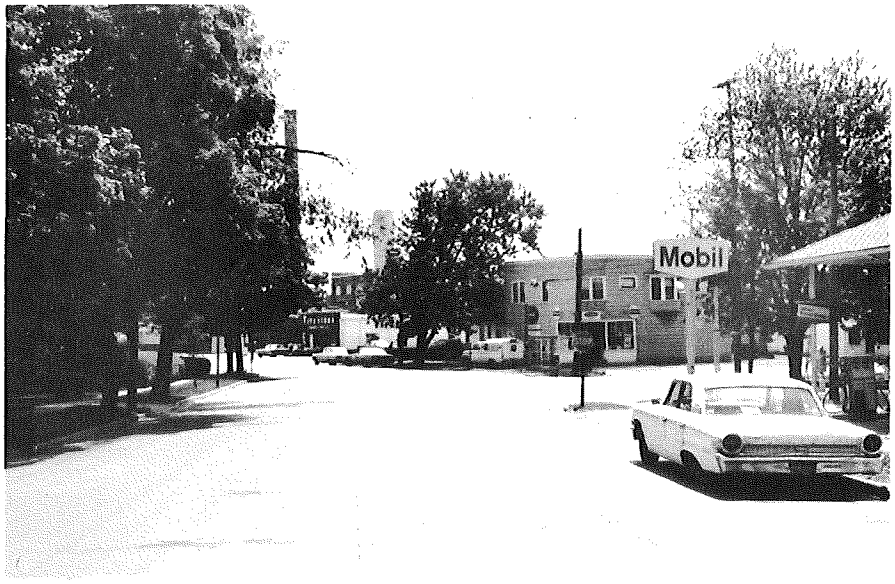


FIGURE 22

LEGEND	MICHIGAN DEPARTMENT OF STATE HIGHWAYS TRAFFIC AND SAFETY DIVISION
Stop & Go Signal (S, R, Y, F, Y) Stop Sign S Flashing Beacon Yield Sign Y	Location MAUMEE AT DEAN AND MAPLE CITY OF ADRIAN LENAWEE CO.
Fatal Injury Skidding Jackknife Overturned Backing Pedestrian (X) Tree Out of Control Driver Intent Deer (V) Violator	Period: 1966 THRU 1970 Accidents – Total 20 P.D. 14 Injury 6 (6) Fatal 0 ( ) C.S. ____ Miles ____ Drawn DJM Plan No. LOCATION # 18 Date 6-8-71

Form 1547 B (Rev. 11/70)

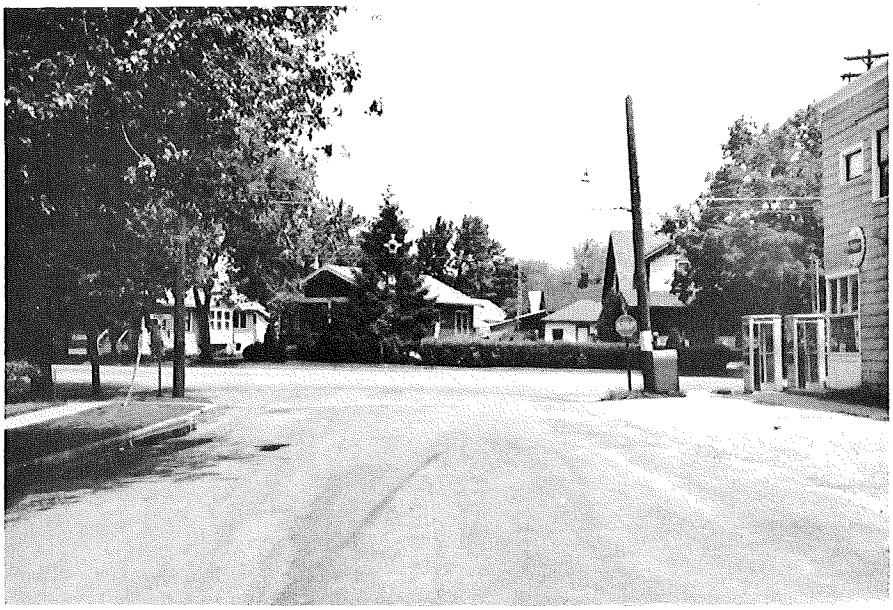
EASTBOUND
MAUMEE STREET



SOUTHEASTBOUND
MAPLE STREET

WESTBOUND
MAUMEE STREET

Figure 22A



NORTHBOUND
DEAN STREET

SOUTHBOUND
DEAN STREET

Figure 22B

LOCATION 19 MAUMEE STREET AT TECUMSEH STREET

(This intersection is part of the proposed one-way system, see TRAFFIC ENGINEERING ANALYSIS.)

Tecumseh Street at Maumee Street is a right-angle intersection located in the east-central part of the city. This location is in a light commercial-residential area. Tecumseh Street has a 40ft. wide bituminous pavement with curb and gutter on both sides, and Maumee Street has a 32ft. wide bituminous pavement with curb and gutter on both sides. Parallel parking is permitted on both sides of all legs of the intersection.

Traffic is controlled by a pretimed single signal head with eight inch lenses, operating on a 60 second cycle with a 50-50 split. The amber time is 5% of the total cycle length.

There is a solid white centerline on Maumee Street and pedestrian crosswalks are marked on all four legs of the intersection.

During the five-year study period there were a total of 20 reported accidents at this location with eight, or 40% of the total being right-angle accidents. The remaining 12 accidents formed no significant pattern.

Recommendations

Since the amber time is only 5%, it is felt that this could be a contributor to the high percentage of angle accidents. It is, therefore, recommended that the amber time be increased to 6% of the total cycle length. It is further recommended that the 60 second cycle length be increased to 70 seconds.

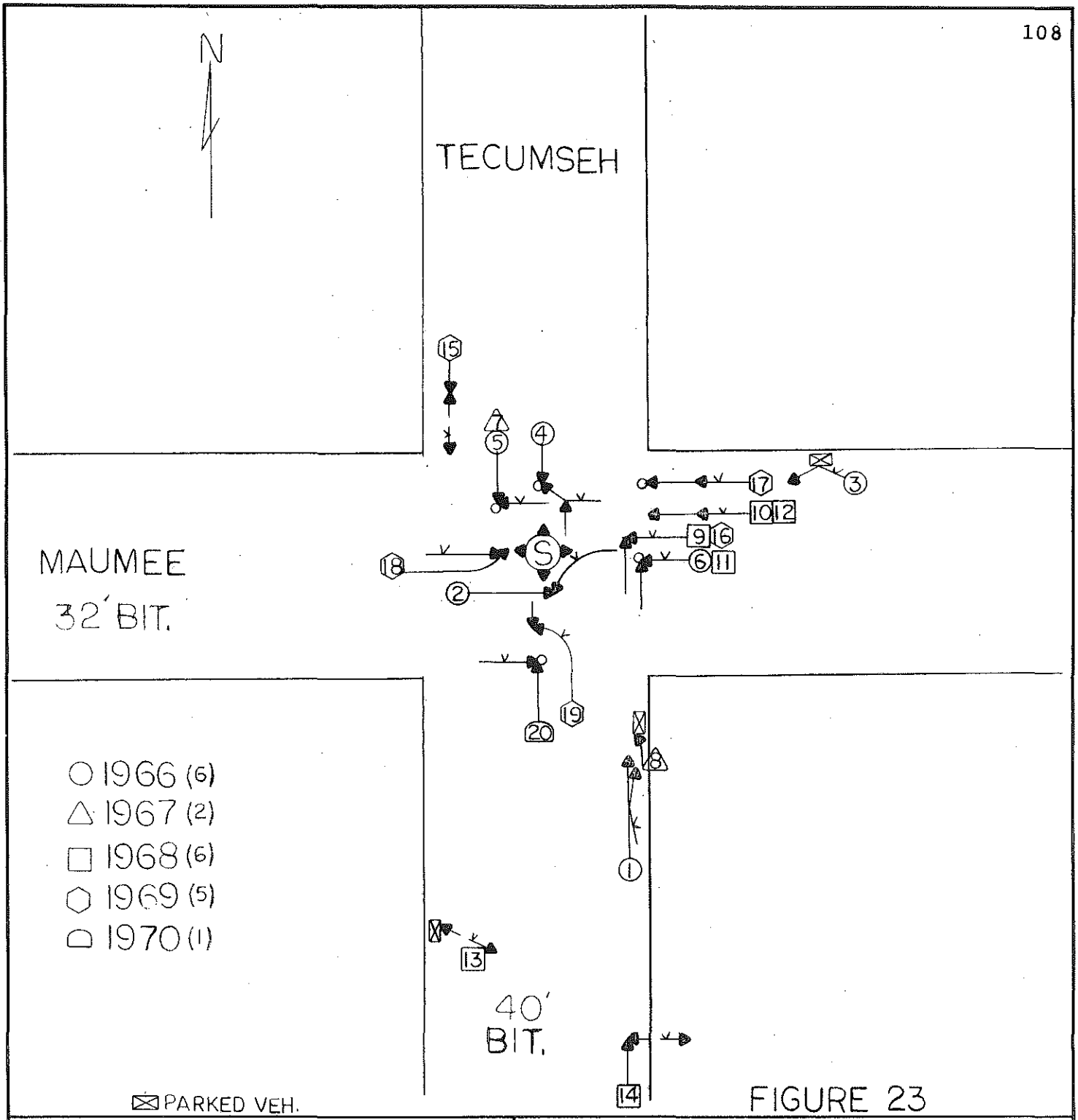


FIGURE 23

LEGEND

Stop & Go Signal — Stop Sign S
Flashing Beacon — Yield Sign Y

Fatal
Injury
Skidding
Jackknife
Overturned
Backing

Pedestrian
Tree
Out of Control
Driver Intent
Deer
Violator

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location TECUMSEH AT MAUMEE
CITY OF ADRIAN
LENAWEE CO.

