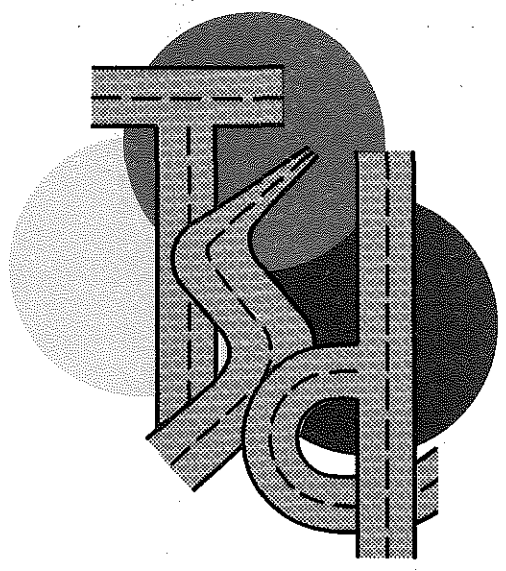


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A TRAFFIC ACCIDENT ANALYSIS  
OF HIGH ACCIDENT LOCATIONS  
IN MARQUETTE COUNTY

Report TSD-SS-156-71



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A TRAFFIC ACCIDENT ANALYSIS  
 OF HIGH ACCIDENT LOCATIONS  
 IN MARQUETTE COUNTY

Report TSD-SS-156-71

by

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July, 1971

PREPARED BY THE  
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Traffic & Safety Division  
Bureau of Operations  
Michigan Department of State Highways

in cooperation with  
The Michigan Office of Highway Safety Planning  
and  
The U. S. Department of Transportation  
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"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 subsequent 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 Marquette County (and providing an inventory of those locations) was designated as State Police responsibility. Because of the fact that a modern or automated system of locating accidents on the county road system is not yet established, the high accident locations for Marquette County (county roads only) were determined by manually extracting and compiling those locations with the highest number of accidents from the 1968 county accident reports. From this list, the 18 highest accident locations (numbered 1 to 18 from the highest number of accidents to the lowest number of accidents) were selected. Once the problem locations were identified, additional accident information for the years 1966, 1967 and 1969 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 and Safety Division of the Department of State Highways a list along with the accident reports of the high accident locations for Marquette County.

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 and 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.

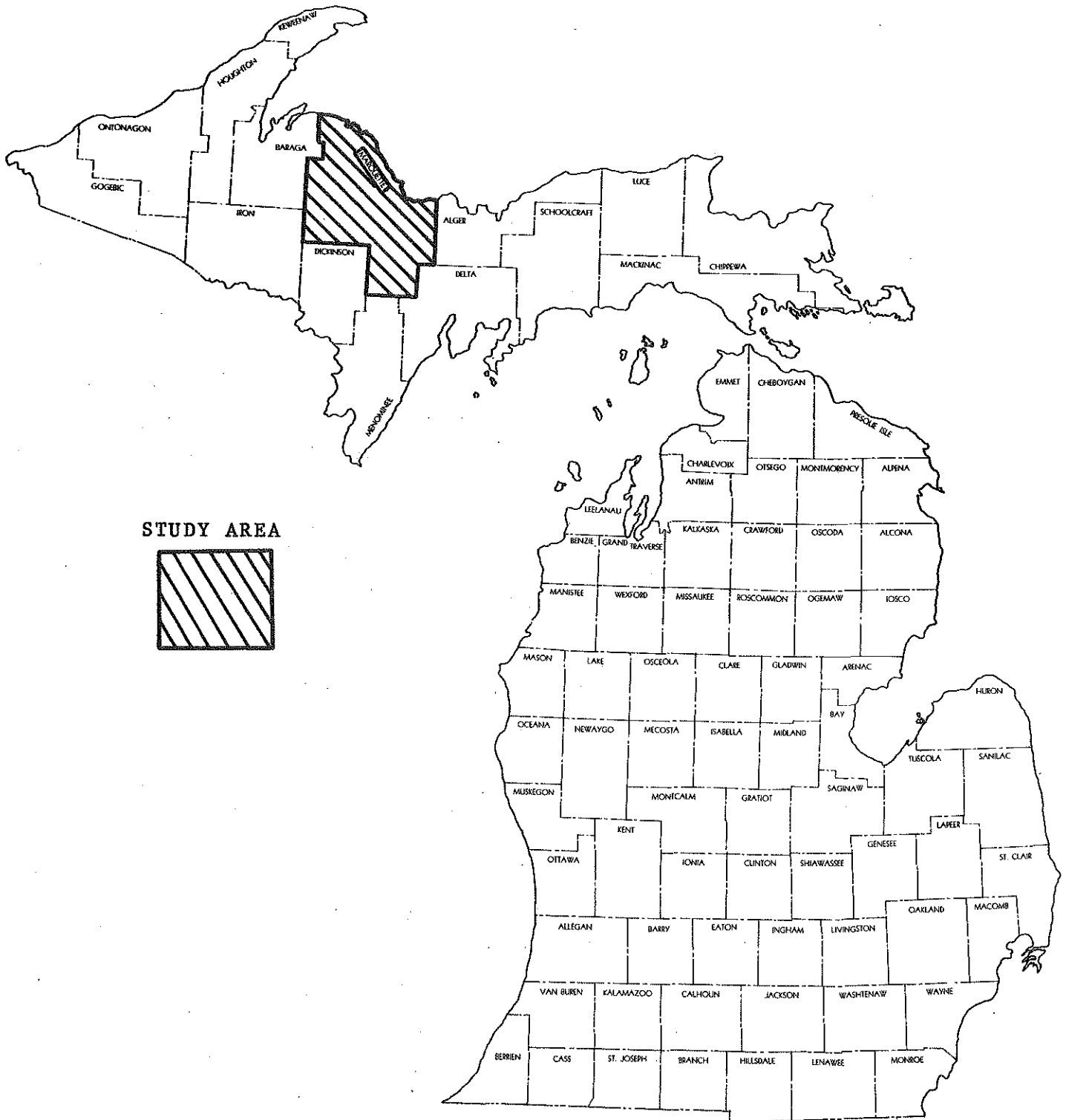
The traffic engineering analysis phase involves evaluating the summarized facts and field data and prescribing the proper remedial treatment.

#### STUDY AREA

Marquette County is located in the mid-western portion of the Upper Peninsula along 70 miles of Lake Superior shoreline. It is bordered by six neighboring counties, Baraga, Iron, Dickinson, Menominee, Delta and Alger (see map on the following page). The county has a total land area of 1,841 square miles which makes up 11% of the total Upper Peninsula area.

Marquette County has a population of 56,154 people

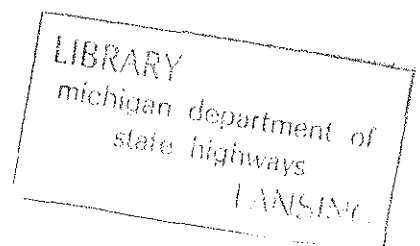
FIGURE 1



according to the 1960 census in the Michigan Statistical Abstract (Eighth Edition). This figure is an increase of 17.8% over the previous decade. A population projection graph found on p. 7 of this report shows the rate at which Marquette County has been growing and the expected growth in the future.

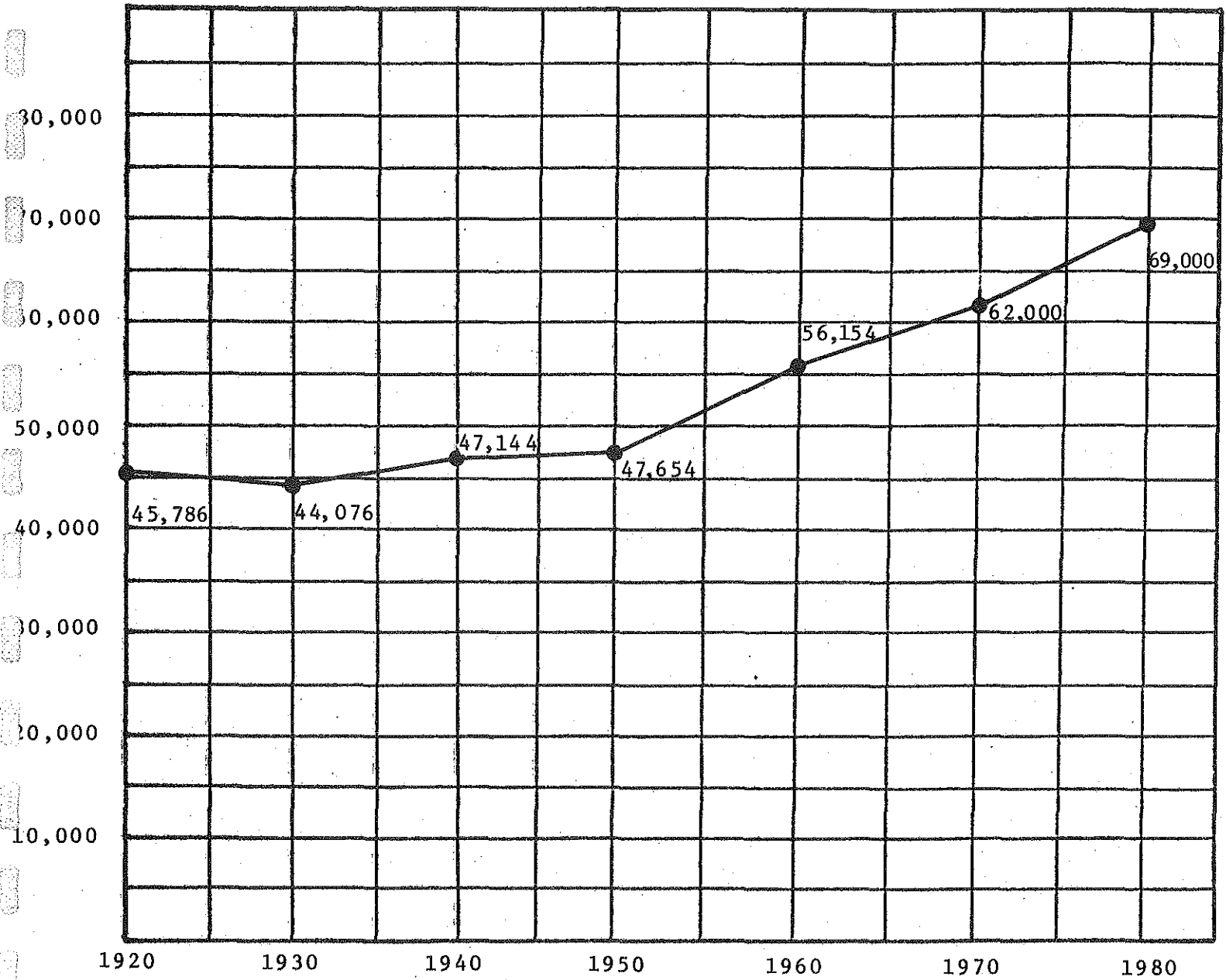
The County of Marquette has a very modern airport facility. The original Marquette County airport was officially opened in 1949. In 1955 plans were made to enlarge the airport because it was no longer large enough to accommodate all the air traffic. At about this same time the United States Air Force indicated they would like to construct an air base on the site of the old airport. K.I. Sawyer Air Force Base was constructed and is now one of the largest facilities of its kind in the country. The county chose another site for their airport which was opened in 1957. Since then, it has grown and expanded and now handles over 61,000 passengers annually.

Along with the Marquette County airport, the county is serviced by two major highways, US-41 and M-28, two railroads, the Soo Line Railroad and the Lake Superior and Ishpeming Railroad and extensive shipyards. These four systems provide Marquette County with adequate freight transportation facilities, plus a means of transportation for local citizens and for tourists who come to enjoy the vast tourist attractions provided by the county and surrounding area.



POPULATION PROJECTION

MARQUETTE COUNTY



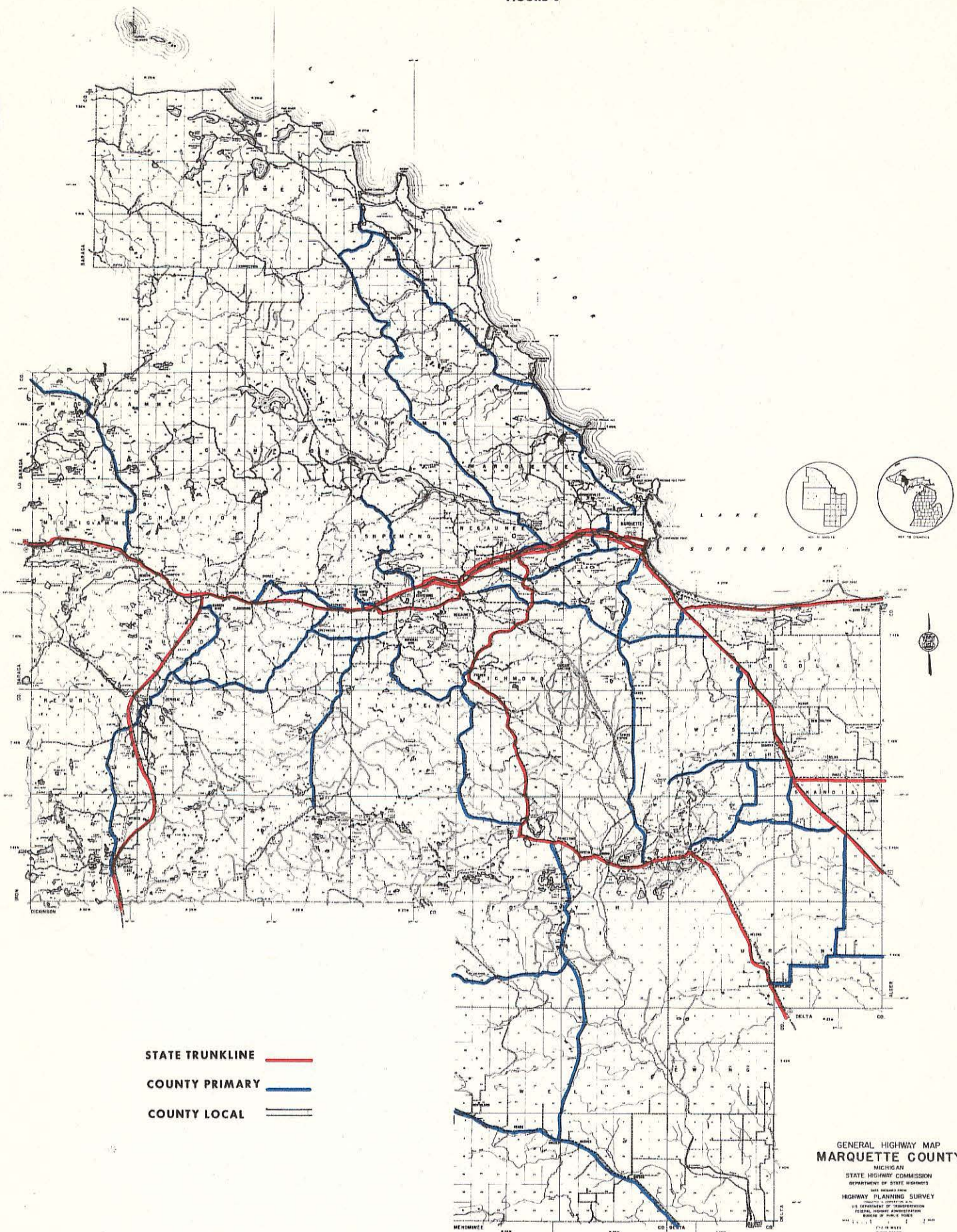
Source: Michigan Statistical Abstract  
Eighth Edition



The geographical area in which Marquette County is located is basically noted for mining and forestry. Farming takes only 3.6% of the total land area, but the value of farm products sold total over \$800,000 annually. Forest lands comprise 95% of the total land area in the county with an annual harvest of over 64,000 cords of pulpwood. This along with the 10,086,000 long tons of iron ore taken annually from the Marquette Iron Range makes Marquette County one of the richest counties in natural resources in the State.

The road system in the county according to the Nineteenth Annual Progress Report compiled by the Local Government Division of the Michigan Department of State Highways is comprised of 128.74 miles of state trunkline, 290.21 miles of county primary roads and 968.83 miles of county local roads for a total of 1,387.78 miles of roadway within the county. A map of this system can be found on p. 9 of this report.

FIGURE 3



STATE TRUNKLINE —  
 COUNTY PRIMARY —  
 COUNTY LOCAL —

GENERAL HIGHWAY MAP  
 MARQUETTE COUNTY  
 MICHIGAN  
 STATE HIGHWAY COMMISSION  
 DEPARTMENT OF STATE HIGHWAYS  
 HIGHWAY PLANNING SURVEY  
 U.S. DEPARTMENT OF TRANSPORTATION  
 FEDERAL HIGHWAY ADMINISTRATION  
 BUREAU OF PUBLIC ROADS

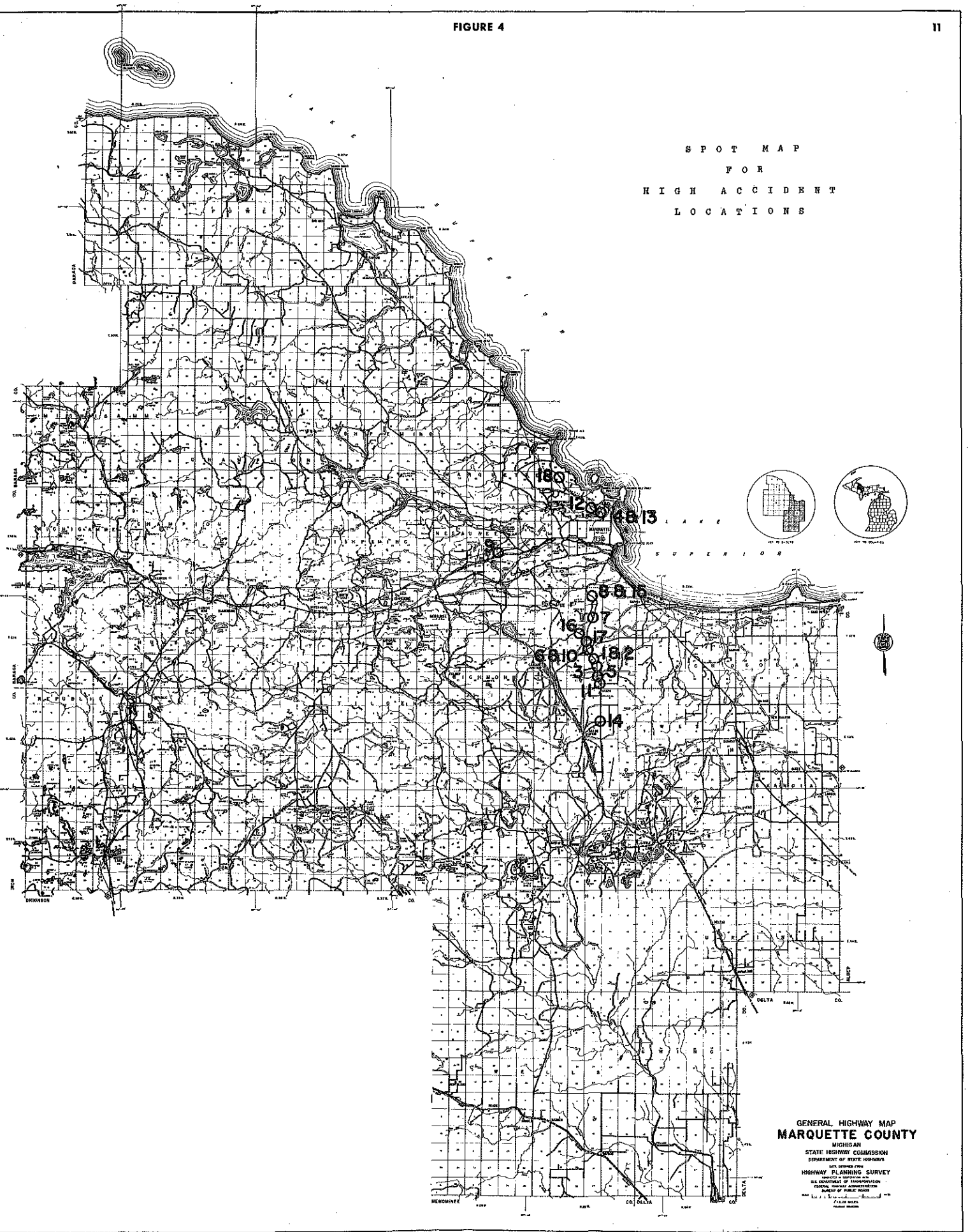
### TRAFFIC ENGINEERING ANALYSIS

The traffic engineering analysis phase involves evaluating the summarized facts and field data and prescribing the proper remedial treatment. The basic tools used in this type of analysis are a graphic representation of accidents, either in a collision diagram or strip map which is used to determine accident patterns. An accident pattern is the prevalence of one or more types of accident occurrence. The pattern gives an indication of the type of correction needed at a specific location. Accident causes, however, are numerous and often difficult to determine. An accident pattern does not always exist. In this case, the accidents may involve one or more serious driving hazards such as slippery pavement, snow or fog, drinking drivers, defective equipment, excessive speed and inadequate traffic controls. In many cases these hazards may be eliminated or at best controlled. In some cases the accident causes may lie in factors outside the jurisdiction of the traffic engineer such as enforcement. In this instance he can offer specific information to the police or other responsible agencies and request their cooperation.

