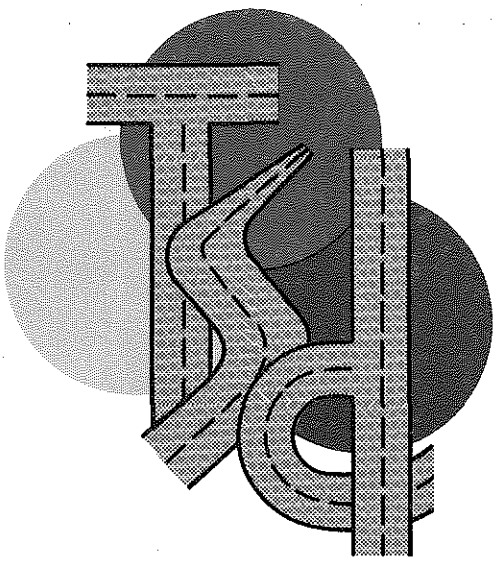
A TRAFFIC ACCIDENT ANALYSIS OF HIGH ACCIDENT LOCATIONS IN OSCEOLA COUNTY

Report TSD-SS-137-70



TRAFFIC and SAFETY DIVISION

DEPARTMENT OF STATE HIGHWAYS
STATE OF MICHIGAN

A TRAFFIC ACCIDENT ANALYSIS OF HIGH ACCIDENT LOCATIONS IN OSCEOLA COUNTY

Report TSD-SS-137-70

by

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STUDY CONDUCTED BY THE

Safety & Surveillance Section
Traffic & Safety Division
Bureau of Operations
Michigan Department of State Highways

in cooperation with

National Highway Safety Bureau
Department of Transportation

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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 accidents and potential 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 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 Executive Office of the Governor 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 engineering corrections to those conditions which may be contributing to accidents.

SCOPE

As highway engineers, we have very little influence on changing or correcting the motorist's ability to drive (driver education, experience and enforcement) or for the condition of the vehicle (manufacturer's design and owner responsibility). We do have, however, the responsibility to construct, operate and maintain the roadway environment within feasible economic and design limits so that the driver and vehicle can function safely within the environment.

The intent of the "Traffic Accident Analysis for Cities and Counties" program is to improve traffic safety on all Michigan streets and roads by expanding the traffic engineering evaluation of factors causing accidents. This is accomplished by conducting a traffic accident analysis of locations which experience high accident frequencies and then 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, a traffic engineering analysis of accidents, technical evaluation of previously compiled facts and consequent recommendations for improvements.

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 Osceola County (and providing an inventory of those locations) was designated as State Police responsibility. Because of the lack of a modern or automatic system of locating accidents on the county road system, the high accident locations for Osceola County were determined by manually extracting and compiling those locations with the highest number of accidents from the 1968 county accident reports. The year 1968 was considered the base year for our study. From this list, the 12 highest accident locations 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 Osceola County.

The second portion of the data collection phase, which is the responsibility of the Department of State Highways, involves preparation of collision diagrams and, if necessary, physical condition diagrams and traffic counts for selected locations.

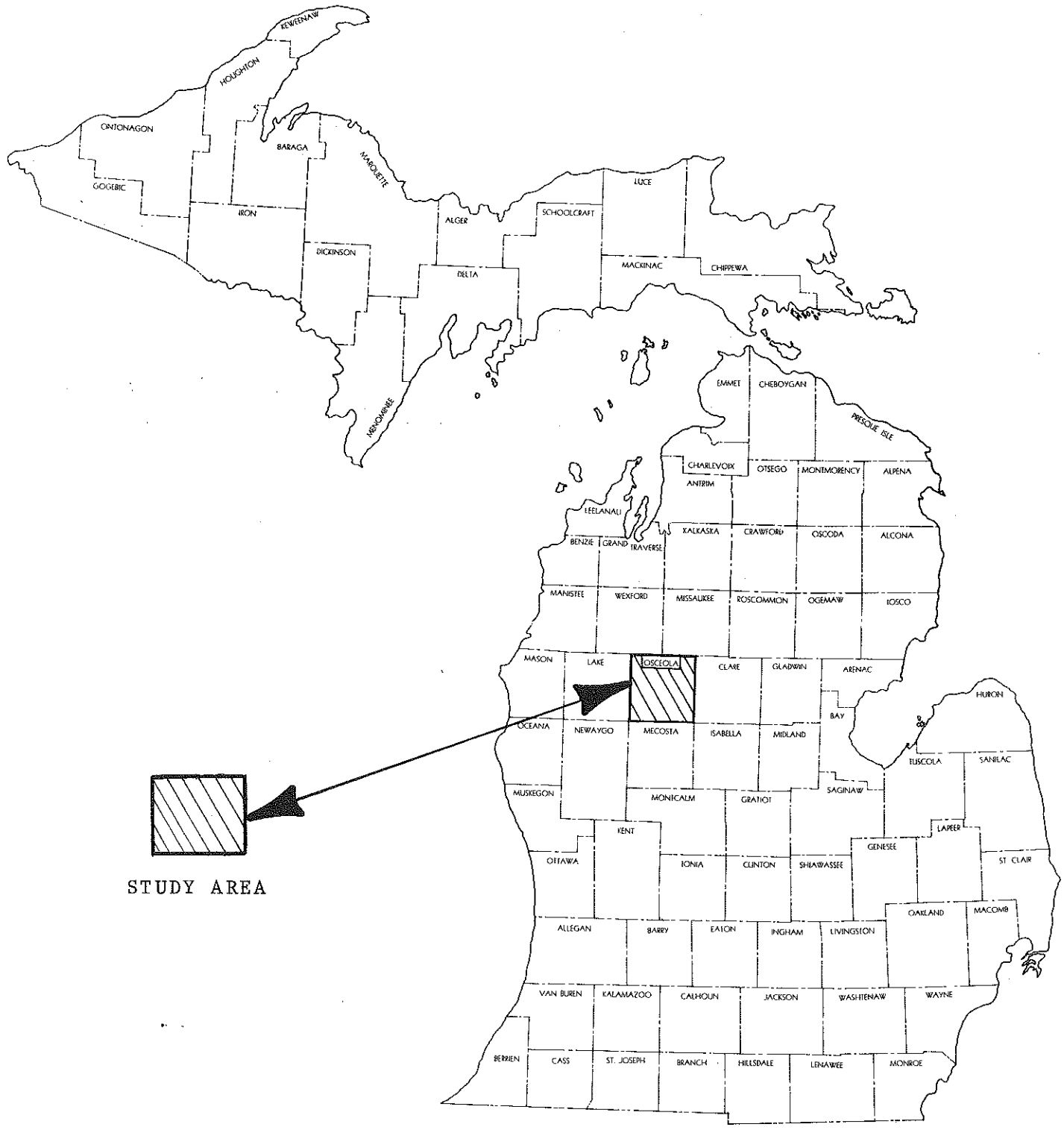
The accident analysis and traffic engineering evaluation phases involve the detailed analysis of the summarized facts and field data and prescribing the proper corrective treatment.

STUDY AREA

Osceola County is located in Michigan's Lower Peninsula in the area designated as the Central High Plains (see map following page). Osceola County is divided into 16 townships with an inland lake area of four square miles and a total area of 581 square miles. It is bordered on the north by Wexford and Missaukee Counties, on the east by Clare County, on the west by Lake County and on the south by Mecosta County.

Population of the County in 1960 was 13,595 with 30% of the total population concentrated in Reed City and Evart. The population projection of the County for the next 30 years indicates an expected average increase lower than the statewide average (see Table I, Appendix I, p. 47). This represents the trend in the rural counties where people are moving to large urban centers. From 1940 to 1960 the population increased only 2.1% while the population projection indicates an increase of 18% over the period 1960 to 1990.

The last century lumber rush brought railways and roads and provided the region with reliable communication and transportation means. The County is agriculturally oriented and there is some commercial production of lumber. However, from 1950 to 1964 there has been a decrease in the number of farms and the percent of land


KEWEENAW
HOUGHTON
ONTONAGON
BARAGA
MARQUETTE
GOGEBIC
IRON
ALGER
SCHOOLCRAFT
LUCE
DICKINSON
DELTA
MACKINAC
CHIPPEWA
MENOMINEE
EMMET
CHEBOYGAN
PRESQUE ISLE
CHARLEVOIX
OTSEGO
MONTMORENCY
ALPENA
ANTRIM
LEELANAU
KALKASKA
CRAWFORD
OSCODA
ALCONA
BENZIE
GRAND TRAVERSE
MANISTEE
WEXFORD
MISSAUKEE
ROSCOMMON
OGEMAW
IOSCO
MASON
LAKE
OSCEOLA
CLARE
GLADWIN
ARENAC
HURON
BAY
OCEANA
NEWAYGO
MECOSTA
ISABELLA
MIDLAND
IOSCOLA
SANILAC
MUSKEGON
MONTCALM
GRATIOT
SAGINAW
KENT
LAPEER
GENESEE
OTTAWA
IONIA
CLINTON
SHIAWASSEE
ST. CLAIR
OAKLAND
MACOMB
ALLEGAN
BARRY
EATON
INGHAM
LIVINGSTON
VAN BUREN
KALAMAZOO
CALHOUN
JACKSON
WASHTENAW
WAYNE
BERRIEN
CASS
ST. JOSEPH
BRANCH
HILLSDALE
LENAWEE
MONROE
STUDY AREA

MAP 1

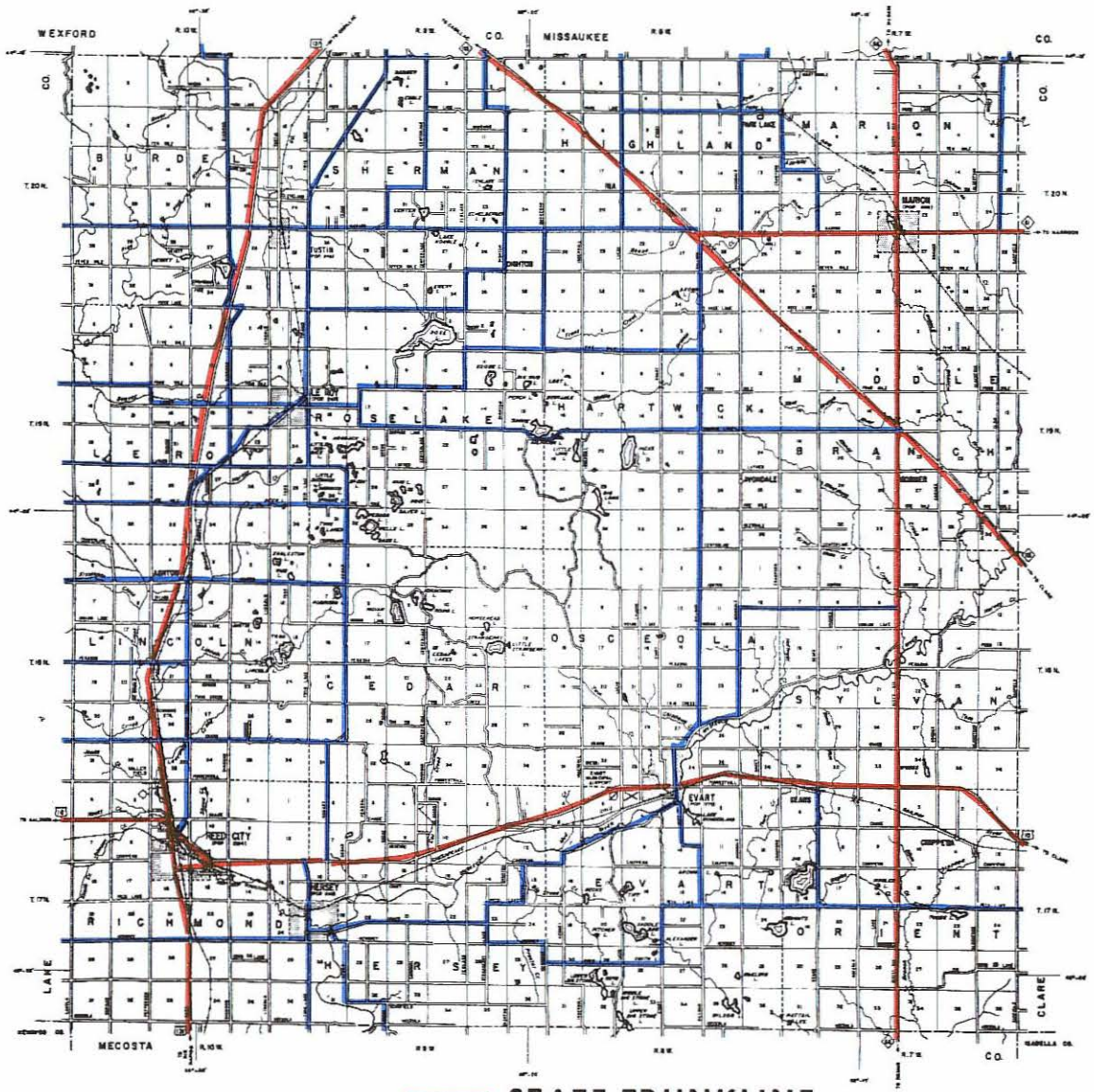
area in farms has decreased from 65.5% to 47.0%. Osceola County is also important in the production of petroleum, natural gas, sand and gravel.

The employed labor force of Osceola County was 4,472 in 1960 with small manufacturing, agriculture and forestry accounting for 45% of the total employment. The large majority of Osceola residents are employed within the County (82.63% as shown on Table II, Appendix I, p. 48). The County's economic development depends to a great extent on a safe, efficient and reliable transportation system.

According to the Eighteenth Annual Progress Report, as compiled by the Local Government Division of the Michigan Department of State Highways, Osceola County has 1,039.87 miles of highways excluding city and incorporated village streets and roads. This includes 96.52 miles of state trunkline, 227.27 miles of county primary and 715.98 miles of local roads. Of the 943.35 miles of county roads, 170.50 miles are hard surfaced and the remaining mileage is either gravel, graded and drained earth or unimproved road (see County map following page).

Traffic congestion is not a significant problem in Osceola County. An implied indication of this fact is that the population density is 23.4 person per square mile in Osceola County versus 137.2 person per square mile in the State of Michigan.

