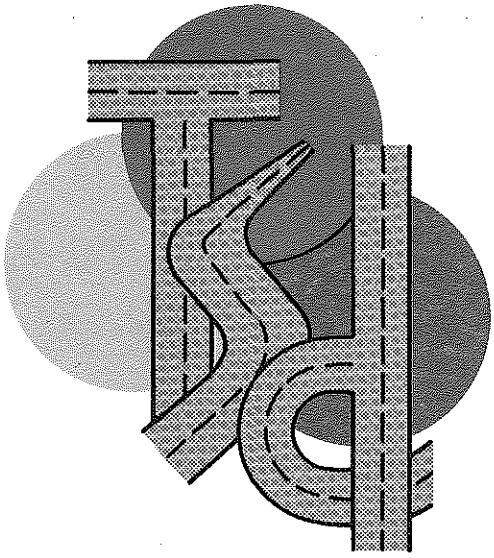
A TRAFFIC ACCIDENT ANALYSIS OF HIGH ACCIDENT LOCATIONS IN THE CITY OF BATTLE CREEK

Report TSD-ES-213-73



TRAFFIC and SAFETY DIVISION

DEPARTMENT OF STATE HIGHWAYS
STATE OF MICHIGAN

10011

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Report TSD-ES-213-73

by

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in cooperation with

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and
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NHTSA Project #MCD-73-1

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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 4.4.13, Traffic Engineering Services, is one of those standards. The purpose of Standard 4.4.13 is to insure the full and proper application of modern traffic engineering principles and uniform standards for traffic control to reduce the likelihood and severity of traffic accidents.

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 recieved, 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 analyses on locations which experience a high accident frequency and summarizing the recommendations for corrective action.

STUDY PROCEDURES

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

Since a portion of the data collection phase involves accident records and reports and since the Michigan Department of State Police is responsible for keeping all accident records in Michigan, the task of identifying and locating the high accident locations in the City of Battle Creek (and providing an inventory of those locations) was designated as State Police responsibility. Because of the fact that an automated system of locating accidents has not yet been established on a statewide basis, the high accident locations (city streets only) for the City of Battle Creek were determined by manually extracting and compiling those locations with the highest number of accidents from the 1969 city accident reports. From this list the 19 highest accident locations on city streets were selected. Once the problem locations were identified, additional accident information for the years 1967, 1968 and 1970 was compiled in order to expand the accident base at each location. Upon completion of this portion of the data collection, the Department of State Police documented and transmitted to the Traffic and Safety Division of the Department of State Highways a list, along with the accident reports, of the high accident locations for the City of Battle Creek.

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.

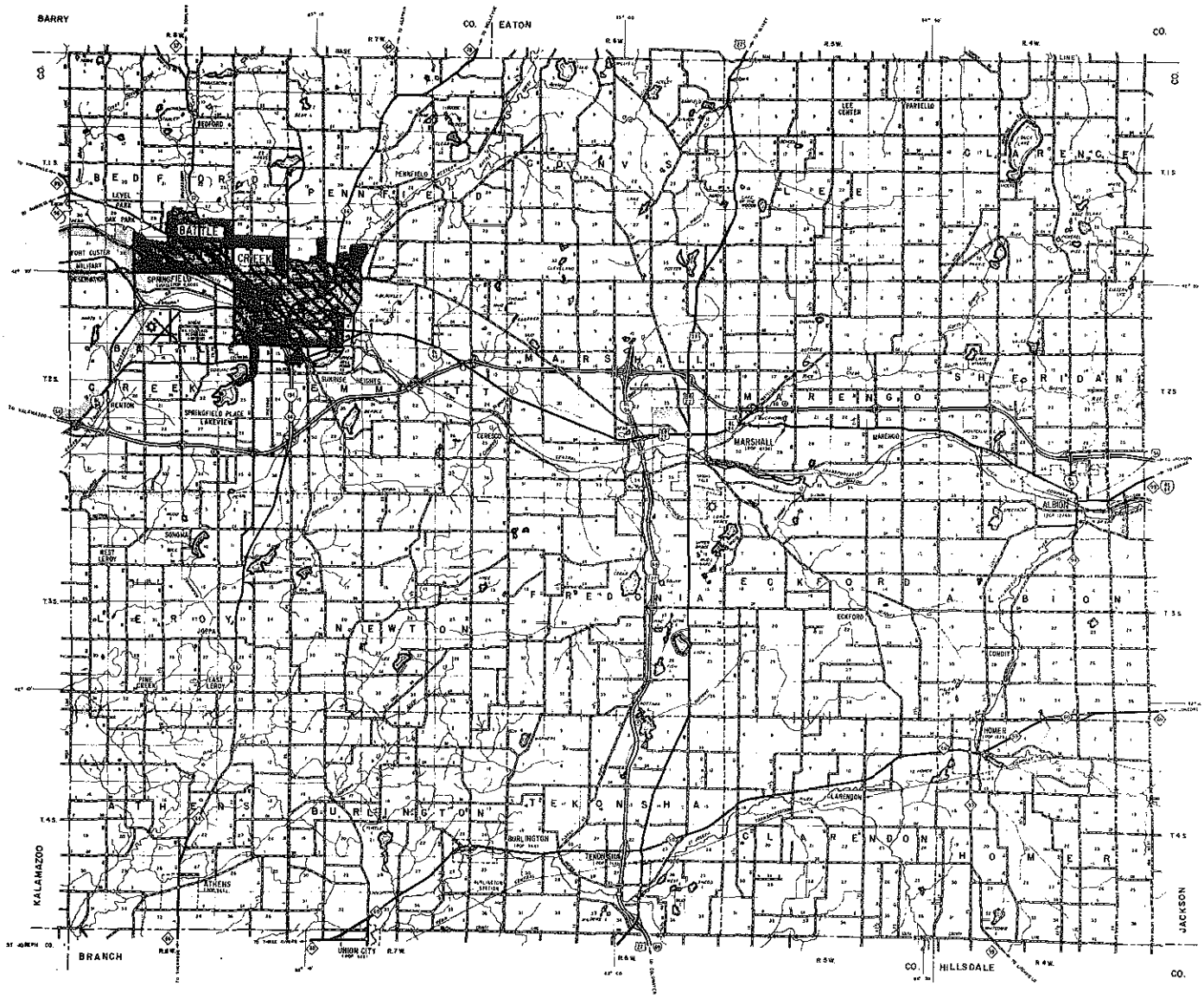
The accident analysis phase involves the analysis of the summarized facts and field data from the viewpoint of a highway traffic engineer with special attention focused on the effect which the highway environment may have had on the accident. Thus, at each high accident location, individual accident reports were reviewed in detail. 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.

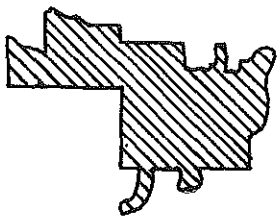
The traffic engineering analysis phase involves evaluating the summarized facts and field data and prescribing the proper remedial treatment.

STUDY AREA

The City of Battle Creek is situated in Battle Creek, Bedford, Emmett and Penfield townships which are located in the northwest section of Calhoun County (Figure 1).

FIGURE 1





STUDY AREA

CITY OF BATTLE CREEK

KEY TO COUNTIES

GENERAL HIGHWAY MAP

CALHOUN 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

SCALE 1" = 5 MILES

712.75 SQ. MILES

POLYCONIC PROJECTION

In the period 1910 to 1930 the population increased in the city substantially and then it remained constant in the 1940's before peaking in the early 1950's (Figure 2). In the late 1950's the city's population began to decline; however, the townships - Battle Creek, Bedford, Emmett, and Penfield - that comprise the Battle Creek Urban Area maintained a constant population growth. The trend toward decentralization has begun in this area. With the economic patterns that are developing in the Detroit to Chicago corridor, it is expected that the population growth in this Urban Area will continue to expand.

Vehicular movement from the city is accomplished over the following highways: M-37, beginning at Battle Creek and providing access to Grand Rapids; M-66, providing north-south access to the Indiana border and the Northern Lower Peninsula; and M-89, beginning at Battle Creek and providing east-west access to Lake Michigan. In addition, three limited access highways - I-94, which is linked to the Central Business District by the I-194 Penetrator; I-69, located ten miles east of the city; and US-131, located 25 miles west of the city - connect the City of Battle Creek with the Interstate System.

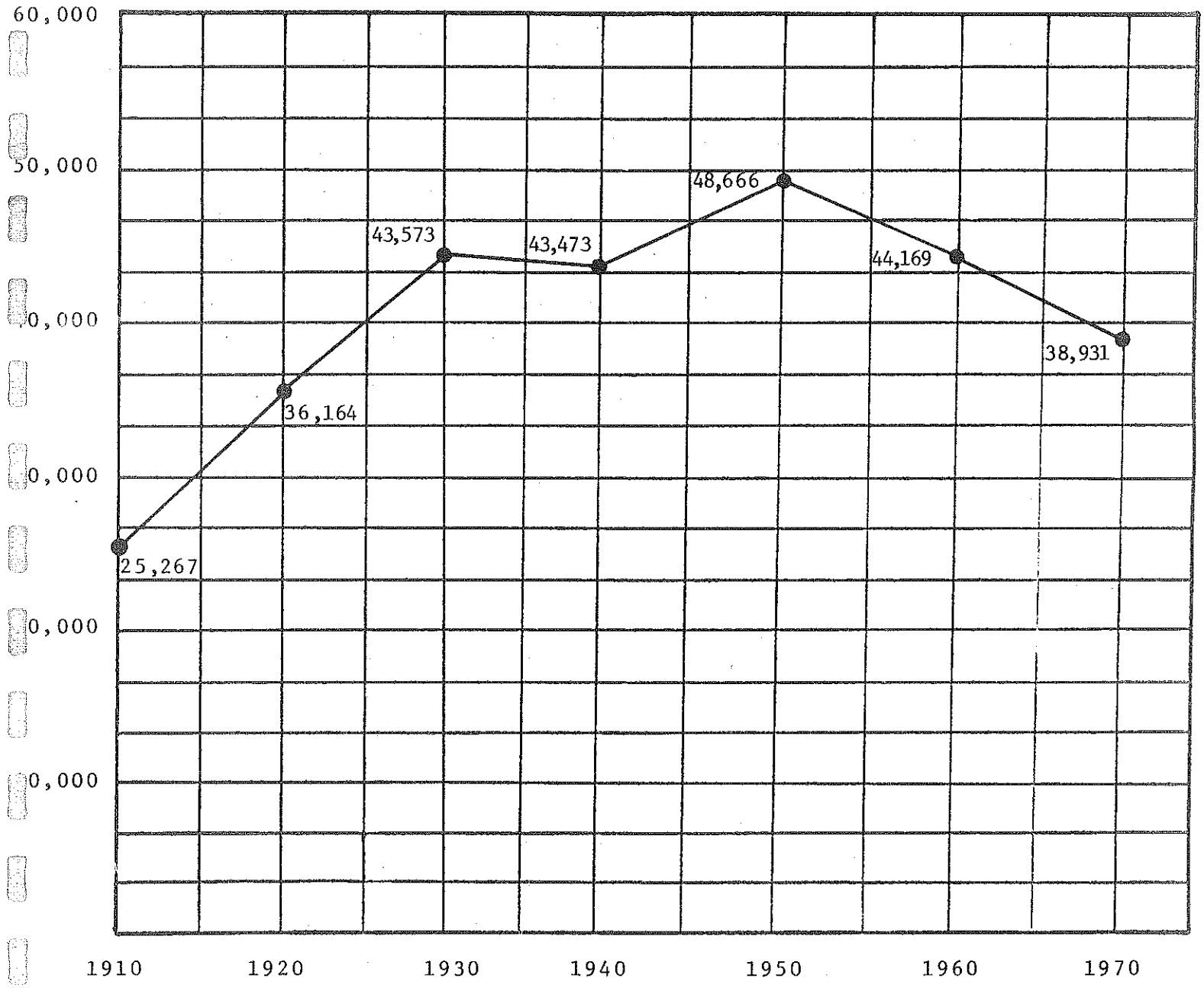
According to the Twentieth Annual Progress Report, as compiled by the Local Government Division of the Michigan Department of State Highways, the City of Battle Creek has 184.67 miles of streets. This figure includes 12.63 miles of state trunkline, 49.83 miles of major city streets and 121.02 miles of local city streets. A map showing these road types can be found in Figure 3.