Period: 1966 THRU 1970
Accidents – Total 20 **P.D.** 13
Injury 7 (9) **Fatal** 0 ( )
C.S. _____ **Miles** _____ **Drawn** DJM
Plan No. LOCATION #19 **Date** 6-8-71

Form 1547 B (Rev. 11/70)

NORTHBOUND
TECUMSEH STREET

SOUTHBOUND
TECUMSEH STREET

Figure 23A

EASTBOUND
MAUMEE STREET

WESTBOUND
MAUMEE STREET

Figure 23B

LOCATION 20 RIVER STREET AT MAPLE STREET AND NORTHWESTERN STREET (See Appendix I, p. 119)

Total	P.D.	Inj.	Fatal
17	11	6	0

LOCATION 21 ERIE STREET AT TECUMSEH STREET (See Appendix I, p. 121)

Total	P.D.	Inj.	Fatal
13	11	2	0

SUMMARY

After an indepth study of each location, recommendations were formulated for 17 of the 21 locations and are as follows:

Location Number	Location Description	Quantity	Recommendations
1	Broad Street at Maumee Street	2	R3-8-30 or
		1	R3-8-30
		1	R3-9-30
			Remove Red Flashing Arrow
			Add Delayed Left Turn Phase
			Obtain Skidometer Tests
2	Beecher Street at Division Street		Increase Amber Time to 7%
			Add Left Turn Lanes
			Obtain Skidometer Tests
3	Beecher Street at Treat Street	4	R4-1-12
		2	R3-7-30
			Increase Amber Time to 7%
			Parking Prohibition
4	Broad Street at Church Street	4	Change Green Lenses
		2	R6-19-30
		2	R5-1 (Revised)
		1	G3-26-30
		1	R3-7-30
		1	R3-1-24
		1	R3-2-24
			Obtain Skidometer Tests
6	Broad Street at Maple Street		Change Cycle Length to 70 Seconds with 6% Amber Time
7	Church Street at Locust Street	4	Install 12" Lenses
		2	R1-1-30
8	Church Street at Division Street	1	R1-1-36
		1	W1-7-48

Location Number	Location Description	Quantity	Recommendations
9	Church Street at Center Street	1 1	W1-7-48 R4-5-12 Increase Amber Time to 6% Change Cycle Length to 70 Seconds Parking Prohibition
10	Maumee Street at Locust Street		Increase Amber Time to 6% Change Cycle Length to 70 Seconds
11	Center Street at Erie Street	1 1	R4-5-12 R4-1-12 Parking Prohibition
12	Maple Street at Winter Street	2 1	R1-1-36 Install Flashing Beacon
13	Beecher Street at Center Street		Increase Amber Time to 6% Removal of Commercial Advertising Sign
14	Center Street at Treat Street	4 3	W10-2 W10-1-36 Pavement Marking (Centerline)
15	Bent Oak Avenue at Riverside Avenue	3 1 1 1	W10-1-36 R1-1-36 W3-1-36 W1-7-48
17	Church Street at Tecumseh Street		Increase Amber Time to 6% Obtain Skidometer Tests Change Cycle Length to 70 Seconds
18	Maumee Street at Dean Street and Maple Street	2 1	Replace Caution Lenses R1-1-24
19	Tecumseh Street at Maumee Street		Increase Amber Time to 6% Change Cycle Length to 70 Seconds

APPENDIX I

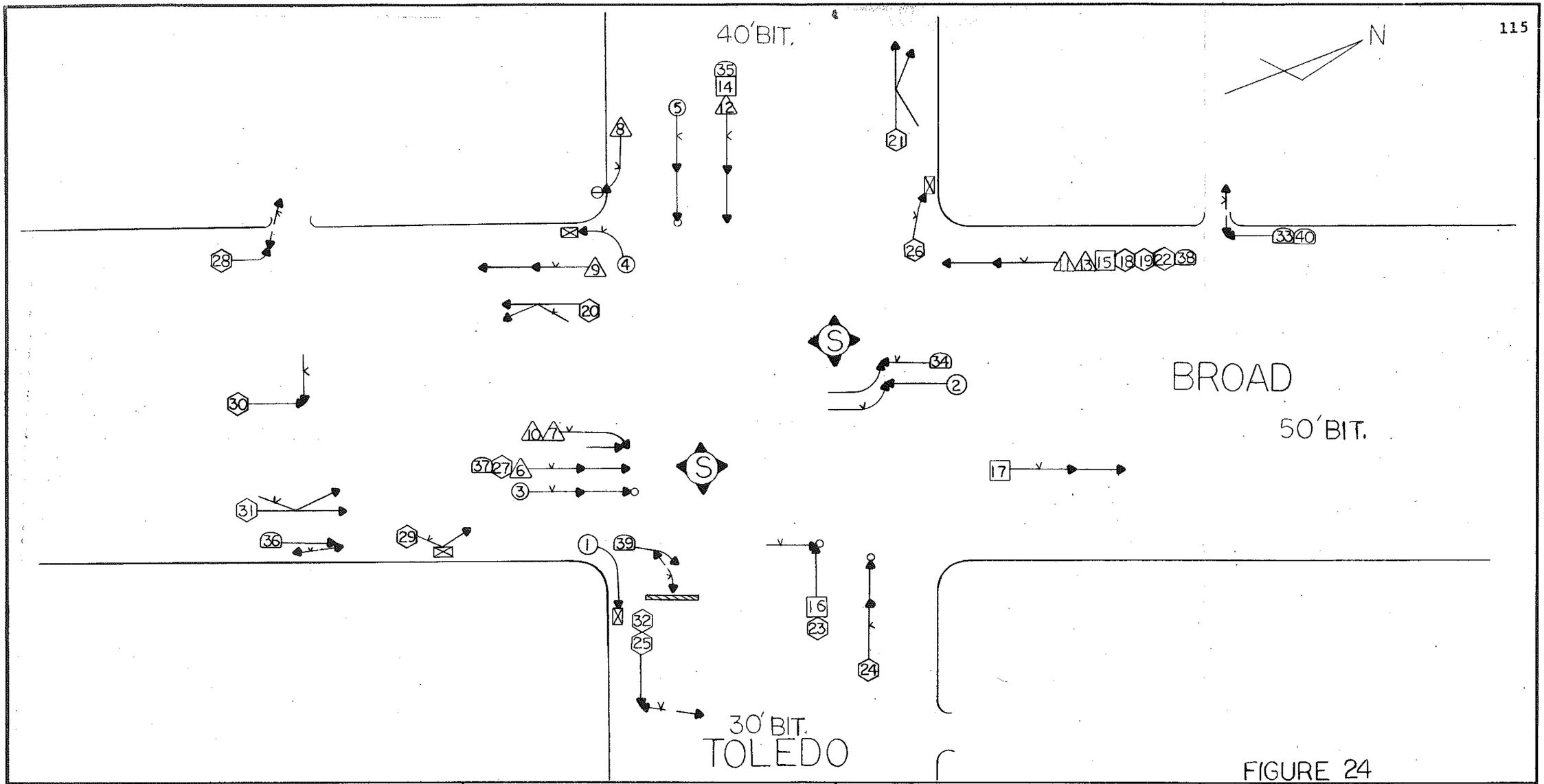


FIGURE 24

REMARKS

⊖ SIGN
⊠ PARKED VEH.
▨ BARICADE

○ 1966 (5)
△ 1967 (8)
□ 1968 (4)
⬡ 1969 (15)
⌓ 1970 (8)

LEGEND

Stop & Go Signal — Stop Sign S
Flashing Beacon — Yield Sign Y
Fatal
Injury
Skidding
Jackknife
Overturned
Backing
Pedestrian
Tree
Out of Control
Driver Intent
Deer
Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1970
Accidents – Total 40
P.D. 34
Injury 6 (7)
Fatal 0 ( )
ADT
Rate /100 mvm
Rate / mv

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location BROAD AT TOLEDO
CITY OF ADRIAN
LENAWEE CO.

C.S. Miles
Drawn DJM Date 6-7-71
Plan No. LOCATION #5

Form 1547 (Rev. 5/69) Sheet of

NORTHBOUND
BROAD STREET

EASTBOUND
TOLEDO

SOUTHBOUND
BROAD STREET

Figure 24A

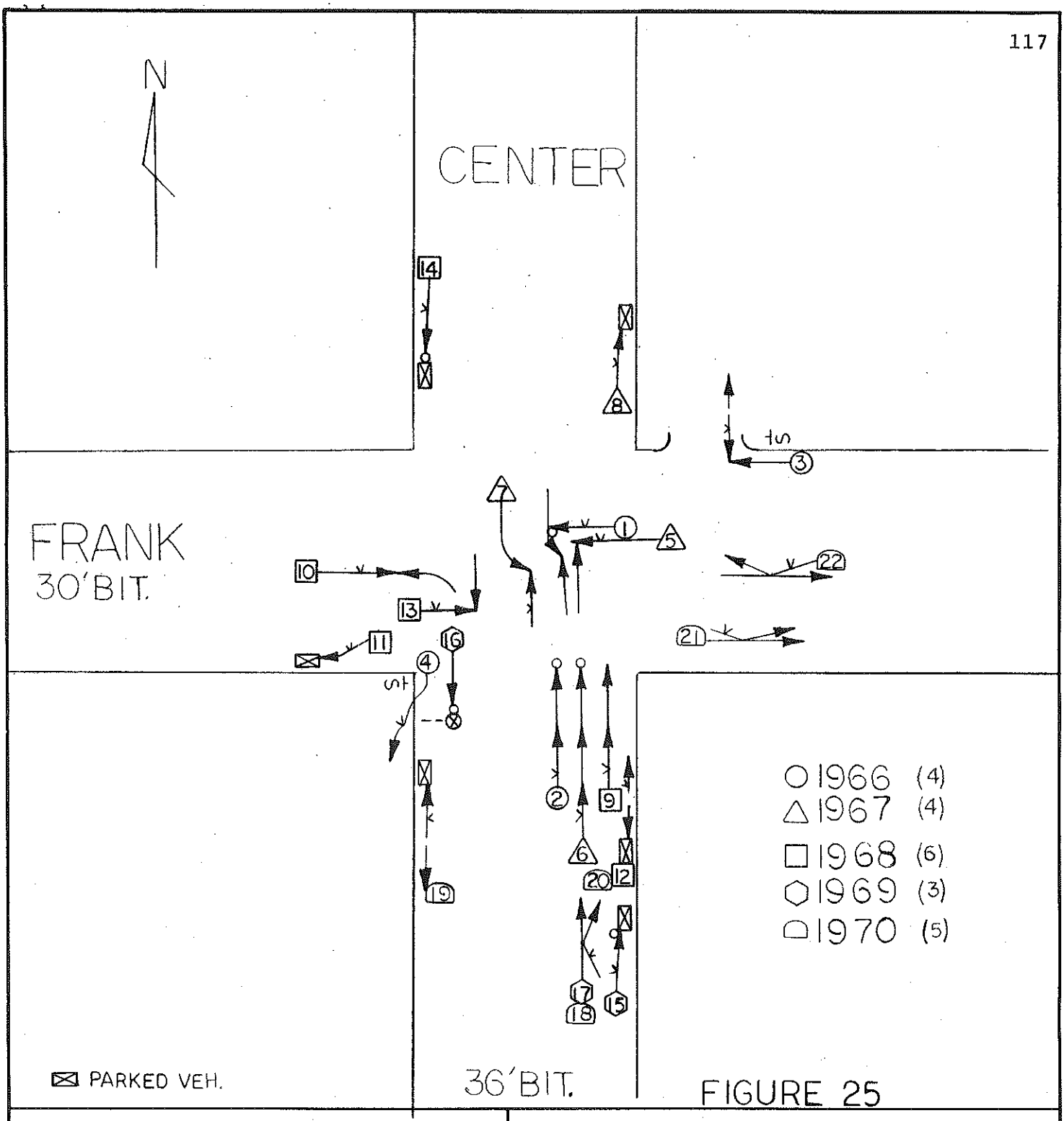


FIGURE 25

LEGEND

Stop & Go Signal — S — R — Y — F — Y
Flashing Beacon

Stop Sign S
Yield Sign Y

Fatal
Injury
Skidding
Jackknife
Overturned
Backing

Pedestrian X
Tree
Out of Control
Driver Intent
Deer
Violator V

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location CENTER AT FRANK
CITY OF ADRIAN
LENAWEE CO.