In Marquette County the traffic engineering analysis began when the State Police, after compiling the accident data for Marquette County, transmitted to the Michigan Department of State Highways 18 high accident locations (see spot map on the following page). Additional statistical information

FIGURE 4

SPOT MAP  
FOR  
HIGH ACCIDENT  
LOCATIONS



GENERAL HIGHWAY MAP  
MARQUETTE COUNTY

MICHIGAN  
STATE HIGHWAY COMMISSION  
DEPARTMENT OF STATE HIGHWAYS  
HIGHWAY PLANNING SURVEY  
UNITED STATES GEOLOGICAL SURVEY  
U.S. DEPARTMENT OF THE INTERIOR  
FEDERAL ROAD ADMINISTRATION  
BUREAU OF PUBLIC ROADS  
1938

was collected on the reported traffic accidents and vehicle registrations in Marquette County. Table 1 (see p. 13), which contains this information, shows that reported traffic accidents increased between 1966 and 1967 and between 1968 and 1969 while the reported traffic accidents decreased between 1967 and 1968. There was a total of 1,683 reported traffic accidents on Marquette County roads during the four-year study period for an average of 420 accidents per year. The 18 high accident locations accounted for 117 of the total reported accidents in the county. This figure is only approximately 7% of the reported accidents. It would appear from these figures that the greatest portion of Marquette County's reported accidents have not occurred at any specific locations but are scattered throughout the entire county. Even so, the county as a whole doesn't experience an alarming accident criticality.

To further document the various facts present at the 18 high accident locations, the following tables were prepared to tabulate and chart specific data (see Tables 2 through 8 on pps. 16 - 20).

2. Monthly and Daily Accident Occurrence
3. Annual Accident Summary
4. Daily and Hourly Accident Occurrence
5. Age of Drivers Involved in Accidents
6. Residence of Drivers Involved in Accidents
7. Weather Conditions at the Scene of Accidents
8. Pavement Conditions at the Scene of Accidents

Table 1

## REPORTED TRAFFIC ACCIDENTS IN MARQUETTE COUNTY

Year	Property Damage	Injury	Fatal	Total	County Road	State Route	Inter- state	Persons	Persons
								Injured	Killed
1966	1,169	514	14	1,697	386	632	0	798	16
1967	1,285	610	15	1,910	451	682	0	950	17
1968	1,613	573	19	2,205	421	796	1	883	24
1969	1,540	498	11	2,049	425	724	1	748	15

## COMPARISON OF ACCIDENT FREQUENCY

Marquette County Total Accidents  
Year Roads State of Mich.

1966	386	302,880
1967	451	299,004
1968	421	305,495
1969	425	331,223

## PERCENTAGE OF CHANGE FOR THE ABOVE TOTALS

1966 - 67	16.8	-1.3
1967 - 68	-6.7	2.2
1968 - 69	1.0	8.4

## VEHICLE REGISTRATIONS IN MARQUETTE COUNTY

Year	Pass.	Comm.	Farm Vehicle	Trailer	Trailer Coach	Motor Cycles	Muni- cipal	Total Plates
1966	22,898	-	-	-	-	-	-	30,947
1967	23,491	4,426	66	2,554	336	634	26	31,533
1968	23,693	4,649	54	2,891	395	686	30	32,398
1969	23,933	4,913	-	3,702	-	768	55	33,371

Table 2 shows that the peak accident month was October which had 15.4% of the reported accidents. September, October and December together comprised 38% of the total accidents in Marquette County. The peak accident day was Friday which had 19.8% of the total accidents.

The information summarized in Table 3 shows that of the 117 accidents at the 18 high accident locations 63 resulted in property damage only, 52 resulted in personal injury and there were two fatalities. The personal injury accidents which amounted to 46% of the total number of accidents can be accounted for by the high number of single vehicle ran-off roadway accidents.

Table 4 shows the peak accident hour as 8:00 to 9:00 p.m. with 10:00 to 11:00 p.m. running a close second. The peak accident periods are 8:00 to 11:00 at night (25%) and 2:00 to 5:00 in the afternoon (22%). The early morning hours (12:00 to 5:00 a.m.) contributed 19 accidents (16%) with a high percentage of these involving single vehicle ran-off roadway accidents.

Tables 5 and 6 contain the age and residence of the drivers involved in the accidents. Almost 78% of the accidents involved drivers between the ages of 16 and 34. This high percentage can be somewhat accounted for by the presence of K. I. Sawyer Air Force Base which is located southwest of the City of Marquette on County Road 553 where 12 of the 18 high accident locations are located. The presence of the Air Base

also will partially account for the high percentage (84.1%) of local residents involved in accidents.

Tables 7 and 8 show the weather conditions and pavement conditions at the locations of the accidents. The weather was clear or cloudy during 70% of the accidents with snow or sleet falling during 23% of the accidents. Pavement conditions were wet, snowy or icy during 50% of the accidents that occurred at the 18 high accident locations. These percentages are not unusual for an area that experiences the snowfall that Marquette County does.

In our analysis of the 18 high accident locations in Marquette County, five were on curves that had painted center-line markings indicating a no passing zone. We recommend that "do not pass" signs and "pass with care" signs accompany the no passing zone pavement markings at all locations where passing is prohibited. Also, the Motor Vehicle Code requires by January 1, 1972, that "no passing zone" pennant signs be employed on the left-hand side of the roadway at all locations where passing is prohibited. Although a no passing zone may be denoted by either the signs or the markings, it is strongly recommended that both be used for the following reasons:

- 1) Snow or dirt may cover the markings
- 2) Certain conditions of precipitation, worn markings or the position of the sun may make it difficult to see the markings
- 3) Markings clearly outline the entire length of the



## ACCIDENT ANALYSIS

Table 2

MONTHLY AND DAILY ACCIDENT OCCURRENCE  
 EIGHTEEN HIGH ACCIDENT LOCATIONS IN MARQUETTE COUNTY

Period Studied: 1966 through 1969

Month	Day of the Week							Monthly Total	Of Total
	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.		
January	4	1	1		2	1		9	7.8
February			3	2	1	3	1	10	8.5
March	2			2	2		2	8	6.8
April		2	2	2			1	7	6.0
May		2	2	1	1		2	8	6.8
June			2	1		4	1	8	6.8
July		1	1	1	2	3	2	10	8.5
August				1	2	1		4	3.4
September		2	2	2	5	3		14	12.1
October	2	3	2	2	4	2	3	18	15.4
November			3		3	2		8	6.8
December	2	2	1	4	1		3	13	11.1
Day Total	10	13	19	18	23	19	15	117	100.0
% of Total	8.5	11.1	16.2	15.4	19.8	16.2	12.8	100.0	

Peak Accident Day: Friday

Peak Accident Month: October

## ACCIDENT ANALYSIS

Table 3

## ANNUAL ACCIDENT SUMMARY

## EIGHTEEN HIGH ACCIDENT LOCATIONS IN MARQUETTE COUNTY

Period Studied: 1966 through 1969

Accident Type	Day	Night	Total
Fatal Accident		2	2
Personal Injury Acc.	23	29	52
Property Damage Acc.	34	29	63
TOTAL	57	60	117

Month	Fatal		Injury		Property Damage		Sub Total		Total
	Day	Night	Day	Night	Day	Night	Day	Night	
January			1	2	3	3	4	5	9
February			1	1	6	2	7	3	10
March			1	2	3	2	4	4	8
April			1	1	2	3	3	4	7
May			4	2	1	1	5	3	8
June			6	1		1	6	2	8
July			3	4	1	2	4	6	10
August				2	1	1	1	3	4
September			1	5	1	7	2	12	14
October		2	3	6	4	3	7	11	18
November			1		5	2	6	2	8
December			1	3	7	2	8	5	13
Sub Total		2	23	29	34	29	57	60	117
TOTAL		2		52		63		117	117

ACCIDENT ANALYSIS

Table 4

DAILY AND HOURLY ACCIDENT OCCURRENCE

EIGHTEEN HIGH ACCIDENT LOCATIONS IN MARQUETTE COUNTY

Period Studied: 1966 through 1969

Hour	Day of the Week							Hour Total	% of Total
	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.		
12 - 1AM	1		1	1	1	2	1	7	6.0
1 - 2AM		1					2	3	2.6
2 - 3AM					1		1	2	1.7
3 - 4AM			2			2	2	6	5.1
4 - 5AM						1		1	0.9
5 - 6AM					1	1		2	1.7
6 - 7AM				1				1	0.9
7 - 8AM	1		1	1	1	2		6	5.1
8 - 9AM			1		2			3	2.6
9 - 10AM	1			1	1			3	2.6
10 - 11AM	1							1	0.9
11 - 12AM					1			1	0.9
12 - 1PM						1		1	0.9
1 - 2PM	2	1		2		2	2	9	7.8
2 - 3PM	1	2	3	1	2	1		10	8.5
3 - 4PM		2	2		1		1	6	5.1
4 - 5PM		2	2	2	4			10	8.5
5 - 6PM		1		1				2	1.7
6 - 7PM			1	2		1	2	6	5.1
7 - 8PM	1		1		2	1	2	7	6.0
8 - 9PM	2	3	2	1	2	1	1	12	10.2
9 - 10PM		1	1	3	1			6	5.1
10 - 11PM			2	2	3	3	1	11	9.3
11 - 12PM						1		1	0.9
Not Stated									
Day Total	10	13	19	18	23	19	15	117	
% of Total	8.5	11.1	16.2	15.4	19.8	16.2	12.8		100.0

Peak Accident Hour: 8 - 9 P.M.

Peak Accident Day: Friday

Table 5

AGE OF DRIVERS INVOLVED IN ACCIDENTS  
EIGHTEEN HIGH ACCIDENT LOCATIONS IN MARQUETTE COUNTY

Period Studied: 1966 through 1969

Age Group	Number of Drivers Involved in				Percent
	Fatal	Injury	Prop. Damage	Total	
Under 16					
16-19		17	20	37	24.5
20-24		23	22	45	29.9
25-34	1	11	23	35	23.2
35-44		6	7	13	8.6
45-54	1	3	6	10	6.6
55-64		3	1	4	2.6
65-74		1	1	2	1.3
75 & Over			1	1	0.7
Not Stated		1	3	4	2.6
Total	2	65	84	151	100.0

Table 6

RESIDENCE OF DRIVERS INVOLVED IN ACCIDENTS

Residence	Number of Drivers Involved in				Percent
	Fatal	Injury	Prop. Damage	Total	
Local	2	53	72	127	84.1
Michigan		8	8	16	10.6
Out of State		3	2	5	3.3
Not Stated		1	2	3	2.0
Total	2	65	84	151	100.0

## ACCIDENT ANALYSIS

Table 7

WEATHER CONDITIONS AT SCENE OF ACCIDENTS  
EIGHTEEN HIGH ACCIDENT LOCATIONS IN MARQUETTE COUNTY

Period Studied: 1966 through 1969

Weather	Severity of Accident				Percent
	Fatal	Injury	Property Damage	Total	
Clear or Cloudy	1	41	40	82	70.1
Rain	1	3	2	6	5.1
Fog		1	1	2	1.7
Snow or Sleet		7	20	27	23.1
Not Stated					
TOTAL	2	52	63	117	100.0

Table 8

PAVEMENT CONDITIONS AT SCENE OF ACCIDENTS

Pavement	Severity of Accident				Percent
	Fatal	Injury	Property Damage	Total	
Dry	1	35	23	59	50.4
Wet	1	6	12	19	16.2
Snowy/Icy		10	26	36	30.8
Icy		1	2	3	2.6
Not Stated					
TOTAL	2	52	63	117	100.0

no passing zone and signs denote the limits thereof

(see Part III, Section B, pps. 280 - 282 of the Michigan Manual of Uniform Traffic Control Devices, Appendix II, p. 99)

A further problem that we found in Marquette County that is also present on a statewide basis is the existence of fixed objects located near the traveled portion of the roadway. In Marquette County we are specifically referring to trees. As mentioned previously, forest lands comprise 95% of the total land area in the county. Thus an out-of-control vehicle leaving the roadway would have a good chance of striking a tree. Ran-off roadway accidents accounted for 64% of the total of 117 accidents that occurred at the 18 high accident locations. Fifty percent of these ran-off roadway accidents involved personal injury with a fatal injury occurring in two of the accidents.

A booklet published by a special AASHO\* Traffic Safety Committee entitled "Highway Design and Operational Practices Related to Highway Safety" states that for adequate safety it is desirable to provide an unencumbered recovery area up to 30 feet from the edge of the traveled way. Studies have indicated that about 80 percent of the vehicles in ran-off roadway accidents did not travel beyond this limit.

In early 1965 the Michigan Department of State Highways initiated a statewide tree removal program. The purpose of

\*American Association of State Highway Officials

the program was to eliminate trees standing 20 ft or closer to the traveled portion of state highways hoping to improve the safety of the roadside environment by reducing the number of tree accidents and related fatal accidents due to vehicle-tree collisions. The results for the three-year period 1965 through 1967 shows that of the 135 control sections where trees were removed, 39 accident rates increased, 59 accident rates decreased and 37 accident rates remained unchanged. For the entire program, the "before" tree accident rate was 10.3 tree accidents/100 mvm and the "after" tree accident rate was 8.6 tree accidents/100 mvm. The total number of tree accidents occurring in all the "before" periods numbered 204 and for the "after" periods, 185 accidents. Fatal accident numbers showed a marked decrease with 18 tree-involved fatal accidents during the "before" period and four tree-involved fatal accidents during the "after" period. The results of this tree removal program did not provide the Highway Department with statistically significant reductions in the number of accidents. However, the results indicate a significant decrease in the number of tree-involved fatal accidents.

In Marquette County we recommend that the County Road Commission eventually remove fixed objects (specifically trees) a distance of 20 ft from the traveled portion of the roadway and where practical a distance of 30 ft. We suggest

a fixed object removal program be initiated and implemented over a period of time. We understand that it would be impractical to immediately remove all fixed objects located 30 ft from the traveled portion of the roadway. We suggest, however, that steps be taken immediately to remove the fixed objects that are located at especially vulnerable areas such as the outside of horizontal curves.

After our analysis of the 18 high accident locations was complete, it was apparent that no engineering recommendations would be feasible for five of these locations. There were no accident patterns at these five locations and no present or potential serious driving hazards that could be eliminated or controlled by traffic engineering. Consequently, this report will discuss in detail the remaining 13 locations. The collision diagrams and pictures for each of these will be found on the page following the discussion. The collision diagrams and pictures for the remaining locations are found in Appendix I.



Locations 1 and 2 County Road 553, (F.A.S. 323), 1.1 to 1.6 miles south of County Road 480, (F.A.S. 880), Sands Township

Both locations are on County Road 553. Location 1 is 1.1 to 1.3 miles south of County Road 480 and Location 2 is 1.4 to 1.6 miles south of County Road 480. Due to the fact that Locations 1 and 2 are abutting locations, we have decided to combine the two locations and discuss them together. County Road 553 is a two lane 22 ft bituminous roadway with narrow gravel shoulders. The alignment of this location in the southerly direction consists of a straight stretch of roadway 0.3 of a mile long with a plus gradient followed by a right-hand curve 0.2 of a mile long. Passing is prohibited on the straight portion of the roadway for southbound traffic and on the curve for both directions of traffic. The prohibition for passing is indicated by painted markings. There are no other traffic controls at this location.

The collision diagram at this location for the study period 1966 through 1969 shows 21 accidents. Out of this total there were 15 ran-off roadway accidents, four sideswipes and two rear-ends. Eight of the 15 ran-off roadway accidents occurred on the curve while the remaining seven accidents occurred on the straight portion of roadway. All eight accidents that occurred on the curve reportedly involved excessive speed with seven of these accidents occurring at night and three of them happening on wet or snowy pavement.

Overall, 16 of the 21 reported accidents or 76% involved excessive speed with 14 of these being single car accidents.

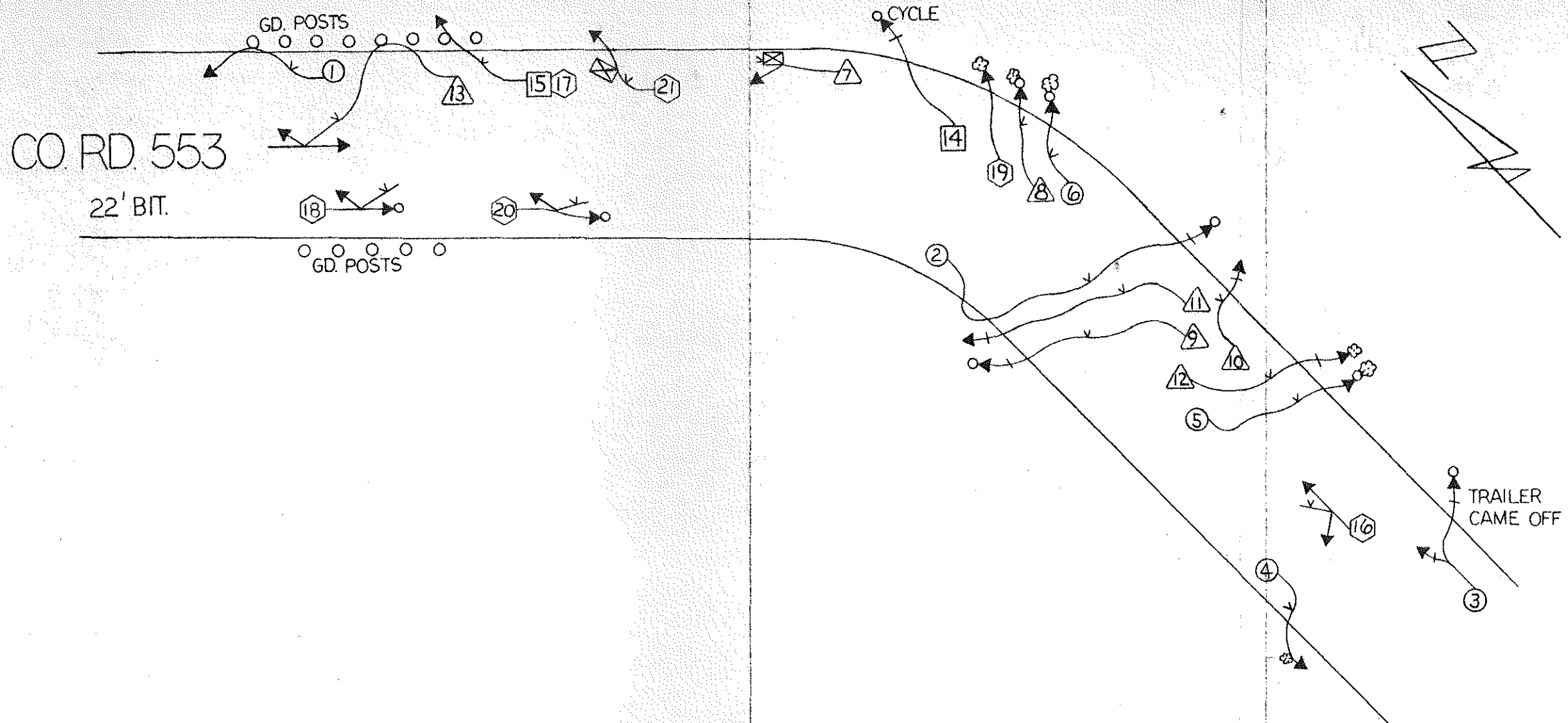
**Recommendations:**

We recommend that 30 in. curve signs (see Part I, Section C, p. 82, Warning Signs - Michigan Manual of Uniform Traffic Control Devices - Appendix II, p. 88) be erected at the beginning of the curve for both north and southbound traffic.