FIGURE 2

POPULATION TREND

CITY OF BATTLE CREEK

1910 - 1970



SOURCE: U. S. Bureau of the Census

CITY OF

BATTLE CREEK

CALHOUN COUNTY

T. 1&2 S. R. 7&8 W.

POP. 38,931 1970 CENSUS

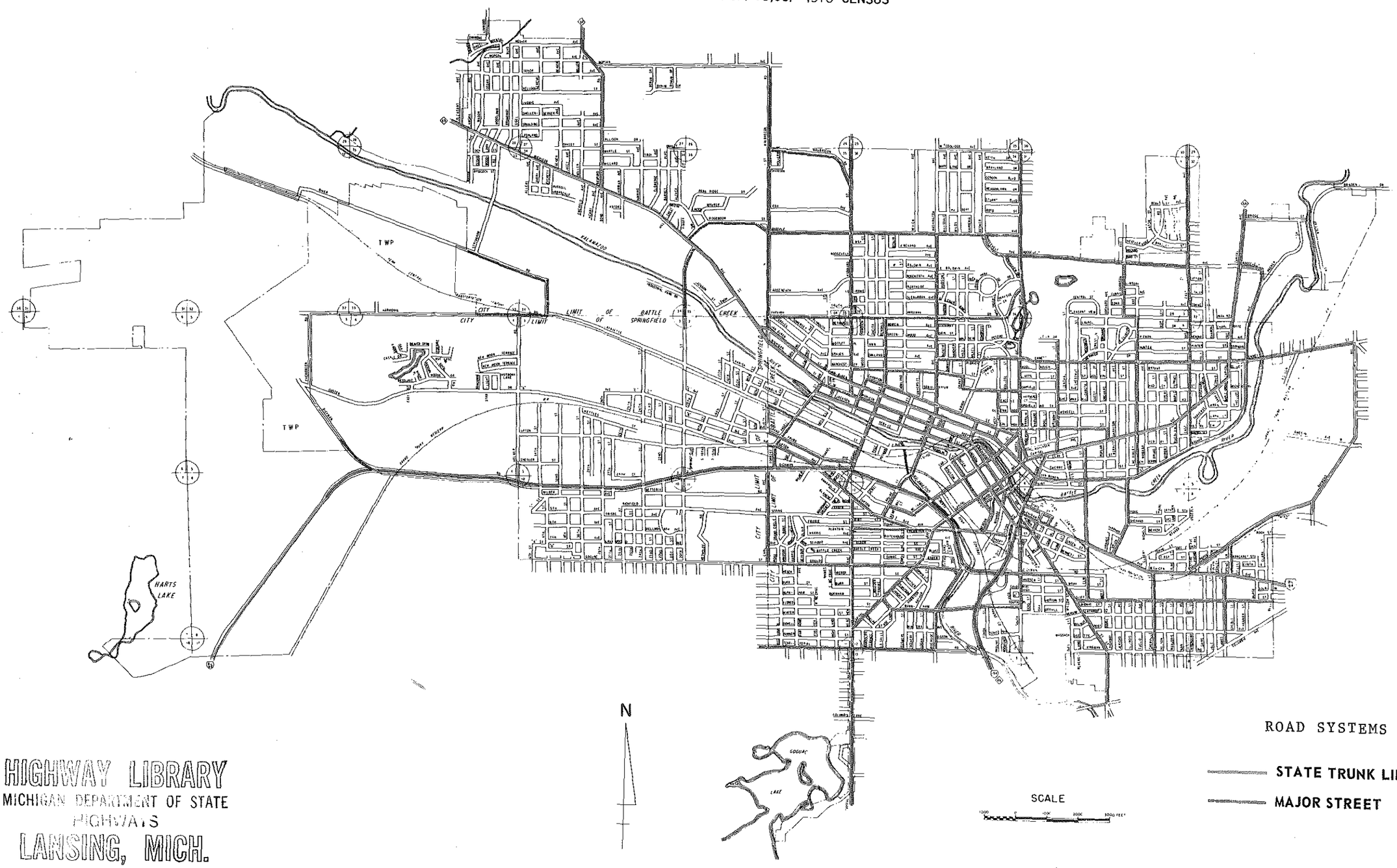


Figure 3

TRAFFIC ENGINEERING ANALYSIS

The traffic engineering analysis phase of our study involves evaluating the summarized facts and field data and prescribing the proper remedial treatment. One of the basic tools used in this type of analysis is a graphic representation of accidents either on a spot collision diagram or strip map which is used to locate the accident and determine accident patterns. This is one of the engineering techniques used in trying to eliminate the causes of accidents. Accident causes, however, are numerous and often difficult to determine. An accident pattern does not always exist. In this case the collisions may involve one or more serious driving hazards such as slippery pavement, snow or fog, drinking drivers, defective equipment, excessive speed or 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 the City of Battle Creek the traffic engineering analysis began when the State Police, after compiling the accident data for the city streets in Battle Creek, transmitted to the Michigan Department of State Highways, 19 high accident locations (Figure 4). There was a total of 6,403 reported traffic accidents on the City of Battle Creek's streets during the four-year study period for an average of 1,601 accidents per year. The 19 high accident locations accounted for 1,286 of the total reported accidents in the city.

Before beginning the traffic engineering analysis of each location, this report will be more effective by collectively arranging the high accident locations that occurred on the same roadway. This procedure would result in analyzing a section of roadway in all aspects related to traffic engineering, and then providing individual treatment for each of the high accident intersections on the segment of roadway. The major city streets that will be examined in this manner include:

Capital Avenue, south of the Central Business District
North Avenue, north of the Central Business District
Michigan Avenue, west of the Central Business District
Michigan Avenue, in the Central Business District

CITY OF

BATTLE CREEK

CALHOUN COUNTY

T. 1&2 S. R. 7&8 W.

POP. 38,931 1970 CENSUS

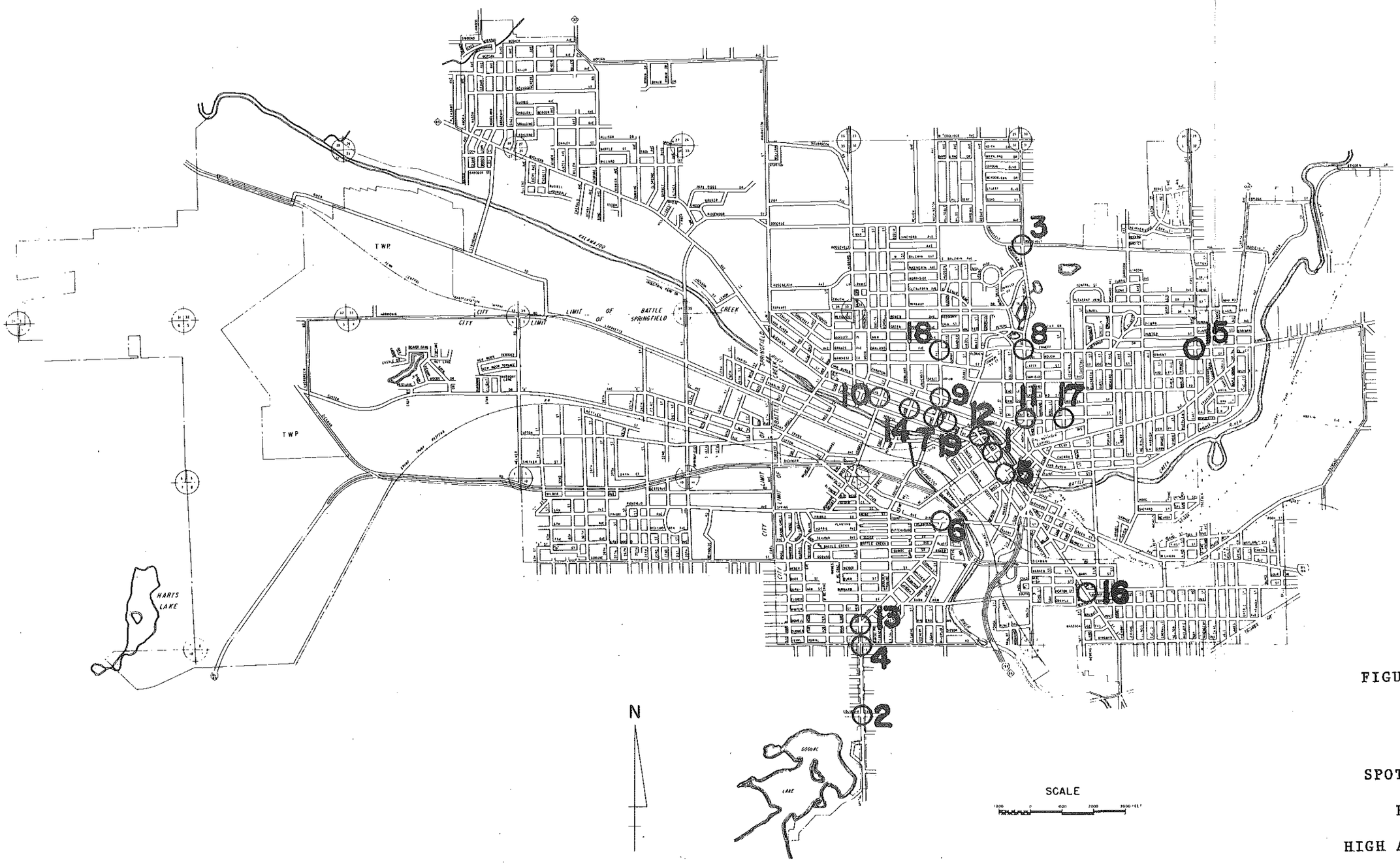


FIGURE 4

SPOT MAP

FOR

HIGH ACCIDENT

LOCATIONS

In the City of Battle Creek 16 of the 19 high accident locations are signalized intersections. Seven of these signalized intersections have a single overhead vehicular signal head. Although only one overhead signal head is required at each signalized intersection under the old Michigan Manual, the new MICHIGAN MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES, which will be issued during 1973, will recommend that at least two vehicular signal faces be provided per approach lane. Some reasons for dual signal heads are as follows:

1. Two (or more) properly located overhead faces will, in almost all cases, provide drivers with a signal indication even though trucks or buses may momentarily obscure one signal face.