Period: 1966 THRU 1970

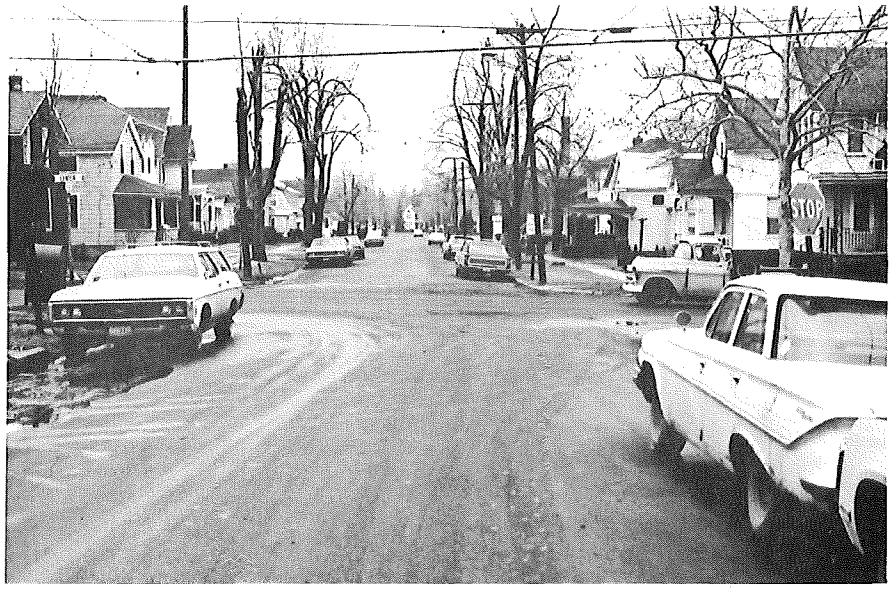
Accidents – Total 22 **P.D.** 16

Injury 6 (9) **Fatal** 0 ( )

C.S. _____ **Miles** _____ **Drawn** DJM

Plan No. LOCATION #16 **Date** 6-28-71

Form 1547 B (Rev. 11/70)



EASTBOUND
FRANK STREET

NORTHBOUND
CENTER STREET

WESTBOUND
FRANK STREET

Figure 25A

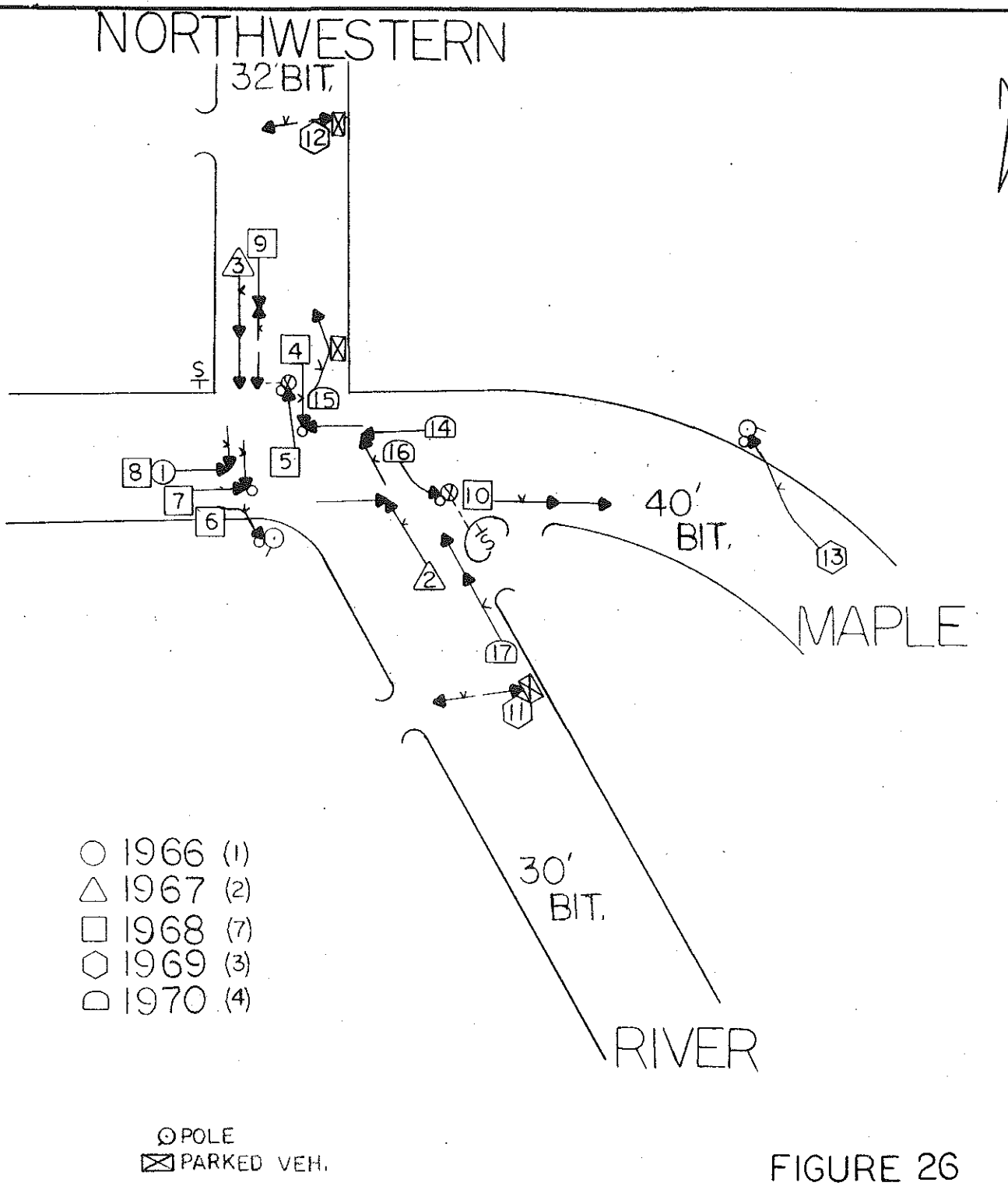


FIGURE 26

LEGEND

Stop & Go Signal — Stop Sign S
Flashing Beacon — Yield Sign Y

Fatal
Injury
Skidding
Jackknife
Overturned
Backing

Pedestrian
Tree
Out of Control
Driver Intent
Deer
Violator

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location RIVER AT MAPLE AND NORTHWESTERN
CITY OF ADRIAN
LENAWEE CO.

Period: 1966 THRU 1970
Accidents – Total 17 **P.D.** 11
Injury 6 (6) **Fatal** 0 ( )
C.S. _____ **Miles** _____ **Drawn** D J M
Plan No. LOCATION #20 **Date** 6-29-71

Form 1547 B (Rev. 11/70)

NORTHBOUND
RIVER STREET

EASTBOUND
MAPLE STREET

SOUTHBOUND
NORTHWESTERN DRIVE

LIBRARY
michigan department of
state highways
LANSING

Figure 26A

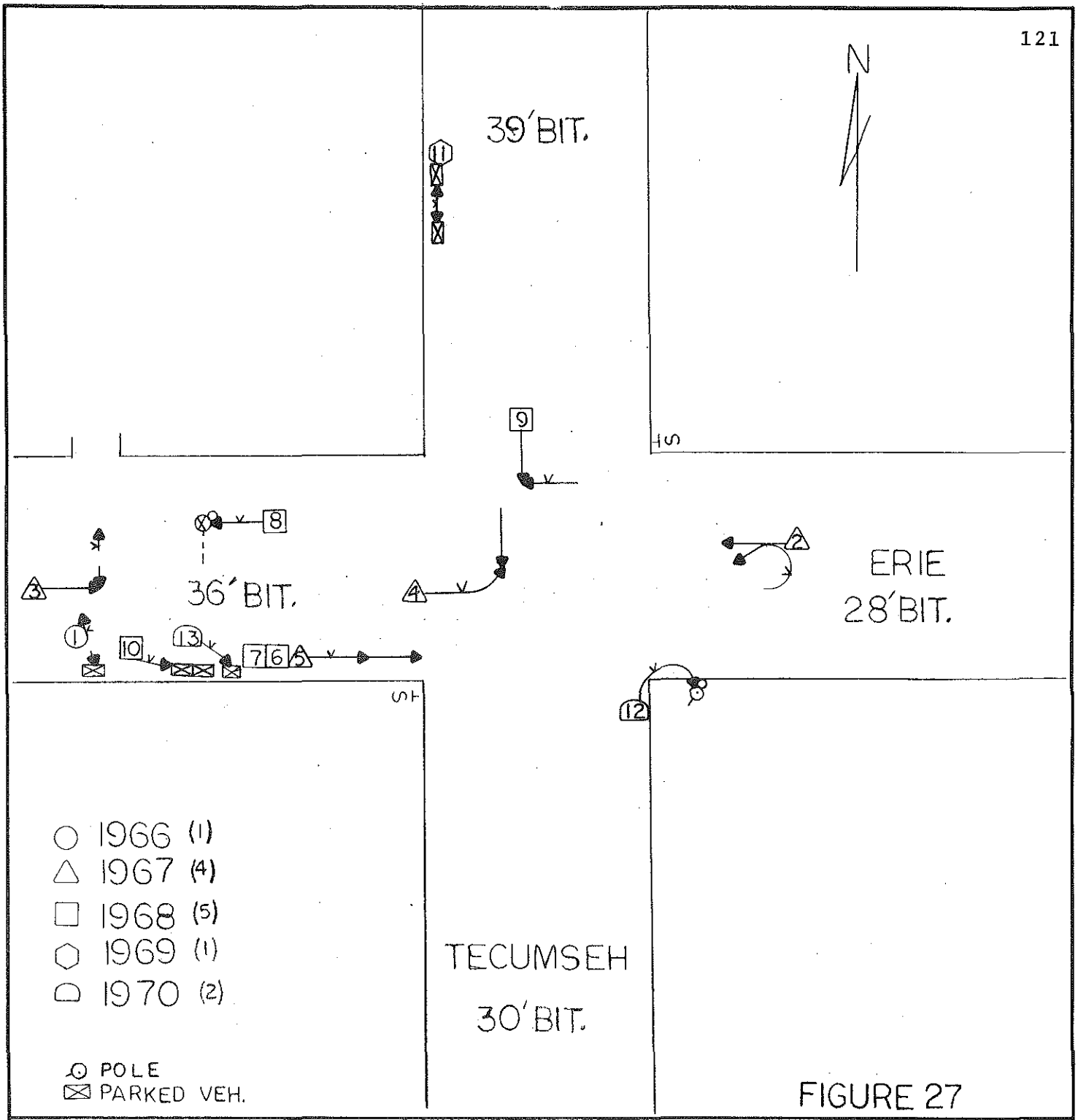


FIGURE 27

LEGEND

Stop & Go Signal — Stop Sign S
Flashing Beacon — Yield Sign Y

Fatal
Injury
Skidding
Jackknife
Overturned
Backing
Pedestrian
Tree
Out of Control
Driver Intent
Deer
Violator

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location ERIE AT TECUMSEH
CITY OF ADRIAN
LENNAWEE CO.