MAP 2



STATE TRUNKLINE

COUNTY PRIMARY

COUNTY LOCAL

OSCEOLA COUNTY

MICHIGAN

STATE HIGHWAY COMMISSION

DEPARTMENT OF STATE HIGHWAYS

DATA OBTAINED FROM

HIGHWAY PLANNING SURVEY

CONDUCTED IN COOPERATION WITH

U.S. DEPARTMENT OF TRANSPORTATION

FEDERAL HIGHWAY ADMINISTRATION

BUREAU OF PUBLIC ROADS

1" = 2.75 MILES

8

The yearly totals of traffic accidents are also fairly constant for the County roads between 1966 and 1969, with the exception of 1968 (see Table III, Appendix I, p. 49).

GLOSSARY

The term "Manual" when used in this report will refer to the "Michigan Manual of Uniform Traffic Control Devices"; publication prepared by the Michigan Department of State Highways in conjunction with the Michigan State Police.

Excerpts of the Manual are included in Appendix II.

TRAFFIC ENGINEERING ANALYSIS

Compared to the millions of vehicle miles traveled, accidents are very rare events. However, they are the only present means available to indicate a failure in the driver-road-vehicle environment. Any of these three may be a major contributor to an accident.

In our analysis, we examined the contributing factors from the viewpoint of a highway traffic engineer with special attention to the effect which the highway environment may have had on the accident. At each high accident location, individual accident reports were reviewed in detail and the accident facts were tabulated and grouped in various tables. It was apparent that no unusually high concentration of accidents existed at any one location. In fact, the highest total at one location for the four-year study period was 11 accidents.

The first step in the traffic engineering analysis phase of Osceola County's high accident locations was the preparation of collision diagrams. At each location accidents were grouped in order to locate the accident in relation to the intersection, approaches to the intersection or section of roadway. The various methods of accident analysis are intended to probe into the detailed aspects of the accidents to determine the reasons for their occurrence.

To further document the various facts present at the 12 high accident locations in Osceola County, the following tables were prepared to analyze the specific data.

IV. Annual Accident Summary

V. Monthly and Daily Accident Occurence

VI. Daily and Hourly Accident Occurrence

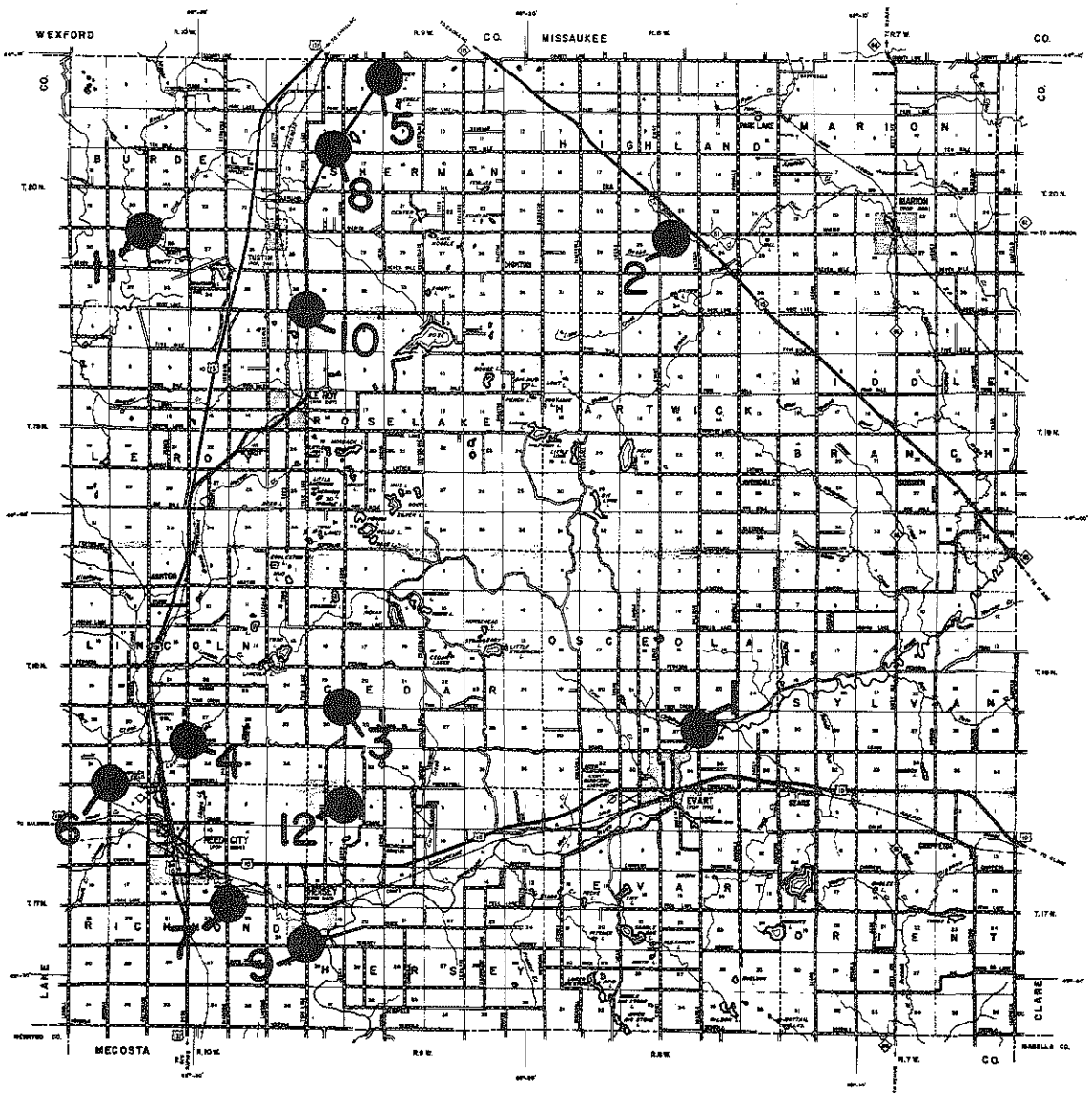
VII. Age of Drivers Involved in Accidents

VIII. Residence of Drivers Involved in Accidents

IX. Weather Conditions at Scene of Accidents

X. Pavement Conditions at Scene of Accidents

This report will discuss in detail only the locations for which recommendations are made. Collision diagrams and photographs for each of these will be found on the page following the discussion. The collision diagram and photographs for the remaining locations are found in Appendix I (see following page for map showing the 12 locations within the County).



LEGEND

ROADS

UNIMPROVED ROAD
GRADED AND DRAINED ROAD
SOIL SURFACED ROAD
GRAVEL OR SIMILAR ROAD
STONE OR SLAG SURFACED ROAD
PAVED ROAD
DIVIDED HIGHWAY
DIVIDED HIGHWAY WITH FRONTAGE ROAD

ROAD SYSTEM DESIGNATION

INTERSTATE HIGHWAY
UNITED STATES HIGHWAY
STATE HIGHWAY
BUSINESS LOOP
BUSINESS ROUTE
BUSINESS SPUR

AIRPORTS

MILITARY FIELD (SOME FACILITIES AVAILABLE)
AIRPORT, COMPLETE FACILITIES (COMMERCIAL OR MUNICIPAL)
AIRFIELD, LIMITED FACILITIES
LANDING AREA OR STRIP (INCLUDES PRIVATE AIRFIELDS)

RAILROADS

RAILROAD (ANY NUMBER TRACKS) USED BY SINGLE OPERATING COMPANY
RAILROAD (ANY NUMBER TRACKS) USED BY MORE THAN ONE OPERATING COMPANY ON SAME OR ADJACENT RIGHTS OF WAY (NO TRACKAGE RIGHTS)
RAILROAD STATION
RAILROAD ABOVE ROAD
RAILROAD BELOW ROAD
RAILROAD TUNNEL

HIGHWAY BRIDGES

GENERAL DRAWBRIDGE
GENERAL CONCRETE
SUSPENSION
ARCH
TRUSS OR GIRDER
HIGHWAY GRADE SEPARATION
INTERCHANGE SHOWING RAMPS

DRAINAGE

NARROW STREAM
WIDE STREAM (OVER 200 FT.)

NAVIGATION

FREE FERRY
TOLL FERRY

DAMS

DAM WITH ROAD
DAM WITHOUT ROAD

BOUNDARIES

NATIONAL BOUNDARY
STATE BOUNDARY
COUNTY BOUNDARY
CIVIL TOWNSHIP BOUNDARY
CONGRESSIONAL (U.S. LAND) TOWNSHIP BOUNDARY
SECTION LINE

CITY AND VILLAGE

STATE CAPITAL
COUNTY SEAT
UNINCORPORATED COMMUNITIES
INCORPORATED CITY OR VILLAGE

KEY TO COUNTIES

HIGH ACCIDENT LOCATION SPOT MAP

MAP 3

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

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DATA OBTAINED FROM
HIGHWAY PLANNING SURVEY
CONDUCTED IN COOPERATION WITH
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS

1" = 2.75 MILES
POLYCONIC PROJECTION

1. Dillman Road @ River Road, Osceola Township

This is a "Y" type intersection of two county primary roads. Dillman Road merges with River Road. The major through traffic movements are from the southwest to the north and from the north to the southwest. The existing traffic controls present are a 24 in. stop sign on westbound River Road and two 24 in. curve signs on eastbound River Road and southbound Dillman Road.

Dillman Road and the paved portion of River Road are 22 ft bituminous with five foot shoulders. There are no center line markings in the vicinity of the intersection.

There were a total of eleven accidents at this intersection over the four years studied. Nine of these accidents were ran-off the roadway type and nine occurred at night (see Figures 1, 1A and 1B following the recommendations).

It is apparent that the sharpness of the existing curve and the lack of warning speed panels were contributing factors to the occurrence of the majority of accidents. Although the accident experience does not justify major reconstruction (as easing the curve) we should recognize this possibility as the ultimate solution to the problem. However, this possibility could be considered in the County's long range program.

Recommendations:

We recommend that the curve signs (W1-2-24, Appendix

II, or p. 82 of Manual) be replaced by 30 in. turn signs. We also recommend that a W1-7-48 bi-directional target arrow be placed in target position for southbound Dillman Road and that a W1-6-48 target arrow be erected for traffic from the west leg of River Road to northbound Dillman Road.

We further recommend that all turn signs be supplemented with 30 mph advisory curve speed panels. This speed panel value was determined by using a devil level indicator and the criteria outlined in Appendix II, p. 75. The following averages were obtained during field investigation.

	MPH	Devil Level Readings
Northbound	25	10°
	28	12°
	35	20°
Southbound	25	10°
	28	12°
	35	18°

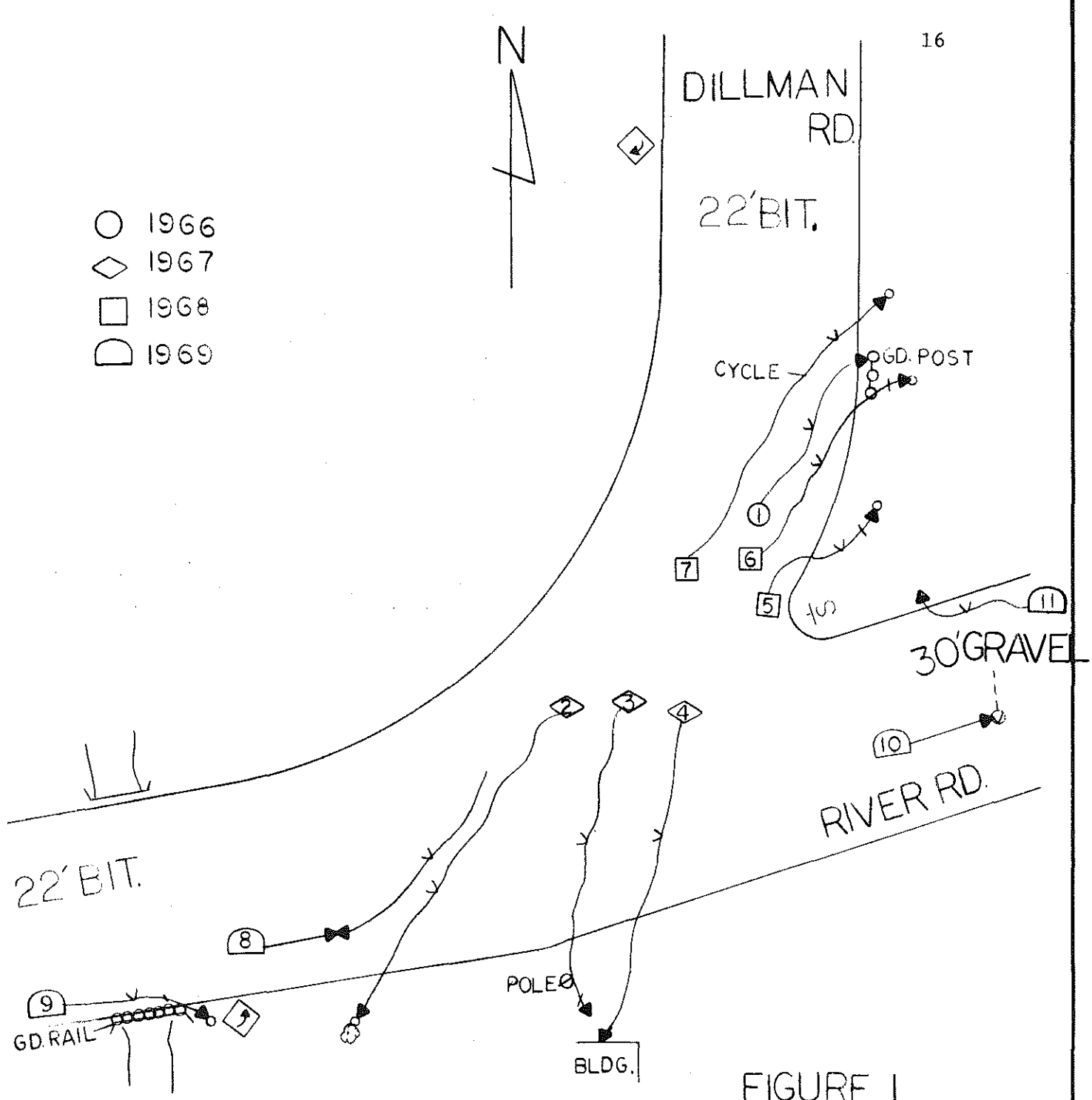


FIGURE 1

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

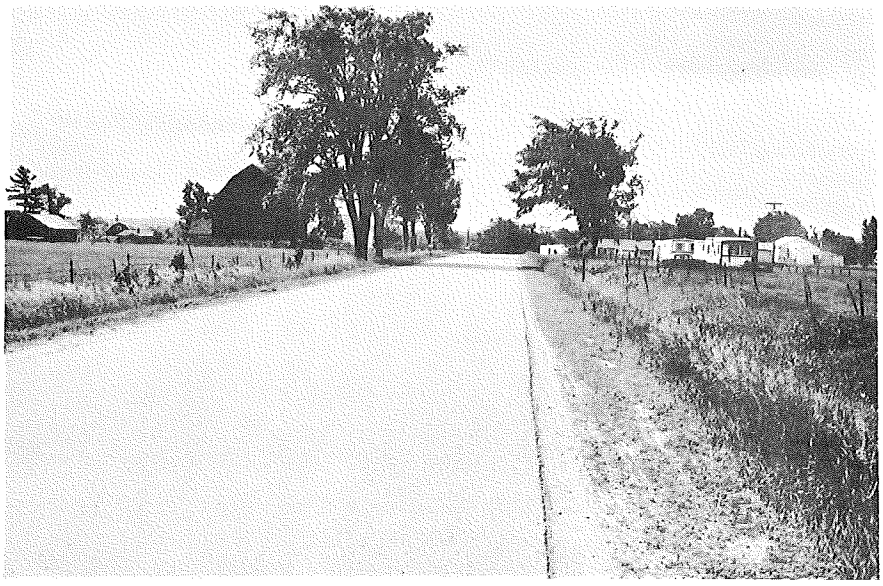
Stop & Go Signal — S — R — Y — F — Y
Flashing Beacon
Stop Sign — S
Yield Sign — Y