Furthermore, due to the high percentage (88%) of night-time accidents at the curve, we recommend that a 48 in. target arrow (see Part I, Section C, p. 88 of the Manual - Appendix II, p. 91) be placed in target position for both north and southbound traffic.

Lastly, to complement the existing no passing zone pavement markings, we recommend that "do not pass" signs and "pass with care" signs (see Part I, Section B, p. 33 of the Manual - Appendix II, p. 84) be erected along with the "no passing zone" pennant signs that are to be located on the left-hand side of the roadway.

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FIGURE 5

REMARKS	LEGEND	ACCIDENT STUDY COLLISION DIAGRAM	MICHIGAN DEPARTMENT OF STATE HIGHWAYS TRAFFIC AND SAFETY DIVISION
○ 1966 △ 1967 □ 1968 ◊ 1969	Stop & Go Signal  S Flashing Beacon  F Stop Sign  S Yield Sign  Y Pedestrian  X Tree  Tree Out of Control  Out of Control Driver Intent  Driver Intent Deer  Deer Violator  V	Period: <u>1966 THRU 1969</u> Accidents - Total <u>21</u> P.D. <u>12</u> Injury <u>9 (16)</u> Fatal <u>0 ( )</u>	Location CO. RD. 553, 1.1 TO 1.6 MI. SOUTH OF CO. RD. 480 SANDS TWP. MARQUETTE CO. C.S. _____ Miles _____ Drawn <u>DVW</u> Date <u>9-17-71</u> Plan No. <u>LOCATION 1 &amp; 2</u>
		ADT _____ Rate _____ /100 mvm Rate _____ / mv	



**SOUTHBOUND**

**CO. RD. 553**



**NORTHBOUND**

**CO. RD. 553**

Location 3     County Road 553, (F.A.S. 323), 1.7 to 1.9 miles south of County Road 480, (F.A.S. 880), Sands Township

County Road 553 in this area is a section of roadway approximately 0.2 miles in length that runs in a north-south direction. The alignment at this location consists of a moderate curve and a slight positive gradient in the southerly direction. County Road 553 has a 22 ft bituminous pavement with narrow gravel shoulders. Passing is prohibited at this location for both directions of traffic and is so indicated by painted pavement markings.

There were nine reported traffic accidents at this location during the four-year study period. Seven of the nine accidents or 78% were the ran-off roadway type. Four of these occurred on wet or snowy pavement with two of them happening at night. All seven of the ran-off roadway accidents were reportedly caused by excessive speed. The remaining two accidents at this location involved an improper turn and a left of centerline violation.

Recommendations:

We recommend that 30 in. curve signs (see Part I, Section C, p. 82 of the Manual - Appendix II, p. 88) be erected at the beginning of the curve for both north and southbound traffic.

Also to complement the curve signs we recommend that 48 in. target arrows (see Part I, Section C, p. 88 of the Manual - Appendix II, p. 91) be placed in target position for both north and southbound traffic.

We further recommend that "do not pass" signs and "pass with care" signs (see Part I, Section B, p. 33 of the Manual - Appendix II, p. 84) be erected along with "no passing zone" pennant signs to supplement the no passing zone pavement markings.

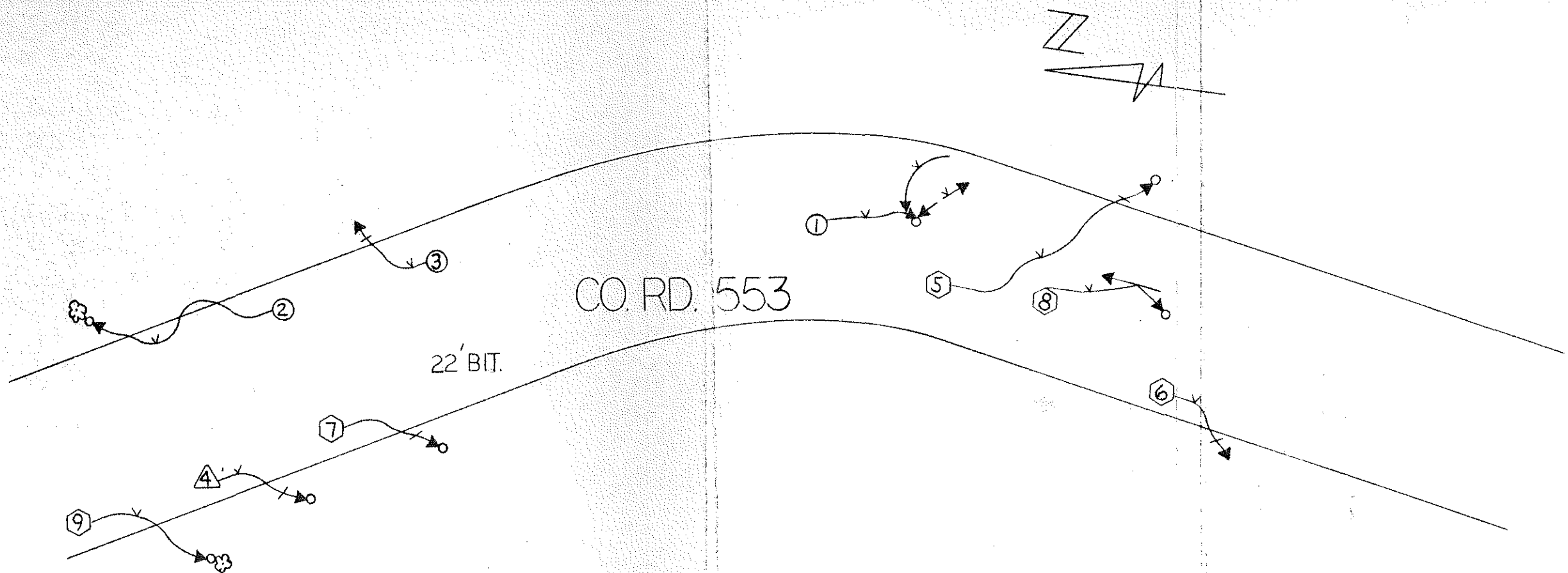


FIGURE 6

REMARKS	LEGEND	ACCIDENT STUDY COLLISION DIAGRAM		MICHIGAN DEPARTMENT OF STATE HIGHWAYS TRAFFIC AND SAFETY DIVISION
		Stop & Go Signal  Stop Sign Flashing Beacon  Yield Sign	Period: <u>1966 THRU 1969</u> Accidents - Total <u>9</u> P.D. <u>2</u> Injury <u>7 (13)</u> Fatal <u>0 ( )</u>	ADT _____ Rate _____ /100 mvm Rate _____ / mv.
○ 1966 △ 1967 □ 1968 ◊ 1969	Fatal  Pedestrian Injury  Tree Skidding  Out of Control Jackknife  Driver Intent Overturned  Deer Backing  Violator			



SOUTHBOUND

CO. RD. 553



NORTHBOUND

CO. RD. 553

FIGURE 6a

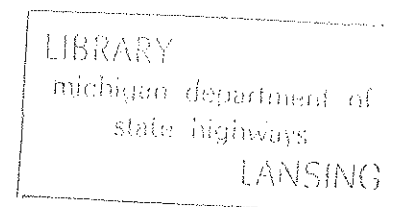


Locations 4 and 13 County Road 550, (F.A.S. 214), from the Marquette City Limits north 0.5 of a mile, Marquette Township

Due to the fact that Locations 4 and 13 are abutting locations, we have decided to combine the two locations and discuss them together. Both locations are located on County Road 550. Location 13 begins at the north city limits of Marquette and runs northerly for approximately 0.2 of a mile. Location 4 is located 0.3 to 0.5 of a mile north of the city limits of Marquette. The horizontal alignment at this location in the northerly direction consists of a moderate left-hand curve at the city limits followed by a short tangent and a sharp left-hand curve that terminates at the Dead River Bridge. County Road 550 has a 22 ft bituminous pavement with gravel shoulders that are narrow in some spots. The pavement and shoulders are in excellent condition.

The existing traffic controls at this location consist of 30 in. turn signs (W1-1-30 - Appendix II, p. 87) with accompanying 35 mph advisory speed panels for the second curve in the northerly direction. There is a narrow bridge sign (W5-2-30, Appendix II, p. 93) for northbound traffic only. Passing is not prohibited in any way at this location. Also, both directions of traffic are given advance notice of a tourist park located west of this location.

There were 13 accidents at this location during the four-year study period. Eight of the accidents happened on the



second curve in the northerly direction, four happened on the Dead River Bridge and the remaining accident happened on the short tangent between the bridge and the curve. Out of the eight accidents at the curve, four were reportedly caused by excessive speed and five happened at night. All of the accidents on the bridge can be attributed in some respect to the narrow road surface and the fact that the bridge railing abuts the pavement.

**Recommendations:**

Due to the five nighttime accidents that occurred on the curve located 0.3 of a mile from the Marquette City Limits, we recommend that 48 in. target arrows (see Part I, Section C, p. 88 of the Manual - Appendix II, p. 91) be placed in target position for both directions of traffic.

We also feel that the horizontal sight distance for this curve is not sufficient for safe passing maneuvers. We feel that if certain trees and other foliage located on the inside of the curves were removed, the sight distance would be improved. However, we are aware of the problems surrounding tree removal. If it is discovered that it would not be feasible to remove the trees and foliage necessary to improve the sight distance, a prohibition on passing would be the only alternative short of reconstruction. Our forces will be in

the Upper Peninsula in the near future, and we would be willing to undertake a traffic survey and engineering study to determine where "no passing zone" signs and markings should be placed.

Furthermore, due to the bridge railing of the Dead River Bridge abutting the pavement, we recommend that reflectorized obstruction panels (see Part I, Section C, p. 140 of the Manual - Appendix II, p. 96) be placed on both sides of the bridge for both directions of traffic. Also, we recommend that the center of the bridge be marked so that it will be easier for an operator to keep his vehicle on the proper side of the bridge surface.

Lastly, we recommend that the 30 in. turn signs be replaced by 30 in. curve signs (see Part I, Section C, pps. 81 - 82 of the Manual - Appendix II, pps. 87 - 88). The present 30 in. turn signs are being used in conjunction with 35 mile per hour advisory speed panels. According to the Michigan Manual of Uniform Traffic Control Devices a turn sign should be used when the device level registers ten degrees or more at a speed of 30 miles per hour or less. Curve signs should be used when the device level registers ten degrees or more at speeds between 30 and 60 miles per hour. Since, in this case the appropriate advisory speed panel is 35 miles per hour, the existing turn signs should be replaced by curve signs.

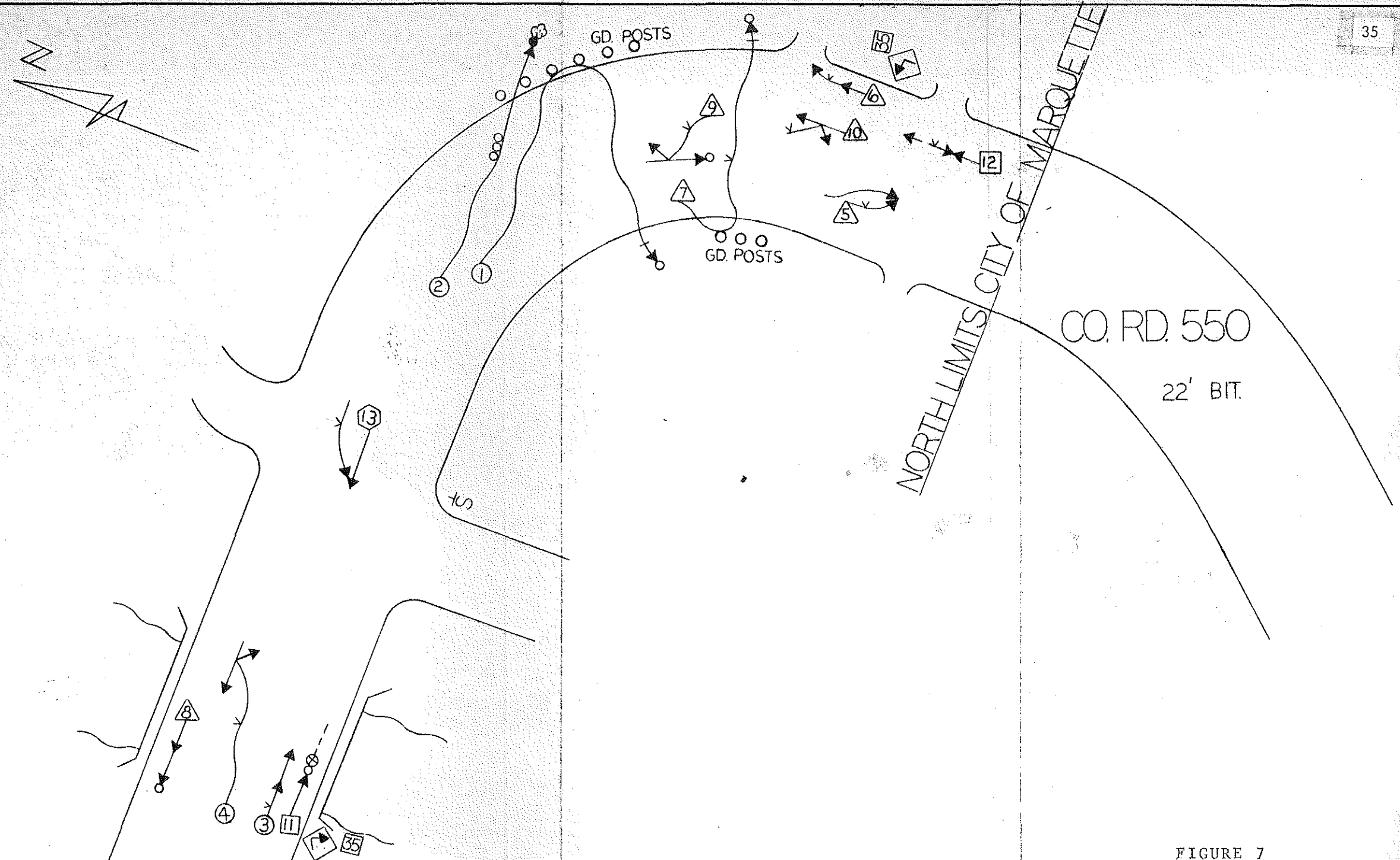
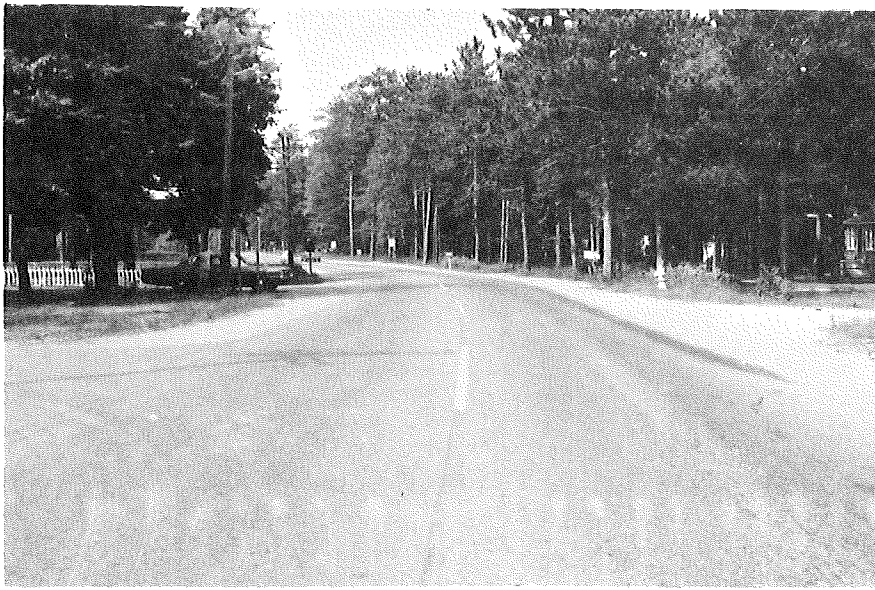


FIGURE 7

REMARKS	LEGEND	ACCIDENT STUDY COLLISION DIAGRAM		MICHIGAN DEPARTMENT OF STATE HIGHWAYS TRAFFIC AND SAFETY DIVISION
<p>○ 1966 △ 1967 □ 1968 ◇ 1969</p>	<p>Stop &amp; Go Signal  Stop Sign  S T Flashing Beacon  Yield Sign  Y T</p> <p>Fatal  Pedestrian  Injury  Tree  Skidding  Out of Control  Jackknife  Driver Intent  Overturned  Deer  Backing  Violator </p>	<p>Period: <u>1966 THRU 1969</u> Accidents - Total <u>13</u> P.D. <u>7</u> Injury <u>5 (7)</u> Fatal <u>1 (2)</u></p>	<p>ADT _____ Rate _____ /100 mvm Rate _____ / mv</p>	<p>Location CO. RD. 550 FROM MARQUETTE CITY LIMITS TO 0.5 MI. NORTH MARQUETTE TWP, MARQUETTE CO. C.S. _____ Miles _____ Drawn <u>DVW</u> Date <u>9-18-70</u> Plan No. <u>LOCATION 4 and 13</u></p>



NORTHBOUND  
CO. RD. 550

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NORTHBOUND  
CO. RD. 550



NORTHBOUND  
CO. RD. 550

FIGURE 7a



EASTBOUND  
CO. RD. 550

EASTBOUND  
CO. RD. 550



EASTBOUND  
CO. RD. 550

FIGURE 7b

Location 5     County Road 553, (F.A.S. 323), 2.3 to 2.5 miles south of County Road 480, (F.A.S. 880), Sands Township

County Road 553 is a 22 ft bituminous roadway with gravel shoulders. The pavement and shoulders are in good condition. The alignment at this location in the northerly direction consists of a right-hand curve with a positive gradient. Passing is not allowed in the northerly direction until a vehicle reaches the crest of the grade. The prohibition on passing is indicated by painted markings. There are no other traffic controls present at this location.