2. Multiple faces provide a safety factor where the signals must compete with a brilliant background such as advertising signs or the sun.

3. The occasional inevitable lamp failure in one face will not leave an approach without any signal indication.

It is, therefore, recommended that the city provide dual signal heads for these locations when it becomes feasible. It is also recommended that all the signals be converted to operate using a minimum amber interval consisting of approximately four seconds.

The City of Battle Creek has a limited number of major streets which have brick surfaced pavement. It is our hypothesis that these brick surfaced roadways have a lower skid coefficient (wsf - wet sliding friction) as compared to Portland Cement concrete surfaced roadways. Our theory is substantiated by the Michigan Department of State Highways, Testing and Research Division, Research Laboratory's Skidometer Testing Program. Their program includes skidometer testing of the previous year's high accident locations on state trunklines to determine the skid coefficient at each high accident location. In 1967 the average skid coefficient for all the concrete surfaced roadways tested was 0.38 wsf as opposed to 0.24 wsf for all brick surfaced roadways. In 1968 the averages were 0.35 wsf for all concrete roadways and 0.26 wsf for all the brick surfaced roadways.

All skidometer test values are expressed as 40 MPH coefficients of wet sliding friction. A wsf value of 0.40 is generally considered the dividing point between "satisfactory" and "unsatisfactory" pavement surfaces and it has been arbitrarily defined as the "Departmental Safety Standard". Surfaces with coefficient values of 0.35 to 0.40 are in a "transitional" or "questionable"

range. Surfaces below 0.35 could be dangerous under wet conditions depending on prevailing speeds, road alignment, and geometrics. Surfaces with wsf's below 0.20 are considered as slippery as packed snow.

Therefore, it is our opinion that the brick surfaced pavements intensify the accident potential during inclement weather. It is recommended that the City of Battle Creek have their brick surfaced roadways skidometer tested (this service is available from the Testing and Research Division of the Michigan Department of State Highways - prior arrangement should be made with Max N. Clyde, Engineer of the Testing and Research Division), and initiate a resurfacing program to correct the deficiencies caused by the brick surfaces.

A technique in determining whether skidometer tests are necessary is by the number of wet pavement accidents occurring at a location. Method #1 involves subtracting the snow and ice accidents from the total accidents over the study period. If the wet pavement accident percentage is more than 40 percent of this new total, skidometer tests should be recommended. In Method #2, if the wet accidents are more than 27 percent of the total accidents at a location over the study period, then skidometer tests should be recommended. If either method is satisfied, then skidometer tests can be recommended. A method of correcting this situation, as used by the Michigan Department of State Highways, Traffic and Safety Division, Geometrics Section, is to prepare a bituminous concrete mixture for each location and resurface the brick pavement.

Some of the major streets in the City of Battle Creek have limited sections of roadway on which delays during the peak period are caused by on-street parking. Parking along these street not only reduces moving traffic by one lane, but also causes delays arising from the movement of vehicles into and out of the parking stalls. Since the city experiences no traffic congestion during the non-rush periods, it is recommended that the city give serious thought to prohibiting on-street parking on their major street system during the peak periods.

The City of Battle Creek should consider the accident problem developing due to the lack of capacity at locations on major roadways exiting and entering the city. Accidents generally occur at those locations where turning movements and improper signalization create undue traffic delays. In order to substantiate the need for added capacity at those locations along the major roadways in the City of Battle Creek, a capacity analysis was made using the methods defined in the 1965 Highway Capacity Manual.

The 1965 Highway Capacity Manual introduced the concept of measuring highway operating characteristics by defining driving conditions (Level of Service) experienced by the driver. Speed and travel time, traffic interruptions, stops and delays, freedom to maneuver and driving comfort and convenience are all considered by the driver when operating under various roadway conditions and are defined qualitatively in the Capacity Manual in terms of Level of Service. Level of Service "A" depicts the best operating conditions possible (no back-ups). The typical approach to an intersection appears quite open, turning movements are easily made, and nearly all drivers find freedom of operation, their only concern being the chance that the traffic signal indication will be red or turn red when they approach. Level of Service "B" represents stable operation. Many drivers begin to feel somewhat restricted within platoons of vehicles. In Level of Service "C", stable operation continues (design capacity). However, occasionally drivers may have to wait through more than one red signal indication and back-ups may develop behind turning vehicles. Most drivers feel somewhat restricted, but not objectionably so. Level of Service "D" encompasses a zone of increasing restriction. Delays to approaching vehicles may be substantial during short peaks within the peak period, but enough cycles with lower demand occur to permit periodic clearance of developing queues, thus preventing excessive back-ups. Capacity operation occurs at Level of Service "E" and represents the most vehicles that any particular intersection approach can accommodate. In practice, full utilization of every cycle in the peak hour is seldom obtained, no matter how great the demand, unless the street is highly friction-free. At critical capacity (Level of Service "E"), there may be longer queues of vehicles waiting upstream of the intersection and delays may be substantial (up to several cycles). The Capacity Manual also defines a Level of Service "F", which represents unstable flow conditions. Back-ups from locations downstream or at the cross street may restrict or prevent movement of vehicles out of the approach under consideration. Hence, volumes carried are not predictable. Each approach at the high accident locations was analyzed using Capacity Analysis Techniques for Design of Signalized Intersections, by Jack Leisch. A volume-to-design capacity ratio (V/C) of 1.00 is used to correspond with Level of Service "C" and is normally used for design purposes. Levels of Service "D" and "E" (V/C ratio greater than 1.00) depict undesirable operating conditions and would normally be investigated for possible improvement.

A method for increasing capacity and avoiding delays and inconvenience is to have the signal system on the major streets interconnected in order to promote platoon flow rather than random flow of vehicles. A system like this can be achieved by creating a definite time relationship between the signals; thereby, progressive movement can be gained for inbound movement in the a.m. peak period

and for outbound movement in the p.m. peak period.

In an effort to increase the capacity on the arterial streets of the City of Battle Creek, it is recommended that the exclusive right turn lane utilized throughout the city be converted to a thru and right turn lane. However, this system can only be implemented at locations where there is enough space to permit two vehicles to pass through the intersection simultaneously. By utilizing a thru and right turn lane the capacity of the thru movement can be increased by 20 percent and this lane can accommodate right turns up to 30 percent of the total approach volume adequately.

After our analysis was complete, it was apparent that no engineering recommendations would be feasible for two of the 19 locations. There were no accident patterns at these two locations and no present driving hazards that could be controlled by traffic engineering. Consequently, this report will discuss in detail the remaining 17 locations. The collision diagram and pictures for each of these will be found on the page following the discussion. The collision diagrams and pictures for the remaining two locations are found in Appendix I.

Capital Avenue (Columbia Avenue to Jackson Street)

This route includes: Locations #2, 4, 6, 13

Capital Avenue between Columbia Avenue and Jackson Street is a major city street extending from the Central Business District in a southerly direction. Capital Avenue has four lanes of moving traffic from Columbia Avenue to Bidwell Street and from Fountain Street to the railroad tracks. Due to parallel parking that is permitted on each side of Capital Avenue there are only two lanes for moving traffic from Bidwell Street to Fountain Street and from the railroad tracks to Jackson Street.

It is recommended that parking be restricted on Capital Avenue on both sides of the street, between Bidwell Street and Fountain Street and the railroad tracks and Jackson Street, during the peak periods. This parking restriction will permit a maximum amount of traffic to negotiate this roadway.

It is also recommended that the City of Battle Creek influence the movement of vehicles on Capital Avenue by interconnecting the signals and creating an inbound (toward the Central Business District) progression in the a.m. peak period and an outbound (away from the Central Business District) progression in the p.m. peak period.

LOCATION 2 CAPITAL AVENUE AT COLUMBIA AVENUE

Capital Avenue intersects Columbia Avenue to form a right-angle signalized intersection. At this location Capital Avenue is a city street, while Columbia Avenue is a Calhoun County road. This intersection has two overhead vehicular signal heads and a separate left turn signal head for each direction.

Capital Avenue is a five lane, 54 ft wide bituminous roadway. Columbia Avenue is a five, 57 ft wide bituminous roadway. Parking is prohibited at this location.

Other traffic controls at this location are a "Speed Limit 35" sign for westbound Columbia Avenue, and a "Speed Limit 35" sign for eastbound Columbia Avenue.

The collision diagram indicates that the rear end accident was the prevalent type at this location during the study period. The accidents at this location consisted of 75 rear ends, 25 improper turning, 14 right-angles, 13 sideswipes, four improper backing and one involving a bicycle. Forty of the accidents at this location occurred on wet pavement.

Recommendations:

The approaches on each leg are divided into a left-turn, a thru and a right-turn lane. This arrangement of lanes has contributed to a deficiency in capacity at this location. A capacity analysis of the approaches indicates the following Levels of Service:

Capital Avenue

Southbound	Left	F
	Thru	F
	Right	B
Northbound	Left	F
	Thru	B
	Right	A

Columbia Avenue

Westbound	Left	A
	Thru	F
	Right	C
Eastbound	Left	A
	Thru	F
	Right	F

By eliminating the left-turn phase for Columbia Avenue and by allowing thru traffic to use both the thru and right-turn lane, the following Levels of Service are achieved:

	Capital Avenue	
Southbound	Left	D
	Thru	D
Northbound	Left	D
	Thru	A
	Columbia Avenue	
Westbound	Left	D
	Thru	D
Eastbound	Left	A
	Thru	F

Although these improvements will not correct all the deficiencies at this location, this intersection will operate within the low D range and will provide adequate capacity on all legs of this intersection.