Period: 1966 THRU 1970
Accidents – Total 13 P.D. 11
Injury 2 (3) Fatal 0 ( )
C.S. Miles Drawn D J M
Plan No. LOCATION #21 Date 6-8-71

EASTBOUND
ERIE STREET

SOUTHBOUND
TECUMSEH STREET

WESTBOUND
ERIE STREET

Figure 27A

APPENDIX II

Section B. Regulatory Signs

Regulatory Signs shall be used to inform highway users of traffic laws or regulations that apply at given places or on given highways. They are essential to indicate the applicability of legal requirements that would not otherwise be apparent. Great care must be exercised to see that they are erected wherever needed to fulfill this purpose, but unnecessary mandates should be avoided.

Included among regulatory signs are some, like those marking the end of a restricted zone, that are related to operational controls though not in themselves imposing any obligations or prohibitions.

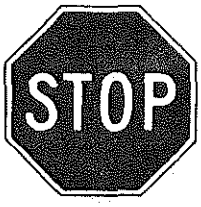
Regulatory signs shall be erected at those locations where the regulations apply and shall be mounted so as to be easily visible and legible to the motorist whose actions they are to govern. Signs that have been erected but are no longer applicable shall be removed. Regulatory signs cannot be expected to command respect and obedience unless the regulations thereon set forth are adequately enforced.

Regulatory signs are classified in the following groups:

(1)	Right-of-Way a. "STOP" Sign b. "YIELD" Sign	(R1 Series)
(2)	Speed	(R2 Series)
(3)	Movement a. Turning b. Alignment c. One Way d. Exclusion	(R3 Series)
(4)	Parking	(R4 Series)
(5)	Pedestrian	(R5 Series)
(6)	Miscellaneous	(R6 Series)

With few exceptions, hereinafter detailed in the specifications for individual signs, regulatory signs are rectangular in shape with the larger dimension vertical and have black legends on white backgrounds. The principal exceptions referred to are the "STOP" sign, the Yield sign, the One Way arrow, and the Parking signs.

STOP SIGN



Reflectorized

R1-1-24	24″ x 24″	(8″ letters)
R1-1-30	30″ x 30″	(12″ letters)
R1-1-36	36″ x 36″	(12″ letters)

All "STOP" signs shall be reflectorized or internally illuminated so that the shape, color, and legend will be comparable to that in day time conditions and will not produce detrimental glare to traffic.

The "STOP" sign may be supplemented by two alternating red flashing beacons in the face or by one red flashing beacon directly above the sign. Such beacon(s) shall be operated continuously.

Place at the point where it is desired to have traffic stop, or as near thereto as possible at the following locations:

1. On streets or highways intersecting a through street or highway.
2. Railroad crossing where a stop is required by order of the appropriate public authority.
3. Opposite all Stop lines applied on the pavement, except at intersections controlled by a traffic control signal.
4. At intersections where a flashing red beacon exists.

There shall be no "STOP" signs on approaches to an intersection where such approaches are controlled by a traffic control signal.

An overhead internally illuminated "STOP" sign may be used in lieu of roadside "STOP" signs.

Secondary messages shall not be used on the face of a "STOP" sign. At a four-way stop intersection, each "STOP" sign may

be supplemented by a separate panel reading "4-WAY". Where this panel is used in conjunction with an R1-1-24, it shall be 24″ x 9″ with 5-inch legend. Where used with an R1-1-30 or R1-1-36, it shall be 30″ x 12″ with a 7-inch legend. Each panel shall have a black legend and border with a white reflectorized background. No additional sign shall be displayed with a "STOP" sign except one of the following: R3-1, R3-2, R3-3, R3-5, R3-6, or R3-23.

A hand held "STOP" sign may be used by Traffic Regulators as provided in Part II, Section E. Drivers facing the hand held "STOP" sign shall come to a complete stop and remain standing until an indication is given to proceed.

For placement see figures 1-3 and 1-4 and for special interim application see page 409.

YIELD SIGN

Reflectorized

R1-2-36 36″ Equilateral Triangle (8″, 3″ and 2½″ letters)

All Yield signs shall be reflectorized or internally illuminated so that the shape, color, and legend will be comparable to that in day time condition and will not produce detrimental glare to traffic.

Place at the point where it is desired to have traffic yield or as near thereto as possible at the following locations:

1. At the approach to an intersection where it is necessary to assign right-of-way to the major road, but where a stop is not necessary at all times.
2. At any location where a special problem exists and where an engineering study indicates the problem to be susceptible to correction by use of the Yield sign.

NO LEFT TURN SIGN

Reflectorized

R3-1-24 24″ x 30″ (6″ and 5″ letters)
R3-1-36 36″ x 48″ (8″ and 7″ letters)

At intersections where left turns are prohibited, one roadside sign shall be placed on the near right corner and one on the far left corner facing approaching traffic. An illuminated sign may be suspended over the roadway in place of, or supplementary to, roadside signs.

When the left turn restriction applies during certain periods only, the use of the "NO LEFT TURN" sign calls for special treatment. The following alternatives are listed in order of preference:

(1) Internally illuminated disappearing legend signs.

(2) Permanently mounted signs incorporating a supplementary legend showing the hours during which the prohibition is in effect.

(3) Movable signs or signs that can be covered.

At intersections with a one-way street the R3-1 shall not be used in lieu of the One Way Arrow sign (R3-23), except where such intersection is the terminus of a one-way street.

For placement see figures 1-4 and 1-5.

NO RIGHT TURN SIGN

Reflectorized

R3-2-24 24″ x 30″ (6″ and 5″ letters)
R3-2-36 36″ x 48″ (8″ and 7″ letters)

At intersections where right turns are prohibited, one roadside sign shall be placed on the near right corner. An additional sign may be placed on the far right corner if required. An illuminated sign may be placed over the roadway in place of, or supplementary to, roadside signs.

When the right turn restriction applies during certain periods only, the use of the "NO RIGHT TURN" sign calls for special treatment. The following alternatives are listed in order of preference:

(1) Internally illuminated disappearing legend signs.

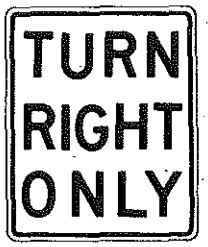
(2) Permanently mounted signs incorporating a supplementary legend showing the hours during which the prohibition is applicable.

(3) Movable signs or signs that can be covered.

At intersections with a one-way street the R3-2 shall not be used in lieu of the One Way Arrow sign (R3-23), except where such intersection is the terminus of a one-way street.

For placement see figures 1-4 and 1-5.

TURN RIGHT ONLY SIGN



Reflectorized

R3-6-24 24″ x 30″ (6″ letters)

At intersections where all traffic is required to turn right, one roadside sign shall be placed on the near right corner and one on the far left corner. An illuminated sign may be suspended over the roadway in place of, or supplementary to, roadside signs.

For placement see figures 1-4 and 1-5.

LANE-USE CONTROL (ROADSIDE SIGN)

Reflectorized

R3-7-30 30″ x 30″ (4″ and 5″ letters)

At an intersection where traffic in the extreme left lane of a one-way roadway is required to turn left, a Left Lane Must Turn Left sign shall be placed on the near left side of the roadway, adjacent to the intersection.

At an intersection where traffic in the extreme right lane of a roadway is required to turn right a Right Lane Must Turn Right

sign shall be placed on the near right side of the roadway, adjacent to the intersection.

Where used, this sign shall be preceded by a G3-25, G3-26, or G3-27 sign sufficiently in advance of the intersection to enable the motorist to select the appropriate lane.

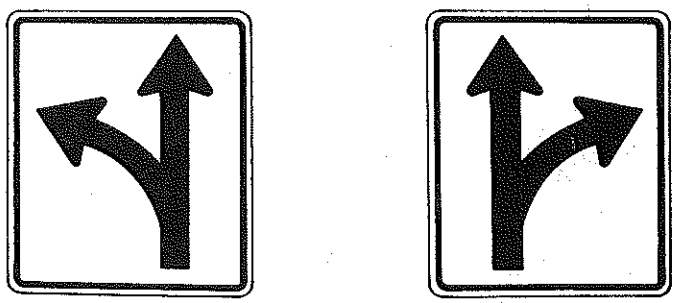
For placement see figures 1-5 and 1-6.

LANE USE CONTROL SIGNS

Reflectorized

R3-8-30 30″ x 36″ (6″ letters)

(Overhead)

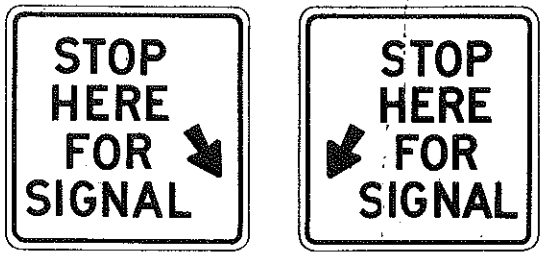


Reflectorized

R3-9-30 30″ x 36″

(Overhead)

STOP HERE FOR SIGNAL SIGN



Reflectorized

R6-19-30 30″ x 30″ (4″ letters)

This sign may be used in cases where it is desired to stop vehicles for a traffic control signal in advance of their normal stopping point. A Stop line shall be painted on the pavement to supplement this sign.

For placement see plate 1-5.

KEEP CLEAR SIGNS

R6-20-24 R6-21-24 R6-22-24

24″ x 30″ (4″ letters)

These signs may be used to provide gaps for cross traffic at locations close to an intersection controlled by a traffic control signal, where the backup from the signal tends to block the cross traffic.

For placement see figure 1-5.

DO NOT ENTER SIGN

Reflectorized

R3-27-24 24″ x 30″ (6″ letters)
R3-27-36 36″ x 48″ (9″ letters)

This sign shall be located at the terminus of a one-way street. It may also be used at the terminus of an interchange ramp or turning roadway where One Way Arrows (R3-23) are not readily apparent to the approaching traffic.