There were eight accidents at this location during the four-year study period. Six of the eight accidents or 75% were the ran-off roadway type. There was also one rear-end accident and one vehicle struck a cow. Out of the six ran-off roadway accidents, five occurred on wet or snowy pavement, three reportedly involved excessive speed and three occurred at night.

Recommendations:

We recommend that 30 in. curve signs (see Part I, Section C, p. 82 of the Manual - Appendix II, p. 88) be erected north and south of the curve.

We further recommend that "do not pass" signs and "pass with care" signs (see Part I, Section B, p. 33 of the Manual -

Appendix II, p. 84) be erected along with "no passing zone" pennant signs to supplement the no passing zone pavement markings.



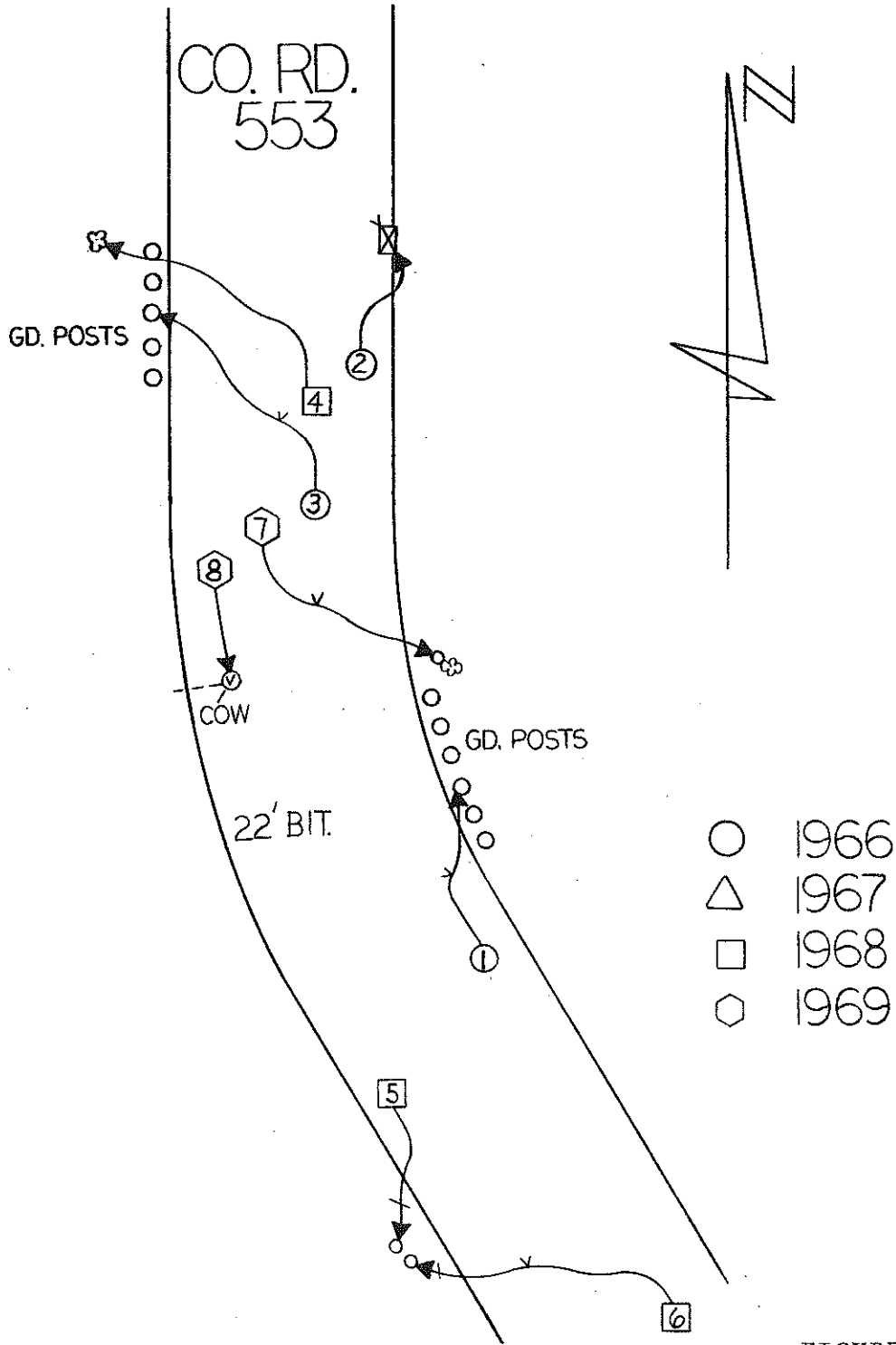
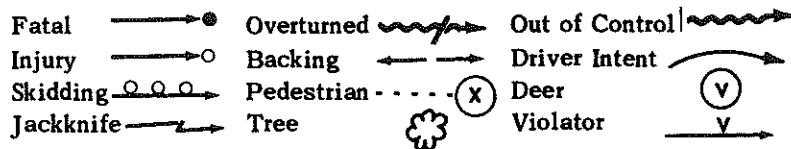
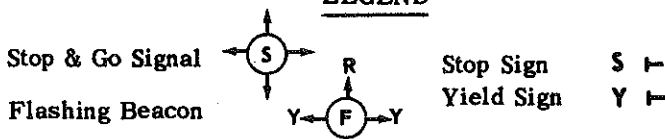


FIGURE 8

MICHIGAN DEPARTMENT OF STATE HIGHWAYS  
Traffic Division

LEGEND



ACCIDENT STUDY  
COLLISION DIAGRAM

Period: 1966 THRU 1969

SANDS TWP Description MARQUETTE CO.

CO. RD. 553 2.3 TO 2.5 MI. SOUTH OF  
CO. RD. 480

Accidents - Total 8

P.D. 6 Injury 2 ( 2 )

Fatal 0 ( )

Acc. Rate/mv \_\_\_\_\_

Acc. Rate/mvm \_\_\_\_\_

C.S. \_\_\_\_\_ Miles \_\_\_\_\_

Drawn DVW Date 3-1-71 Rev. \_\_\_\_\_

Plan No. LOCATION 5



SOUTHBOUND

CO. RD. 553



NORTHBOUND

CO. RD. 553

FIGURE 8a

Locations 6 and 10 County Road 553, (F.A.S. 323), 0.7 to 1.0 mile south of County Road 480, (F.A.S. 880), Sands Township

Due to the fact that Locations 6 and 10 are abutting locations and together are only 0.3 of a mile long, we have decided to discuss them as one location. Both locations are sections of roadway located on County Road 553. Location 6 is located 0.7 to 0.9 miles south of County Road 480 while Location 10 is located one mile south of County Road 480. The alignment in the southerly direction consists of a left-hand curve and a positive gradient. County Road 553 has a 22 ft bituminous pavement with gravel shoulders. Passing is prohibited at the curve and is so indicated by painted markings. There are no other traffic controls at this location.

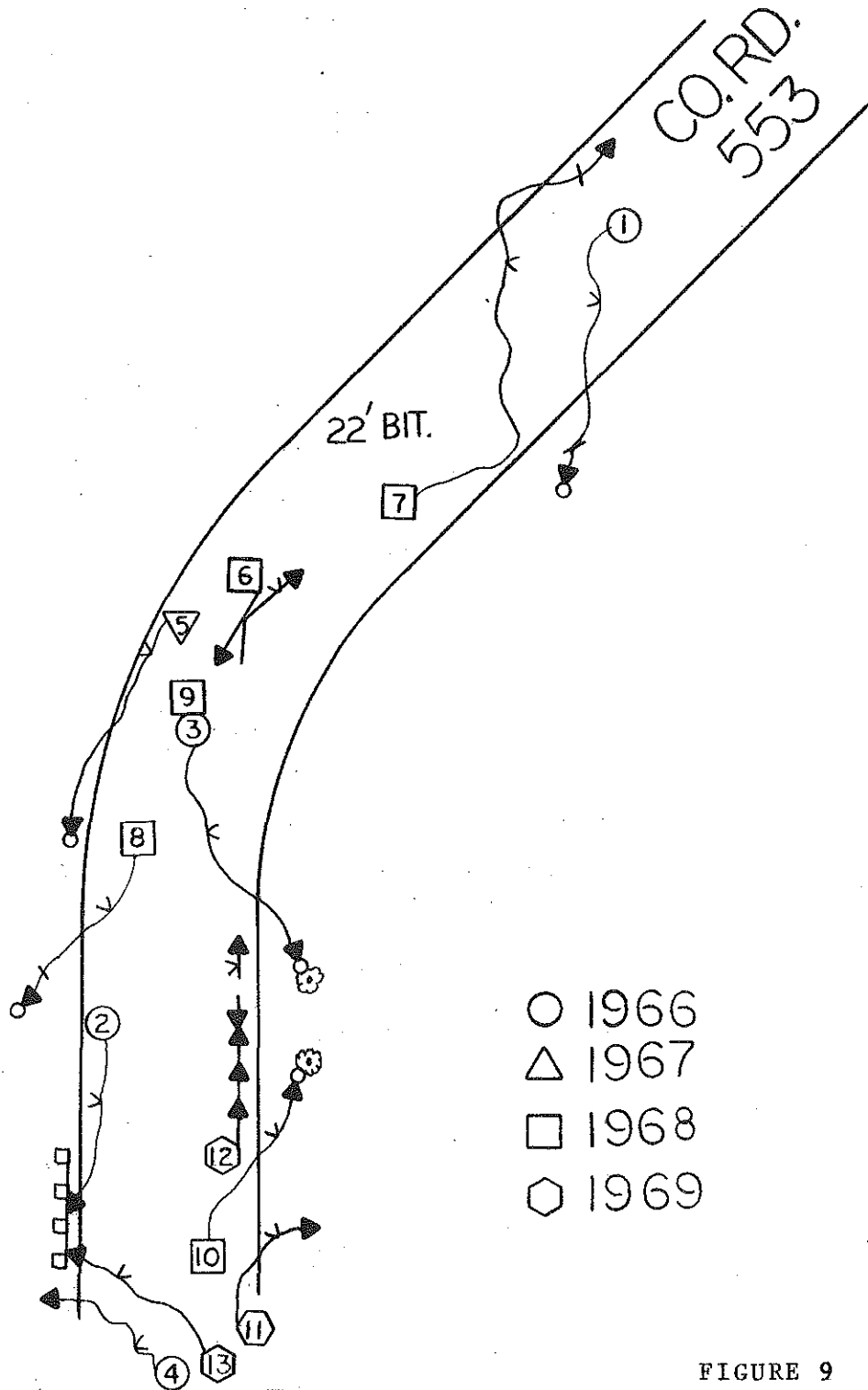
The collision diagram for this location during the four-year study period shows 13 accidents. Of this total 11 accidents were the ran-off roadway type. Ten of these accidents reportedly involved excessive speed and nine happened at night.

**Recommendations:**

We recommend that 30 in. curve signs (see Part I, Section C, p. 82 of the Manual - Appendix II, p. 88) be erected before the curve for both directions of traffic. This improvement will help reduce the accidents caused by excessive speed by

giving the operator advance warning of the curve. Also, due to the high percentage of night accidents (69%), we recommend that 48 in. target arrows (see Part I, Section C, p. 88 of the Manual - Appendix II, p. 91) be used in target position at the curve for both directions of traffic.

Furthermore to supplement the existing no passing zone pavement markings, we recommend that "do not pass" signs and "pass with care" signs (see Part I, Section B, p. 33 of the Manual - Appendix II, p. 84) be erected along with "no passing zone" pennant signs.



- 1966
- △ 1967
- 1968
- ⬡ 1969

FIGURE 9

MICHIGAN DEPARTMENT OF STATE HIGHWAYS  
Traffic Division

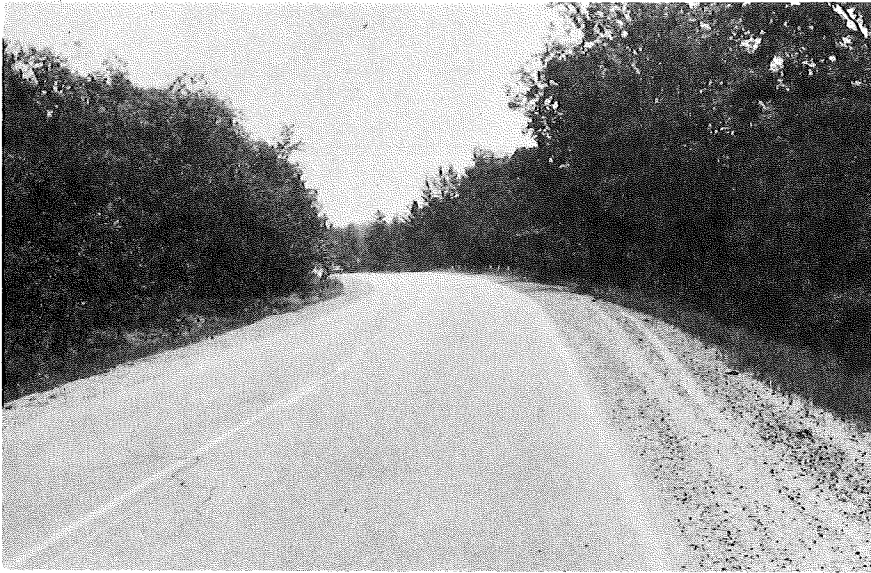
LEGEND

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

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

ACCIDENT STUDY  
COLLISION DIAGRAM

Period: 1966 THRU 1969  
 MARQUETTE CO. Description SANDS TWP  
 CO. RD. 553 0.7 TO 1.0 MI. SOUTH OF CO. RD. 480  
 Accidents - Total 13  
 P.D. 6 Injury 7 (12)  
 Fatal 0 ( )  
 Acc. Rate/mv \_\_\_\_\_  
 Acc. Rate/mvm \_\_\_\_\_  
 C.S. \_\_\_\_\_ Miles \_\_\_\_\_  
 Drawn DJM Date 9-17-70 Rev. \_\_\_\_\_  
 Plan No. LOCATION 6 and 10



SOUTHBOUND  
CO. RD. 553



SOUTHBOUND  
CO. RD. 553



NORTHBOUND  
CO. RD. 553

FIGURE 9a

Location 7     County Road 553, (F.A.S. 323), 1.3 to 1.5 miles north of County Road 480, (F.A.S. 880), Sands Township

This section of County Road 553 is an open stretch of rural highway. County Road 553 has a 22 ft bituminous pavement with narrow gravel shoulders. The roadway and shoulders are in excellent condition. The horizontal alignment in the northerly direction consists of a left-hand curve. Passing is prohibited and is so indicated by painted pavement markings.

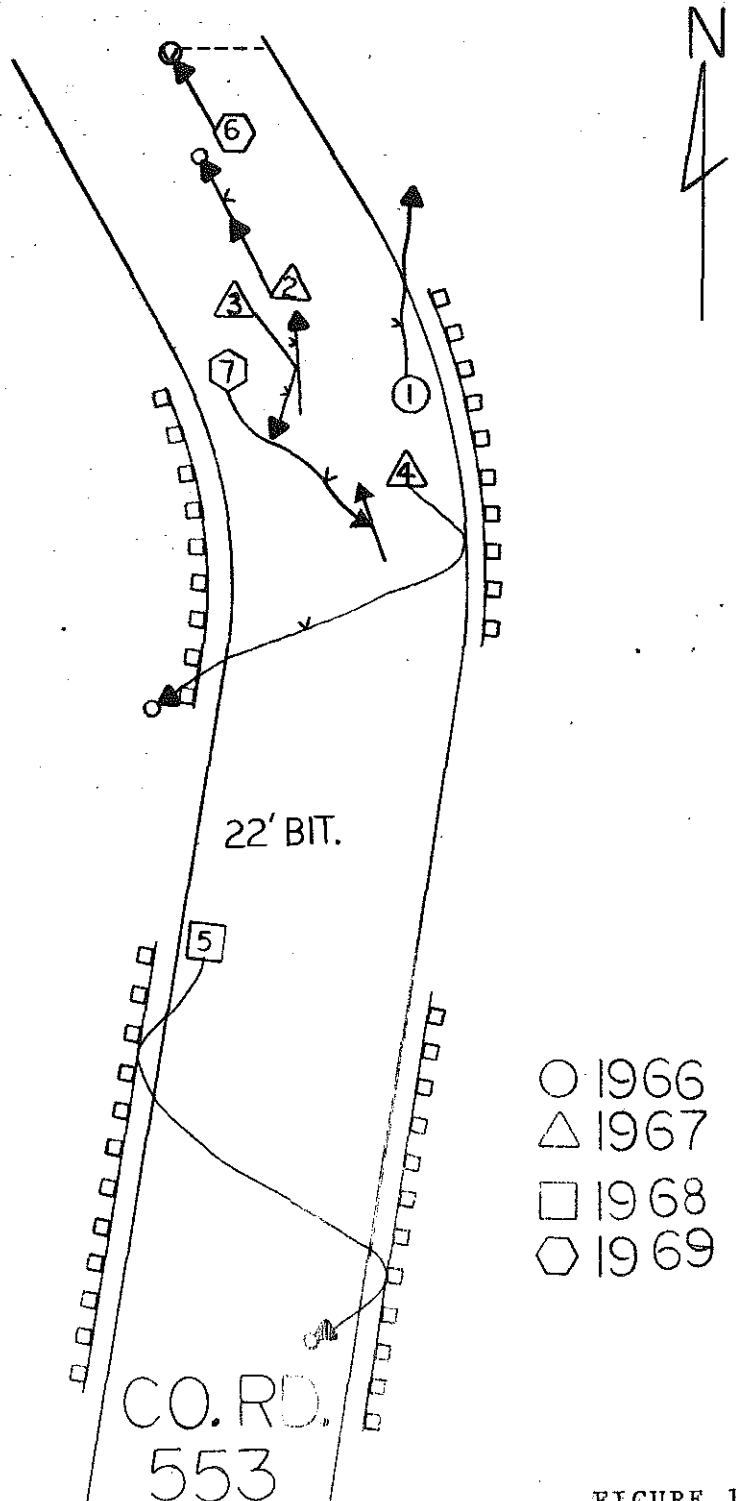
Out of the seven accidents at this location during the four-year study period, four occurred on the curve while the other three occurred on the approaches to the curve. All four of the accidents that happened on the curve reportedly involved excessive speed and three of these accidents happened at night.

**Recommendations:**

Due to the high percentage of nighttime accidents on the curve (75%), we recommend that 30 in. curve signs (see Part I, Section C, p. 82 of the Manual - Appendix II, p. 88) be placed before the curve for both directions of traffic. Furthermore, we recommend that 48 in. target arrows (see Part I, Section C, p. 88 of the Manual - Appendix II, p. 91) be placed in target position for both directions of traffic.

Also to supplement the existing no passing zone pavement markings, we recommend that "do not pass" signs and "pass with care" signs (see Part I, Section B, p. 33 of the Manual - Appendix II, p. 84) be erected along with "no passing zone" pennant signs.





- 1966
- △ 1967
- 1968
- ⬡ 1969

CO. RD.  
553

22' BIT.