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

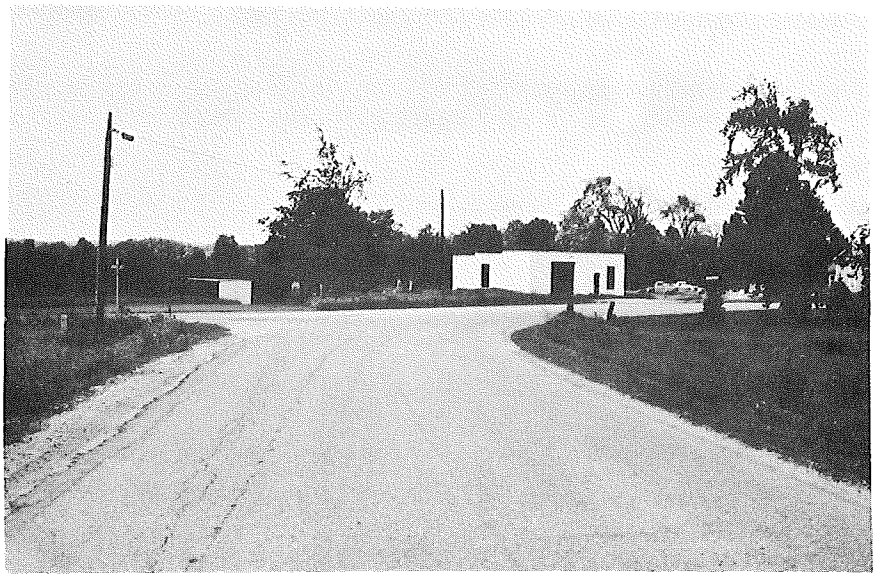
ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969
OSCEOLA CO. Description OSCEOLA TWP

Accidents – Total 11
P.D. 7 Injury 4 (5)
Fatal 0 ( )
Acc. Rate/mv
Acc. Rate/mvm
C.S. Miles
Drawn DVW Date 6 - 8 - 70 Rev.
Plan No. LOCATION #1



SOUTHBOUND DILLMAN ROAD



SOUTHBOUND DILLMAN ROAD

FIGURE 1A

EASTBOUND

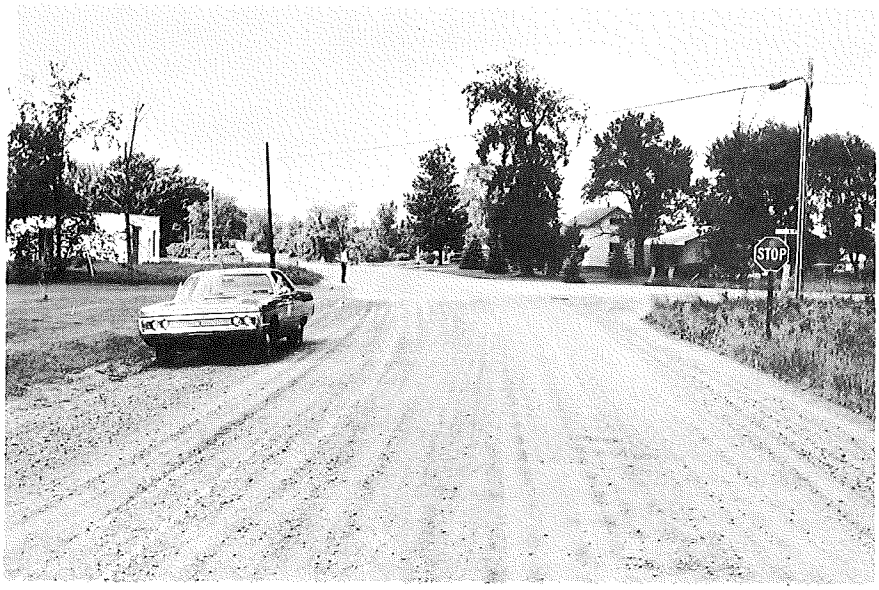
RIVER ROAD

APPROACHING THE CURVE

EASTBOUND

RIVER ROAD

AT THE CURVE



WESTBOUND

RIVER ROAD

FIGURE 1B

2. Marion Road, 0.8 mile west of M-115, Highland Township

This section of Marion Road is gently rolling and on tangent. Marion Road is a 20 ft bituminous road with 6 foot shoulders and center line markings. There were six accidents at this location and all of them were caused by deer (see Figures 2 and 2A).

Recommendation:

We suggest that consideration be given to the erection of warning signs for deer crossing area (W12-8-36, Appendix II, p. 76) at this location for eastbound and westbound traffic. As required by the Manual, a joint investigation must be made by representatives of the Michigan Department of Conservation and the agency having jurisdiction over the highway before this sign is installed.

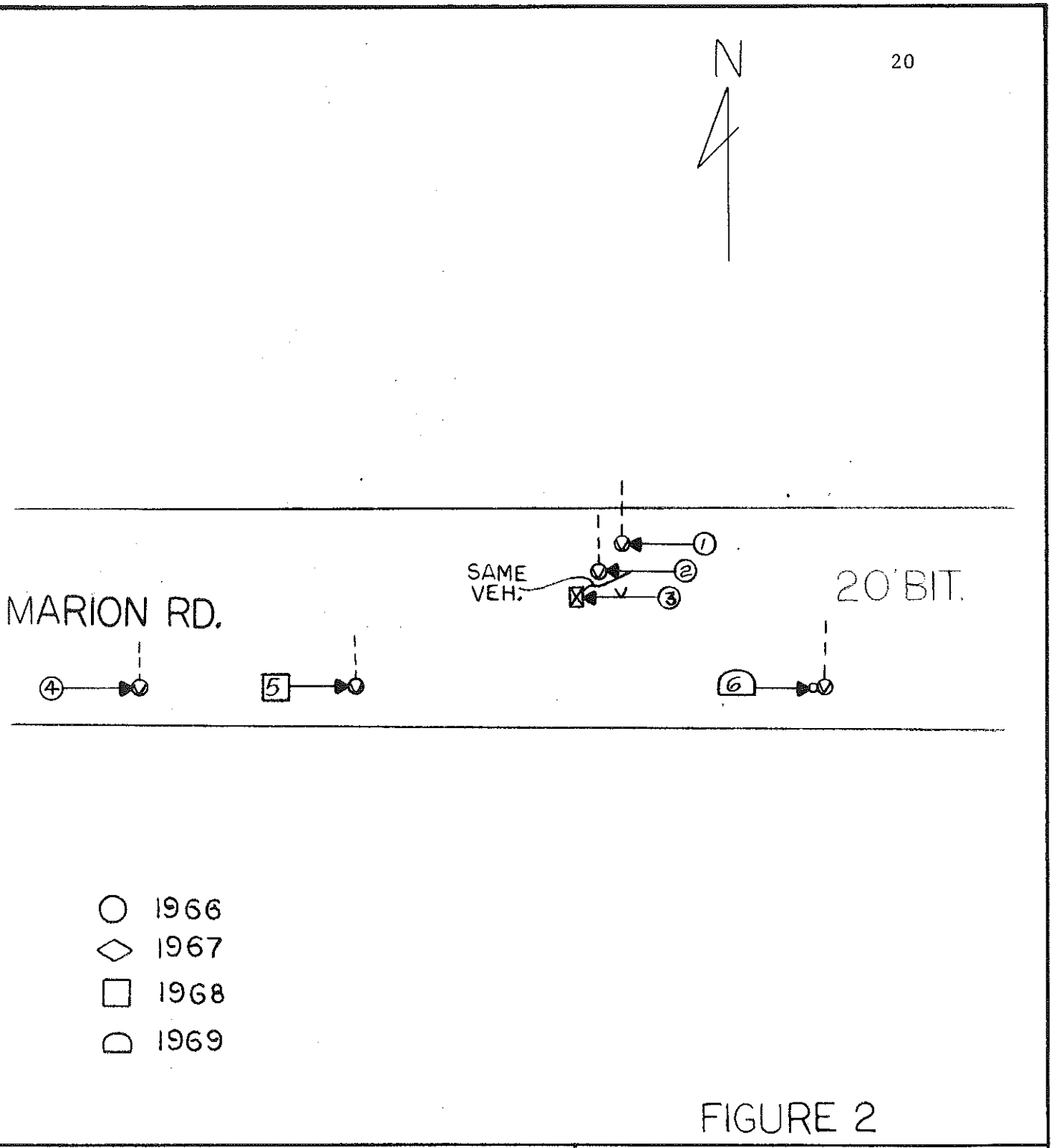


FIGURE 2

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

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

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969

OSCEOLA CO. Description HIGHLAND TWP.

0.8 MI. WEST OF M-115

Accidents – Total 6 (1)

P.D. 5 Injury 1

Fatal 0 ( )

Acc. Rate/mv

Acc. Rate/mvm

C.S. Miles

Drawn D.J.M. Date 6-9-70 Rev.

Plan No. LOCATION #2

EASTBOUND

MARION ROAD

WESTBOUND

MARION ROAD

FIGURE 2A

3. Cedar Road @ Twin Creek Road, Cedar Township

Twin Creek Road is a narrow earth road forming almost a "T" intersection with Cedar Road (see Figures 3, 3A and 3B following the recommendations). Traffic controls are a 24 in. stop sign on Twin Creek Road and two 24 in. curve signs on Cedar Road.

Cedar Road is a 20 ft bituminous road with lightly patched edges and four to six foot shoulders. Centerline markings and yellow no passing lines are present throughout the accident location.

There were a total of four accidents at this location during the period 1966 through 1969, and they were all due to the failure of the drivers involved to negotiate the curves. No accidents were reported for Twin Creek Road traffic. The geometrics of the intersection are not considered critical and the amount of traffic is extremely low on Twin Creek Road. Therefore, no pictures are included for Twin Creek Road (see Figures 3A and 3B, pps. 25 and 26 for Cedar Road pictures).

Recommendations:

We recommend that the existing reverse curve signs be replaced by winding road signs (W1-5-30, Appendix II, p. 71 or p. 87 of Manual) to denote the series of curves. Furthermore, we recommend that the winding road signs be supplemented with 30 mph advisory curve speed panels.

The appropriate speed was determined by using a devil level indicator and the criteria outlined in Appendix II, p. 75. The following averages were obtained during field investigation.

		Devil Level Readings		
	MPH	1st Curve	2nd Curve	3rd Curve
Northbound	30	8°	10°	10°
	35	12°	14°	12°
	40	18°	18°	18°
Southbound	30	10°	10°	10°
	35	12°	12°	12°
	40	16°	18°	18°

The first curve southbound corresponds to curve number three northbound, but in both cases the appropriate speed legend recommended is 30 mph.

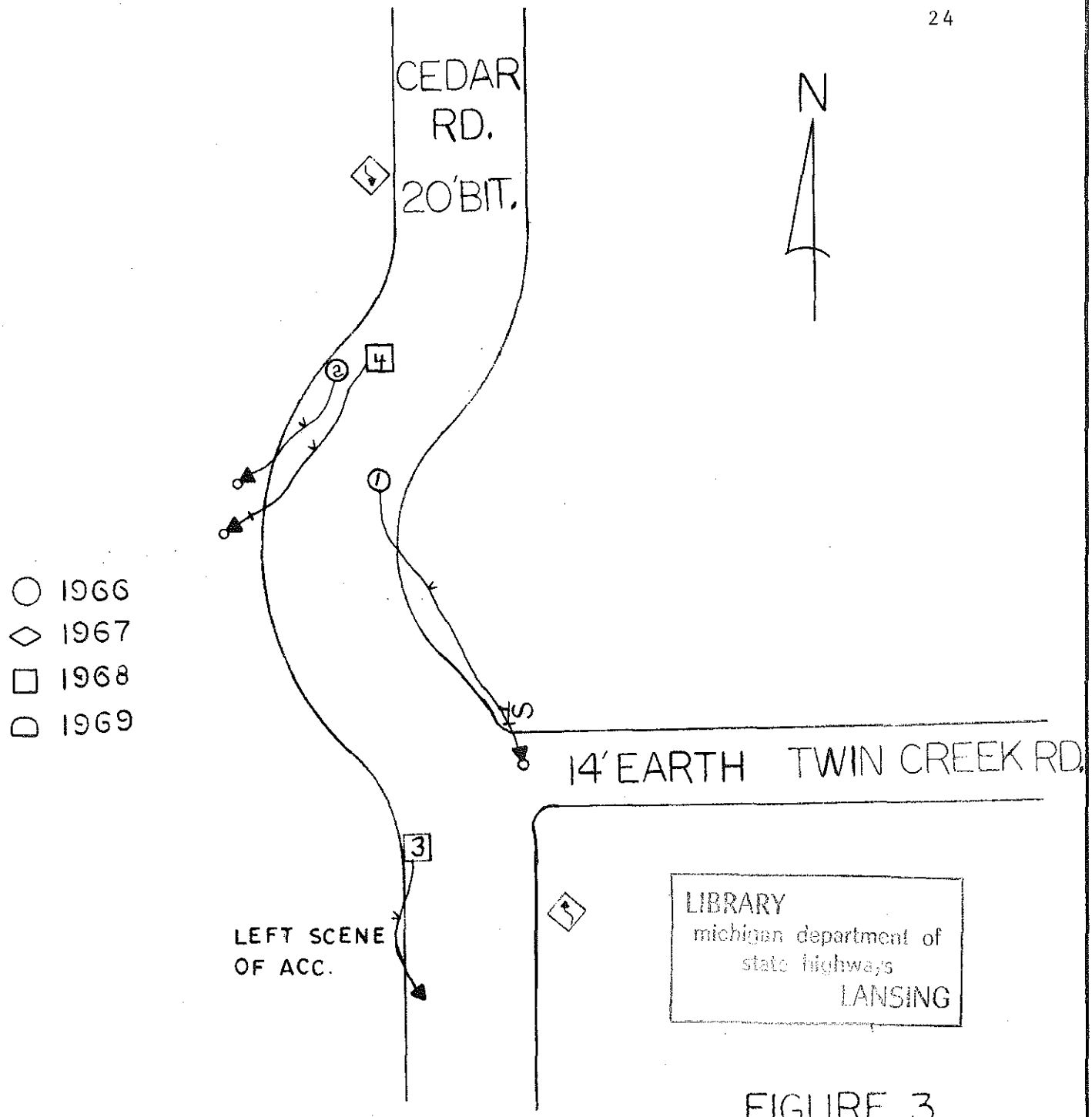


FIGURE 3

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

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

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

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969
OSCEOLA CO. Description CEDAR TWP.