For placement see figure 1-5.

COMMERCIAL VEHICLES PROHIBITED SIGN

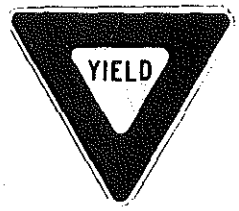
Reflectorized

R3-28-24 24″ x 30″ (4″ letters)

This sign shall be used where local authorities or county road commissions, with respect to highways under their jurisdiction, have by ordinance or resolution prohibited commercial vehicles from such highways. The sign shall be placed at the beginning and at required intervals throughout the restricted area.

For placement see figure 1-5.

5. Where an R1–2–36 "YIELD" sign is to be replaced or added, a sign with a red legend and 5-inch red border on a white background may be used.

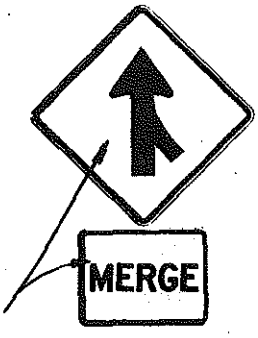


R1–2
36" x 36" x 36"

6. Where an R3–27–24 "DO NOT ENTER" sign is to be replaced or added, a 30-inch white square panel may be used, on which is inscribed a 29-inch diameter red circle with a white band 5 inches in width placed horizontally across the center of the circle. The legend "DO NOT ENTER" shall appear in white letters, with the words "DO NOT" above the band and "ENTER" below the band. If an R3–27–36 sign is to be replaced or added, a similar design, correspondingly larger, may be used. The use of an R3–36–24 "BULLSEYE" sign, as provided for by general revision number 2 to the MMUTCD, is hereby rescinded except for use as an illuminated sign suspended over the roadway at an intersection facing the "wrong-way" direction of travel.

R5–1
30" x 30"

7. Where a W4–1 "MERGING TRAFFIC" sign is to be replaced or added, a 30-inch or 48-inch diamond-shaped symbol sign, together with appropriate size "MERGE" panel, may be used.



Black Legend
on a yellow
background

W4–1
30" x 30"
24" x 18"

8. Where a W9–1 "SCHOOL" or a W9–2 "SCHOOL CROSSING" sign is to be

NO PARKING AT ANY TIME SIGN

Non-reflectorized

R4-1-12 12″ x 18″ (2″ letters)

This sign shall be located at adequate intervals on sections of highway where parking is prohibited by ordinance or Traffic Control Order. Normally, the distance between signs in rural areas should be a minimum of 200 feet.

For placement see figure 1-5.

NO STOPPING, STANDING, PARKING SIGN

Non-reflectorized

R4-2-12 12″ x 18″ (2″ letters)

This sign shall be located at adequate intervals along sections of highway where stopping, standing, and parking is prohibited by an ordinance or Traffic Control Order. Normally, the distance between signs in rural areas should be a minimum of 200 feet.

For placement see figure 1-5.

NO PARKING HERE TO CORNER SIGN

Non-reflectorized

R4-5-12 12″ x 18″ (2″ letters)

This sign should be located in advance of any corner where parking is prohibited in accordance with the Michigan Vehicle Code, local ordinance, or Traffic Control Order.

For placement see figure 1-5.

NO PARKING — BUS STOP SIGN

Non-reflectorized

R4-6-12 12″ x 18″ (2″ letters)

This sign shall be located at the beginning and/or end of any space reserved for the loading or unloading of buses.

For placement see figure 1-5.

Reflectorized
G3-26-30 30″ x 30″
(6″ letters)

The Roadside "LEFT (RIGHT) TURN LANE" sign may be used where an additional lane is provided or where traffic on a multiple lane pavement fails to organize properly.

Where an additional lane has been provided, this sign shall be placed at the beginning of such lane adjacent to that point at which the lane becomes full width. Where used on a multiple lane pavement, it shall be located in advance of the appropriate intersection at the approximate distance indicated below:

85th Percentile Speed			
35 & Below	36-45	46-55	56 & Over
250′	400′	550′	750′

Where greater emphasis is required the G3-27 should be used. For placement see figures 1-6 and 1-20.

Section C. Warning Signs

Introduction

Warning signs shall be used for the purpose of warning traffic of existing or potentially hazardous conditions either on or adjacent to the roadway. Warning signs require caution on the part of the motorist and may call for reduction of speed or other maneuver in the interest of his own safety and that of other motorists and pedestrians. Adequate warnings are of great assistance to the vehicle operator and are valuable in safeguarding and expediting traffic. However, the use of warning signs should be kept to a minimum. Too frequent use of them or their unnecessary use to warn of conditions which are apparent tends to bring disrespect for all signs.

The conditions warranting warning signs are classified in the following groups according to the type of conditions to which they are applied:

1.	Changes in Horizontal Alignments	(W1 Series)
2.	Intersections	(W2 Series)
3.	Advance Warning of Control Devices	(W3 Series)
4.	Converging Traffic Lanes	(W4 Series)
5.	Narrow Roadways	(W5 Series)
6.	Changes in Highway Design	(W6 Series)
7.	Grades	(W7 Series)
8.	Roadway Surface Conditions	(W8 Series)
9.	Schools and Pedestrians	(W9 Series)
10.	Railroad Crossings	(W10 Series)
11.	Entrances and Crossings	(W11 Series)
12.	Miscellaneous	(W12 Series)
13.	Construction and Maintenance	(W13 Series)*

Warning signs with certain exceptions shall be diamond-shaped (square with one diagonal vertical) and shall have a "Highway Yellow" background with black legend. These exceptions are

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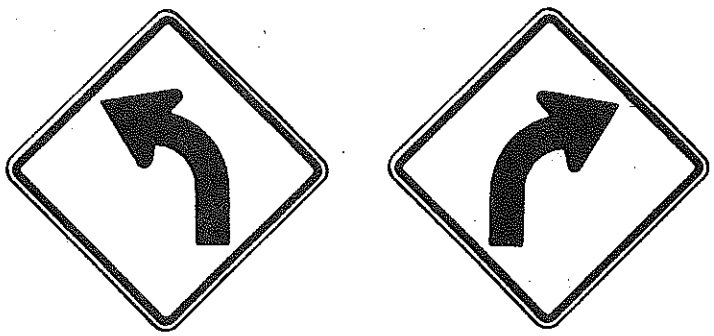
*Special warning signs for highway construction and maintenance projects are to be found in Part II of this Manual.

the Railroad Crossing signs, the Target Arrow signs, the Curve Speed panel, the Exit Speed sign, the Obstruction panel, and the Lattice Background. Other exceptions to the diamond shape are provided for in the case of temporary signs for highway construction and maintenance.

The use of warning signs should be limited to those standard signs set forth in this section. However, after the Engineer has exhausted all possibilities, it may be found that no standard sign fits the situation and warning signs, other than those specified, may be required. Such signs shall conform with the general specifications for size (30″ minimum), shape, and color of warning signs. All warning signs having significance during hours of darkness shall be reflectorized or illuminated.

CURVE SIGN



Reflectorized

W1-2-30 30″ x 30″
W1-2-36 36″ x 36″
W1-2-48 48″ x 48″

The Curve sign shall be used to denote changes in alignment where a ball bank indicator or Devil Level registers 10° or more at speeds between 30 and 60 miles per hour, and at such other locations where the change in alignment of the roadway is not apparent to the driver. Additional protection may be provided by use of the Curve Speed panel (W12-1).

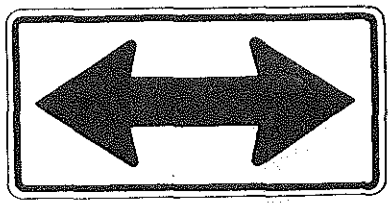
The Curve sign shall be located in advance of the point of curvature at the approximate distance indicated below:

85th Percentile Speed			
35 & Below	36-45	45-55	56 & Over
250′	400′	550′	750′

Curves that are less than 400 feet apart shall be designated by the W1-4 sign.

For placement see figures 1-11 and 1-35.

BI-DIRECTIONAL TARGET ARROW SIGN



Reflectorized

W1-7-48 48″ x 24″

W1-7-96 96″ x 48″

The Bi-Directional Target Arrow sign may be used at "T" or "Y" intersections to inform the driver of the abrupt changes in highway alignment. To increase its target value and to obscure misleading topography, the sign may be mounted on a Lattice Background (W12-10).

This sign shall not be used to mark the ends of medians, center-piers, etc., where there is no change in the direction of travel for all traffic.

When used, this sign shall be erected in target position and, if possible, it should be mounted high enough to be visible for at least 500 feet. It shall be placed at five feet minimum bottom height and two feet from the edge of the shoulder or curb face.

Where further emphasis of the required movements is desired, the W1-7-96 may be used in lieu of the unit consisting of the W1-7-48 and the W12-10.

STOP AHEAD SIGN

Reflectorized

W3-1-30 30″ x 30″ (6″ letters)
W3-1-36 36″ x 36″ (8″ letters)

The "STOP AHEAD" sign shall be erected in advance of an intersection where traffic is required to stop and the "STOP" sign is not visible to motorists for a sufficient distance or where emphasis is needed because of poor observance of the stop. The "STOP AHEAD" sign may also be used in advance of a red flashing beacon.

Where required, the W3-1-30 shall be used in advance of a 24-inch "STOP" sign and the W3-1-36 in advance of a 30 or 36-inch "STOP" sign.

Except where used on State trunkline highways at junctions with other State trunkline highways, it shall be located in advance of the required stop at the approximate distance indicated below:

85th Percentile Speed			
35 & Below	36-45	46-55	56 & Over
250′	400′	550′	750′

For location on State trunkline highways see figures 1-17 and 1-26.

For placement see figure 1-11.

RAILROAD ADVANCE WARNING SIGN

Reflectorized

W10-1-36 36″ diameter (8″ letters)

The circular Railroad Advance Warning sign shall be erected in advance of all railroad crossings. The distance from the intersection of the center line of the highway with the nearest rail to the sign location shall be not less than 250 feet nor more than 350 feet. All such signs must be maintained free from obstruction to vision for not less than 300 feet in advance of the sign.

For placement see figure 1-11.