FIGURE 10

MICHIGAN DEPARTMENT OF STATE HIGHWAYS  
Traffic Division

LEGEND

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

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

ACCIDENT STUDY  
COLLISION DIAGRAM

Period: 1966 THRU 1969  
 SANDS TWP. Description MARQUETTE CO.  
 CO. RD. 553 1.3 TO 1.5 MI. NORTH OF  
 CO. RD. 480  
 Accidents - Total 7  
 P.D. 4 Injury 3 (3)  
 Fatal 0 ( )  
 Acc. Rate/mv \_\_\_\_\_  
 Acc. Rate/mvm \_\_\_\_\_  
 C.S. \_\_\_\_\_ Miles \_\_\_\_\_  
 Drawn D.J.M. Date 11-13-70 Rev. \_\_\_\_\_  
 Plan No. LOCATION 7



SOUTHBOUND  
CO. RD. 553  
APPROACHING THE CURVE

SOUTHBOUND  
CO. RD. 553



NORTHBOUND  
CO. RD. 553

FIGURE 10a

Locations 8 and 15 County Road 553, (F.A.S. 323), 0.1 to 0.7 miles south of the Marquette City Limits, Sands Township

Due to the close proximity of Locations 8 and 15, we have combined the two locations and will discuss them together. Both locations are located on County Road 553. Location 8 is 0.5 to 0.7 miles south of the Marquette City Limits and Location 15 is 0.1 to 0.3 miles south of the Marquette City Limits. County Road 553 has a 22 ft bituminous pavement that is in excellent condition. The shoulders which are also in excellent condition are narrow in some spots. The horizontal alignment at this location consists of a reverse curve 0.5 of a mile long and a straight portion of roadway north of the reverse curve that is 0.2 of a mile long. Steel guardrail exists on the inside and outside of each of the two curves.

The existing traffic controls at this location consist of 30 in. reverse curve signs (W1-4-30 - Appendix II, p. 89) with accompanying 45 mph advisory speed panels. We concur with the 45 mph advisory speed panel on the basis of the devil level readings taken at the first curve in the southerly direction which in this case is the most critical curve. The readings we took at this location were as follows:

Northbound		Southbound	
Speed	Reading	Speed	Reading
55	14 <sup>o</sup>	55	16 <sup>o</sup>
50	10 <sup>o</sup>	50	14 <sup>o</sup>
45	6 <sup>o</sup>	45	10 <sup>o</sup>

(see Part I, Section C, pps. 132 - 133 of the Manual - Appendix II, pps. 94 - 95)

This location is also in a no passing zone and this is indicated by painted pavement markings.

The collision diagrams for this location indicates 11 accidents during the four-year study period. Ten of these accidents were the ran-off roadway type with the remaining accident involving improper parking. Nine of the ten ran-off roadway accidents reportedly involved excessive speed with eight of these occurring at night. Overall, nine of the 11 accidents occurred at night.

Recommendations:

Due to the high percentage of nighttime accidents (82%), we recommend that 48 in. target arrows (see Part I, Section C, p. 88 of the Manual - Appendix II, p. 91) be placed in target position for both curves. The target arrows will make the alignment of the curve more apparent at night.

Also, to supplement the existing no passing zone pavement markings, we recommend that "do not pass" signs and "pass with care" signs (see Part I, Section B, p. 33 of the Manual - Appendix II, p. 84) be erected along with "no passing zone" pennant signs.

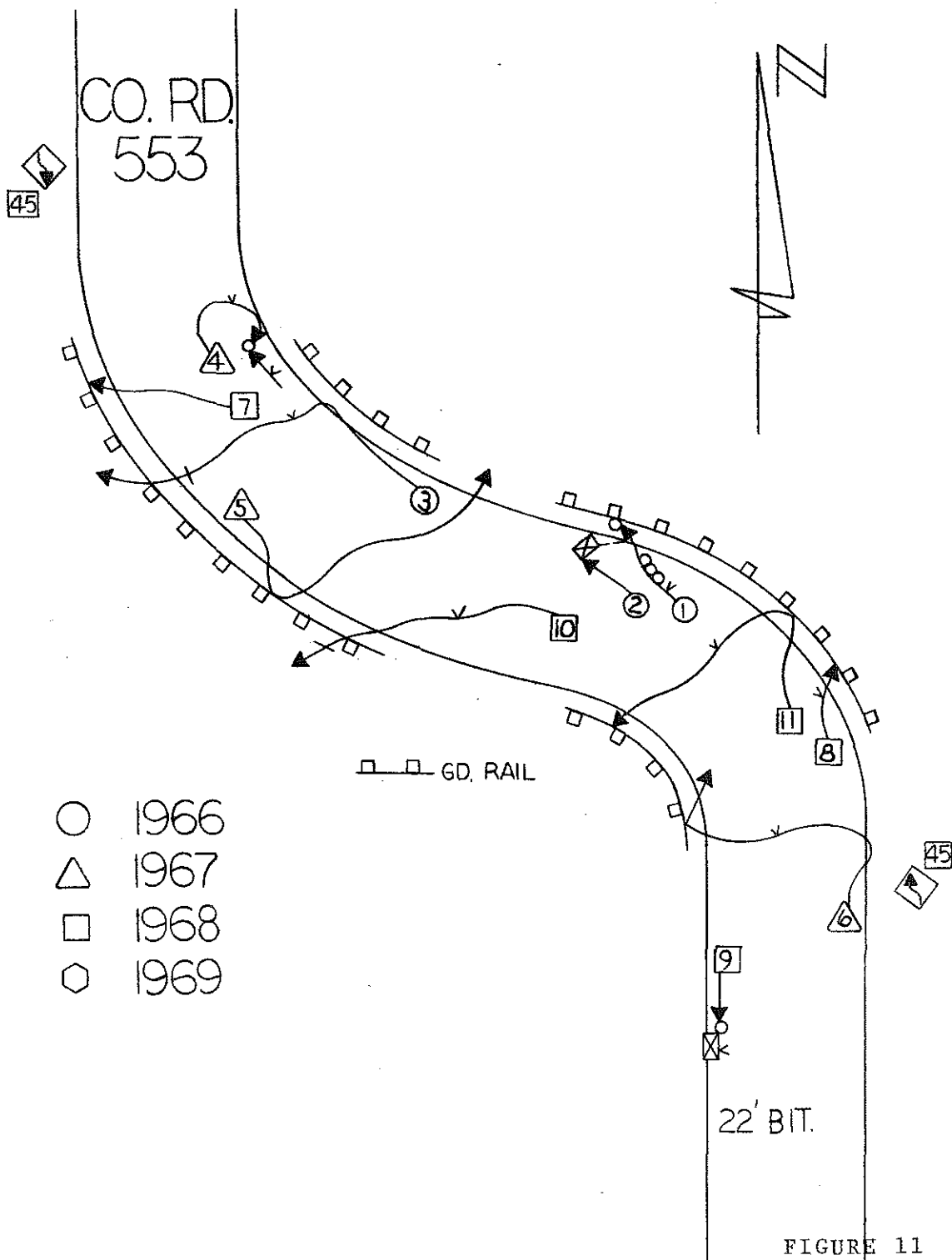
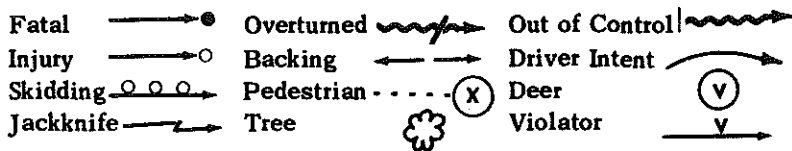
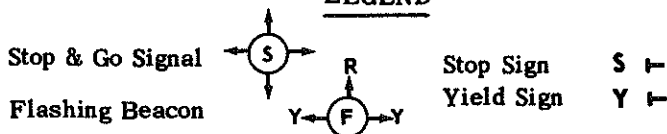


FIGURE 11

MICHIGAN DEPARTMENT OF STATE HIGHWAYS  
Traffic Division

LEGEND



ACCIDENT STUDY  
COLLISION DIAGRAM

Period: 1966 THRU 1969

SANDS TWP Description MARQUETTE CO.

CO. RD. 553 0.1 TO 0.7 MI. SOUTH OF  
MARQUETTE CITY LIMITS

Accidents - Total 11

P.D. 8 Injury 3 (6)

Fatal 0 ( )

Acc. Rate/mv \_\_\_\_\_

Acc. Rate/mvm \_\_\_\_\_

C.S. \_\_\_\_\_ Miles \_\_\_\_\_

Drawn DVW Date 3-2-71 Rev. \_\_\_\_\_

Plan No. LOCATION 8 and 15



NORTHBOUND  
CO. RD. 553

NORTHBOUND  
CO. RD. 553



NORTHBOUND  
CO. RD. 553

FIGURE 11a



SOUTHBOUND  
CO. RD. 553

SOUTHBOUND  
CO. RD. 553



SOUTHBOUND  
CO. RD. 553

FIGURE 11b

Location 9 County Road 502, 0.1 to 0.3 miles east of U. S. 41, Sands Township (see Appendix I, p. 70)

<u>Total</u>	<u>P.D.</u>	<u>Inj.</u>	<u>Fatal</u>
6	5	1	0

Location 10 County Road 553, (F.A.S. 323), 1.0 mile south of County Road 480, (F.A.S. 880), Sands Township (combined with Location 6, see p. 42)

Location 11 County Road 553, (F.A.S. 323), from County Road NA to 0.2 miles north, Sands Township

County Road 553 and County Road NA form a "T" intersection. The alignment in the southerly direction approaching the "T" intersection consists of a left-hand curve with a positive gradient. County Road 553 has a 22 ft bituminous pavement with narrow shoulders. Passing is prohibited on the curve and is so indicated by painted pavement markings.

County Road NA has a 20 ft bituminous pavement that is in excellent condition. The only traffic control on County Road NA is a 24 in. stop sign (R1-1-24, Appendix II, p. 83) giving County Road 553 the right of way.

There were six accidents at this location during the four-year study period. Three of these accidents happened on the curve at night with all of them reportedly involving excessive



speed. Two of the remaining three accidents happened at the intersection of County Road 553 and County Road NA. Both of these accidents also reportedly involved excessive speed.

**Recommendations:**

Due to the fact that all three of the accidents on the curve happened at night, we recommend that 30 in. curve signs (see Part I, Section C, p. 82 of the Manual - Appendix II, p. 88) be placed before the curve for both directions of traffic. Also, to complement the curve signs we recommend that a 48 in. target arrow (see Part I, Section C, p. 88 of the Manual - Appendix II, p. 91) be placed in target position for southbound traffic.

Furthermore, we recommend that a 48 in. bi-directional target arrow (see Part I, Section C, p. 89 of the Manual - Appendix II, p. 92) be placed at the end of County Road NA.

Lastly, to supplement the existing no passing zone pavement markings, we recommend that "do not pass" signs and "pass with care" signs (see Part I, Section B, p. 33 of the Manual - Appendix II, p. 84) be erected along with "no passing zone" pennant signs.

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state highways  
LANSING

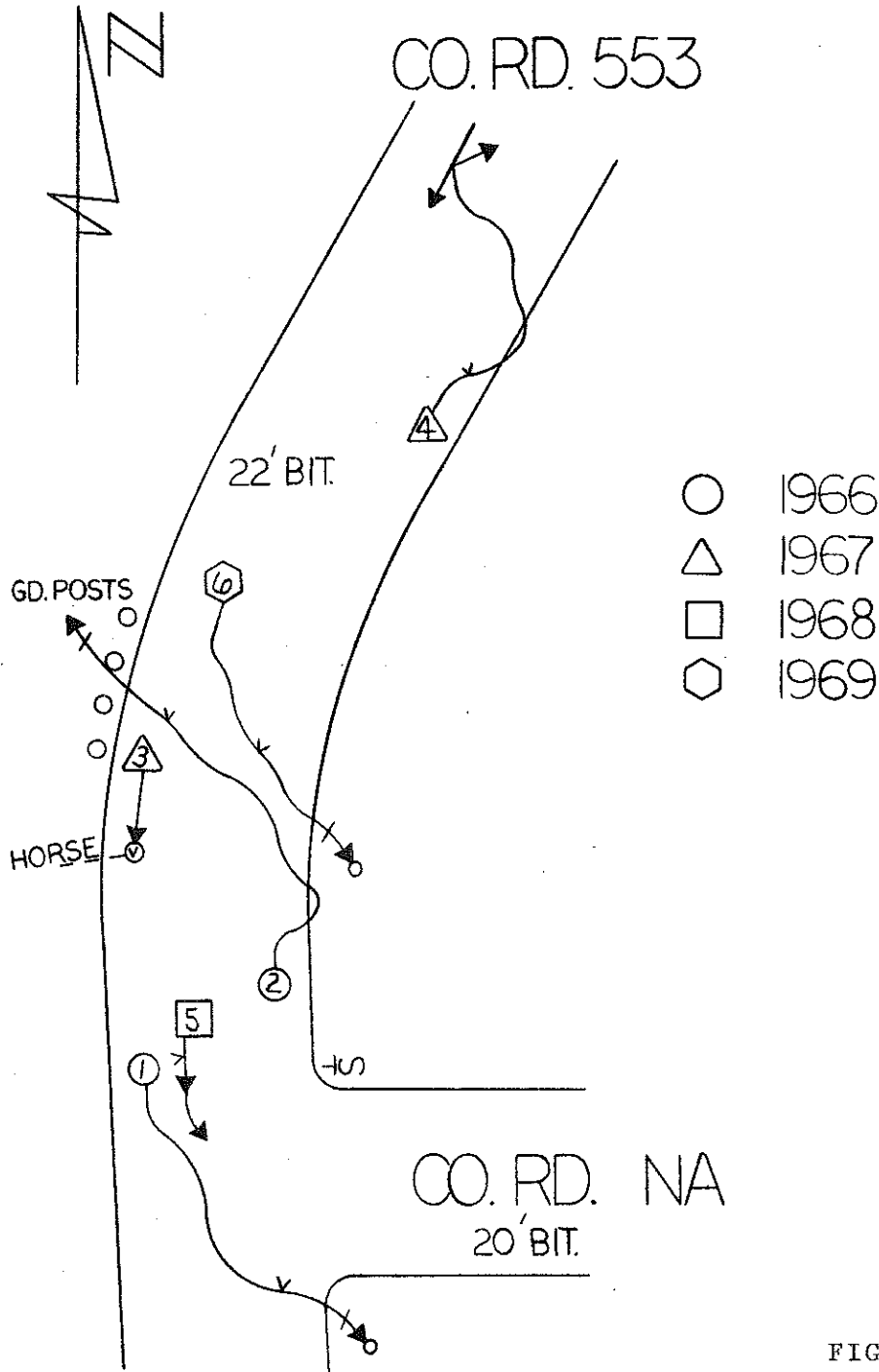
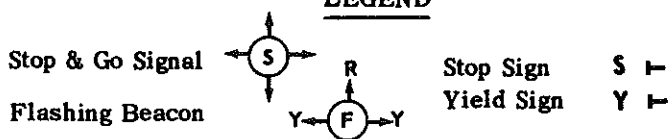


FIGURE 12

MICHIGAN DEPARTMENT OF STATE HIGHWAYS  
Traffic Division

LEGEND



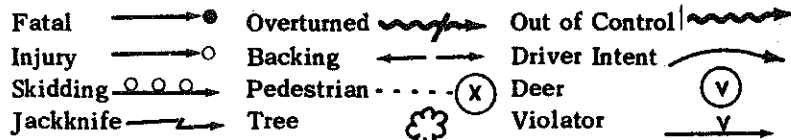
ACCIDENT STUDY  
COLLISION DIAGRAM

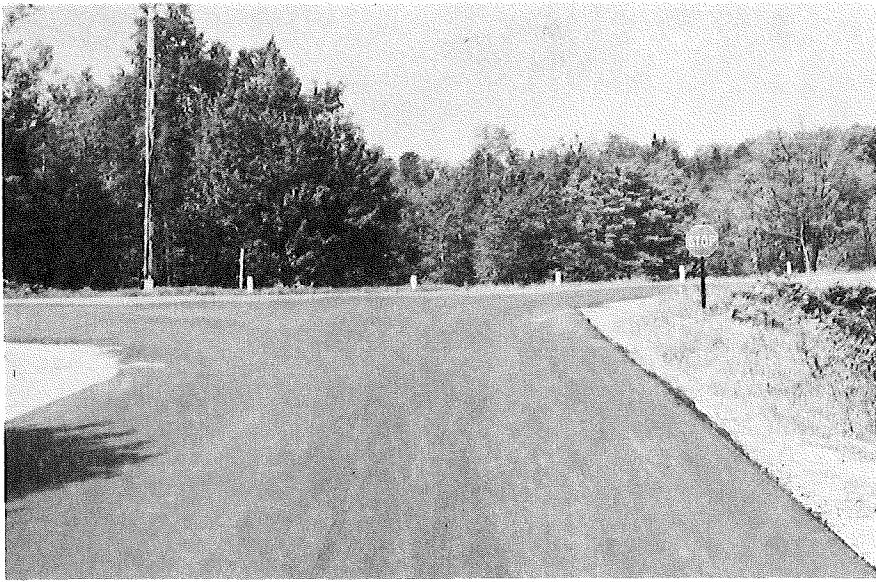
Period: 1966 THRU 1969  
 SANDS TWP. Description MARQUETTE CO.  
 CO. RD. 553 FROM CO. RD. NA TO 0.2 MI. NORTH

Accidents - Total 6 ( 5 )  
 P.D. 4 Injury 2  
 Fatal 0

Acc. Rate/mv \_\_\_\_\_  
 Acc. Rate/mvm \_\_\_\_\_

C.S. \_\_\_\_\_ Miles \_\_\_\_\_  
 Drawn DVW Date 3-5-71 Rev. \_\_\_\_\_  
 Plan No. LOCATION 11





WESTBOUND  
CO. RD. NA

NORTHBOUND  
CO. RD. 553



SOUTHBOUND  
CO. RD. 553



FIGURE 12a

Location 12 County Road 550, (F.A.S. 214), at L. S. & I. Railroad crossing, Marquette Township (see Appendix I, p. 72)

<u>Total</u>	<u>P.D.</u>	<u>Inj.</u>	<u>Fatal</u>
5	3	2	0

Location 13 County Road 550, (F.A.S. 214), at the Marquette City Limits, Marquette Township (combined with Location 4, see p. 32)

Location 14 County Road 553, (F.A.S. 323), and County Road NT or NB to 0.2 miles north on County Road 553, Sands Township (see Appendix I, p. 74)

<u>Total</u>	<u>P.D.</u>	<u>Inj.</u>	<u>Fatal</u>
5	4	1	0

Location 15 County Road 553, (F.A.S. 323), 0.1 to 0.3 miles south of Marquette City Limits, Sands Township (combined with Location 8, see p. 50)

Location 16 County Road 480, (F.A.S. 880), 0.3 to 0.5 miles west of County Road 553, (F.A.S. 323), Sands Township (see Appendix I, p. 77)

<u>Total</u>	<u>P.D.</u>	<u>Inj.</u>	<u>Fatal</u>
5	1	4	0

Location 17 County Road 553, (F.A.S. 323), 0.4 to 0.6 miles south of County Road 480, (F.A.S. 880), Sands Township (see Appendix I, p. 79)

<u>Total</u>	<u>P.D.</u>	<u>Inj.</u>	<u>Fatal</u>
4	2	1	1

Location 18 County Road 550, (F.A.S. 214), 3.3 to 3.5 miles north of Marquette City Limits

The most critical aspect of this section of County Road 550 is its horizontal alignment which is a reverse curve. County Road 550 has a 22 ft bituminous pavement with narrow gravel shoulders. The roadway and shoulders are in excellent condition. The existing traffic controls consist of a 30 in. winding road sign (W1-5-30, Appendix II, p. 90) at the beginning of the reverse curve for both directions of traffic. There are no advisory speed panels or any prohibition to passing such as painted pavement markings or no passing signs.

There were four ran-off roadway accidents at this location during the four-year study period. All four accidents reportedly involved excessive speed and occurred during the daytime while there was only one accident that occurred under snowy or icy conditions.