Accidents – Total 4 (4)
P.D. 1 Injury 3
Fatal 0 ( )
Acc. Rate/mv
Acc. Rate/mvm
C.S. Miles
Drawn D J M Date 6 30 70 Rev.
Plan No. LOCATION #3

NORTHBOUND
CEDAR ROAD
APPROACHING THE CURVES

NORTHBOUND
CEDAR ROAD
AT TWIN CREEK

NORTHBOUND
CEDAR ROAD
AT THE CURVE

FIGURE 3A

SOUTHBOUND

CEDAR ROAD

APPROACHING THE CURVE

SOUTHBOUND

CEDAR ROAD

APPROACHING THE CURVE

SOUTHBOUND

CEDAR ROAD

AT THE CURVE

FIGURE 3B

4. Mackinaw Trail @ Grand Road, Lincoln Township (see Appendix I, pps. 55 and 56)

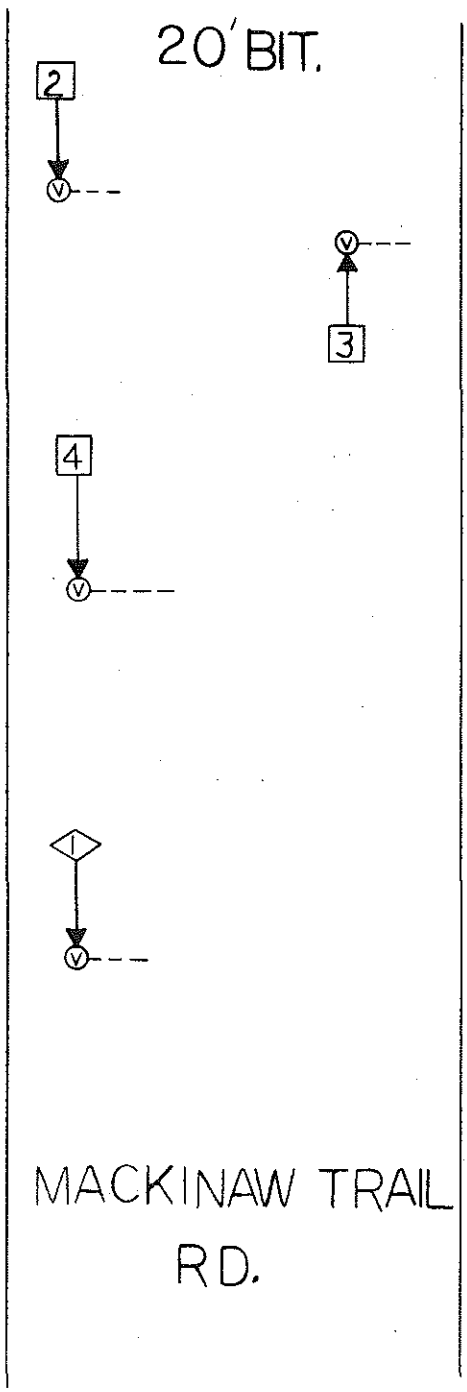
Total	P.D.	Inj.	Fat.
4	2	2	0

5. Mackinaw Trail, 0.1 to 0.2 mile south of County Line, Sherman Township

Throughout the location, Mackinaw Trail is gently rolling and on tangent. The roadway is 20 ft wide with bituminous surface and ten foot shoulders. There were four accidents at this location during the study period 1966 through 1969 and all of them were car-deer accidents (see Figures 5 and 5A following the recommendation).

Recommendation:

We suggest that consideration be given to the erection of warning signs for deer crossing area (W12-8-36, Appendix II, p. 76) at this location for north and southbound traffic. As required by the Manual, a joint investigation must be made by representatives of the Michigan Department of Conservation and the agency having jurisdiction over the highway before this sign is installed.



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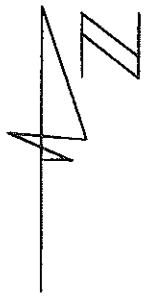


1966
1967
1968
1969

FIGURE 5

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

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

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

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969
OSCEOLA CO. Description SHERMAN TWP
MACKINAL TRAIL 0.1 TO 0.2 MILE SOUTH OF
COUNTY LINE RD.
Accidents – Total 4 ( )
P.D. 4 Injury 0
Fatal 0 ( )
Acc. Rate/mv
Acc. Rate/mvm
C.S. Miles
Drawn DVW Date 6-10-70 Rev.
Plan No. LOCATION #5

NORTHBOUND MACKINAW TRAIL

SOUTHBOUND MACKINAW TRAIL

FIGURE 5A

6. Norman Road @ Forest Hill Road, Lincoln Township

Norman Road is 20 ft bituminous with five foot shoulders and center line markings. It intersects Forest Hill Road at right angles. Forest Hill Road is a gravel road in good condition.

The existing traffic controls are two 24 in. yield signs on Forest Hill Road. There were only two intersectional accidents at this location over the period studied. However, there is a visibility problem at this intersection caused by two garages in the northeast and northwest quadrants (see Figures 6 and 6A following the recommendation). All the traffic on Forest Hill Road has to come to a complete stop before safely entering the intersection.

Recommendation:

We recommend that the existing yield signs be replaced by stop signs.

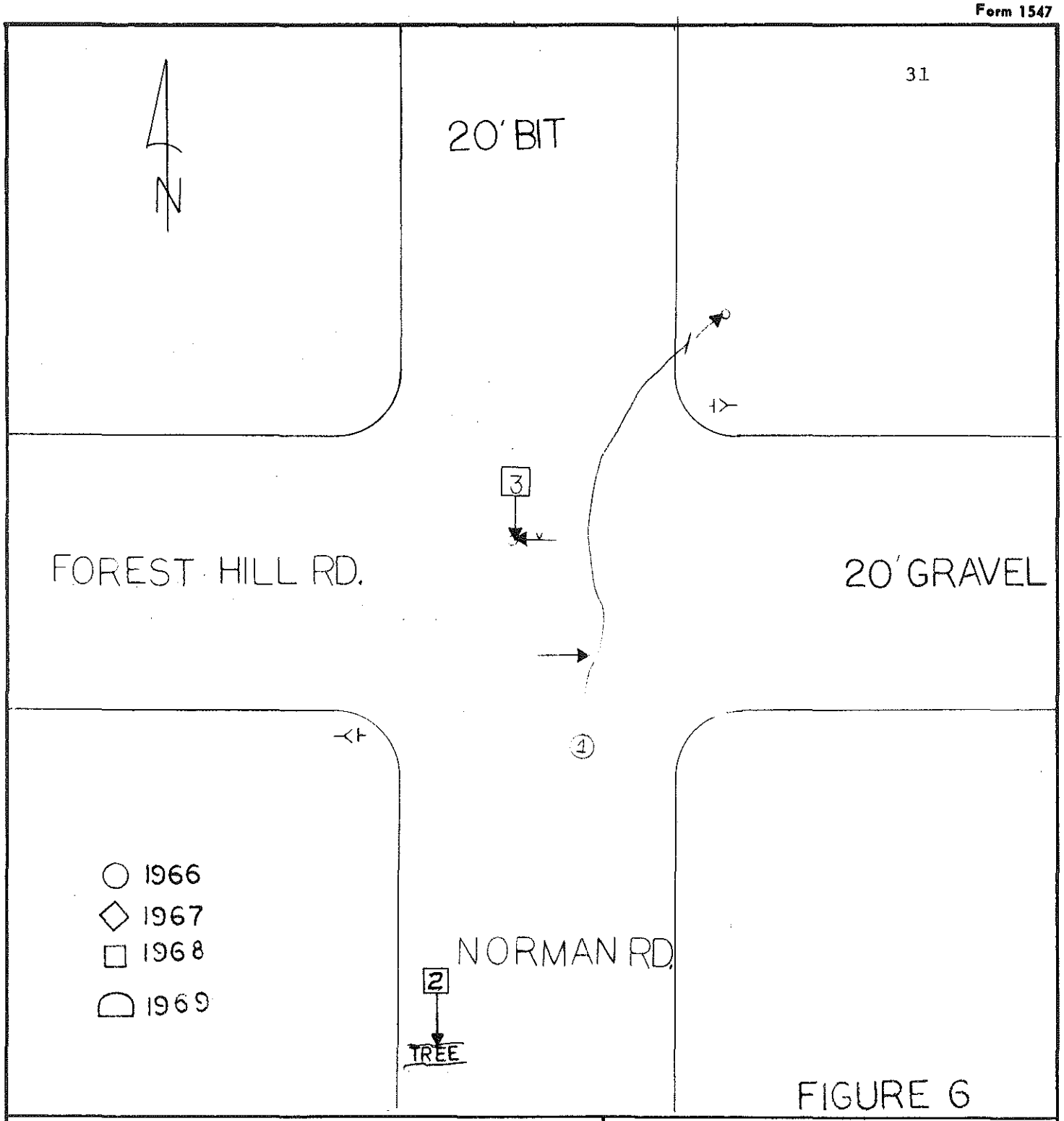


FIGURE 6

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

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

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

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969
OSCEOLA CO. Description LINCOLN TWP.

Accidents – Total 3
P.D. 1 Injury 2 (2)
Fatal 0 ( )
Acc. Rate/mv
Acc. Rate/mvm
C.S. Miles
Drawn DJM Date 6-15-70 Rev.
Plan No. LOCATION #6

EASTBOUND

FOREST HILL ROAD

NORTHBOUND

NORMAN ROAD

WESTBOUND

FOREST HILL ROAD

FIGURE 6A

7. Diamond Road @ Peck Lake Road, Richmond Township, (see Appendix I, pps. 57 and 58)

Total	P.D.	Inj.	Fat.
3	1	2	0

8. Mackinaw Trail @ 10 Mile Road, Sherman Township, (see Appendix I, pps. 59 and 60)

Total	P.D.	Inj.	Fat.
3	1	2	0

9. Twin Lake Road @ Hersey Road, Richmond Township, (see Appendix I, pps. 61 and 62)

Total	P.D.	Inj.	Fat.
2	1	1	0

10. Mackinaw Trail @ Rose Lake Road, Rose Lake and Burdell Townships

Mackinaw Trail (Old US-131) is a 20 ft wide bituminous roadway with five foot shoulders and center line markings. It intersects Rose Lake Road at right angles (see Figures 10 and 10A). The west portion of Rose Lake Road is a gravel road. The east portion is 20 ft wide bituminous with six foot shoulders and center line markings.

Existing traffic controls are two 36 in. stop ahead signs and two 36 in. stop signs on Rose Lake Road. There is also a 36 in. crossroad warning sign on southbound Mackinaw Trail.

It is difficult to see the intersection from the north approach. This difficulty led to the erection of the crossroad warning sign. However, at the time the field study was made, large tree branches were completely covering the crossroad sign. Some tree trimming is necessary to restore visibility of the warning sign at this location.

Recommendation:

Although there are no reported accidents indicating violation of the stop sign on westbound Rose Lake Road, we recommend that the stop ahead sign be replaced by a new sign, since the existing one is in poor condition and has lost its reflectivity.