RAILROAD CROSSING SIGN

Reflectorized

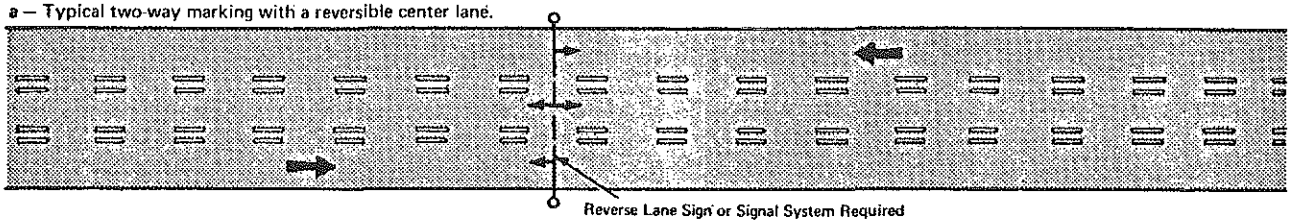
W10-2 (5½" and 4" letters)

The Railroad Crossing sign shall be used in advance of a railroad-highway grade crossing. A supplementary legend denoting the number of tracks may be used only for those crossings consisting of two or more tracks. If crossings are separated by 100 feet or more each shall be treated as a separate crossing.

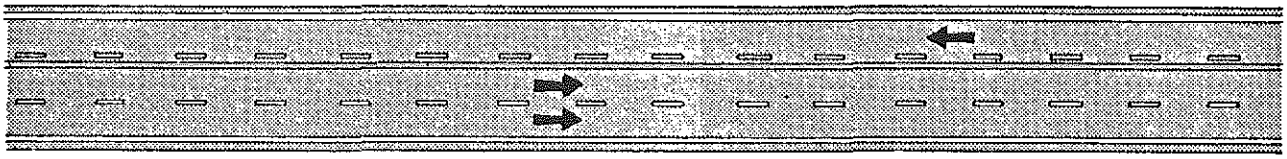
This sign shall be located in advance of the nearest rail at a distance specified by railroad authorities. Distance from the roadway shall be as specified by figure 1-11. In no case shall this sign be mounted or placed in the roadway.

Details concerning responsibility for furnishing, renewing, or maintaining the Railroad Crossing sign are outlined in Section 5, Act 270 P.A. 1921, as amended.

a — Typical two-way marking with a reversible center lane.



b — Typical two-way marking where motorists in a single lane are permitted to pass.



c — Typical two-way marking where motorists in a single lane are not permitted to pass.

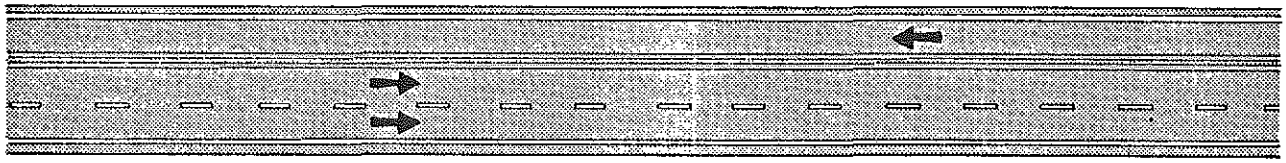
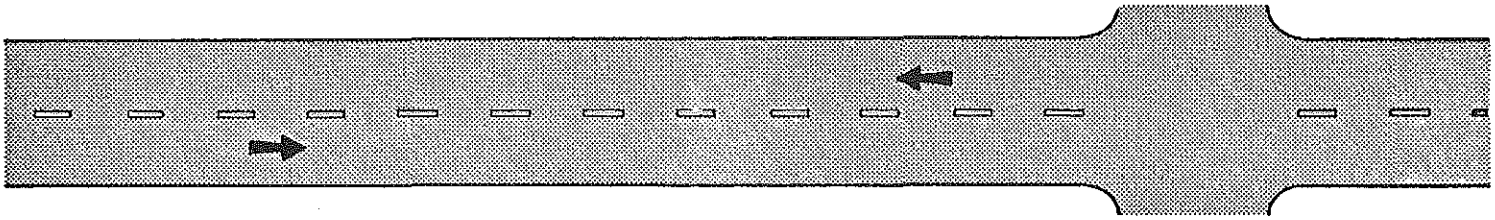


Figure 3–1. Typical two-way marking applications.

a — Typical two-lane, two-way marking with passing permitted.



b — Typical two-lane, two-way marking with passing prohibited zones.

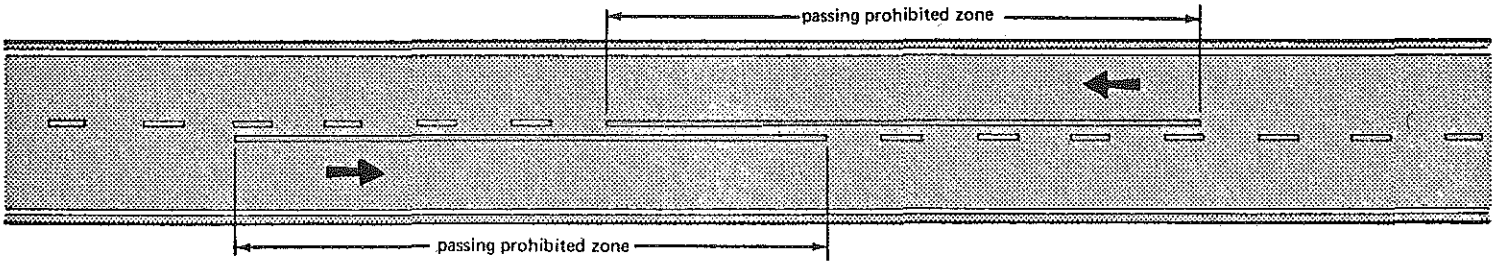
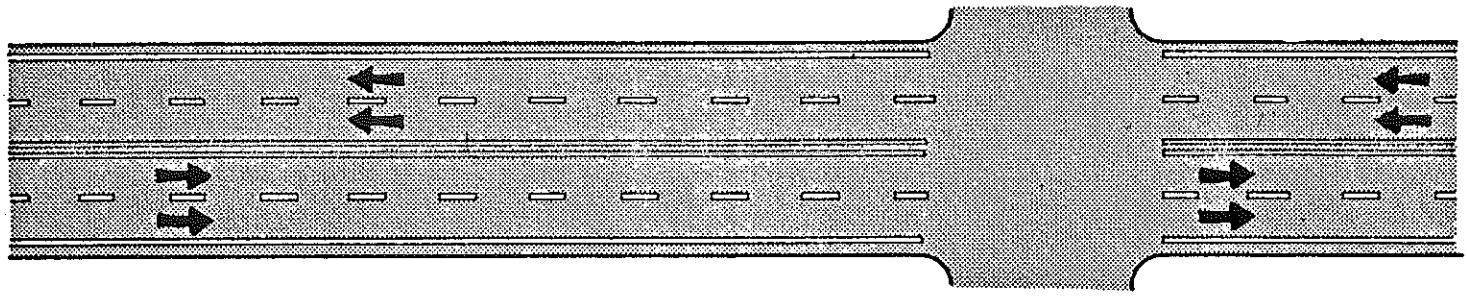


Figure 3–2. Typical 2-lane, two-way marking applications.

a — Typical multi-lane, two-way marking.



b — Typical multi-lane, two way marking with single lane left turn channelization.

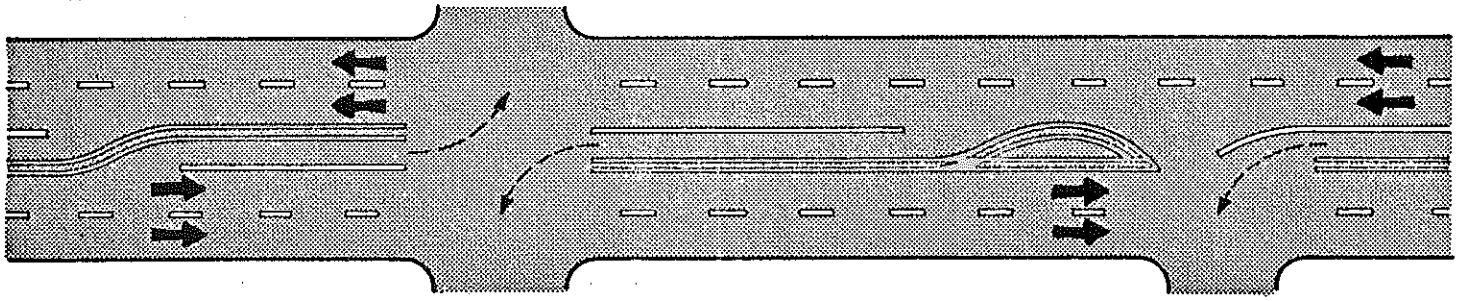
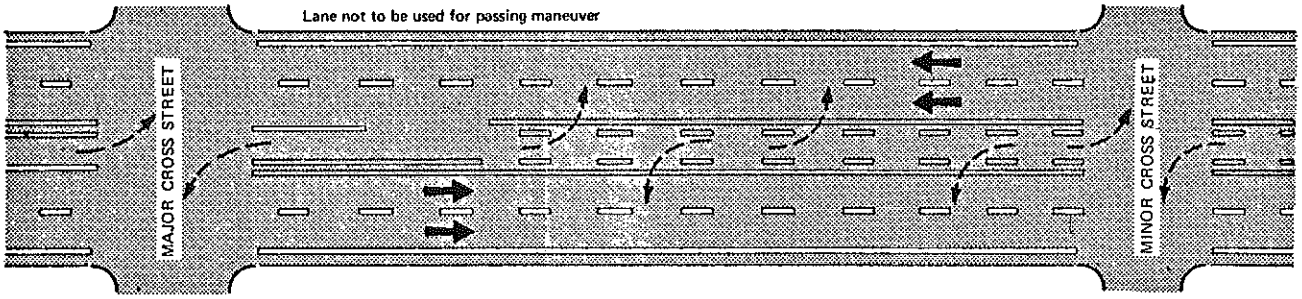


Figure 3–3. Typical multilane, two-way marking applications.

a — Typical multi-lane, two-way marking with single lane, two-way left turn channelization.



b — Typical multi-lane, two-way marking with dual lane left turn channelization.

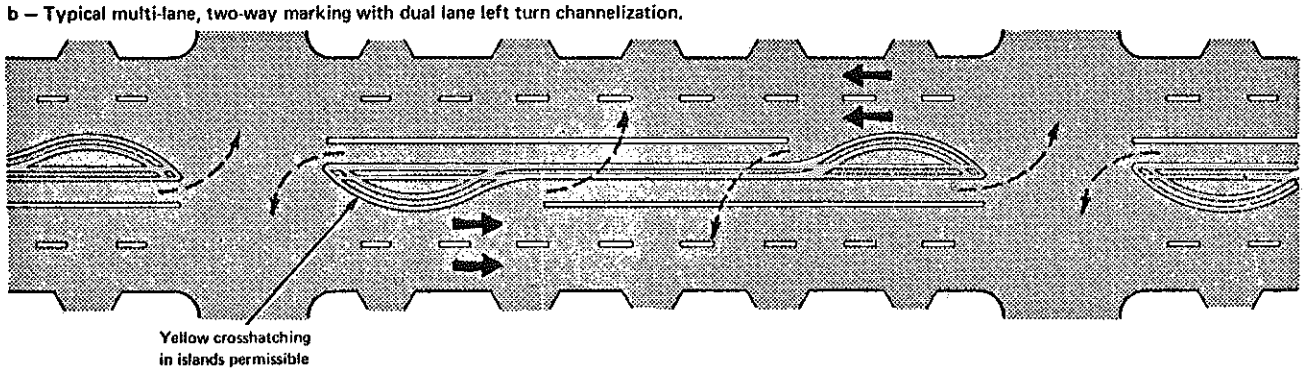


Figure 3–4. Typical multilane, two-way marking applications.