Recommendations:

Since this location is a reverse curve and not a series

*Re-align?*

of curves, we recommend that the winding road sign be replaced by a reverse curve sign (see Part I, Section C, p. 86 of the Manual, Appendix II, p. 89). Furthermore, we recommend 35 mph advisory speed panels accompany the reverse curve signs. The 35 mph advisory speed was chosen on the basis of devil level readings taken at the most critical curve which in this case is the first curve in the southerly direction. The devil level readings for the curve were as follows:

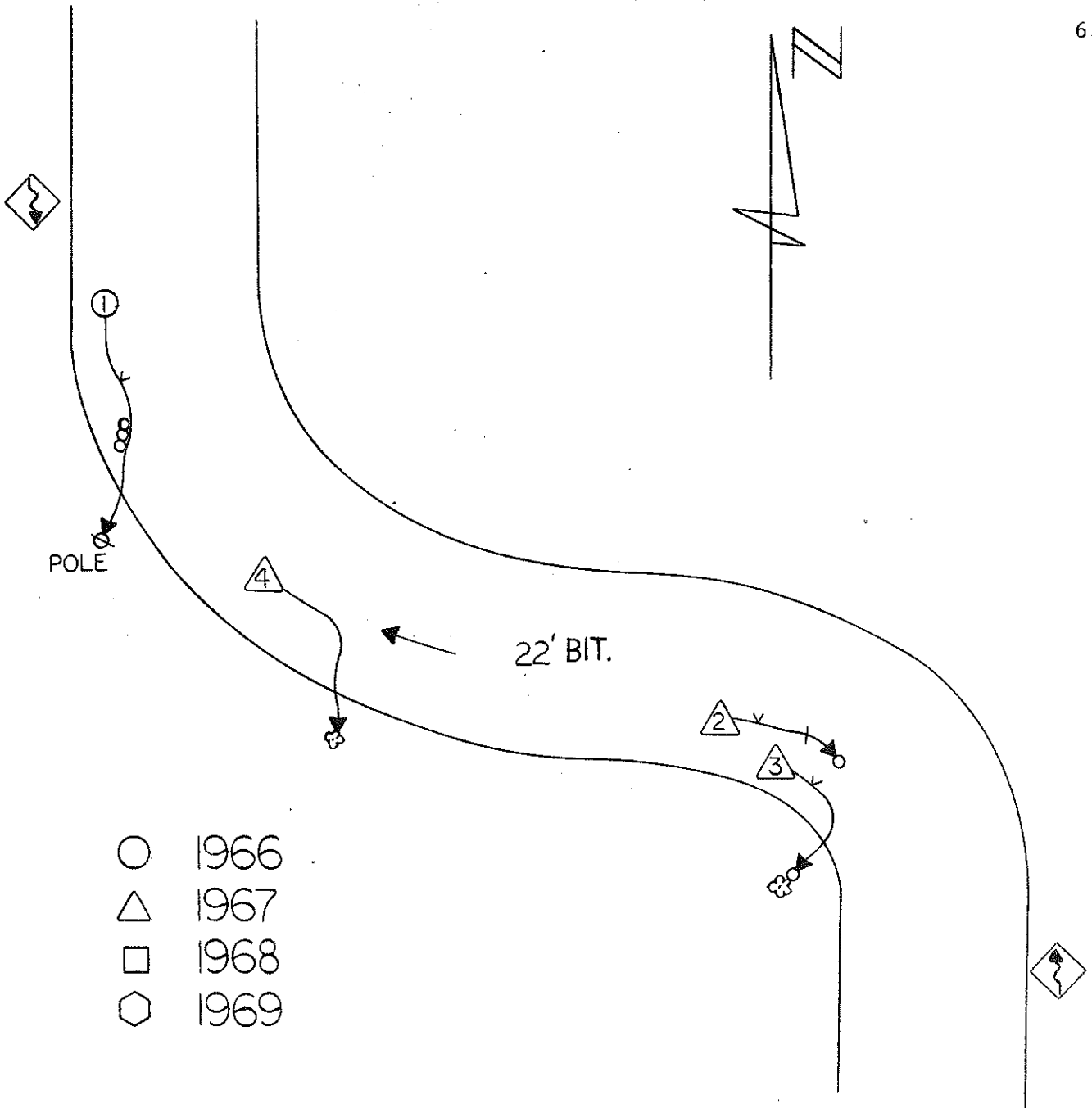
North		South	
Speed	Reading	Speed	Reading
45	14 <sup>o</sup>	45	16 <sup>o</sup>
40	12 <sup>o</sup>	40	13 <sup>o</sup>
35	10 <sup>o</sup>	35	10 <sup>o</sup>

(see Part I, Section C, pps. 132 - 133 of the Manual - Appendix II, pps. 94 - 95)

Also, to complement the reverse curve signs, we recommend that 48 in. target arrows (see Part I, Section C, p. 88 of the Manual, Appendix II, p. 91) be used in target position to outline the alignment of both curves at night.

Another problem at this location may be the fact that the horizontal sight distance for the reverse curve is not sufficient for safe passing maneuvers. One of the four accidents involved passing while two other accidents reportedly involved left of center violations that caused other vehicles to run off the roadway. We feel that if certain trees and other foliage located on the inside of the curves were removed the sight distance would be improved. However, we are aware

of the problems surrounding tree removal. If it is discovered that it would not be feasible to remove the trees and foliage necessary to improve the sight distance, a prohibition on passing would be the only alternative short of reconstruction. Our forces will be in the Upper Peninsula in the near future, and we would be willing to undertake a traffic survey and engineering study to determine where "no passing zone" signs and markings should be placed.



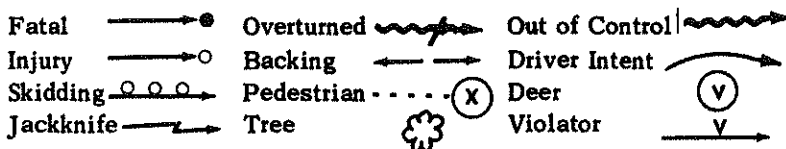
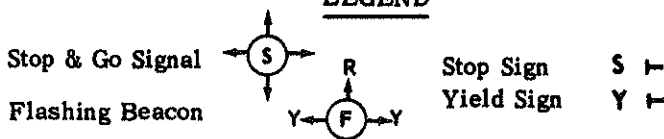
- 1966
- △ 1967
- 1968
- ⬡ 1969

CO. RD. 550

FIGURE 13

MICHIGAN DEPARTMENT OF STATE HIGHWAYS  
Traffic Division

LEGEND



ACCIDENT STUDY  
COLLISION DIAGRAM

Period: 1966 THRU 1969

MARQUETTE TWP. Description MARQUETTE CO.

CO. RD. 550, 3.3 TO 3.5 MI. NORTH OF  
MARQUETTE CITY LIMITS

Accidents - Total 4 (4)

P.D. 2 Injury 2

Fatal 0 ( )

Acc. Rate/mv \_\_\_\_\_

Acc. Rate/mvm \_\_\_\_\_

C.S. \_\_\_\_\_ Miles \_\_\_\_\_

Drawn DVW Date \_\_\_\_\_ Rev. \_\_\_\_\_

Plan No. LOCATION 18





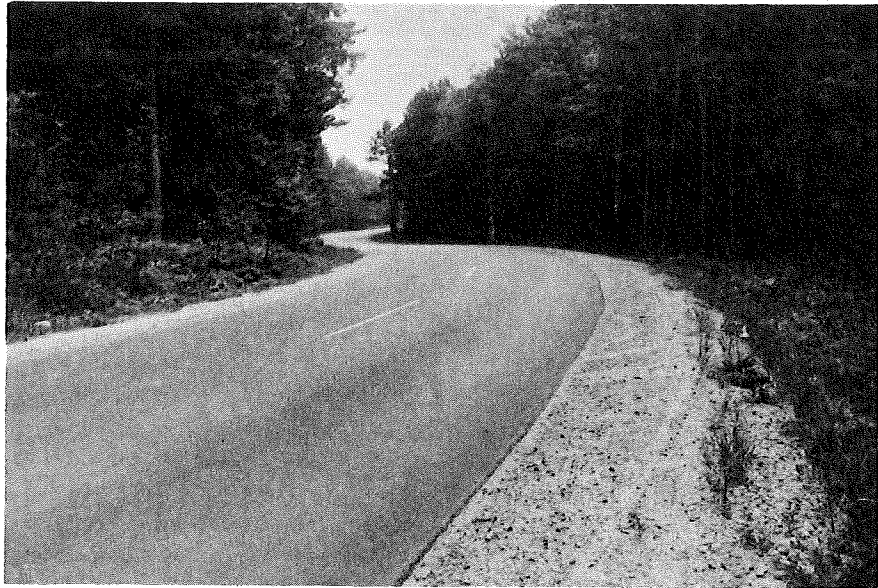
NORTHBOUND  
CO. RD. 550

NORTHBOUND  
CO. RD. 550



SOUTHBOUND  
CO. RD. 550

FIGURE 13a



SOUTHBOUND  
CO. RD. 550



SOUTHBOUND  
CO. RD. 550

SUMMARY

The Department of State Police submitted 18 high accident locations for Marquette County to the Michigan Department of State Highways. After an indepth study of these locations, we formulated recommendations for 13 of them. The locations and their recommendations are as follows:

Location Number	Location Description	Quantity	Recommendations
1 and 2	County Road 553, (F.A.S. 323), 1.1 to 1.6 miles south of County Road 480, (F.A.S. 880), Sands Township	2	W1-2-30
		2	W1-6-48
		2	R3-17-24
		2	R3-18-24
		2	W14-3 (No Passing Zone Pennant Signs)
3	County Road 553, (F.A.S. 323), 1.7 to 1.9 miles south of County Road 480, (F.A.S. 880), Sands Township	2	W1-2-30
		2	W1-6-48
		2	R3-17-24
		2	R3-18-24
		2	W14-3 (No Passing Zone Pennant Signs)
4 and 13	County Road 550, (F.A.S. 214), from the Marquette City Limits north 0.5 of a mile, Marquette Township	2	W1-2-30
		2	W1-6-48
		4	W12-9

Location Number	Location Description	Quantity	Recommendations
5	County Road 553, (F.A.S. 323), 2.3 to 2.5 miles south of County Road 480, (F.A.S. 880), Sands Township	2	W1-2-30
		2	R3-17-24
		2	R3-18-24
		2	W14-3 (No Passing Zone Pennant Signs)
6 and 10	County Road 553, (F.A.S. 323), 0.7 to 1.0 mile south of County Road 480, (F.A.S. 880), Sands Township	2	W1-2-30
		2	W1-6-48
		2	R3-17-24
		2	R3-18-24
		2	W14-3 (No Passing Zone Pennant Signs)
7	County Road 553, (F.A.S. 323), 1.3 to 1.5 miles north of County Road 480, (F.A.S. 880), Sands Township	2	W1-2-30
		2	W1-6-48
		2	R3-17-24
		2	R3-18-24
		2	W14-3 (No Passing Zone Pennant Signs)
8 and 15	County Road 553, (F.A.S. 323), 0.1 to 0.7 miles south of the Marquette City Limits, Sands Township	4	W1-6-48
		2	R3-17-24
		2	R3-18-24
		2	W14-3 (No Passing Zone Pennant Signs)
11	County Road 553, (F.A.S. 323), from County Road NA to 0.2 miles north, Sands Township	2	W1-2-30
		1	W1-6-48
		1	W1-7-48
		2	R3-17-24
		2	R3-18-24
		2	W14-3 (No Passing Zone Pennant Signs)

Location Number	Location Description	Quantity	Recommendations
18	County Road 550, (F.A.S. 214), 3.3 to 3.5 miles north of Marquette City Limits	2 2 4	W1-4-30 W12-1-21 W1-6-48

# APPENDIX I

LIBRARY  
michigan department of  
state highways  
LANSING

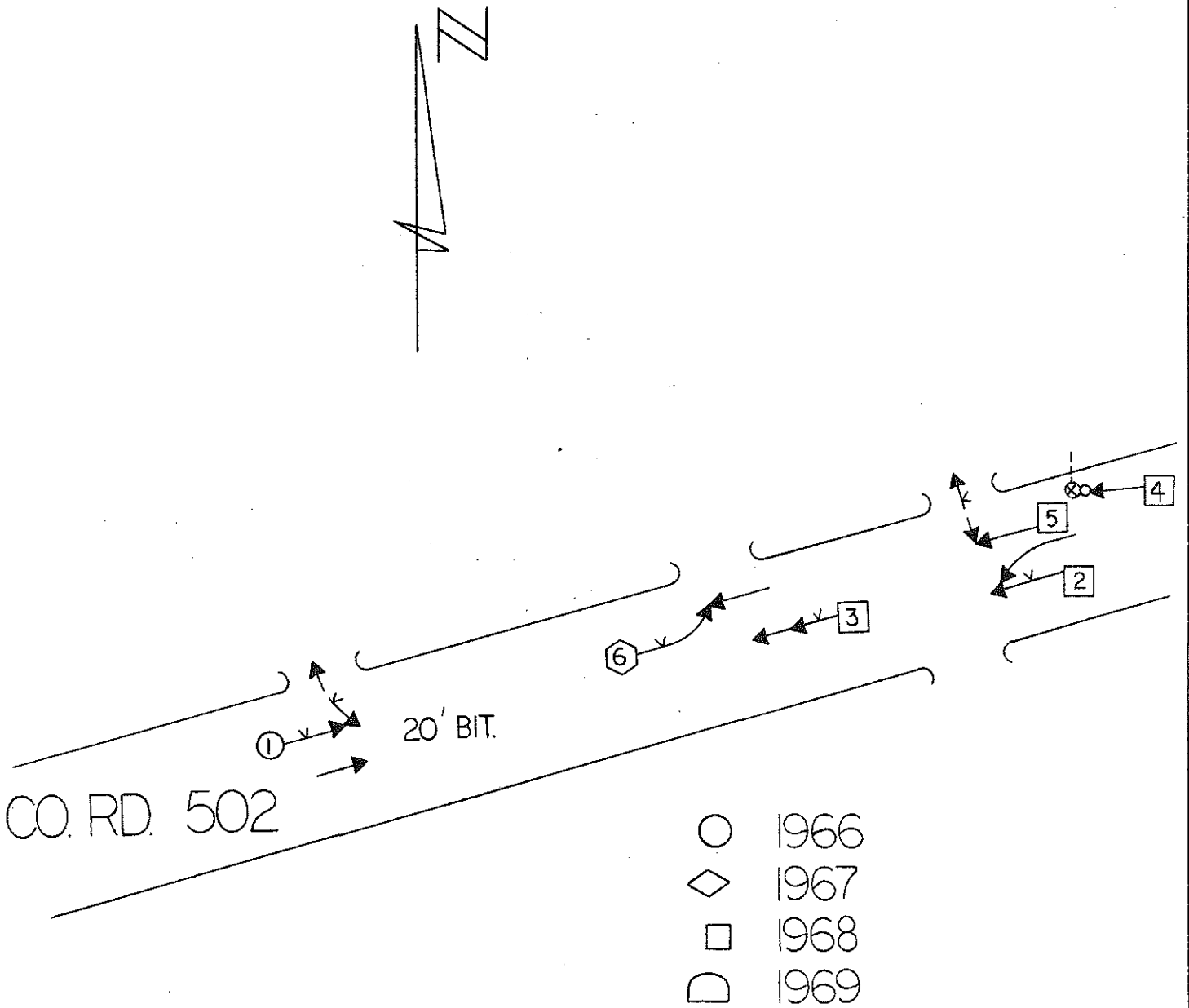
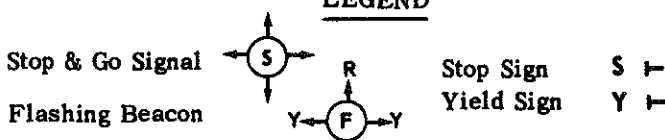


FIGURE 14

MICHIGAN DEPARTMENT OF STATE HIGHWAYS  
Traffic Division

LEGEND



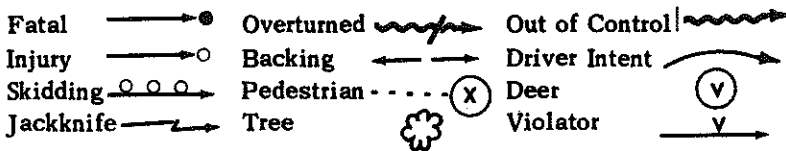
ACCIDENT STUDY  
COLLISION DIAGRAM

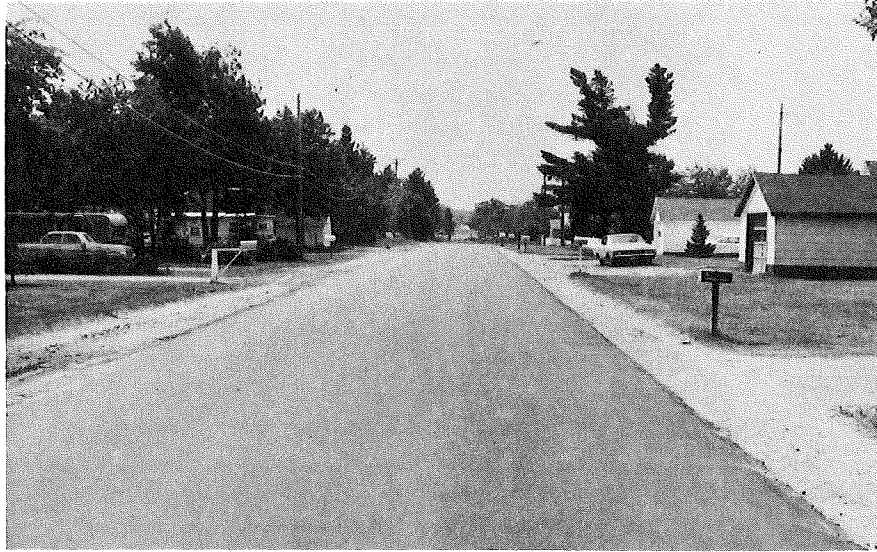
Period: 1966 THRU 1969  
 NEGAUNEE TWP. Description MARQUETTE CO.  
 CO. RD. 502, 0.1 TO 0.3 MI. EAST OF US-41

Accidents - Total 6  
 P.D. 5 Injury ( )  
 Fatal 0 ( )

Acc. Rate/mv \_\_\_\_\_  
 Acc. Rate/mvm \_\_\_\_\_

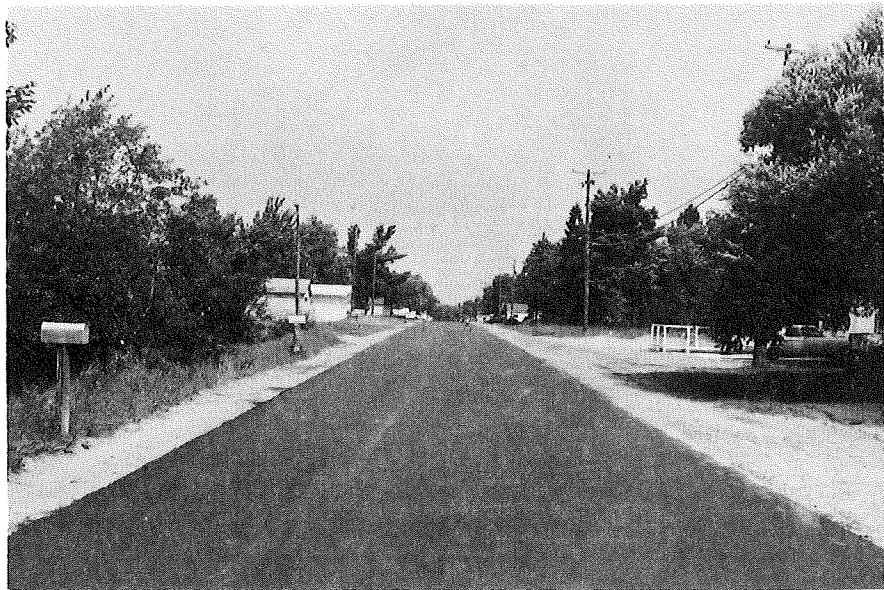
C.S. \_\_\_\_\_ Miles \_\_\_\_\_  
 Drawn DJM Date 11-19-70 Rev. \_\_\_\_\_  
 Plan No. LOCATION 9