Form 1547

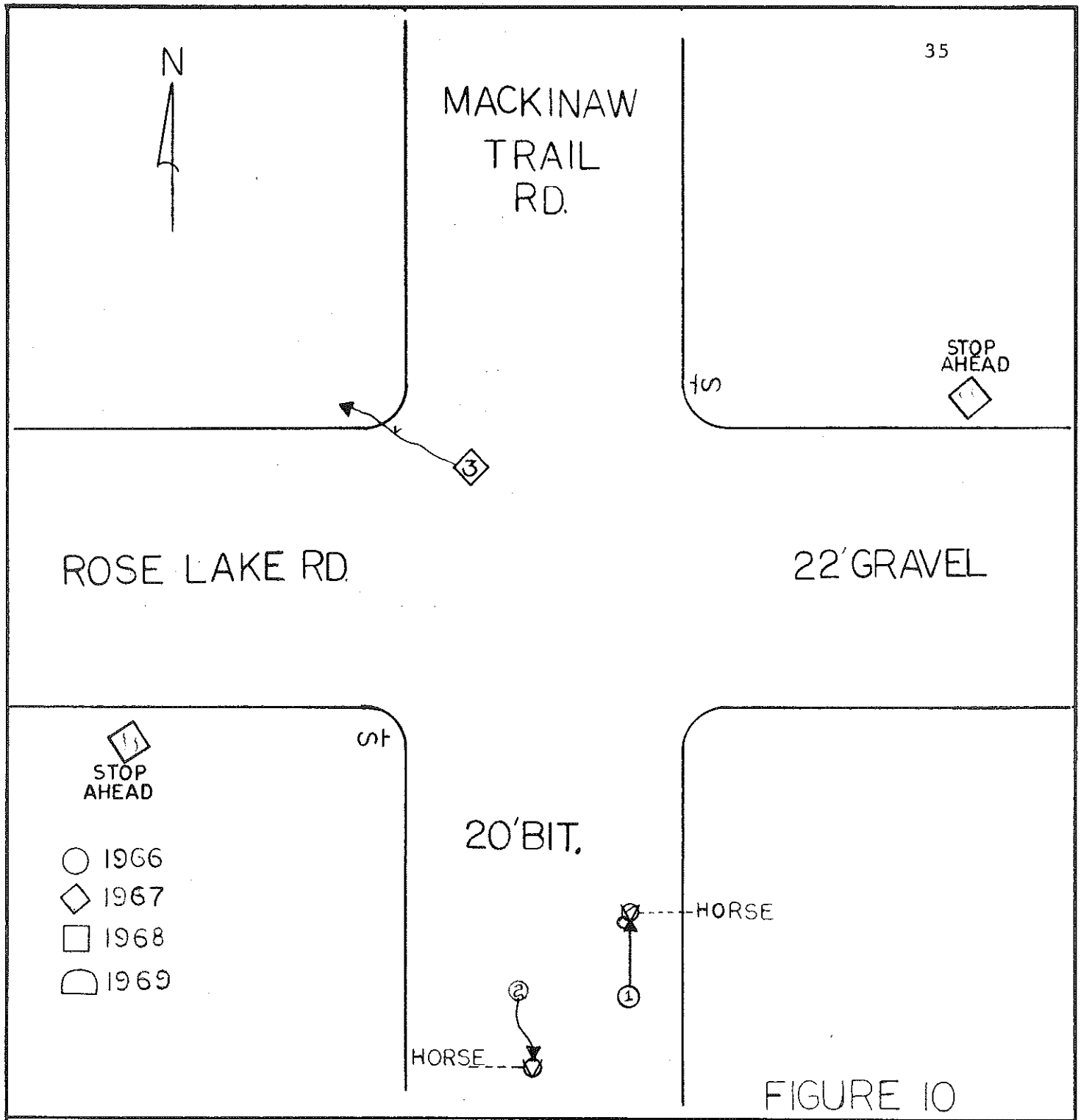


FIGURE 10

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

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

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

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969
OSCEOLA CO. Description BURDELL TWP

Accidents – Total 3 (1)
P.D. 2 Injury
Fatal 0 ( )
Acc. Rate/mv
Acc. Rate/mvm

C.S. Miles
Drawn DJM Date 6-16-70 Rev.
Plan No. LOCATION #10

EASTBOUND

ROSE LAKE ROAD

SOUTHBOUND

MACKINAW TRAIL ROAD

WESTBOUND

ROSE LAKE ROAD

FIGURE 10A

11. Marion Road, 0.1 mile west of Patterson Road, Burdell Township

Marion Road is 20 ft wide bituminous throughout this location with two foot to five foot shoulders and center line markings. The location is characterized by abrupt changes in vertical and horizontal alignment (see Figures 11A through 11C). Also, at this location Marion Road crosses Pine Creek on a high embankment where existing guardrail may not offer the required protection to a vehicle leaving the road near Pine Creek.

The traffic control on eastbound Marion Road is a turn sign (W1-1 24 in., Appendix II, p. 68). On westbound Marion Road the controls are a curve sign (W1-2 24 in.) and a W1-6-48 target arrow (see Appendix II, pps. 69 and 72). There are no speed control signs in the vicinity of the curves and no advisory curve speed panels present on the curve signs.

There were only three accidents at this location during the study period. However, after field investigation, the study team concluded that this location is a potentially hazardous one. The rural nature of the area contributes to high vehicular speeds, and a large percentage of the motorists may try to maintain this speed unaware of the abruptly changing conditions.

Recommendations:

We recommend that the existing curve and turn sign be re-

placed by reverse curve signs (W1-4-30, Appendix II) and that additional reverse curve signs be erected for each direction of traffic. The additional reverse curve signs shall be erected in the vicinity of the river crossing just west of the river for eastbound traffic and east of the river for westbound traffic.

During field investigation, the study team concluded that advisory curve speed panels were desirable at this location. Devil level indicator readings were recorded at various speeds for both directions. The following averages were determined.

		Devil Level Readings			
	MPH	1st Curve	2nd Curve	3rd Curve	4th Curve
Westbound	50	12°	10°	8°	8°
	45	11°	10°	7°	7°
	40	10°	9°	6°	6°
Eastbound	50	8°	6°	12°	12°
	45	7°	6°	10°	9°

The first curve for eastbound direction is the same as the fourth curve for westbound direction. Based on these readings and indicating the speed on the panel as that of the slowest curve, we recommend advisory curve speed panels with 45 mph legend for both directions of traffic.

We also recommend that target arrows be erected in target position at each curve for both directions of traffic.

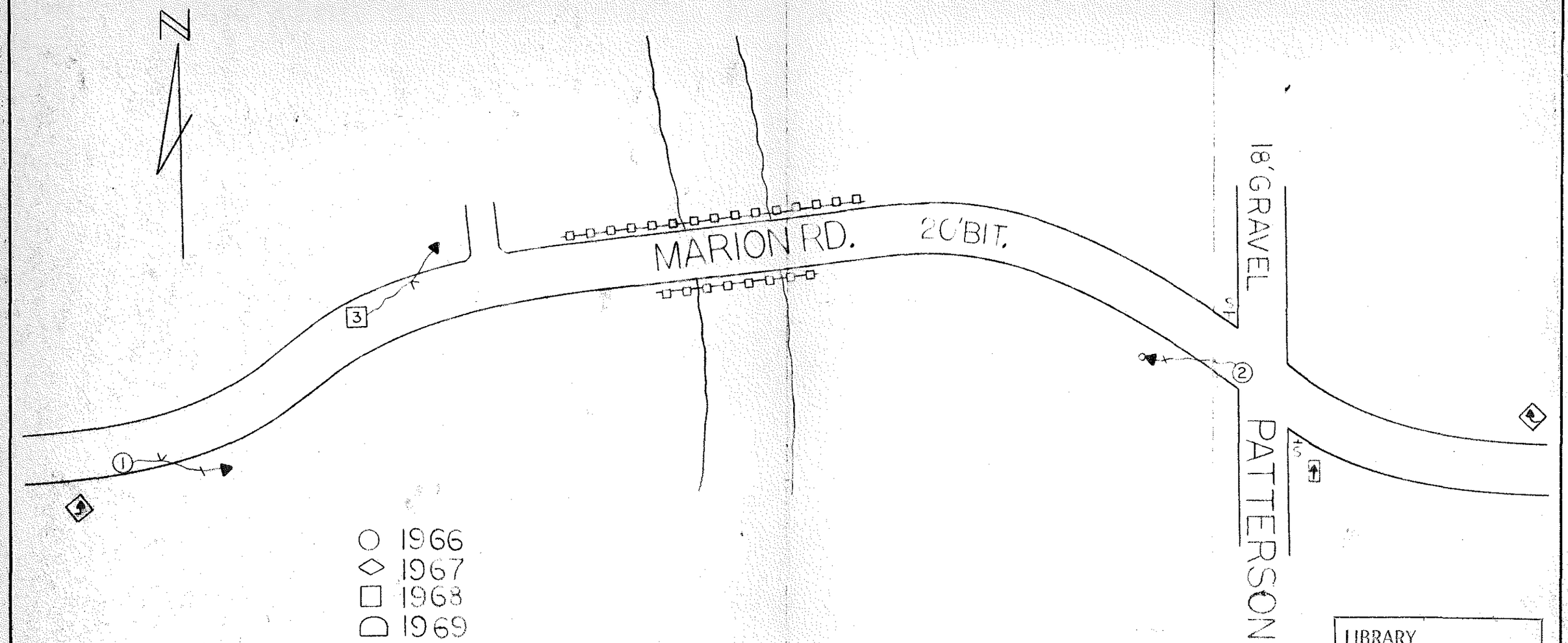


FIGURE 11

REMARKS

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 1969
Accidents – Total 3
P.D. 2
Injury 1 (1)
Fatal 0 ( )
ADT
Rate /100 mvm
Rate / mv

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location MARION RD AT PATTERSON RD.
OSCEOLA CO.
BURDEL TWP.

C.S. Miles
Drawn DJM Date 12-2-70
Plan No. LOCATION #11

Form 1547 (Rev. 6/69) Sheet of

WESTBOUND

MARION ROAD

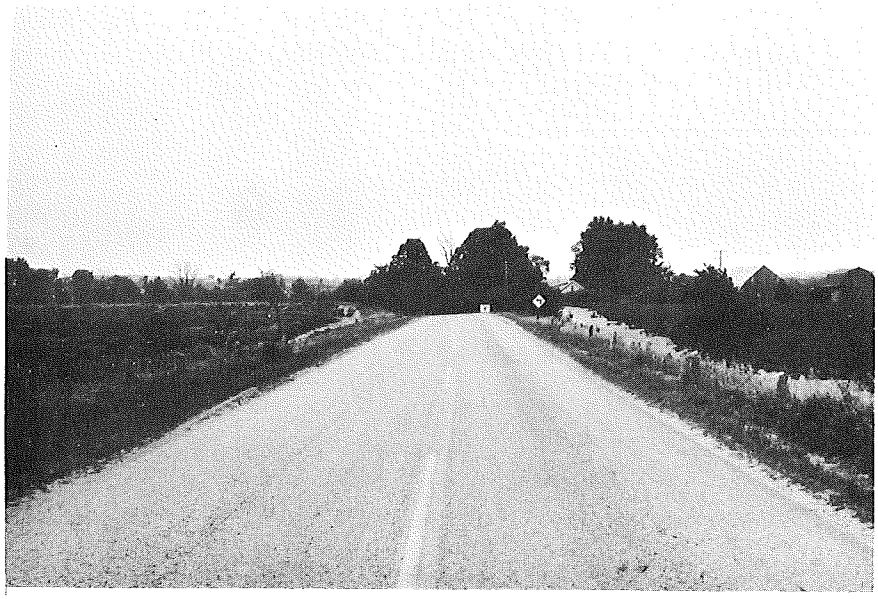
WESTBOUND

MARION ROAD

WESTBOUND

MARION ROAD

FIGURE 11A



EASTBOUND

MARION ROAD

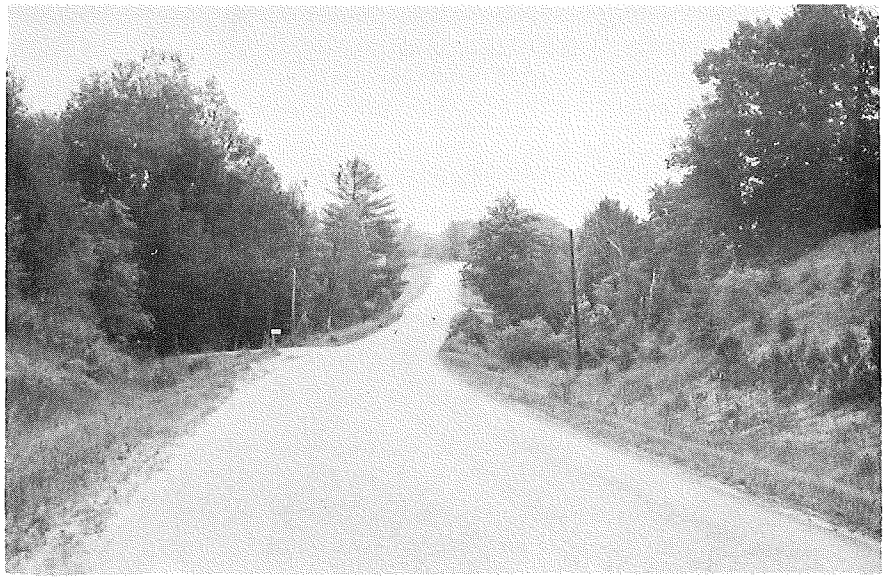
EASTBOUND

MARION ROAD

EASTBOUND

MARION ROAD

FIGURE 11B



EASTBOUND

MARION ROAD

EASTBOUND

MARION ROAD

SOUTHBOUND

PATTERSON ROAD

FIGURE 11C

12. Cedar Road, 1.5 miles north of US-10, Hersey Township, (see Appendix I, pps. 63 and 64)

Total	P.D.	Inj.	Fat.
3	3	0	0

SUMMARY AND CONCLUSIONS

There was a total of 911 reported traffic accidents on Osceola County roads during the study period 1966 through 1969 for an average of 228 accidents per year.

The information summarized in Table IV shows that during the years 1966 through 1969 a total of 50 accidents occurred at the 12 highest accident locations in Osceola County. Of these 20 resulted in personal injury and 30 were property damage. There were no fatalities during this period at the locations studied.

Table V shows that the peak accident month was October accounting for 18% of the accidents. It also shows that Sunday was the peak accident day with Saturday and Sunday accounting for 50% of the total accidents.

The figures in Table VI indicate that the peak accident hour occurs between 8 and 9 p.m. This hour together with the hours between 6 - 7 p.m. and 12 - 1 a.m. accounted for 44% of the accidents.

The information contained in Table VIII shows that 77% of the drivers involved in accidents at the study locations were local residents. Table IX shows that 82% of the accidents occurred when the weather was generally clear. As shown in Table X, 66% of the accidents occurred when the pavement was dry; 8% when the pavement was wet and the rest when it was either snowy or icy.

Our analysis of the accident problem on county roads in Osceola County in relationship to spot or high accident locations reveals that there are no critical problems which cannot be eliminated by the modest engineering means related to a spot improvement program.

The accident information summarized in Tables IV through X may yield some basic information needed by those agencies interested in highway safety from the standpoint of driver education, law enforcement and street patrol activities.