In order to keep vehicles passing through this intersection in their proper lanes, it is recommended that this intersection be realigned, resurfaced and pavement marked for five lane traffic operation. Since over 30 percent of the accidents occurred on wet pavement and since over 56 percent of the accidents were rear end collisions, the resurfacing of the intersection will also aid in reducing this type of accident.

Progression along Columbia Avenue is not adequate and contributes to the high number of rear end accidents. Since Columbia Avenue is a county roadway, a recommendation for progression along Columbia Avenue will be made in the Calhoun County report. However, it is suggested that the City of Battle Creek contact Calhoun County in order to achieve progression of traffic on both Capital Avenue and Columbia Avenue.

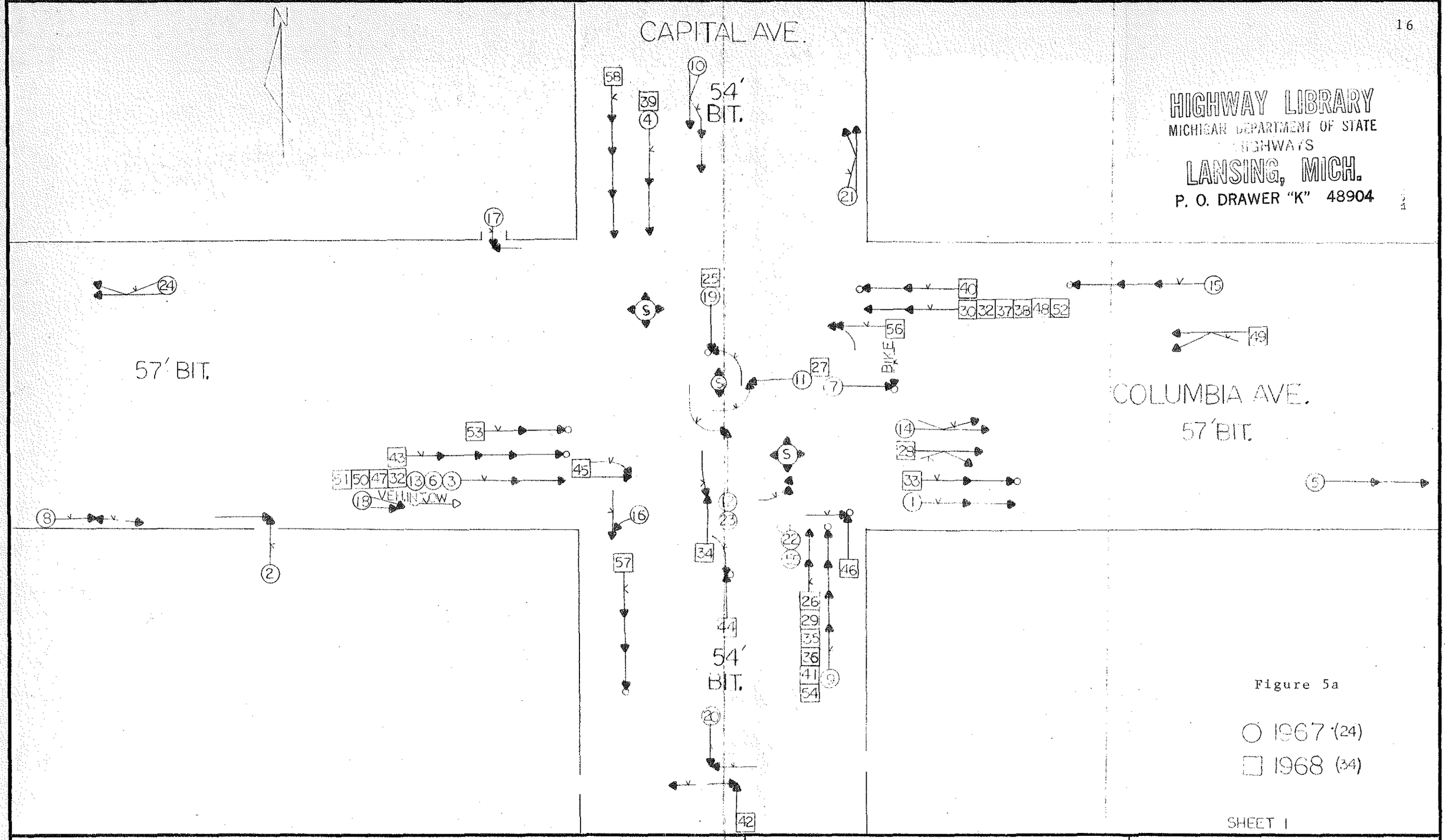


Figure 5a

○ 1967 (24)
□ 1968 (34)

SHEET 1

LEGEND

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

Period: 1967 THRU 1970

Accidents -- Total 133 P.D. 99

Injury 34 (51) Fatal 0 ( )

C.S. _____ Miles _____ Drawn _____

Plan No. LOCATION 2 Date 2-10-72

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location COLUMBIA AT CAPITAL
CITY OF BATTLE CREEK
CALHOUN CO.

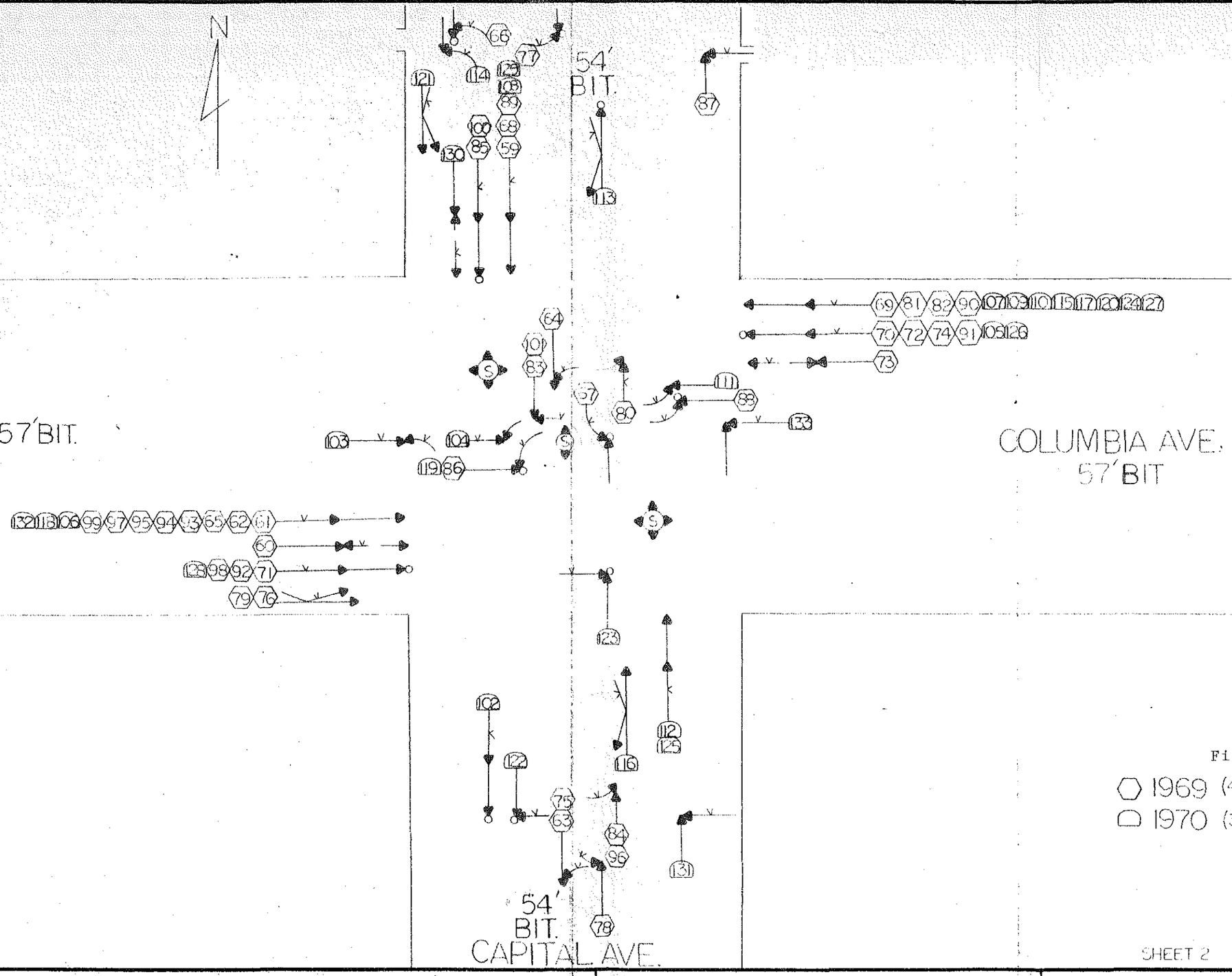


Figure 5b

○ 1969 (43)

□ 1970 (32)

SHEET 2

LEGEND

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

Period: 1967 THRU 1970

Accidents – Total 133 P.D. 99

Injury 34 (51) Fatal 0 ( )

C.S. _____ Miles _____ Drawn DJM

Plan No. LOCATION 2 Date 2-10-72

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location COLUMBIA AT CAPITAL
CITY OF BATTLE CREEK
CALHOUN CO.

NORTHBOUND CAPITAL AVENUE

SOUTHBOUND CAPITAL AVENUE

Figure 5c

EASTBOUND COLUMBIA AVENUE

WESTBOUND COLUMBIA AVENUE

Figure 5d

LOCATION 4 W. TERRITORIAL ROAD AT CAPITAL AVENUE, S.W.

Territorial Road and Capital Avenue intersect to form a right-angle signalized intersection located at the south limits of the City of Battle Creek. Two overhead vehicular signal heads control traffic at this signalized intersection. Southbound traffic on Capital Avenue is permitted (by signing) to turn right after stopping during the red phase.

Capital Avenue is a 42 ft wide bituminous roadway. Parallel parking is permitted on Capital Avenue south of the intersection. Territorial Road is a 34 ft wide bituminous roadway west of the intersection and a 37 ft wide bituminous roadway east of the intersection. Parallel parking is permitted on the north side of both legs of Territorial Road, and angle parking is permitted on the south side.

The prevalent accident during the study period at this high accident location was the rear end type which accounted for 27 of 99 accidents. Also, at this location there were 17 improper turning, 22 improper backing, 17 sideswipes, nine involving parked vehicles, and seven right-angle accidents.

Recommendations

Since most of the existing accident patterns at this location are those which should be improved or possible eliminated by better lane continuity and improved visibility for left turning vehicles, it is recommended that five lane traffic operation be provided at this location. This can be achieved by removing parking on the west side of Capital Avenue south of the intersection and by widening Capital Avenue (west side) north of the intersection (Figure 6d).