SOUTHWESTBOUND

CO. RD. 502



NORTHEASTBOUND

CO. RD. 502



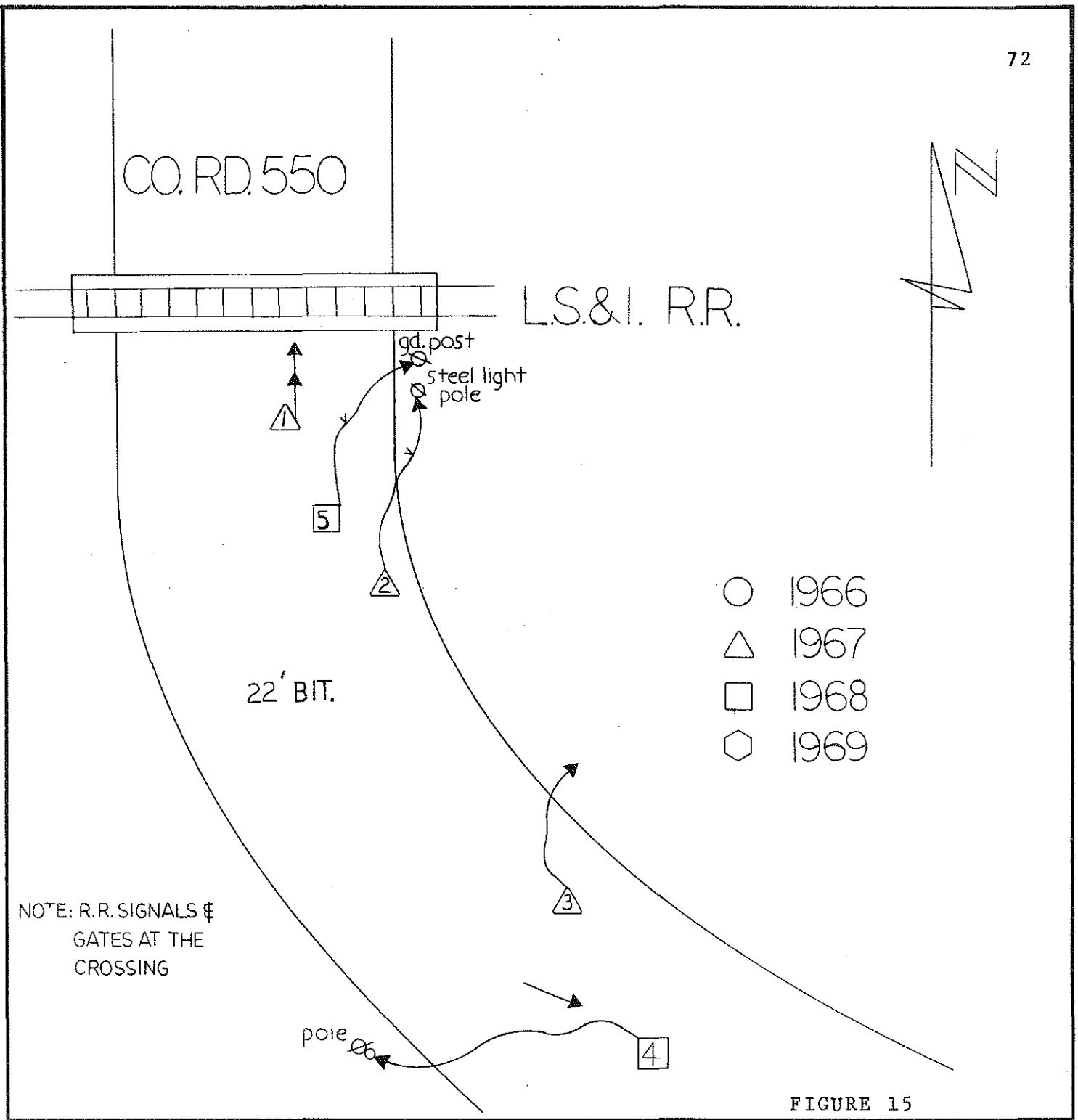
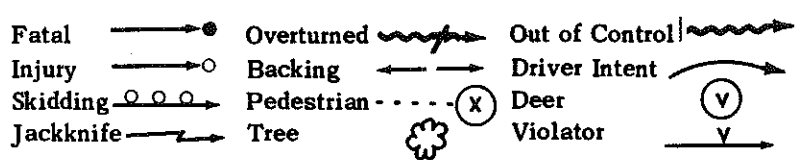
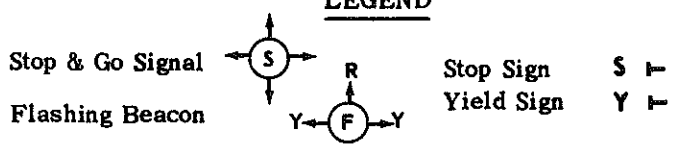


FIGURE 15

MICHIGAN DEPARTMENT OF STATE HIGHWAYS  
Traffic Division

ACCIDENT STUDY  
COLLISION DIAGRAM

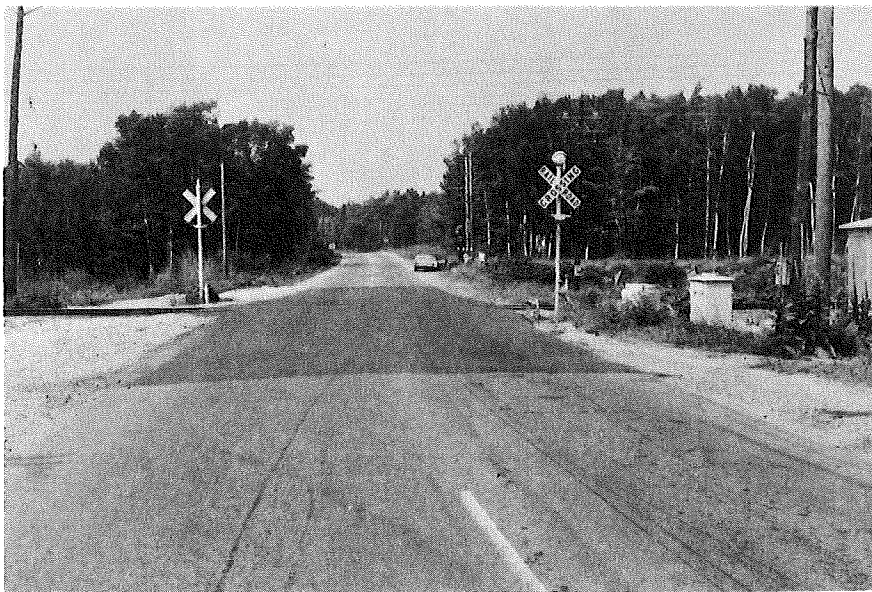
LEGEND



Period: 1966 THRU 1969  
 MARQUETTE TWP. Description MARQUETTE CO.  
CO. RD. 550 at L.S. & I. R.R. CROSSING  
 Accidents - Total 5  
 P.D. 3 Injury 2 (2)  
 Fatal 0 ( )  
 Acc. Rate/mv \_\_\_\_\_  
 Acc. Rate/mvm \_\_\_\_\_  
 C.S. \_\_\_\_\_ Miles \_\_\_\_\_  
 Drawn DVW Date 9-23-70 Rev. \_\_\_\_\_  
 Plan No. LOCATION 12

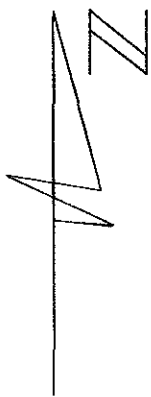


SOUTHBOUND  
CO. RD. 550

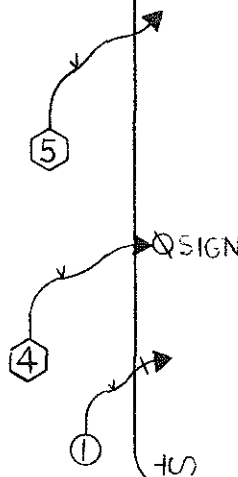


NORTHBOUND  
CO. RD. 550

FIGURE 15a



22' BIT.



20' BIT.

CO. RD. NB

21' BIT.

CO. RD NT

SH

- 1966
- △ 1967
- 1968
- ◇ 1969

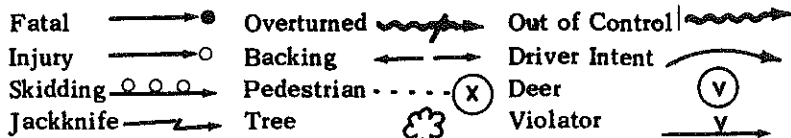
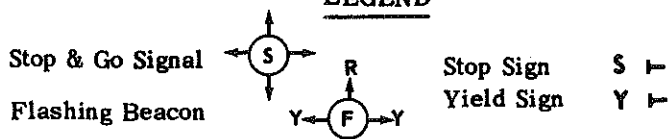


CO. RD 553

FIGURE 16

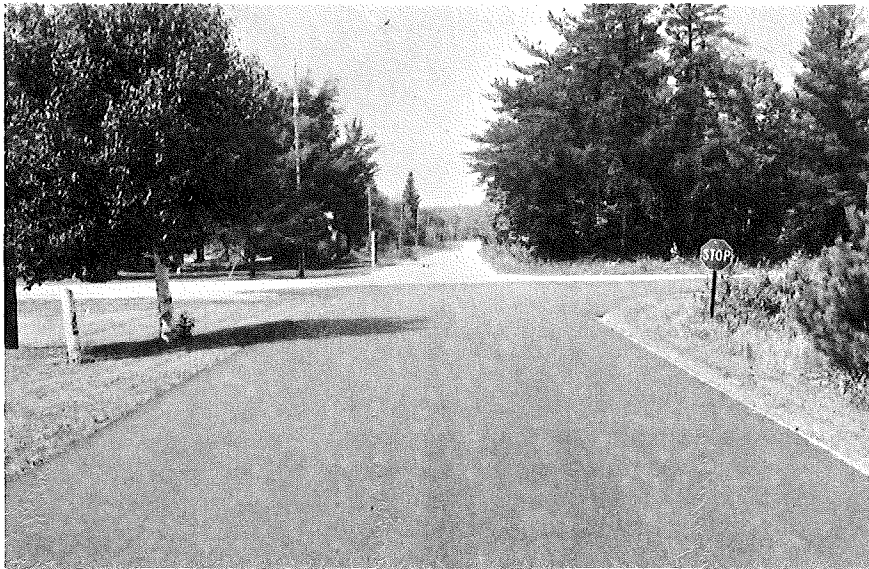
MICHIGAN DEPARTMENT OF STATE HIGHWAYS  
Traffic Division

LEGEND



ACCIDENT STUDY  
COLLISION DIAGRAM

Period: 1966 THRU 1969  
SANDS TWP. Description MARQUETTE CO.  
CO. RD. 553 FROM CO. RD. NB OR NT 0.2 MI. NORTH  
 Accidents - Total 5  
 P.D. 4 Injury 1 ( )  
 Fatal 0 ( )  
 Acc. Rate/mv \_\_\_\_\_  
 Acc. Rate/mvm \_\_\_\_\_  
 C.S. \_\_\_\_\_ Miles \_\_\_\_\_  
 Drawn DVW Date 9-21-70 Rev. \_\_\_\_\_  
 Plan No. LOCATION 14



WESTBOUND  
CO. RD. NT



SOUTHBOUND  
CO. RD. 553



SOUTHBOUND  
CO. RD. 553



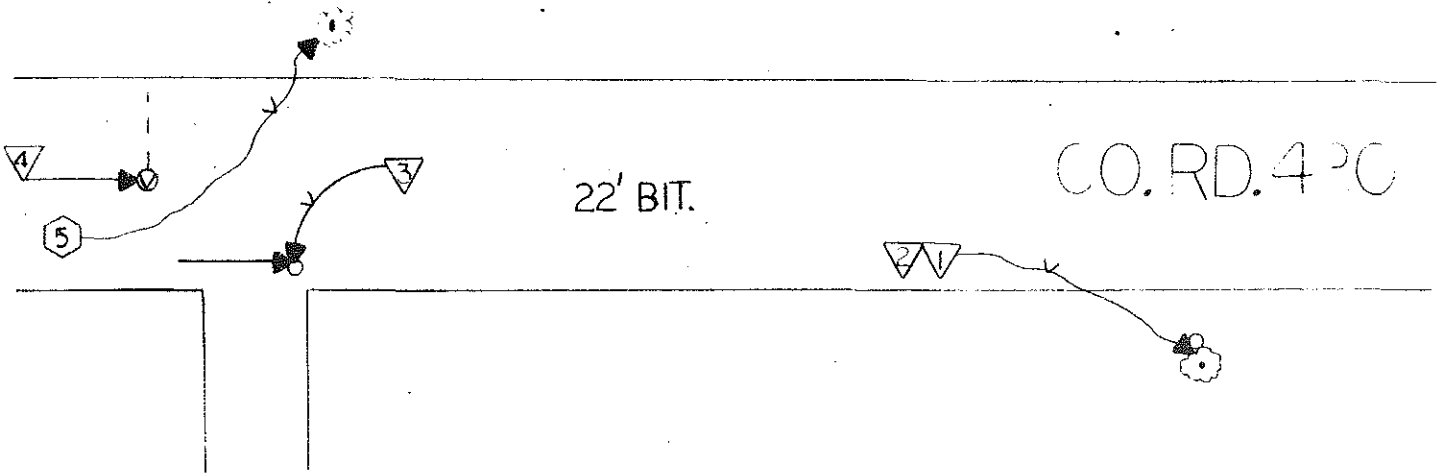
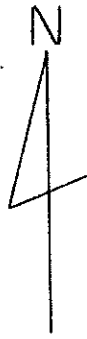
EASTBOUND  
CO. RD. NB



NORTHBOUND  
CO. RD. 553

LIBRARY  
michigan department of  
state highway  
LANSING

FIGURE 16b

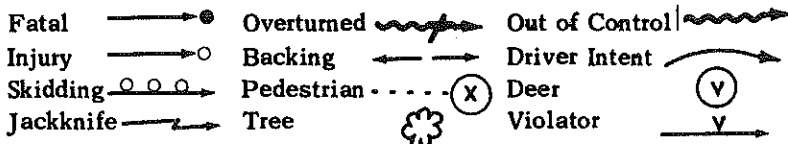
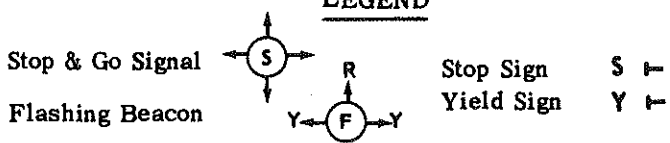


- 1966
- △ 1967
- 1968
- ⬡ 1969

FIGURE 17

MICHIGAN DEPARTMENT OF STATE HIGHWAYS  
Traffic Division

LEGEND



ACCIDENT STUDY  
COLLISION DIAGRAM

Period: 1966 THRU 1969  
 SANDS TWP, Description MARQUETT CO.  
 CO. RD. 45 0.3 TO 0.5 MI WEST  
 OF CO. RD. #3  
 Accidents - Total 5  
 P.D. Injury 4 (S)  
 Fatal ( )  
 Acc. Rate/mv \_\_\_\_\_  
 Acc. Rate/mvm \_\_\_\_\_  
 C.S. \_\_\_\_\_ Miles \_\_\_\_\_  
 Drawn L.M. Date 11-18-70 Rev. \_\_\_\_\_  
 Plan No. LOCATION 16



EASTBOUND  
CO. RD. 480



WESTBOUND  
CO. RD. 480

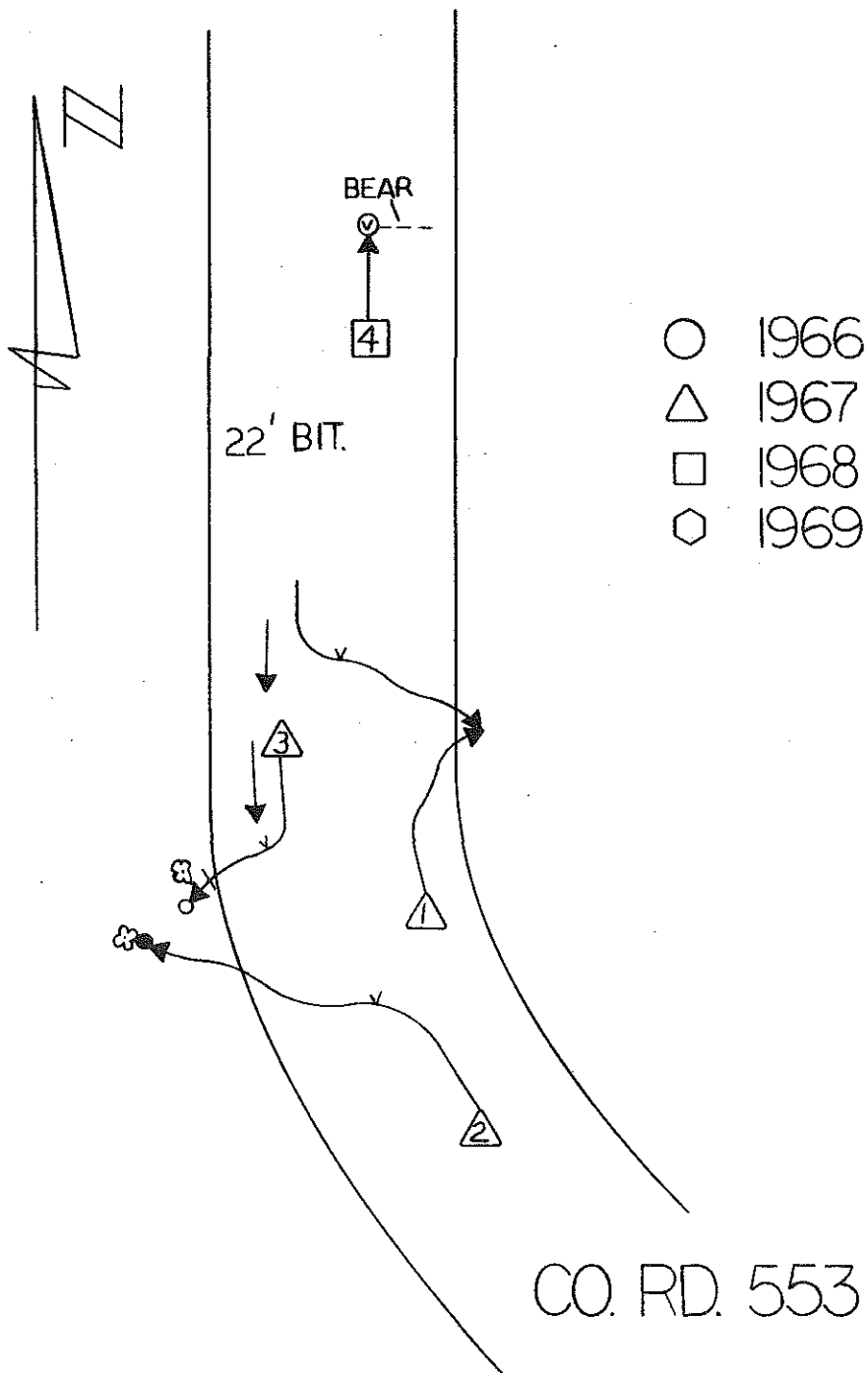
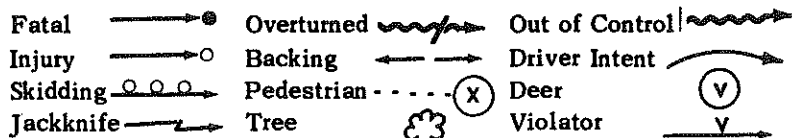
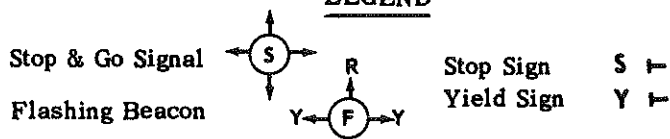


FIGURE 18

MICHIGAN DEPARTMENT OF STATE HIGHWAYS  
Traffic Division

LEGEND



ACCIDENT STUDY  
COLLISION DIAGRAM

Period: 1966 THRU 1969  
SANDS TWP. Description MARQUETTE CO.  
CO. RD. 553 0.4 TO 0.6 MI. SOUTH OF  
CO. RD. 480  
 Accidents - Total 4  
 P.D. 2 Injury 1 (3)  
 Fatal 1 (1)  
 Acc. Rate/mv \_\_\_\_\_  
 Acc. Rate/mvm \_\_\_\_\_  
 C.S. \_\_\_\_\_ Miles \_\_\_\_\_  
 Drawn DVW Date 3-2-71 Rev. \_\_\_\_\_  
 Plan No. LOCATION 17





SOUTHBOUND  
CO. RD. 553



NORTHBOUND  
CO. RD. 553

# 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  | (R1 Series) |
| a. "STOP" Sign    |             |
| b. "YIELD" Sign   |             |
| (2) Speed         | (R2 Series) |
| (3) Movement      | (R3 Series) |
| a. Turning        |             |
| b. Alignment      |             |
| c. One Way        |             |
| d. Exclusion      |             |
| (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

**DO NOT PASS SIGN**

Reflectorized

R3-17-24 24" x 30" (6" letters)

This sign may be used to indicate the beginning of a No Passing Zone.