APPENDIX I

TABLE I

POPULATION INVENTORY AND FORECAST

Year	Osceola County	Michigan
1940	13,309	5,256,106
1950	13,797	6,371,766
1960	13,595	7,823,194
1990	16,046	11,233,000
PERCENT CHANGE		
1940-50	+3.7	21.2
1950-60	-1.5	22.8
1960-90	+18.0	43.6

Source: United States Department of Commerce
Bureau of the Census

OSCEOLA COUNTY PLACE OF WORK AND RESIDENCE

Place of Work, 1960

TABLE II

	Osceola Co.	Lake Co.	Wexford Co.	Missaukee Co.	Clare Co.	Isabella Co.	Mecosta Co.	Newaygo Co.	Grand Rapids	Kent Co.	Muskegon-Muskegon Heights	Muskegon Co.	Mason Co.	Elsewhere	Not Reported
Burdell Twp.	141	4	41	0	0	0	0	0	5	0	0	0	0	12	9
Cedar Twp.	25												4		
Evart City	497						11		8					24	8
Evart Twp.	120						4							9	5
Hartwick Twp.	138		16											4	9
Hersey Twp.	202						15							9	
Highland Twp.	118		41	11	4									4	8
LeRoy Twp.	139		18											13	8
Lincoln Twp.	242		5			4	12			4				8	13
Marion Twp.	341		29	4	55				4					8	16
Middle Branch Twp.	57		4	5	8										9
Orient Twp.	114				8									8	17
Osceola Twp.	155		11											8	5
Reed City	807		4		4		32		3	4				4	21
Richmond Twp.	329	4					17							4	8
Rose Lake Twp.	54		26											4	
Sherman Twp.	94	4	65						4					4	
Sylvan Twp.	122				8										8
TOTAL	3,695	12	260	20	87	4	91	0	24	8	0	0	4	123	144

		% of Total
Osceola County Residents Employed in Osceola County	3,695	82.63
Osceola County Residents Employed Outside Osceola County	777	17.37
TOTAL Osceola County Residents Employed	4,472	100.00

SOURCE: U. S. Department of Commerce
Bureau of the Census

TABLE III

REPORTED TRAFFIC ACCIDENTS IN OSCEOLA COUNTY

Year	Property Damage	Injury	Fatal	Total	County Road	State Route	Inter-state	Persons Injured	Persons Killed
1966	338	112	4	454	204	250	0	164	4
1967	350	125	10	485	226	259	0	247	13
1968	422	129	7	558	265	293	0	212	10
1969	414	137	9	560	216	344	0	273	11

COMPARISON OF ACCIDENT FREQUENCY

Year	Osceola County Roads	Total Accidents State of Mich.
1966	204	302,880
1967	226	299,004
1968	265	305,495
1969	216	331,223

PERCENT CHANGE FOR ABOVE TOTALS

1966-67	10.78%	-1.28
1967-68	17.25%	2.17
1968-69	-18.49%	8.42

VEHICLE REGISTRATIONS IN OSCEOLA COUNTY

Year	Pass.	Comm.	Farm Vehicle	Trailer	Trailer Coach	Motor Cycles	Muni-cipal	Total Plates
1966	-	-	-	-	-	-	-	8,575
1967	5,640	1,370	154	1,114	120	247	0	8,645
1968	5,962	1,548	161	1,230	149	257	12	9,313
1969	5,997	1,770	-	-	-	276	10	9,569

ACCIDENT ANALYSIS

Table IV

ANNUAL ACCIDENT SUMMARY

TWELVE HIGH ACCIDENT LOCATIONS IN OSCEOLA COUNTY

Period Studied: 1966 through 1969

* * * * * * * *

Accident Type	Day	Night	Total
Fatal Accident			
Personal Injury Acc.	11	9	20
Property Damage Acc.	7	23	30
Total	18	32	50

* * * * * * * *

Month	Fatal		Injury		Prop. Damage		Sub. Total		Total
	Day	Night	Day	Night	Day	Night	Day	Night	
January			1		3	3	4	3	7
February			1	1			1	1	2
March						1		1	1
April			2	2		2	2	4	6
May			1	2		1	1	3	4
June			1	1	1		2	1	3
July			1				1		1
August			2	1		2	2	3	5
September			1				1		1
October			1	2	1	5	2	7	9
November					1	6	1	6	7
December					1	3	1	3	4
S. Total			11	9	7	23	18	32	50
Total			20		30		50		

ACCIDENT ANALYSIS

Table V

MONTHLY AND DAILY ACCIDENT OCCURRENCE

TWELVE HIGH ACCIDENT LOCATIONS IN OSCEOLA COUNTY

Period Studied: 1966 through 1969

* * * * * * * * * *

Month	Day of the Week							Monthly Total	% of Total
	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.		
January	1		1	1		1	3	7	14
February				1		1		2	4
March	1							1	2
April	1			1	2	1	1	6	12
May						1	3	4	8
June	1			1			1	3	6
July						1		1	2
August		1			2	2		5	10
September							1	1	2
October	2	1			1	1	4	9	18
November	3	1		1	1	1		7	14
December				1		3		4	8
Day Total	9	3	1	6	6	12	13	50	100
% of Total	18	6	2	12	12	24	26	100	

Peak Accident Day: Sunday

Peak Accident Month: October

Table VI

DAILY AND HOURLY ACCIDENT OCCURRENCE

TWELVE HIGH ACCIDENT LOCATIONS IN OSCEOLA 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				5	7	14
1 - 2AM							1	1	2
2 - 3AM				1		1		2	4
3 - 4AM					1			1	2
4 - 5AM									
5 - 6AM				1	1			2	4
6 - 7AM	1				1			2	4
7 - 8AM									
8 - 9AM	1							1	2
9 - 10AM		1				1	1	3	6
10 - 11AM									
11 - 12AM							1	1	2
12 - 1PM									
1 - 2PM		1			1		1	3	6
2 - 3PM						1		1	2
3 - 4PM				2				2	4
4 - 5PM				1		2		3	6
5 - 6PM						3		3	6
6 - 7PM	2	1		1	1		2	7	14
7 - 8PM	1					1		2	4
8 - 9PM	2				1	3	2	8	16
9 - 10PM									
10 - 11PM	1							1	2
11 - 12PM									
Not Stated									
Day Total	9	3	1	6	6	12	13	50	100
% of Total	18	6	2	12	12	24	26	100	

Peak Accident Hour: 9:00PM

Peak Accident Day: Sunday

Table VII

AGE OF DRIVERS INVOLVED IN ACCIDENTS

TWELVE HIGH ACCIDENT LOCATIONS IN OSCEOLA COUNTY

Period Studied: 1966 through 1969

* * * * * * * * * * *

Age Group	Number of Drivers Involved in				Percent
	Fatal	Injury	Prop. Damage	Total	
Under 16		1		1	1.75
16-19		4	9	13	22.81
20-24		7	4	11	19.30
25-34		4	8	12	21.05
35-44		3	7	10	17.55
45-54		3	3	6	10.53
55-64		1		1	1.75
65-74		1	1	2	3.51
75 & Over					
Not Stated			1	1	1.75
Total		24	33	57	100%

* * * * * * * *

Table VIII

RESIDENCE OF DRIVERS INVOLVED IN ACCIDENTS

Residence	Number of Drivers Involved in				Percent
	Fatal	Injury	Prop. Damage	Total	
Local		16	28	44	77.19
Michigan		5	4	9	15.80
Out of State		3		3	5.26
Not Stated			1	1	1.75
Total		24	33	57	100%

Table IX

WEATHER CONDITIONS AT SCENE OF ACCIDENTS

TWELVE HIGH ACCIDENT LOCATIONS IN OSCEOLA COUNTY

Period Studied: 1966 through 1969

* * * * * * * * * *

Weather	Severity of Accident				Percent
	Fatal	Injury	Prop. Damage	Total	
Clear or Cloudy		19	22	41	82
Rain			1	1	2
Fog		1	3	4	8
Snow or Sleet			4	4	8
Not Stated					
Total		20	30	50	100%

* * * * * * * * *

TABLE X

PAVEMENT CONDITIONS AT SCENE OF ACCIDENTS

Pavement	Severity of Accident				Percent
	Fatal	Injury	Prop. Damage	Total	
Dry		17	16	33	66
Wet		2	2	4	8
Snowy/Icy		1	12	13	26
Icy					
Not Stated					
Total		20	30	50	100%

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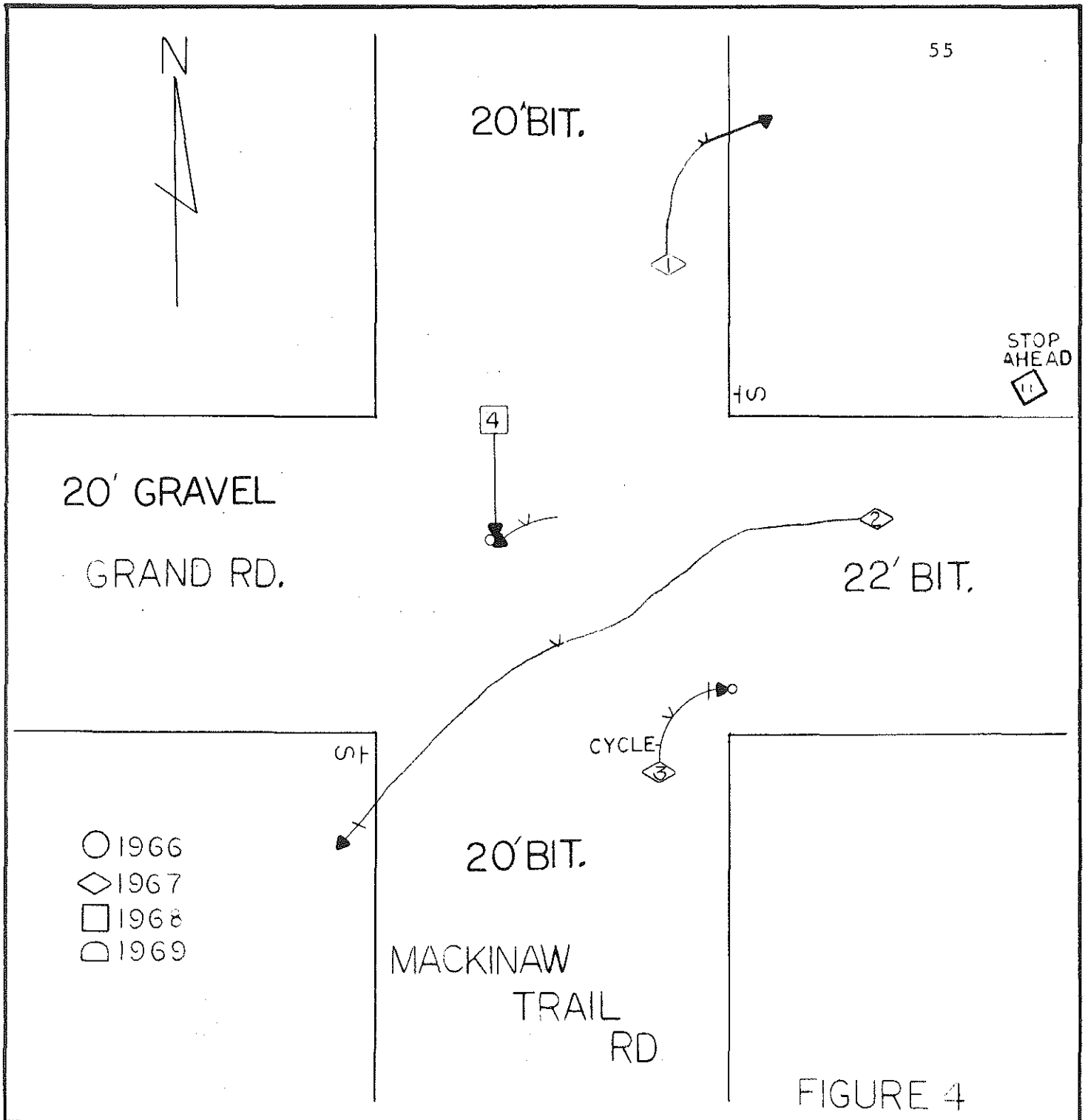


FIGURE 4

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

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

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

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969
OSCEOLA CO. Description LINCOLN TWP

Accidents – Total 4
P.D. 2 Injury 2 (3)
Fatal 0 ( )
Acc. Rate/mv
Acc. Rate/mvm
C.S. Miles
Drawn DVW Date 6-10-70 Rev.
Plan No. LOCATION #4