Since 14 accidents involved angle parked vehicles, it is recommended that the angle parking on the south side of Territorial Road east and west of the intersection be converted to parallel parking. This parallel parking will not hinder traffic, since it will be between the curb and sidewalk off the driving surface.

In order to improve traffic operations at this location, it is recommended that three traffic lanes be provided on Territorial Road, one for right and thru movements and one for left turns. This can be accomplished by removing parking on the north side of Territorial Road for a distance of 175 ft from the crosswalk, east and west of the intersection (Figure 6d).

Since the "Stop On Red Then Turn Right" sign is not considered legal (Michigan Vehicle Code) without a separate signal head, it is recommended that if the city desires to permit right turns from southbound Capital Avenue, a red flashing arrow signal be installed.

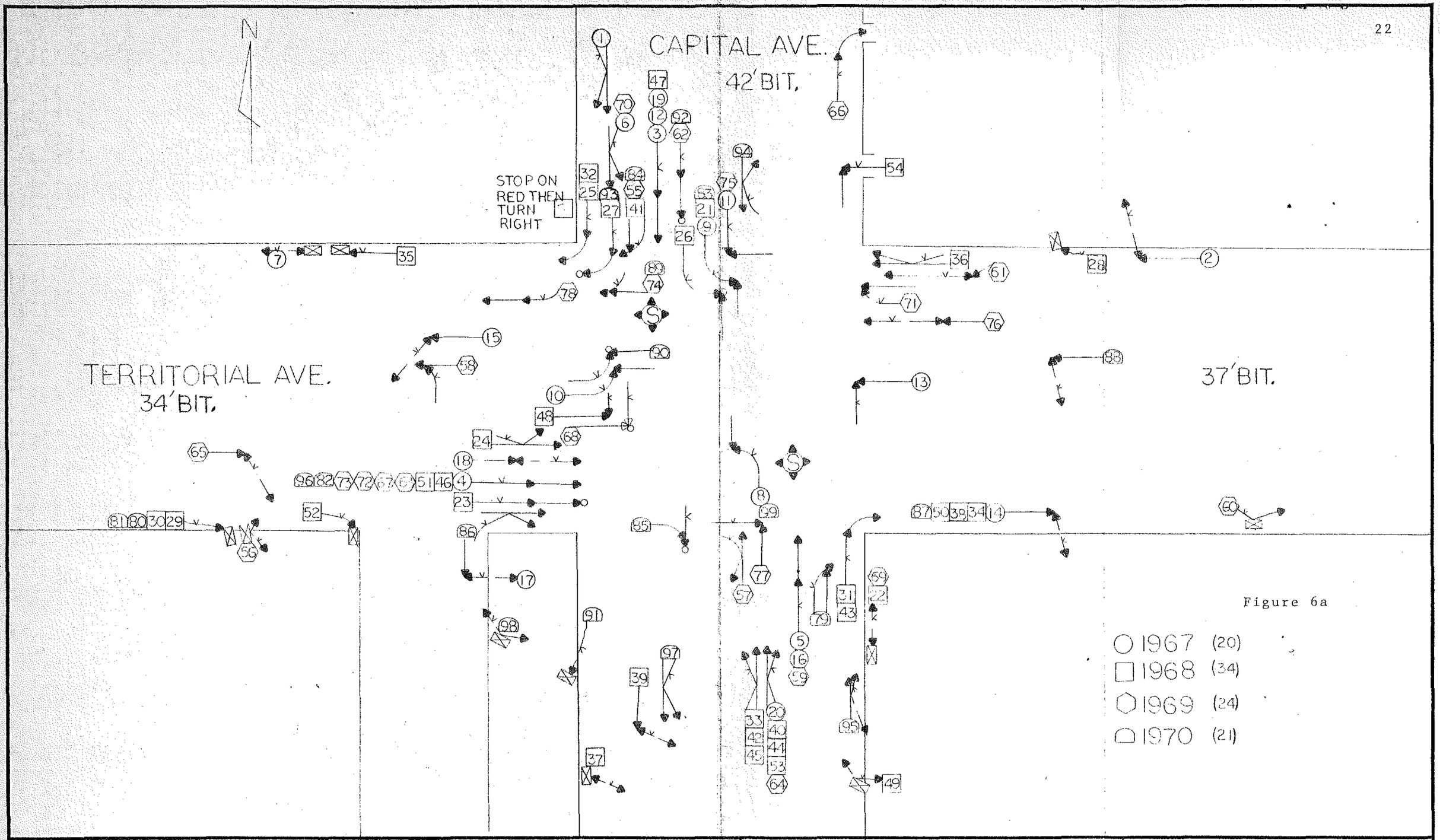


Figure 6a

○ 1967 (20)
□ 1968 (34)
⬡ 1969 (24)
▭ 1970 (21)

LEGEND

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

Period: 1967 THRU 1970

Accidents – Total 99 P.D. 90

Injury 9 (16) Fatal 0 ( )

C.S. _____ Miles _____ Drawn DJM

Plan No. LOCATION 4 Date 1-28-72

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location CAPITAL AT TERRITORIAL
CITY OF BATTLE CREEK
CALHOUN CO.

NORTHBOUND CAPITAL AVENUE

SOUTHBOUND CAPITAL AVENUE

NORTHBOUND PARKING LOT DRIVE

Figure 6b

EASTBOUND TERRITORIAL ROAD

WESTBOUND TERRITORIAL ROAD

Figure 6c

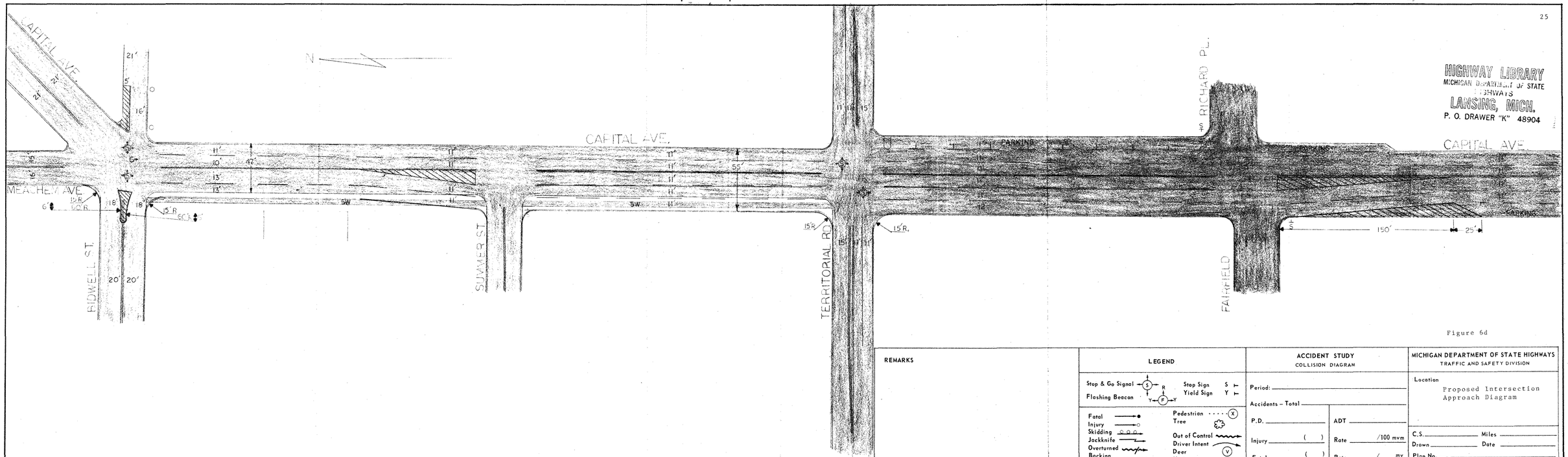


Figure 6d

REMARKS	LEGEND	ACCIDENT STUDY COLLISION DIAGRAM	MICHIGAN DEPARTMENT OF STATE HIGHWAYS TRAFFIC AND SAFETY DIVISION
	Stop & Go Signal (S, R, Y, P, Y) Stop Sign S Yield Sign Y Flashing Beacon Fatal Injury Skidding Jackknife Overturned Backing Pedestrian (X) Tree Out of Control Driver Intent Deer (V) Violator	Period: _____ Accidents – Total _____ P.D. _____ ADT _____ Injury _____ ( ) Rate _____ /100 mvm Fatal _____ ( ) Rate _____ / mv	Location Proposed Intersection Approach Diagram C.S. _____ Miles _____ Drawn _____ Date _____ Plan No. _____

Form 1547 A (Rev. 6/69) Sheet _____ of _____

LOCATION 6 CAPITAL AVENUE AT FOUNTAIN STREET

Capital Avenue at Fountain Street is a four-legged intersection located south of the Central Business District. There are two overhead vehicular signal heads at this intersection.

Capital Avenue is a four lane, 44 ft bituminous roadway north of the intersection and a five lane, 53 ft wide bituminous roadway south of the intersection. Fountain Street is a five lane, 48 ft wide bituminous roadway west of the intersection and a five lane, 51 ft wide bituminous roadway east of the intersection. Parking is prohibited at this intersection. On northbound Capital Avenue there is a traffic Regulatory sign that indicates "Right Lane Must Turn Right".

The collision diagram indicates that the rear end collision, with 27, and the improper turn accident, with 27, occurred with the highest frequency. Other accidents at this location were 16 right-angles, eleven sideswipes, six ran off roadway, four improper backing, one involving a pedestrian and one involving a bicycle.

Recommendations

Since the greatest number of head-on left turn accidents at this location involved southbound to eastbound traffic and since this left turn must be negotiated through a difficult turning angle, it is recommended that the left turn from southbound Capital Avenue onto eastbound Fountain Street be prohibited. This prohibited left turn can be accomplished either north of the intersection on BL-94 or south of the intersection onto the street located south of the Sears Department Store. At this intersection one "No Left Turn" sign (R3-1-36, Appendix II, p. 118) should be erected on the near right corner and one on the far left corner facing approaching traffic. To supplement the "No Left Turn" signs on the corners, it is recommended that a two faced 24 in. x 30 in. case sign be installed with the legend "No Left Turn" facing southbound Capital Avenue traffic and "Center Lane For Left Turn Only" facing northbound Capital Avenue traffic.

The approaches on Fountain Street are divided into a left turn lane, a thru lane and a right turn lane. Since these lanes are very narrow, it is recommended that the pavement be repainted so that each approach lane would be 10 ft wide and that the exclusive right turn lane be converted to a thru and right turn lane. An alternate arrangement (a two lane approach) would be to pavement mark the approach lanes to include a left turn lane and a thru and right turn lane.