The method used to determine the length of a No Passing Zone is established in Part III of this Manual.

For placement see figure 1-5.

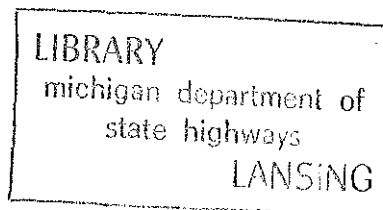
**PASS WITH CARE SIGN**

Reflectorized

R3-18-24 24" x 30" (6" letters)

This sign may be used to indicate the end of a No Passing Zone. It shall be used at the end of a zone when the "DO NOT PASS" sign (R3-17) has been used at the beginning of the zone.

For placement see figure 1-5.



## 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

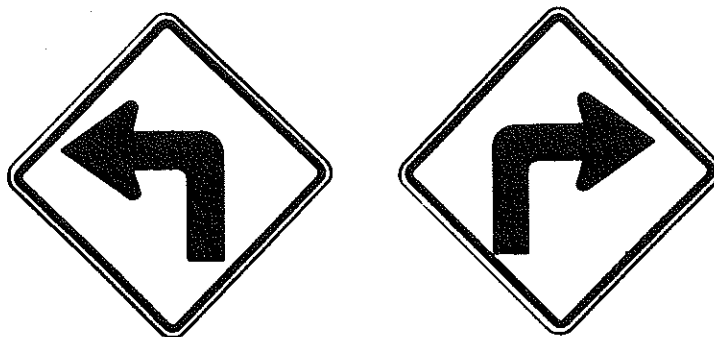
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\*Special warning signs for highway construction and maintenance projects are to be found in Part II of this Manual.

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.

### TURN SIGN



#### Reflectorized

W1-1-30	30" x 30"
W1-1-36	36" x 36"
W1-1-48	48" x 48"

The Turn sign shall be used to denote changes in the horizontal alignment of all roads (except minor roads and streets where in the judgment of the engineer the use of this sign is unnecessary) where a ball bank indicator or Devil Level registers ten degrees or more at a speed of 30 miles per hour or less. Where this sign is warranted, consideration should be given to the use of a Target Arrow (W1-6). Additional protection may be provided by use of the Curve Speed panel (W12-1).

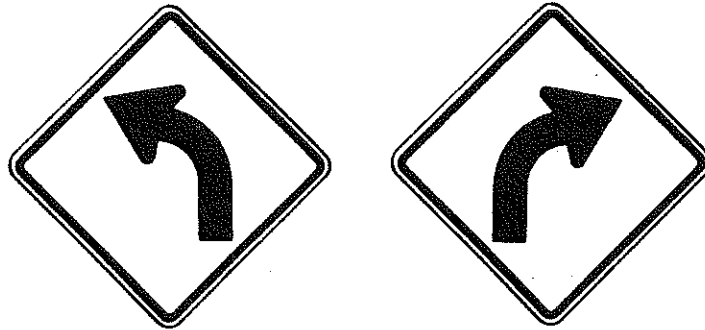
This sign shall be located in advance of the point of curvature at the approximate distance indicated below:

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

Turns or a turn and a curve that are less than 400 feet apart shall be designated by the W1-3 sign.

For placement see figure 1-11.



**CURVE SIGN**

ReflectORIZED

W1-2-30 30" x 30"

W1-2-36 36" x 36"

W1-2-48 48" x 48"

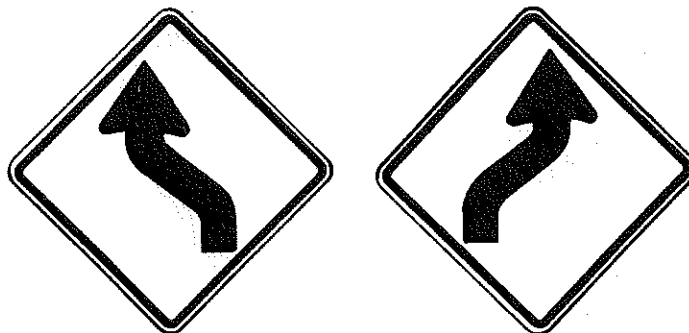
The Curve sign shall be used to denote changes in alignment where a ball bank indicator or Devil Level registers 10° or more at speeds between 30 and 60 miles per hour, and at such other locations where the change in alignment of the roadway is not apparent to the driver. Additional protection may be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

**REVERSE CURVE SIGN****Reflectorized**

W1-4-30 30" x 30"

W1-4-36 36" x 36"

W1-4-48 48" x 48"

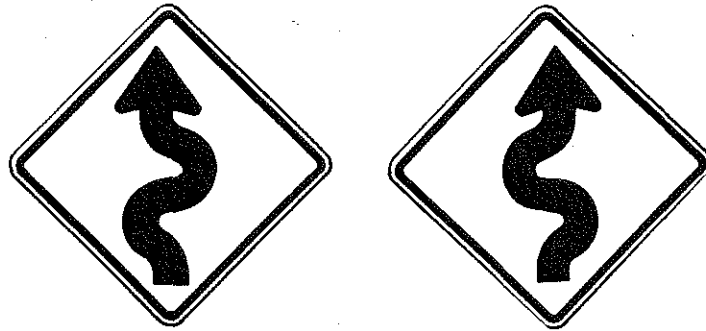
On all roads (except minor roads and streets, where in the judgment of the engineer the use of this sign is unnecessary) where two curves in opposite directions are separated by a tangent of less than 400 feet a Reverse Curve sign shall be used. Additional protection may be provided by use of the Curve Speed panel (W12-1). The speed indication displayed shall be that of the slower curve.

This sign shall be located in advance of the point of curvature of the first curve at the approximate distance indicated below:

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

For placement see figure 1-11.

### WINDING ROAD SIGN



Reflectorized

W1-5-30 30" x 30"

W1-5-36 36" x 36"

W1-5-48 48" x 48"

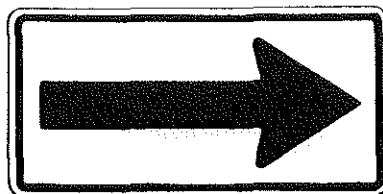
The Winding Road sign shall be used (except on minor roads and streets where in the judgment of the engineer the use of this sign is unnecessary) where there is a series of three or more turns or curves, separated by tangent distances of less than 400 feet. Where this sign is warranted, consideration should be given to the use of a target arrow (W1-6) in target position at each turn or curve. Additional protection may be provided by use of the Curve Speed panel (W12-1). The speed indication displayed shall be that of the slower turn or curve.

This sign shall be located in advance of the point of curvature of the first curve or turn at the approximate distance indicated below:

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

For placement see figure 1-11.

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**TARGET ARROW SIGN**

Reflectorized

W1-6-48 48" x 24"

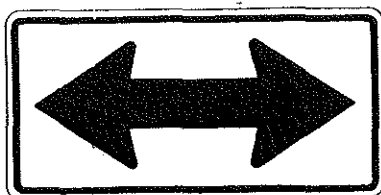
W1-6-96 96" x 48"

This sign may be used as a supplement to a Turn or Curve sign for potentially hazardous turns or curves. To increase its target value and to obscure misleading topography, the sign may be mounted on a Lattice Background (W12-10).

Where further emphasis of the required movement is desired, the W1-6-96 may be used in lieu of the unit consisting of the W1-6-48 and the W12-10.

This sign shall not be used to mark the ends of medians, centerpiers, etc., where there is no change in the direction of travel for all traffic. Further, it shall not be used as a route directional confirmatory marker or in any location where an intersecting street or highway of equal or nearly equal importance presents a choice of movement.

When used, the Target Arrow sign shall be erected in target position and, if possible, 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.

**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.

**NARROW BRIDGE SIGN**

Reflectorized

W5-2-30 30" x 30" (5" letters)

W5-2-36 36" x 36" (6" letters)

This sign shall be used in advance of a bridge structure which has a clear two-way roadway width of less than 19 feet but more than 17 feet.

Where used, it shall be located in advance of each end of the bridge at the approximate distance indicated below:

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

For placement see figure 1-11.

### CURVE SPEED PANEL



Reflectorized

W12-1-21 21" x 21" (10" and 3" letters)

W12-1-24 24" x 24" (12" and 3" letters)

The Curve Speed panel may be used as a supplement to the W1-1 through W1-5 signs only and shall display a speed legend in increments of five miles per hour. Since this legend is advisory, no Traffic Control Order is required. The W12-1-21 shall only be used with the appropriate 36 inch W1 sign and the W12-1-24 with the appropriate 48 inch W1 sign.

To determine the accurate negotiable speed on a turn or curve by the use of a ball bank indicator or Devil Level, several runs should be made in the same direction to obtain the most accurate reading possible. Readings obtained from several trial runs in the same direction shall determine the curve speed for that respective direction. Since the comfortable turn or curve speed on a specific turn or curve may vary, depending on direction of travel, the same procedure shall be used to obtain the curve speed for the opposite direction.

The following table indicates the speed to be used on the Curve Speed panel.

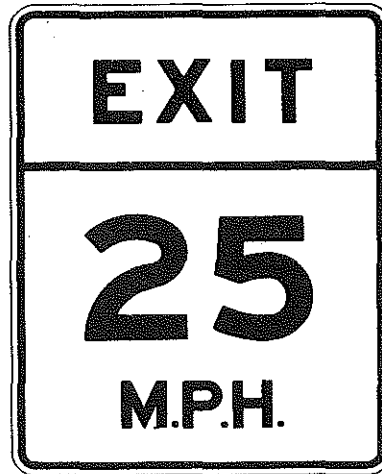
Indicator Reading	Speedometer Reading	Appropriate Panel Legend
10°	60, 59, or 58	60
10°	57, 56, 55, 54, or 53	55
10°	52, 51, 50, 49, or 48	50
10°	47, 46, 45, 44, or 43	45
10°	42, 41, 40, 39, or 38	40
10°	37, 36, 35, 34, or 33	35
12°	32, 31, 30, 29, or 28	30
12°	27, 26, 25, 24, or 23	25

Indicator Reading	Speedometer Reading	Appropriate Panel Legend
14°	22, 21, 20, 19, or 18	20
14°	17, 16, 15, 14, or 13	15
14°	12, 11, or 10	10

The speed legend displayed may equal but never exceed that of the posted speed limit in a Speed Control Zone.

For placement see figure 1-11.

#### EXIT \_\_\_\_ MILES PER HOUR SIGN



ReflectORIZED

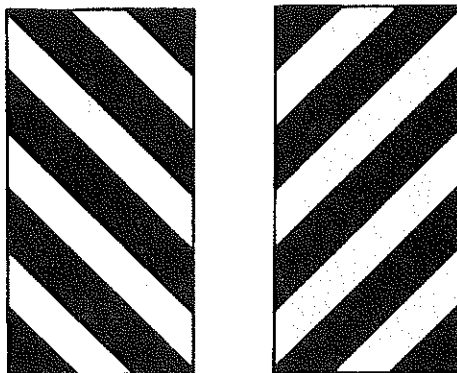
W12-2-48 48" x 60" (8", 16", and 6" letters)

This advisory sign shall be used only at ramps exiting from freeways where the safe speed of the first curve on the off-ramp, as determined by conditions at each individual location, is found to be less than 70 percent of the design speed for the freeway.

If a safe speed indication is required for a second curve on an off-ramp well beyond the gore, a curve sign with a curve speed panel should be used.

For placement see figure 1-35.



**OBSTRUCTION PANEL**

Reflectorized

W12-9-24 24" x 48"

The Obstruction Panel, having diagonal stripes pointing down and toward the roadway at 45 degrees, shall be used to delineate each side and both ends of a culvert, bridge railing, grade separation pier, and other obstruction facing approaching traffic under the following conditions: If the clear roadway over or under a structure is less than 19 feet wide, or, if culvert and bridge railings or vertical portions of an underpass are 4 feet or less from the pavement edge.

This sign shall be placed either on or one foot in advance of the obstruction at a bottom height of three feet. The inside edge of this sign shall be placed flush with the inside edge of the obstruction.

4. At congested locations, particularly on city streets, where the roadway will accommodate more lanes of traffic than would be the case without the use of lane lines. These include;
  - a. Locations between loading islands and sidewalk curbs.
  - b. Locations where the normal lane width is decreased.
  - c. Approaches to widened intersections.
5. On one-way streets or roadways where maximum efficiency in utilization of the roadways is desired.

Lane lines shall be broken white lines, not less than 4 nor more than 6 inches wide. Line segments may be 20 feet in length with 30-foot gaps or 15-foot segments separated by 25-foot gaps. The transverse spacing of lane lines, that is, the lane width, should not normally be less than 10 feet with 12 feet being the desirable width. In urban areas, a minimum of 9 feet is permissible where a maximum number of lanes must be made available, as at a signalized intersection where provision must be made for the most efficient storage of stopped vehicles.

On State trunklines no lane which is occupied by legally parked vehicles shall be marked with a lane line. When a lane line is located adjacent to parked vehicles on a curbed roadway, the distance from the face of curb to such lane line should be 24 feet (minimum 22 feet). The provisions of this paragraph are strongly recommended for other streets and highways.

#### **No Passing Zones**

No passing zones shall be established at vertical and horizontal curves and elsewhere on two and three lane highways where passing must be prohibited because of dangerously restricted sight distances or other hazardous conditions.

Under the Michigan Vehicle Code, the State Highway Commissioner and the County Road Commissions are authorized, after a traffic survey and engineering study, to determine those portions of any highway under their jurisdiction where overtaking and passing is especially hazardous and to indicate such locations by No Passing Zone signs and/or markings positioned in such manner that an ordinary observant driver will be able to observe the directions thereof and obey the same.

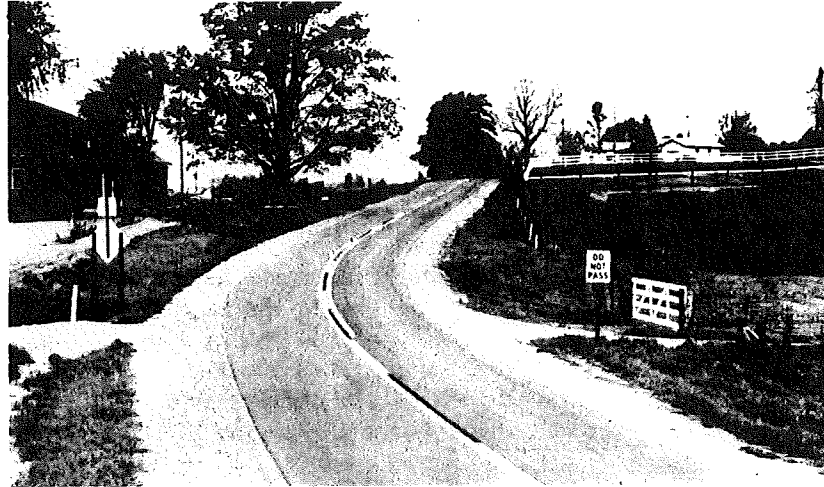


Figure 3-1. No passing zone markings.

On State trunkline highways no passing zones shall be established at all vertical and horizontal curve locations where the sight distance is less than 1000 feet. On other streets and highways no passing zones shall be established on the basis of the above criteria or where the sight distance becomes less than that indicated in the table below for a given speed:

85th Percentile Speed (m.p.h.)	Minimum Sight Distance (feet)
30	500
40	600
50	800
60	1000
65	1100

Where signs are used to denote a no passing zone, the "DO NOT PASS" (R3-17) shall be placed at the beginning of the zone and the "PASS WITH CARE" (R3-18) at the end of the zone. Where markings are used, they shall consist of a solid yellow barrier line placed to the right of a center line (lane line on three lane highways). The barrier line shall be not less than 4 nor more than 6 inches in width and shall be separated from the adjacent line by a space of not less than 3 nor more than 4 inches.

Although a no passing zone may be denoted by either the signs or the markings, it is strongly recommended that both be used for the following reasons:

1. Snow or dirt may cover the markings.
2. Certain conditions of precipitation, worn markings or the position of the sun may make it difficult to see markings.
3. Markings clearly outline the entire length of the no passing zone and signs denote the limits thereof.

No passing zones at successive vertical curves or successive vertical and horizontal curves shall be connected to form a continuous zone if the distance between the ending of one zone and the beginning of the next is less than 400'.

If the actual no-passing distance is less than 200' in length a no passing zone shall not be established. Where the actual no-passing distance is more than 200' but less than 500' in length the no passing zone shall be increased to 500' with the increase in length at the beginning. These distances shall not apply in the case of a no passing zone established because of construction or maintenance activity.

At those locations where a vertical and horizontal curve occur simultaneously, the length of the no passing zone shall be governed by either the vertical or horizontal curve, whichever has the shorter sight distance.

A method for locating and determining the limits of no passing zones at vertical and horizontal curves is shown by figure 3-2.

#### **Pavement Edge Lines**

Pavement edge lines have proven beneficial in reducing shoulder maintenance and in making driving more comfortable for the motorist, particularly at night and during inclement weather. Where used, they shall be solid white lines 4" in width, placed on the pavement adjacent to its edge.

Pavement edge lines may be used throughout sections of highway or at isolated locations, such as sections of winding road, horizontal curves, and approaches to intersections.