EASTBOUND

GRAND ROAD

NORTHBOUND

MACKINAW TRAIL

WESTBOUND

GRAND ROAD

FIGURE 4A

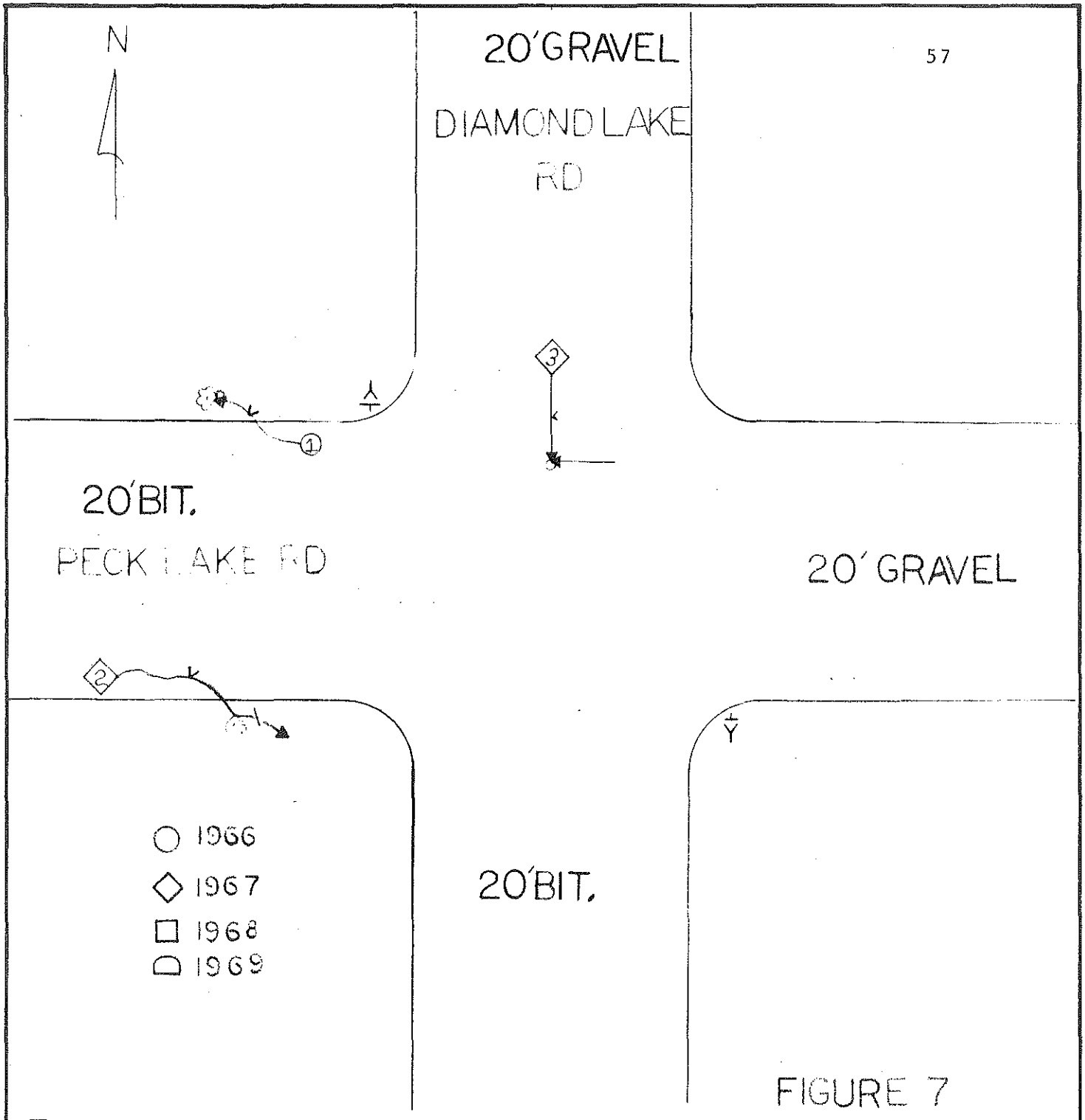


FIGURE 7

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

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

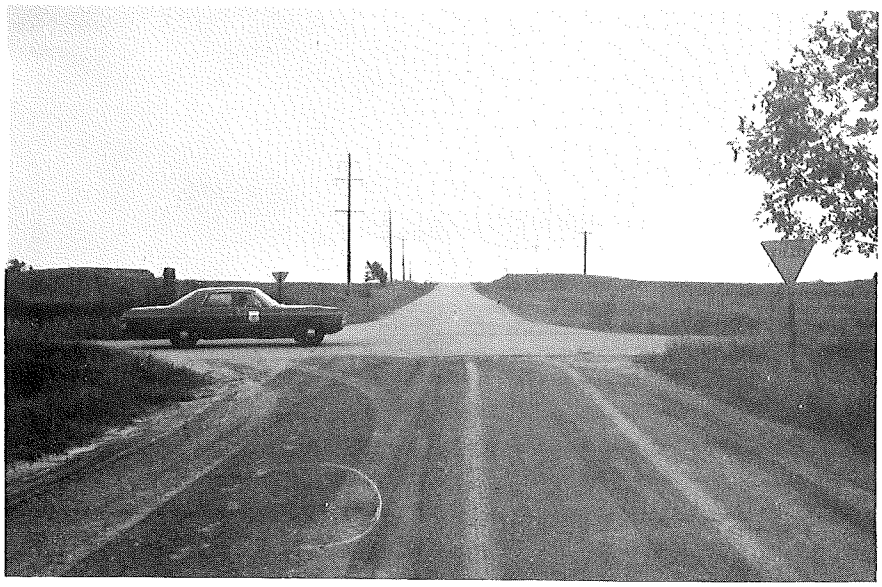
Fatal — Injury — Skidding — Jackknife — Overturned — Backing — Pedestrian — Tree — Out of Control — Driver Intent — Deer — Violator

ACCIDENT STUDY
COLLISION DIAGRAM

Period: [illegible] THRU 1969

[illegible] EOLA CO. Description PIONMONT TWP.

Accidents – Total 3 ( )
P.D. 1 Injury 2
Fatal 0 ( )
Acc. Rate/mv
Acc. Rate/mvm
C.S. Miles
Drawn DJM Date 6 16 70 Rev.
Plan No. LOCATION #7

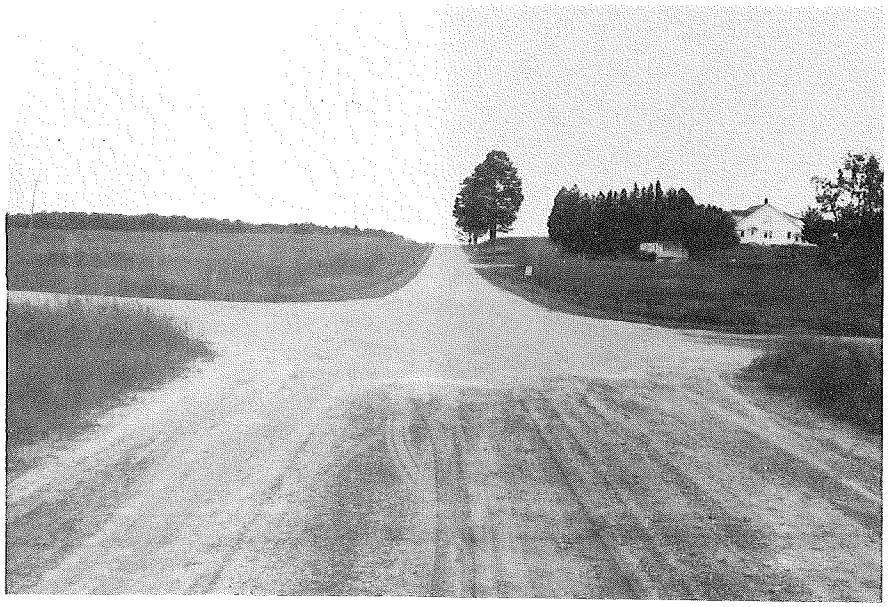


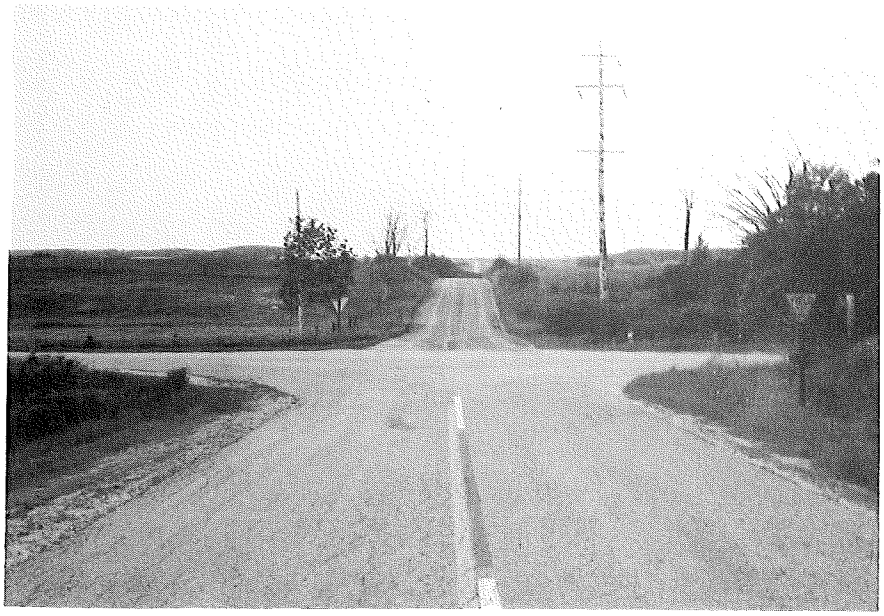
SOUTHBOUND

DIAMOND LAKE ROAD

WESTBOUND

PECK LAKE ROAD





NORTHBOUND

DIAMOND LAKE ROAD

FIGURE 7A

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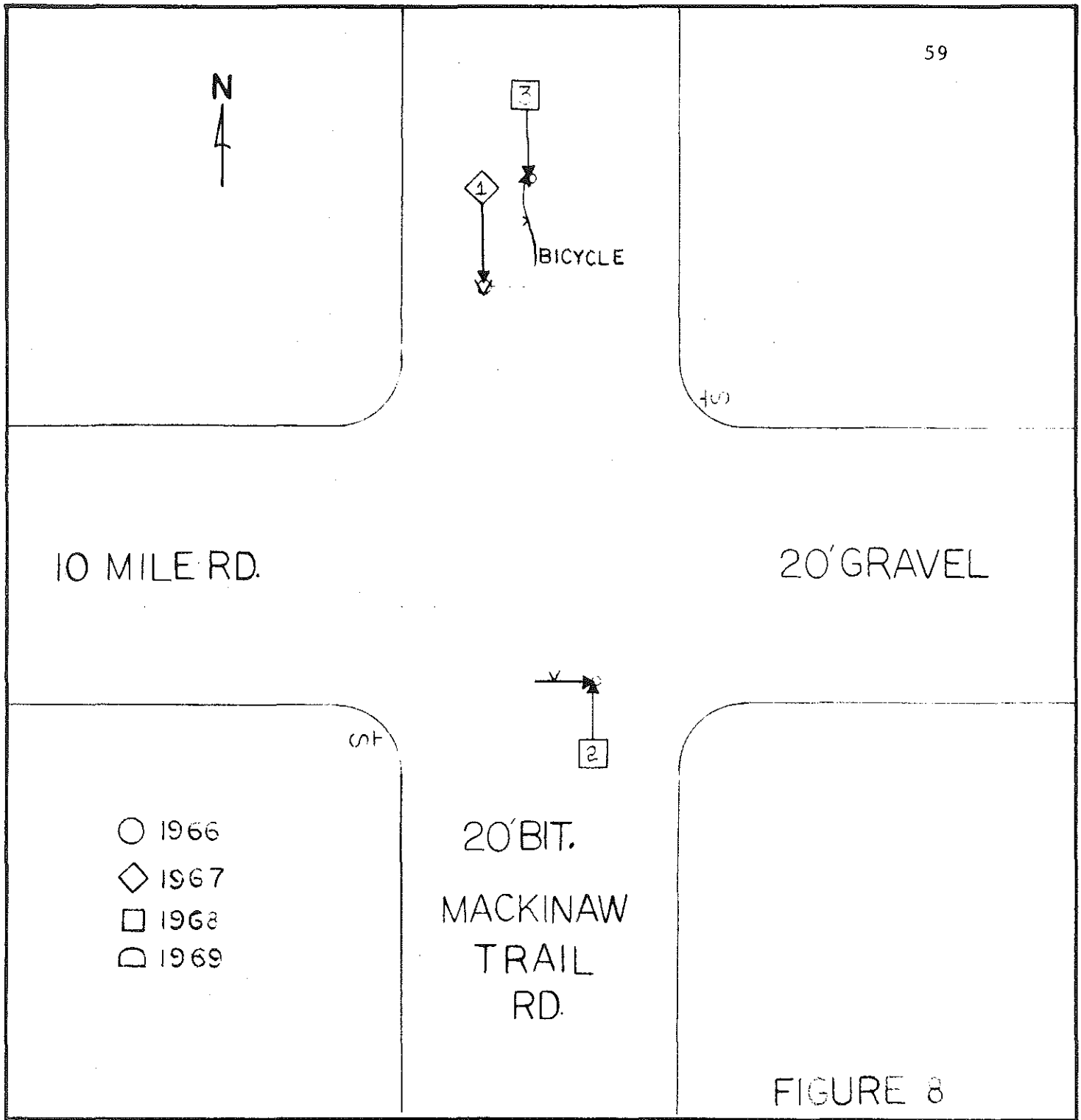


FIGURE 8

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

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

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

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969
OSCEOLA CO. Description SHERMAN TWP

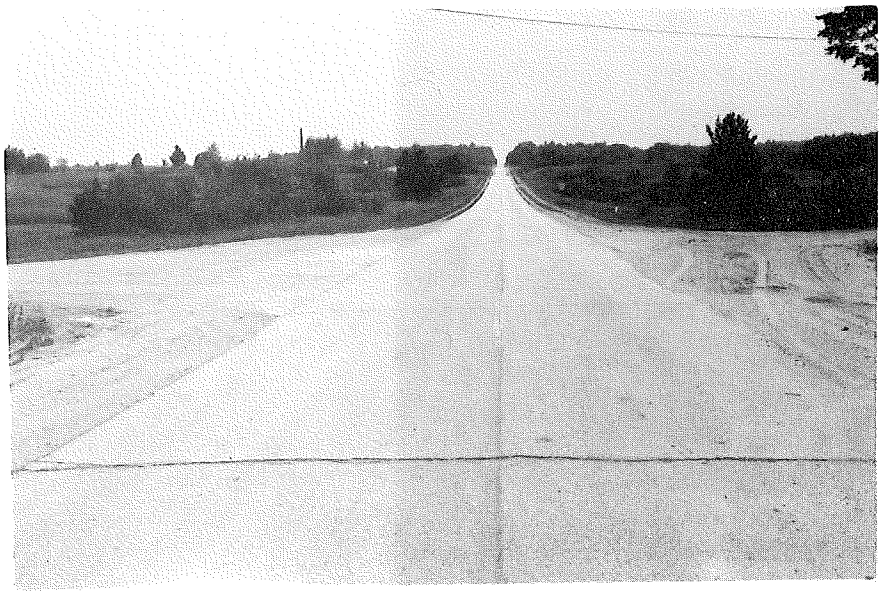
Accidents – Total 3
P.D. 1 Injury 2 (3)
Fatal 0 ( )
Acc. Rate/mv
Acc. Rate/mvm
C.S. Miles
Drawn DJM Date 6-16-70 Rev.
Plan No. LOCATION #8