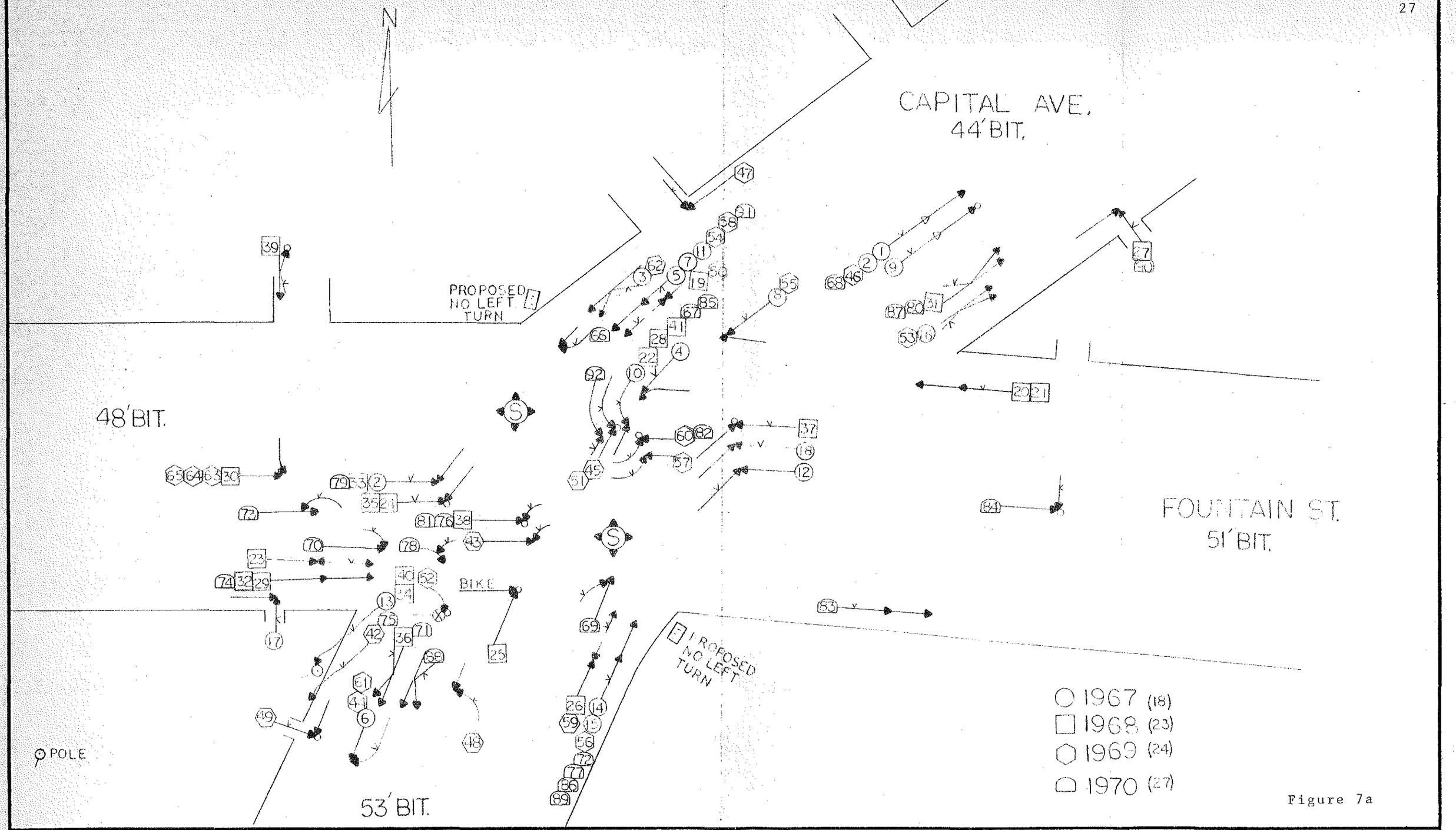


Figure 7a

LEGEND

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

Period: 1967 THRU 1970

Accidents – Total 92 P.D. 76

Injury 16 (28) Fatal 0 ( )

C.S. _____ Miles _____ Drawn DJM

Plan No. LOCATION 6 Date 1-24-72

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location CAPITAL AT FOUNTAIN
CITY OF BATTLE CREEK
CALHOUN CO.

FORM NO. 1347 REV. 5-71

NORTHEASTBOUND CAPITAL AVENUE

SOUTHWESTBOUND CAPITAL AVENUE

Figure 7b

EASTBOUND FOUNTAIN STREET

WESTBOUND FOUNTAIN STREET

Figure 7c

LOCATION 13 CAPITAL AVENUE AT BIDWELL STREET AND MEACHAM AVENUE

Bidwell Street, Meacham Avenue and Capital Avenue form a multi-leg signalized intersection. This location has three overhead vehicular signal heads which provide two signal faces for Capital Avenue traffic and one signal face each for Bidwell Street and Meacham Avenue traffic.

Capital Avenue is a 42 ft wide bituminous roadway extending south-west from the Central Business District and curving to the south at this intersection. Parking is permitted on Capital Avenue north of the intersection.

Bidwell Street is a 40 ft wide bituminous roadway west of the intersection and a 21 ft wide bituminous roadway east of the intersection. Parking is prohibited on the north side of Bidwell Street east of the intersection. Meacham Avenue is a 30 ft wide bituminous roadway extending north from the intersection. Parking is prohibited on the west side of Meacham Avenue.

Rear end collisions occurred with the highest frequency at this location accounting for 18 of 46 accidents during the four-year study period. Other accident types which occurred at this high accident location were ten sideswipes, five ran off roadways, four improper backing, four involving parked vehicles, three right-angles and two improper turning.

Recommendations

To improve the operation of the signal system along Capital Avenue, it is recommended that this intersection be geometrically realigned to create a two phase signal operation. This can be accomplished by requiring (by a traffic island) eastbound traffic on Bidwell Street west of the intersection to turn right. An alternate solution would be to create a one way westbound street on Bidwell east of the intersection for one block. The east leg of Bidwell Street will be closed by a traffic island prohibiting egress onto Capital Avenue; however, northbound Capital Avenue traffic will be permitted to turn right onto Bidwell Street and two-way traffic will be maintained on Bidwell Street east of the intersection.

The new phasing of the signal at this location will include two continual indications, a green indication for northbound Capital Avenue and stop sign for the right turn off the west leg of Bidwell Street. Phase A would permit southbound traffic on Capital Avenue to have the right-of-way. Phase B would permit southbound traffic on Meacham Avenue and northbound traffic wanting to go from Capital Avenue to Meacham Avenue to have the right-of-way.

It is recommended that two Lane Use Control signs (R3-8-30, Appendix II, p. 120) be erected for northbound Capital Avenue traffic south of the intersection to indicate that one lane is for thru traffic and the other lane is for traffic turning right.

It is also recommended that parking be prohibited on Bidwell Street east of the intersection on the south side of the street. The street's width (21 ft) creates conflicts when two vehicles confront each other and this situation is intensified by allowing parking on one side of the street.

It is further recommended that the left turn off southbound Capital Avenue be prohibited. Two "No Left Turn" signs (R3-1-36, Appendix II, p. 118) should be erected, on one the near right corner and one on the far left corner facing approaching traffic.

It is also recommended that another signal face be installed for southbound Meacham Avenue so that this intersection conforms with the recommendation of the new MANUAL.

Furthermore, it is recommended that the west side of Capital Avenue south of Bidwell Street be widened five ft for one block. Then traffic will be able to travel on southbound Capital Avenue through the intersection and will be able to remain in their proper (13 ft) lane; thereby, reducing the sideswipe accidents at this location. This recommendation is also made in conjunction with Location #4.

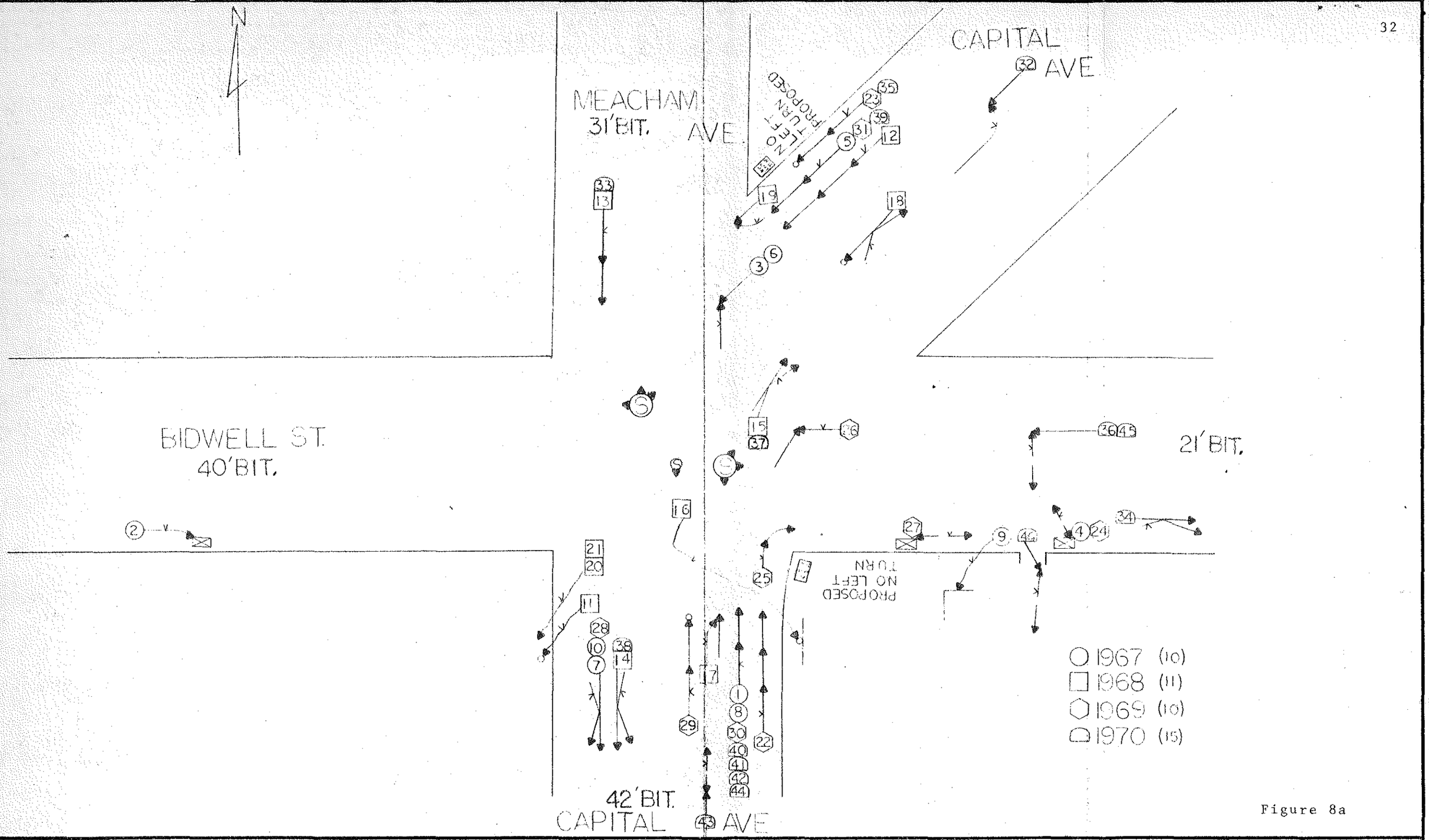


Figure 8a

LEGEND

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

Period: 1967 THRU 1970

Accidents – Total 46 P.D. 40

Injury 6 (7) Fatal 0 ( )