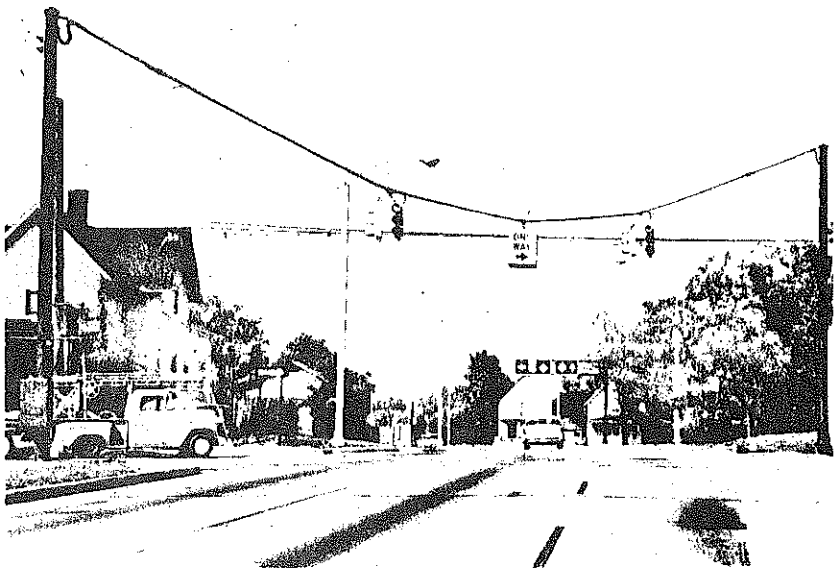


Figure 4-2. Traffic control signal installation with illuminated case sign.

Types of Mountings for Signal Heads

Signal heads shall be mounted over the traveled portion of the roadway using either cable or mast arm suspension. Supplementary signal heads may be placed along the side of the roadway on poles or pedestals.

Signals shall be so located that the meaning of the indications is always clear and unmistakeable. It is essential that signal indications be readily visible to drivers in all lanes approaching the signal location.

Number of Signal Faces

At signalized intersections, where one or more approach is a State trunkline highway, there shall be a minimum of two overhead vehicular signal faces, located over the traveled portion of the roadway, visible to traffic on each approach. Where a separate turning signal(s) is provided, only one indication is required for each signalized turning movement. See figure 4-13.

At all other signalized intersections, a minimum of one overhead vehicular signal face per approach is required. It is strongly recommended, however, that at least two vehicular signal faces be provided per approach for the following reasons:

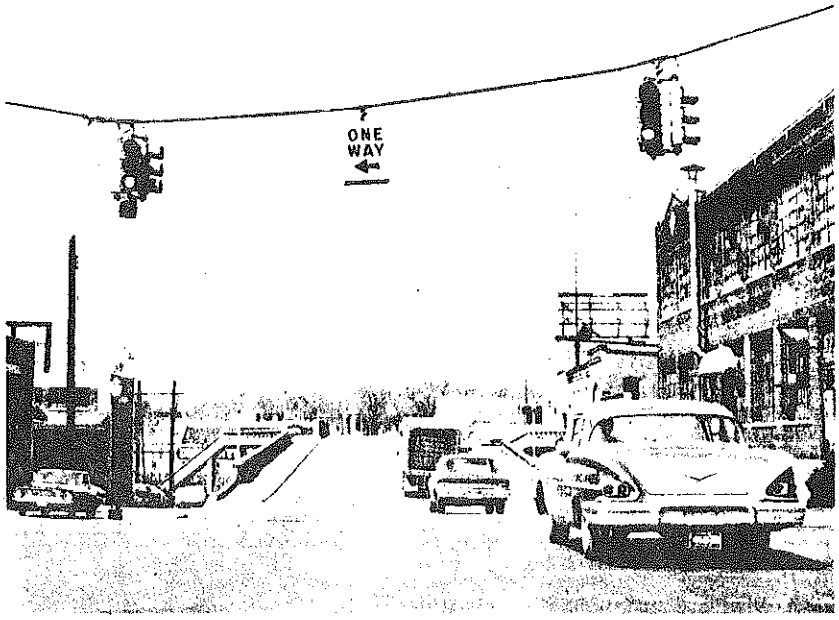


Figure 4-3. Traffic control signal installation with delayed left turn arrow.

1. Two (or more) properly located overhead faces will in almost all cases provide drivers with a signal indication even though trucks or buses may momentarily obscure one signal face.
2. Multiple faces provide a safety factor where the signals must compete with a brilliant background such as advertising signs or the sun.
3. The occasional inevitable lamp failure in one face will not leave an approach without any signal indication.

Where only one vehicular signal face is provided per approach, it shall be positioned as near to the intersection of the centerlines of the intersecting roadways as possible.

The number of signal faces in excess of two per approach will be dictated by local conditions such as the number of vehicular lanes, the need for special turn indications, and the configuration of the intersection and channelizing islands.

Vehicular signals may be supplemented by pedestrian signals, where warranted, located at each end of each controlled crosswalk.

Section D. Pretimed Signals

Definition

A pretimed signal is a traffic control signal which alternately directs traffic to stop or to proceed in accordance with a single predetermined time schedule or a series of such schedules.

Operational features of pretimed signals, such as cycle length, split, sequence, offset, etc., can be changed according to a predetermined program.

Advance Engineering Data Required

A comprehensive investigation of traffic conditions and physical characteristics of the intersection is required to determine the necessity for a signal installation and to furnish necessary data for the proper design and operation of a signal that is found to be warranted. Such data may include:

1. The number of vehicles entering the intersection in each hour from each approach during all 24 hours of a representative day.
2. Vehicular volumes for each traffic movement from each approach (may be classified by vehicle type) during each 15-minute period of the high eight hours of a representative day.
3. Pedestrian volume counts on each crosswalk during the same periods as the vehicular counts in paragraph two above and also during hours of highest pedestrian volume, if not already covered. Pedestrian surveys must usually be tailored to fit the expected problem. For instance, at locations where complaints have been received concerning school children crossing the highway, the survey should differentiate between school children and adults.
4. The 85th-percentile speed of vehicles on the approaches to the intersection.
5. A condition diagram showing details of the physical layout, including such features as intersectional geometrics, channelization, grades, sight-distance restrictions, bus stops and routings, parking conditions, pavement markings, street lighting, driveways, location of nearby rail-

road crossings, distance to nearest signals, utility poles and fixtures, and adjacent land use.

6. A collision diagram showing accident experience by type, direction of movement, severity, weather, pavement condition, time of day, date and day of week for at least one year.
7. Vehicle-seconds delay determined separately for each approach.
8. The number, length of gap (in seconds) and distribution of gaps in the vehicular traffic on the major street.

Warrants for Pretimed Signals

Pretimed signals may be installed and operated only when one or more of the following warrants are satisfied:

Warrant 1.—Minimum vehicular volume.
Warrant 2.—Interruption of continuous traffic.
Warrant 3.—Minimum pedestrian volume.
Warrant 4.—Progressive movement.
Warrant 5.—Accident experience.
Warrant 6.—Combinations of warrants.

The investigation of the need for signal control should include an analysis of the degree to which each of the above warrants is met.

When for a period of four or more consecutive hours any traffic volume drops to 50 percent or less of the stated volume warrants, it is desirable that flashing operation be substituted for conventional operation for the duration of such periods. However, such flashing operation should be restricted to no more than three separate periods during each day.

Warrant 1, Minimum Vehicular Volume

The minimum vehicular volume warrant is intended for application where the volume of intersecting traffic is the principal reason for consideration of signal installation. The warrant is satisfied when for each of any eight hours of an average day the traffic volumes given below exist on the major street and on the higher-volume minor-street approach to the intersection.

Minimum Vehicular Volumes for Warrant 1.

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)	Vehicles per hour on higher-volume minor-street approach (one direction only)
Major Street	Minor Street		
1*	1*	500	150
2 or more	1*	600	150
2 or more	2 or more	600	200
1*	2 or more	500	200

*Flaring required to separate left turning traffic from through and right turning traffic.

The major-street and the minor-street volumes are for the same eight hours. During those eight hours, the direction of higher volume on the minor street may be on one approach during some hours and on the opposite approach during other hours.

When the 85th-percentile speed of major-street traffic exceeds 40 miles per hour, or when the intersection lies within the built-up area of an isolated community having a population less than 10,000, the minimum vehicular volume warrant is 70 percent of the requirements above, in recognition of differences in the nature and operational characteristics of traffic in urban and rural environments and smaller municipalities.

Warrant 2, Interruption of Continuous Traffic

The interruption of continuous traffic warrant is intended for application where operating conditions on a major street are such that the minor-street traffic suffers undue delay or hazard in entering or crossing the major street. The warrant is satisfied when for each of any eight hours of an average day the traffic volumes given below exist on the major street and on the higher-volume minor-street approach to the intersection, and the signal installation will not seriously disrupt progressive traffic flow.

Minimum Vehicular Volumes for Warrant 2.

Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)	Vehicles per hour on higher-volume minor-street approach (one direction only)
Major Street	Minor Street		
1*	1*	750	75
2 or more	1*	900	75
2 or more	2 or more	900	100
1*	2 or more	750	100

*Flaring required to separate left turning traffic from through and right turning traffic.

The major-street and minor-street volumes are for the same eight hours. During those eight hours, the direction of higher volume on the minor street may be on one approach during some hours and on the opposite approach during other hours.

When the 85th-percentile speed of major-street traffic exceeds 40 miles per hour, or when the intersection lies within the built-up area of an isolated community having a population less than 10,000, the interruption of continuous traffic warrant is 70 percent of the requirements above, in recognition of differences in the nature and operational characteristics of traffic in urban and rural environments and smaller municipalities.

Warrant 3, Minimum Pedestrian Volume

The minimum pedestrian volume warrant is satisfied when for each of any eight hours of an average day the following traffic volumes exist:

1. On the major street 600 or more vehicles per hour enter the intersection (total of both approaches); or 1,000 or more vehicles per hour (total of both approaches) enter the intersection on the major street where there is a raised median island four feet or more in width; and
2. During the same eight hours as in paragraph one there are 150 or more pedestrians per hour on the highest volume crosswalk crossing the major street.