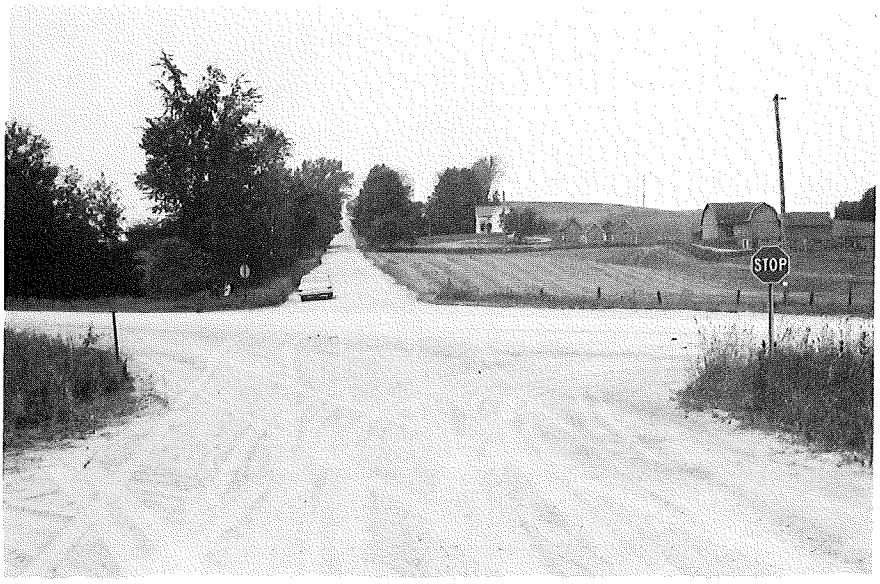
EASTBOUND

TEN MILE ROAD

NORTHBOUND

MACKINAW TRAIL ROAD





WESTBOUND

TEN MILE ROAD

FIGURE 8A

Form 1547

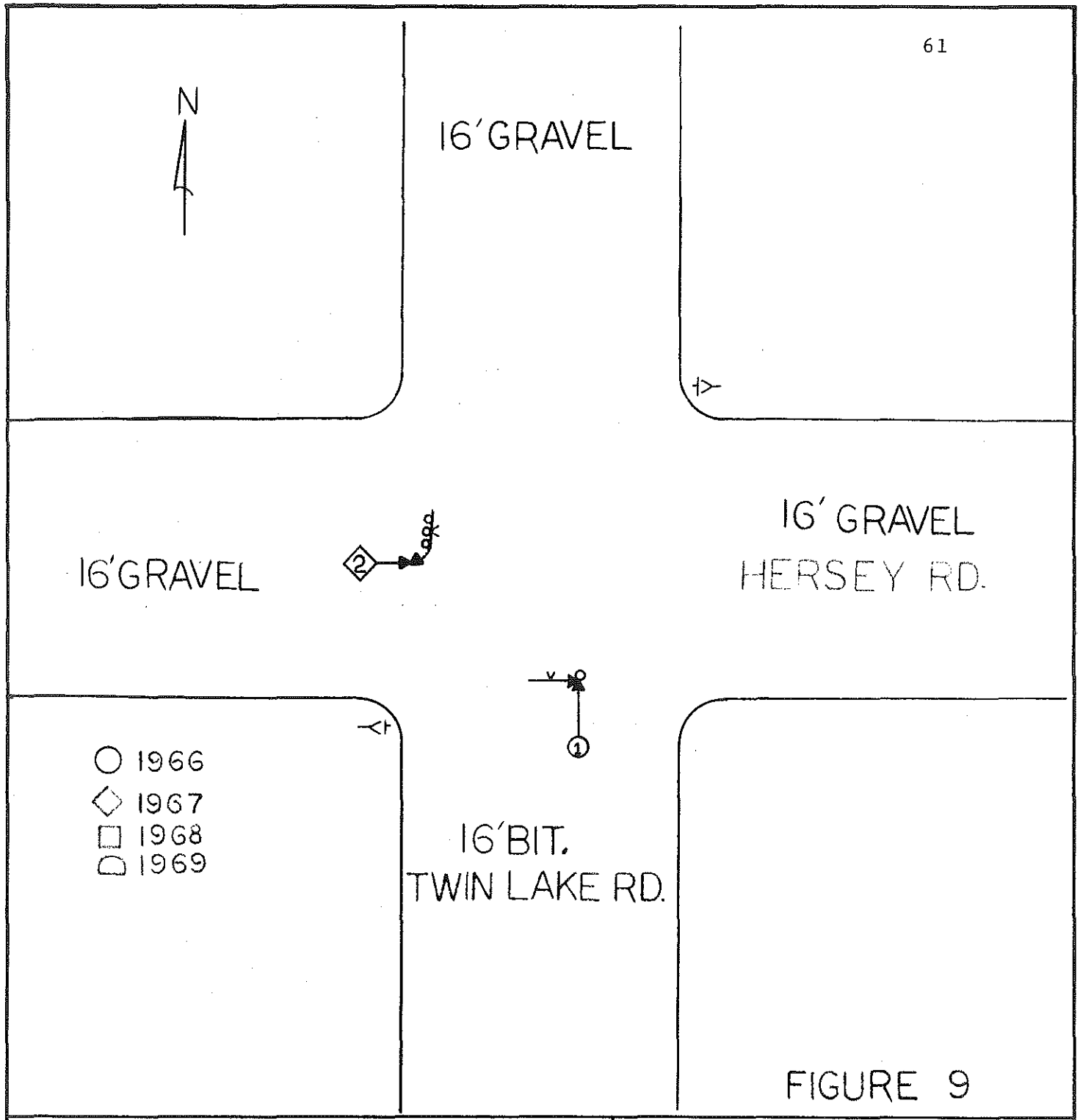


FIGURE 9

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

Stop & Go Signal — S — R — Y — F — Y
Flashing Beacon
Stop Sign S
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 1969
OSCEOLA CO. Description HERSEY TWP

Accidents – Total 2 (4)
P.D. 1 Injury 1
Fatal 1 ( )
Acc. Rate/mv
Acc. Rate/mvm
C.S. Miles
Drawn DJM Date 7-13-70 Rev.
Plan No. LOCATION # 9

EASTBOUND

HERSEY ROAD

NORTHBOUND

TWIN LAKE ROAD

WESTBOUND

HERSEY ROAD

FIGURE 9A

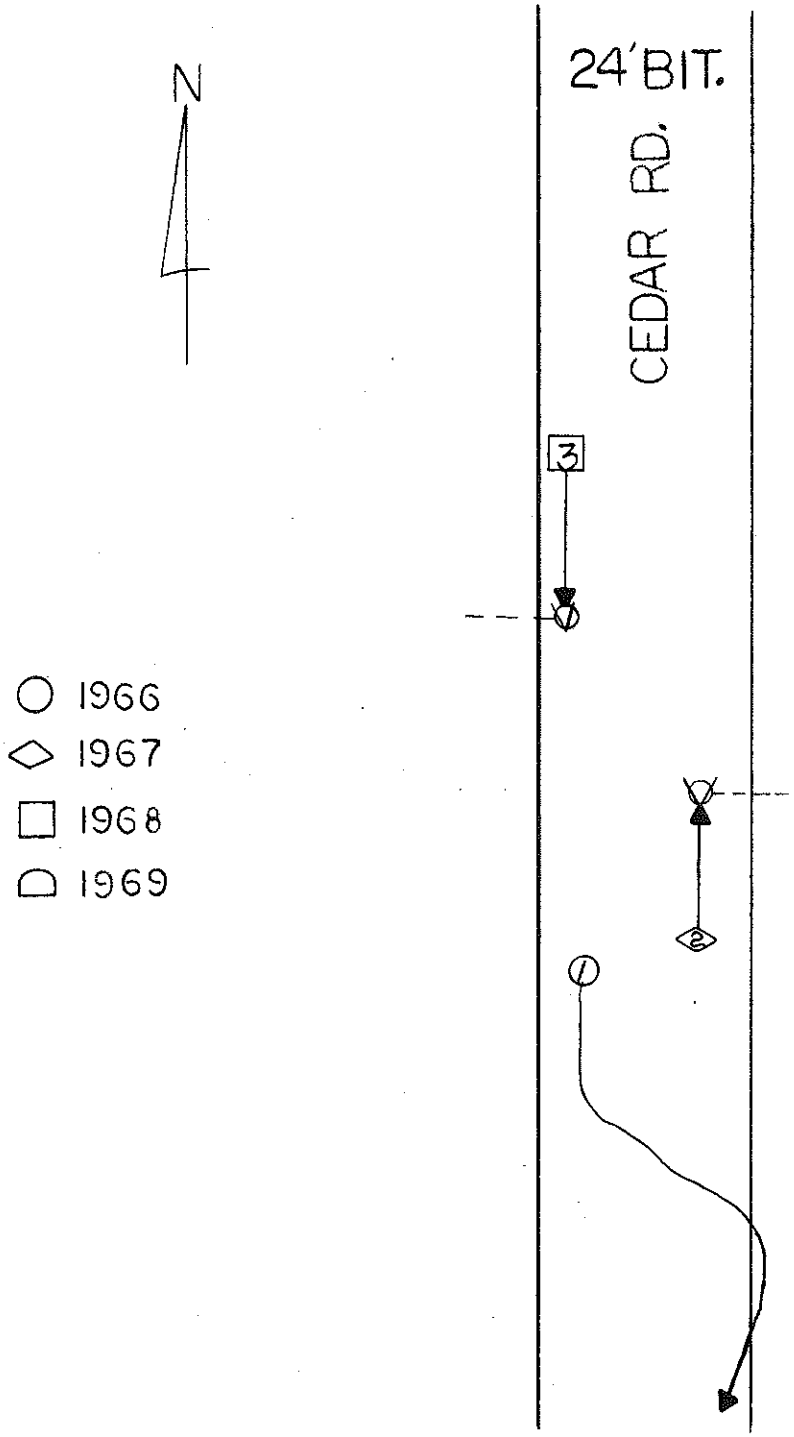


FIGURE 12

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
Traffic Division

LEGEND

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

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

ACCIDENT STUDY
COLLISION DIAGRAM

Period: 1966 THRU 1969
OSCEOLA CO. Description HERSEY TWP.
1.5 MI. NORTH OF U.S.-10

Accidents – Total 3
P.D. 3 Injury 0 (0)
Fatal 0 (0)
Acc. Rate/mv
Acc. Rate/mvm

C.S. Miles
Drawn DJM Date 6-29-70 Rev.
Plan No. LOCATION #12

NORTHBOUND

CEDAR ROAD

SOUTHBOUND

CEDAR ROAD

FIGURE 12A

APPENDIX II

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)*

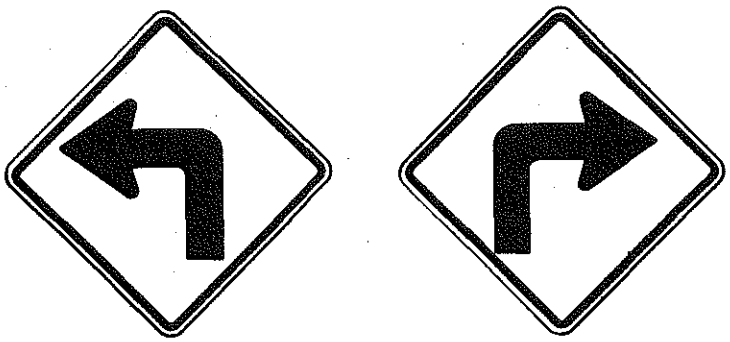
Warning signs with certain exceptions shall be diamond-shaped (square with one diagonal vertical) and shall have a "Highway Yellow" background with black legend. These exceptions are

*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:

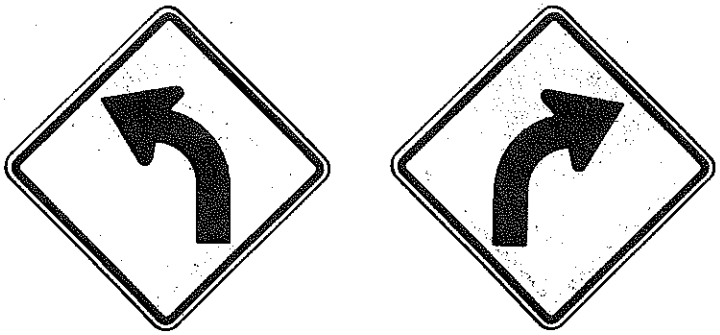
85th Percentile Speed			
35 & Below	36-45	46-55	56 & Over
250′	400′	550′	750′

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.

(Rev. 1)

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).

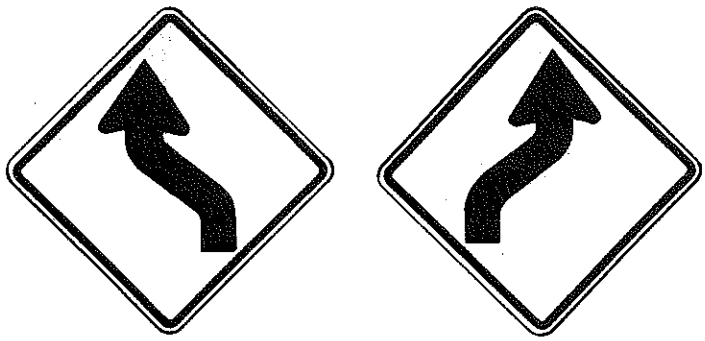
The Curve sign shall be located in advance of the point of curvature at the approximate distance indicated below:

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.

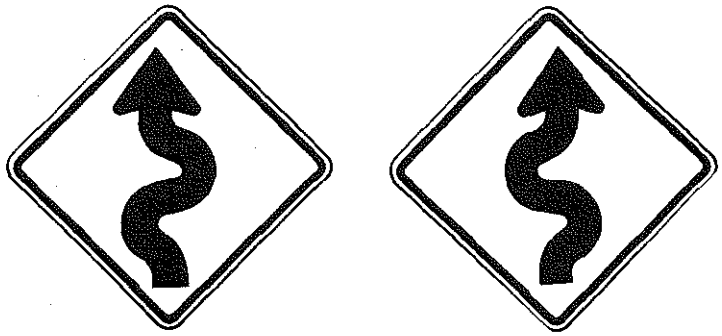
This sign shall be located in advance of the point of curvature of the first curve at the approximate distance indicated below:

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

For placement see figure 1-11.

(Rev. 1)

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.

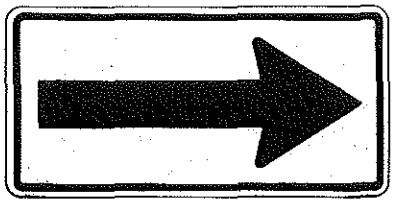
This sign shall be located in advance of the point of curvature of the first curve or turn at the approximate distance indicated below:

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

For placement see figure 1-11.

(Rev. 1)

TARGET ARROW SIGN



Reflectorized

W1-6-48 48″ x 24″

W1-6-96 96″ x 48″

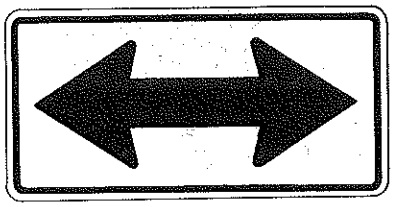
This sign may be used as a supplement to a Turn or Curve sign for potentially hazardous turns or curves. To increase its target value and to obscure misleading topography, the sign may be mounted on a Lattice Background (W12-10).

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.

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.

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

DEER AREA SIGN

Reflectorized

W12-8-36 36″ x 36″ (8″ letters)

This sign may be used in advance of, and at intervals throughout, sections of highway where deer cross in somewhat well defined patterns and evidence exists that such crossings constitute a hazard.

A joint investigation must be made by representatives of the Michigan Department of Conservation and the agency having jurisdiction over the highway before this sign may be installed.

For placement see figure 1-11.