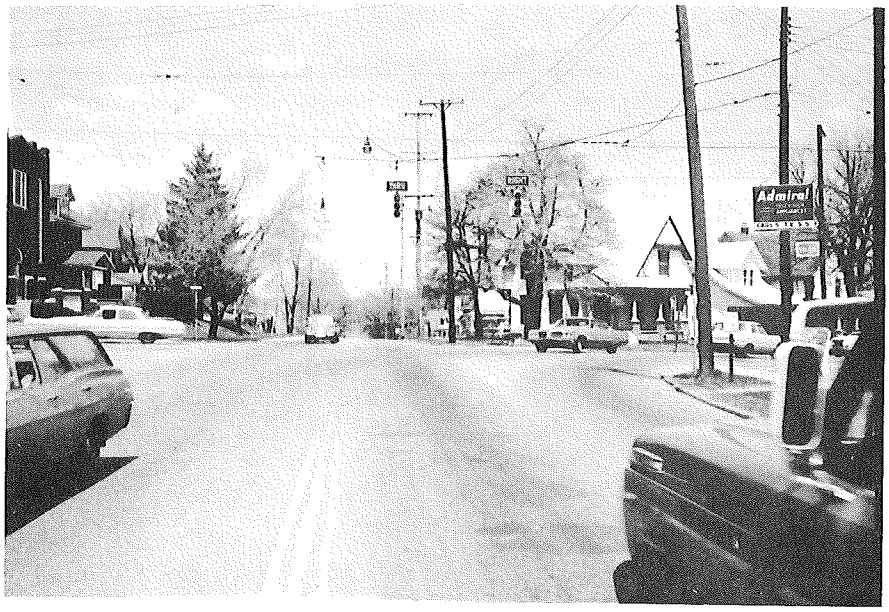
C.S. _____ Miles _____ Drawn DJM

Plan No. LOCATION 13 Date 12-7-71

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location CAPITAL AT BIDWELL AND MEACHAM
CITY OF BATTLE CREEK
CALHOUN CO.

FORM NO. 1547 REV. 5-71



NORTHBOUND CAPITAL AVENUE

AND MEACHAM AVENUE

SOUTHBOUND CAPITAL AVENUE

AND MEACHAM AVENUE

SOUTHWESTBOUND CAPITAL AVENUE

Figure 8b

EASTBOUND BIDWELL STREET

WESTBOUND BIDWELL STREET

Figure 8c

North Avenue (McCamly Street to Roosevelt Avenue)

This route includes: Locations #3, 8, 11

North Avenue is a major city street providing access to and from the northern section of the city to the Central Business District. From Calhoun Street to Emmett Street there are two lanes for moving vehicles due to the on-street parking. From Emmett Street to Roosevelt Avenue, North Avenue has four lanes of moving traffic.

To improve capacity along this north-south route, it is recommended that parking be prohibited between McCamly Street and Emmett Street during the peak periods. Also, this roadway operation will be greatly improved if the signals are interconnected creating progressive movement inbound and outbound on North Avenue during the peak periods.

LOCATION 3 ROOSEVELT AVENUE AT NORTH AVENUE

Roosevelt Avenue and North Avenue intersect to form a right-angle signalized intersection located in the north portion of the city. This signalized intersection has two overhead vehicular signal heads.

North Avenue is a four lane, 40 ft wide bituminous roadway providing the city with a major north-south route to and from the Central Business District. North Avenue has a positive gradient in the northerly direction. Roosevelt Avenue is a four lane, 46 ft wide bituminous roadway west of the intersection and a two lane, 24 ft wide bituminous roadway east of the intersection. Roosevelt Avenue has an ascending gradient approaching the intersection from the east. Parking is prohibited at this intersection.

The collision diagram indicates that turning accidents were the prevalent type during the four-year study period. The accident breakdown by type at this high accident location shows 55 improper turns, 16 rear ends, 15 right-angles, 15 sideswipes, two ran off roadways and one miscellaneous. Of the 55 turning accidents 33 occurred as vehicles attempted to turn from northbound North Avenue onto westbound Roosevelt Avenue. Thirty-four of the accidents happened on wet pavement at this location.

Recommendations

Permanent Recommendation:

From the collision diagram it is apparent that there is a left turn problem for northbound North Avenue traffic. It is, therefore, recommended that the City of Battle Creek create a five lane, 55 ft wide roadway for north and southbound North Avenue (Figure 9d) traffic by adding 7.5 ft to each side of the existing roadway. The fifth lane would accommodate the vehicles that want to turn left.

Furthermore, it is recommended that the east leg (Roosevelt Avenue) be flared from two lanes (24 ft) to four lanes (48 ft) at the intersection, and a landing zone of approximately 50 ft should be constructed at this location. The added lanes will permit vehicles to go around left turning traffic.

Interim Recommendation:

The City of Battle Creek has recently installed a left turn green arrow for northbound North Avenue and a right turn flashing red arrow for eastbound Roosevelt Avenue. These arrows operate at the beginning of the green phase for northbound North Avenue.

Since the "leading" left turn green arrow gives no warning of the impending change in right-of-way assignment, and since this operation is in violation of the Michigan Manual, it is, therefore, recommended that these arrows be removed.

It is recommended that the left turn from northbound North Avenue to westbound Roosevelt Avenue be prohibited. This maneuver can be accomplished either at Springview Drive located south of the intersection, or Goodale Street located north of the intersection. The prohibiting of the left turn will necessitate the erection of two "No Left Turn" signs (R3-1-24), one for the near right corner (southeast) and one for the far left corner (northwest) approaching traffic.

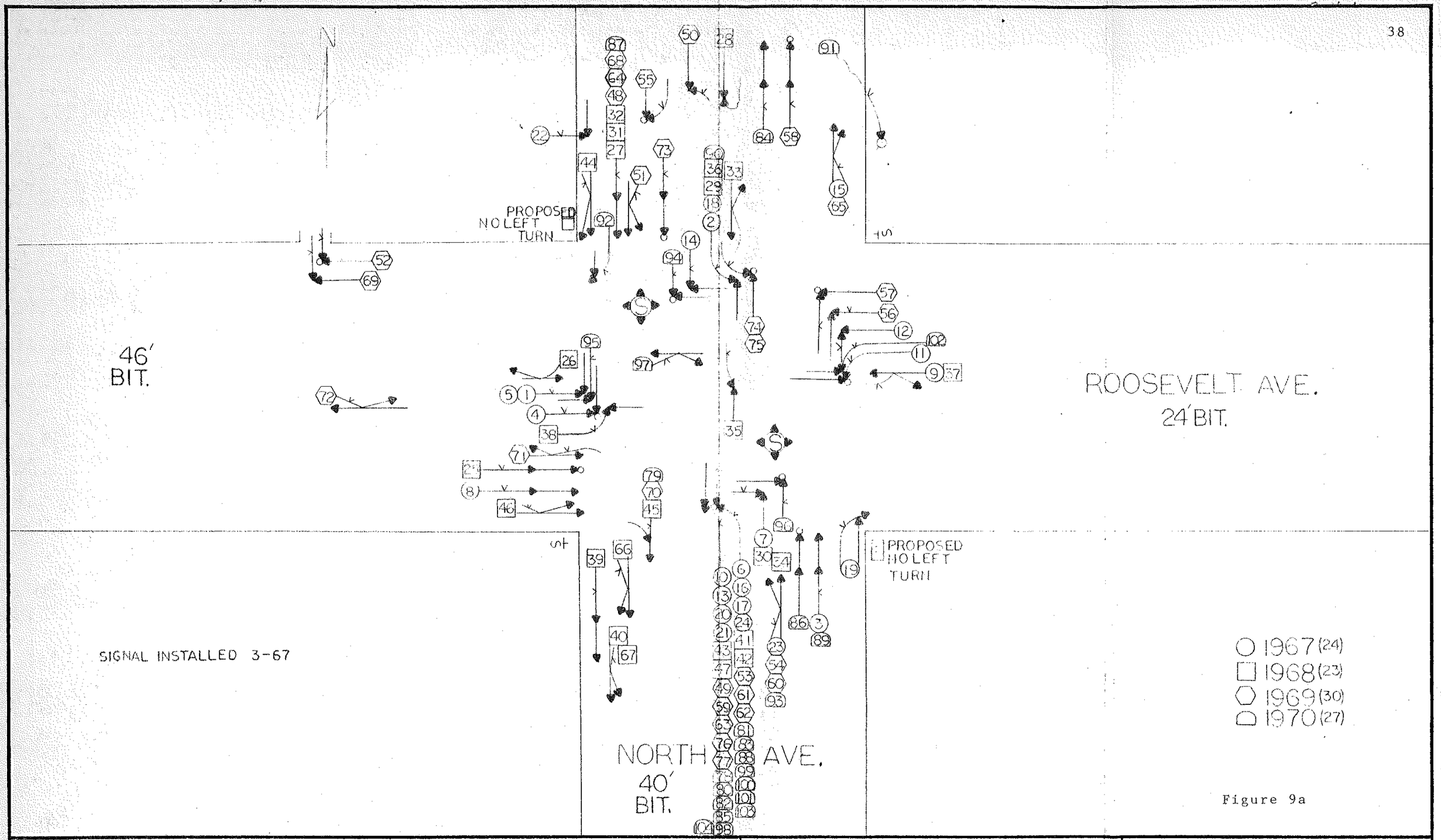


Figure 9a

LEGEND

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

Period: 1967 THRU 1970

Accidents -- Total 104 P.D. 75

Injury 29 (45) Fatal 0 ( )

C.S. _____ Miles _____ Drawn DJM

Plan No. LOCATION 3 Date 2-2-72

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location ROOSEVELT AT NORTH
CITY OF BATTLE CREEK
CALHOUN CO.