When the 85th-percentile speed of major-street traffic exceeds

40 miles per hour, or when the intersection lies within the built-up area of an isolated community having a population of less than 10,000, the minimum pedestrian volume warrant is 70 percent of the requirements above, in recognition of differences in the nature and operational characteristics of traffic in urban and rural environments and smaller municipalities.

A signal installed under this warrant at an isolated intersection should be of the semi-traffic-actuated type with push buttons for pedestrians crossing the main street. If such a signal is installed at an intersection within a coordinated system, it should be equipped and operated with control devices which provide proper coordination.

Signals installed under this warrant shall be equipped with pedestrian indications.

In connection with signals installed for school crossings, it should be understood that a signal is not the only remedy nor is it necessarily the correct solution to the perplexing problem of traffic conflicts between vehicles and school children. Brief periods during which the hazards are unusually high are often better handled by officer control or adult crossing guards.

In some circumstances the pupils' response to signal indications is so inadequate that the signal can become a contributory factor in increasing rather than decreasing accidents. The response to officer control or adult crossing guards is usually less uncertain.

It is, therefore, believed that signals should not ordinarily be installed at school crossings where schoolboy patrols or adult crossing guards can be used effectively, where students can be directed to cross at locations which are already controlled by signals or police officers, or where pedestrian refuge islands provide adequate protection.

Complete facts should be obtained and studied by competent traffic engineering authorities before decisions are made on the installation of signals in the vicinity of schools. As a result of these studies and consideration of the control methods listed above, traffic signals may be warranted if:

1. Pedestrian crossing volumes at a designated school crossing on the major street exceed 250 pedestrians in each of two hours; and
2. During each of the same two hours vehicular traffic through the designated school crossing exceeds 800 vehicles; and

3. There is no signal within 1,000 feet of the crossing.

When the 85th-percentile speed of major-street traffic exceeds 40 miles per hour or when the intersection lies within the built-up area of an isolated community having a population less than 10,000, the warrant is 70 percent of the requirements above, in recognition of differences in the nature and operational characteristics of traffic in urban and rural environments and smaller municipalities.

School crossing signals installed under this warrant should be of the pedestrian-actuated type. They shall be equipped with pedestrian indications.

Warrant 4, Progressive Movement

Progressive movement control sometimes necessitates traffic signal installations at intersections where they would not otherwise be warranted in order to maintain proper grouping of vehicles and effectively regulate group speed. The progressive movement warrant is satisfied when:

1. On an isolated one-way street or on a street which preponderantly has unidirectional traffic significance, adjacent signals are so far apart that the desired degree of platooning and speed control of vehicles would otherwise be lost.
2. On a two-way street, adjacent signals do not provide the desired degree of platooning and speed control; and the proposed and adjacent signals can constitute a progressive signal system.

In a single-alternate signal system the minimum spacings between the proposed signal and existing adjacent signals should closely approximate the distance D in feet, or full unit multiples thereof, given by the formula $D = CS \div 1.364$ where C = cycle length in seconds, and S = design speed of signal system in miles per hour. The above table, illustrating the relationship between cycle length, signal spacing, and system speed, shows that signal spacings under 1,000 feet are not capable (with practical cycle lengths) of rendering progressive, two-way movement with acceptable speeds. It further indicates that desirable minimum signal spacing with 60-, 65-, or 70-second cycle lengths is approximately 1,320 feet or ¼ mile.

System Design Speeds in Relation to Cycle Length and Signal Spacing for Single-alternate Systems[1]

Cycle length of System	Design Speed for Signal Spacing of—		
	1320 feet (¼ mile)	1,000 feet (approx. 3/16 mile)	660 feet (⅛ mile)
Seconds	M.p.h.	M.p.h.	M.p.h.
40	45	34.1	22.5
45	40	30.3*	20
50	36	27.3*	18
55	32.7	24.8*	16.4
60	30*	22.7	15
65	27.7*	21	13.8
70	25.7*	19.5	12.9
75	24	18.2	12
80	22.5	17.1	11.3

[1]With identical speeds in both directions.
*Starred numbers represent practical speeds.

Warrant 5, Accident Experience

The common opinion of the general public that signals materially reduce the number of accidents is rarely substantiated by experience. Not infrequently there are more accidents with signals in operation than before signal installation. Hence, if none of the warrants except the accident experience warrant described below is fulfilled, the initial presumption should be against signalization. Signals should not be installed on the basis of a single spectacular accident or on the basis of unreasonable demands and dire predictions of accidents which allegedly might occur. The accident-experience warrant is satisfied when:

1. Adequate trial of less restrictive remedies with satisfactory observance and enforcement has failed to reduce the accident frequency; and
2. Five or more reported accidents of types susceptible of correction by a traffic control signal have occurred within a 12-month period, each accident involving personal

injury or property damage to an apparent extent of $100 or more; and

3. There exists a volume of vehicular and pedestrian traffic not less than 80 percent of the requirements specified in the minimum vehicular-volume warrant, the interruption of continuous traffic warrant, or the minimum pedestrian-volume warrant; and
4. The signal installation will not seriously disrupt progressive traffic flow.

Any signal installed solely on the accident experience warrant should be semi-traffic-actuated with control devices which provide proper coordination if installed at an intersection within a coordinated system, and normally should be full traffic-actuated if installed at an isolated intersection.

A traffic control signal, when obeyed by drivers and pedestrians, can be expected to eliminate or reduce materially the number and seriousness of the following types of accidents:

1. Those involving substantially right-angle collisions or conflicts, such as occur between vehicles on intersecting streets.
2. Those involving conflicts between straight-moving vehicles and crossing pedestrians.
3. Those between straight-moving and left-turning vehicles approaching from opposite directions, if an independent time interval is allowed during the signal cycle for the left-turn movement.

On the other hand, traffic control signals cannot be expected to reduce the following types of accidents:

1. Rear-end collisions, which often increase after signalization.
2. Collisions between vehicles proceeding in the same or opposite directions, one of which makes a turn across the path of the other.
3. Accidents involving pedestrians and turning vehicles when both move during the same interval.
4. Other types of accidents, if pedestrians or drivers do not obey the signals.

Warrant 6, Combination of Warrants

Signals may occasionally be justified where no one warrant is satisfied but two or more are satisfied to the extent of 80 percent or more of the stated values. These exceptional cases should be decided on the basis of a thorough analysis of facts.

Adequate trial of other remedial measures which cause less delay and inconvenience to traffic should precede installation of signals under this warrant.

Selection of Type of Pretimed, Control Mechanism

Where any of the previously described warrants is satisfied and the decision has been made to install a pretimed signal, it is necessary to select the type of pretimed mechanism to be installed. The possible choices include the following, for which advantages are set forth in the next few paragraphs:

1. Nonsynchronous pretimed controller for isolated intersections.
2. Synchronous type of pretimed controller for isolated intersections.
3. Controllers providing for coordination.

Nonsynchronous Pretimed Controllers for Isolated Intersections

This type of controller, which is timed by an electronic device, is not desirable and should be used only at isolated intersections warranting signalization where it is unlikely that there will be any need for coordination with other intersections during the expected life of the controller.

By use of auxiliary devices, cycle lengths and proportions allotted to the various go intervals can be changed a limited number of times during the day. However, traffic-actuated or synchronous pretimed equipment is preferable where such changes are desirable.

Synchronous Pretimed Controller for Isolated Intersections

This type of controller uses a synchronous timing motor and should be used at isolated intersections where:

1. In the future, the installation is likely to be coordinated with other signal installations or to be supervised by a master controller.

PART V. MISCELLANEOUS ELECTRICAL DEVICES

Section A. Introduction

The number of applications of electricity in the field of traffic control devices is numerous, limited only to the ingenuity of the traffic engineer. A few of these applications will be discussed in this Part of the Manual.

In addition to traffic control signals (which were discussed in Part IV.) electrical traffic control devices may be broken into the following categories:

1. Flashing Beacons.
2. Illuminated Signs.
3. Highway Lighting.
4. Lane Control Signals.

Section B. Flashing Beacons

Definition and Application

A flashing beacon is a section of a standard traffic signal head or a similar type of device, having a yellow or red lens in each face, which is illuminated by intermittent flashes.

Flashing beacons perform a useful function at locations where traffic or physical conditions do not justify conventional traffic signals. At other special points of hazard, experience has indicated that the flashing beacon is effective in calling the attention of drivers to these locations.

Warrants for Flashing Beacons at Intersections

A flashing beacon which flashes yellow for the major highway and red for the minor highway, may be installed over the point of intersection of the center lines of two highways under any one of the following warrants:

1. Where a serious concentration of accidents (four or more over a two year period) which are susceptible of correction by the cautioning or stopping of traffic exists.

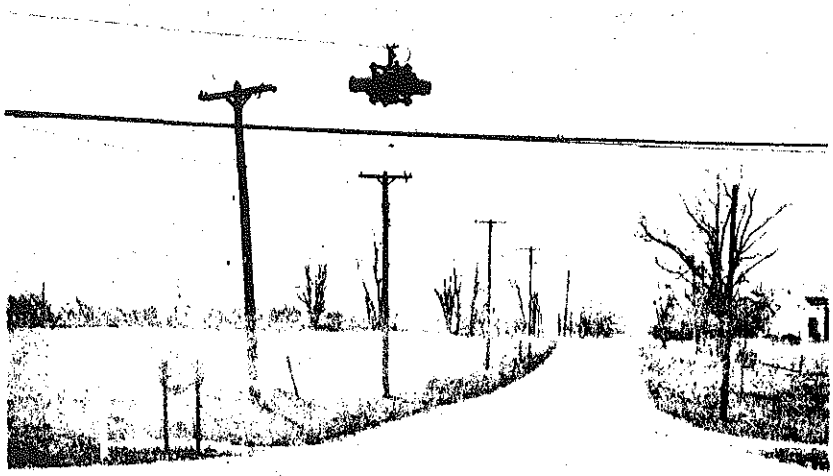


Figure 5-1. Overhead flashing beacon.

2. Where sight distance is extremely limited or where other conditions make it especially desirable to emphasize the need for stopping one street and for cautioning the other.

Since public respect of the flashing beacon depends, to some extent, on the limited, judicial use of the device, it is best to consider the installation of the flashing beacon only after lesser control devices have been tried, such as a 36 inch "STOP" sign (R1-1), a "STOP AHEAD" sign (W3-1), and a Lattice Background (W12-10).

Design

Flashing beacon units and their mountings shall follow the general design specifications for standard traffic signals, which include the following essentials:

1. Each signal unit lens shall have a visible diameter of not less than 8 inches.
2. The illuminating element, lens, reflector, and visor shall each be of such design as to render the lens, when illuminated, clearly visible to traffic facing the signal at all distances up to 1000 feet under all atmospheric conditions except dense fog.