NORTHBOUND NORTH AVENUE

SOUTHBOUND NORTH AVENUE

Figure 9b

EASTBOUND ROOSEVELT AVENUE

WESTBOUND ROOSEVELT AVENUE

Figure 9c

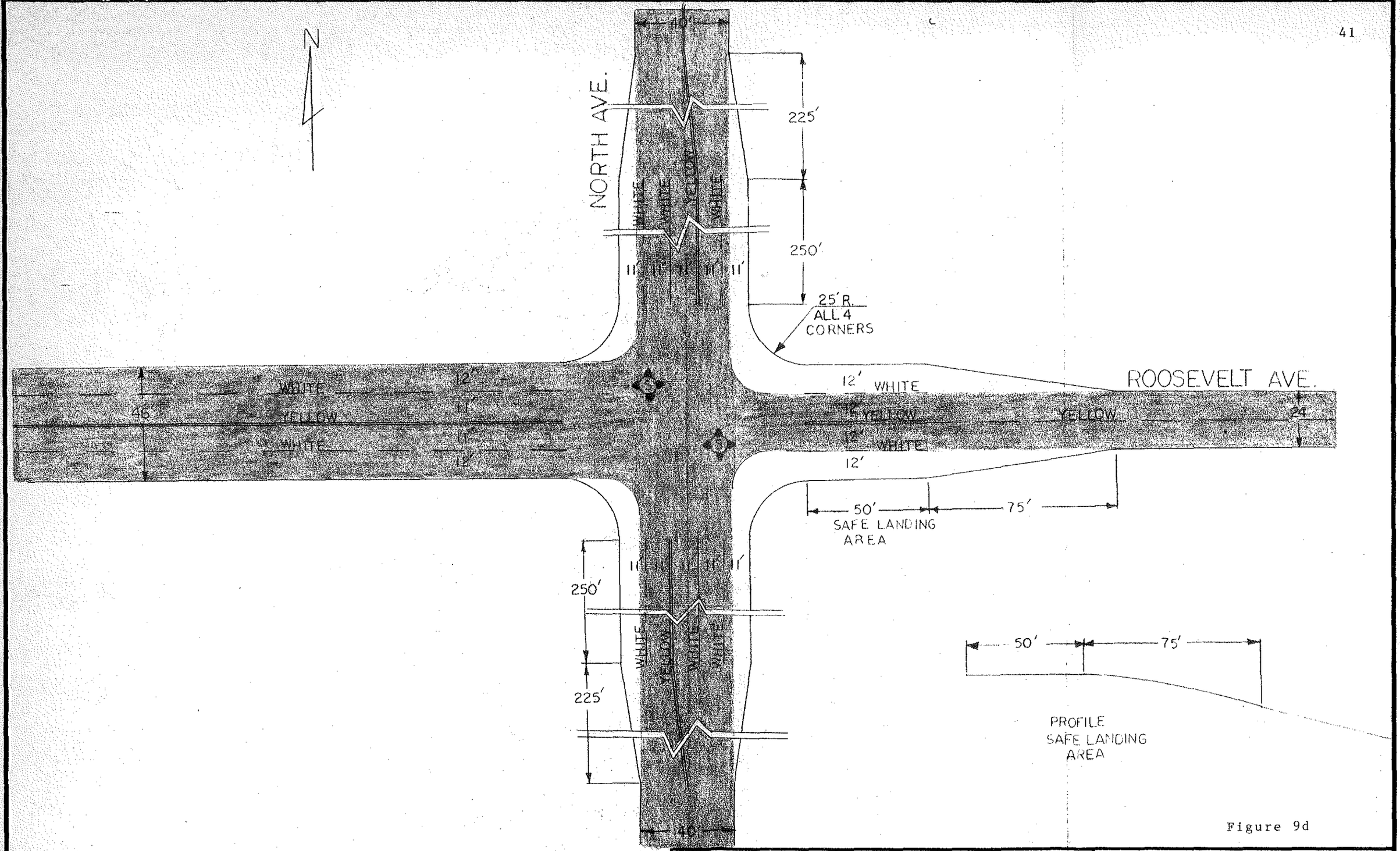


Figure 9d

STATE OF MICHIGAN DEPARTMENT OF STATE HIGHWAYS TRAFFIC & SAFETY DIVISION	AUTH. NO.	DRAWN DJM	PROPOSED WIDENING AND PAVEMENT MARKINGS
	CONT. SEC.	DATE 3-9-72	
	REF.	SCALE	
	SHEET OF	PLAN	

FORM 1595A (REV. 10-68)

LOCATION 8 NORTH AVENUE AT EMMETT STREET

North Avenue and Emmett Street intersect to form a right-angle signalized intersection. This location has two overhead vehicular signal heads. North Avenue is a four lane, 44 ft wide bituminous roadway. Emmett Street is a four lane, 40 ft wide bituminous roadway west of the intersection and a four lane, 44 ft wide bituminous roadway east of the intersection. On-street parking is prohibited at this location.

The remaining traffic controls at this location consist of elongated pavement marking arrows which exist on all legs of this intersection. The arrows indicate that on each two lane approach one lane is for left turns and the other lane is for thru and right turn traffic.

There were 77 accidents at this location during the four-year study period. Thirty-nine of these accidents were of the rear end variety. The remaining accidents involved 17 improper turns, nine sideswipes, five right-angles, three improper backing, two ran off roadways, one head-on and one involving a bicycle. Over 50 percent of the accidents at this location occurred on wet pavement.

Recommendations

A capacity analysis of the approaches to the intersection reveals the following Levels of Service:

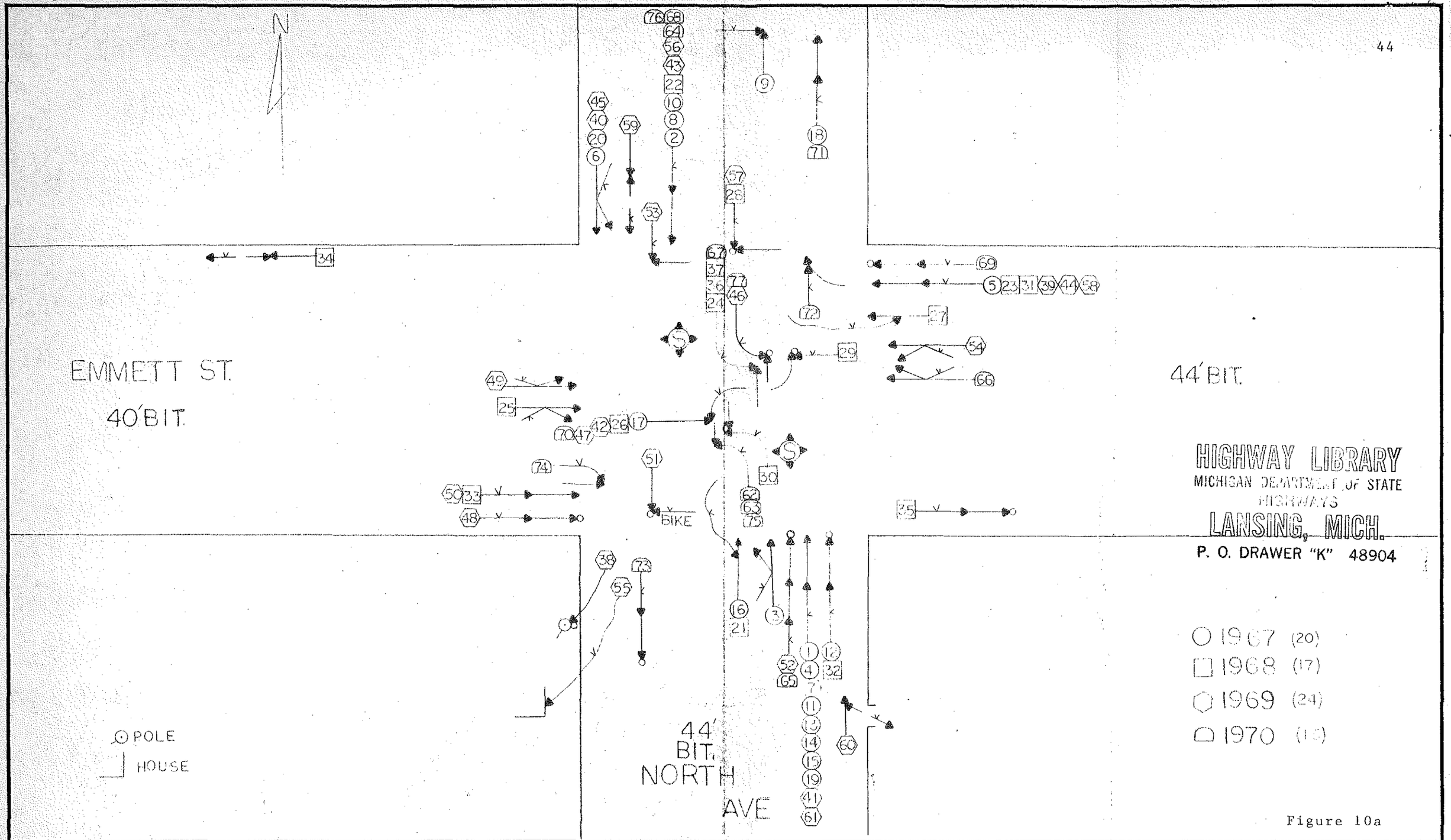
	North Avenue	
Southbound	Left	E
	Thru-Right	B
Northbound	Left	A
	Thru-Right	E
	Emmett Avenue	
Eastbound	Left	E
	Thru-Right	E
Westbound	Left	A
	Thru-Right	E

By constructing an exclusive left turn lane for North Avenue and by using a 50-50 cycle split at this intersection, the following Levels of Service are achieved:

	North Avenue	
Southbound	Left	C
	Thru	A
Northbound	Left	A
	Thru	A
	Emmett Avenue	
Eastbound	Left	C
	Thru	A
Westbound	Left	A
	Thru	A

Therefore, it is recommended that an exclusive left turn lane for north and southbound North Avenue be constructed at this intersection. This can be accomplished by adding 5.5 ft on each side of the street (Figure 10d). The proposed improvement will not only improve the capacity of the intersection, but will improve visibility for the completion of left turns.

Since over half of the accidents occurred on wet pavement, it is recommended that the City of Battle Creek have skidometer tests conducted at this location.



○ 1967 (20)
□ 1968 (17)
⬡ 1969 (24)
▭ 1970 (16)

Figure 10a

LEGEND

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

Period: 1967 THRU 1970

Accidents – Total 77 P.D. 61

Injury 16 (26) Fatal 0 ( )

C.S. _____ Miles _____ Drawn DJM

Plan No. LOCATION 8 Date 1-12-72

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

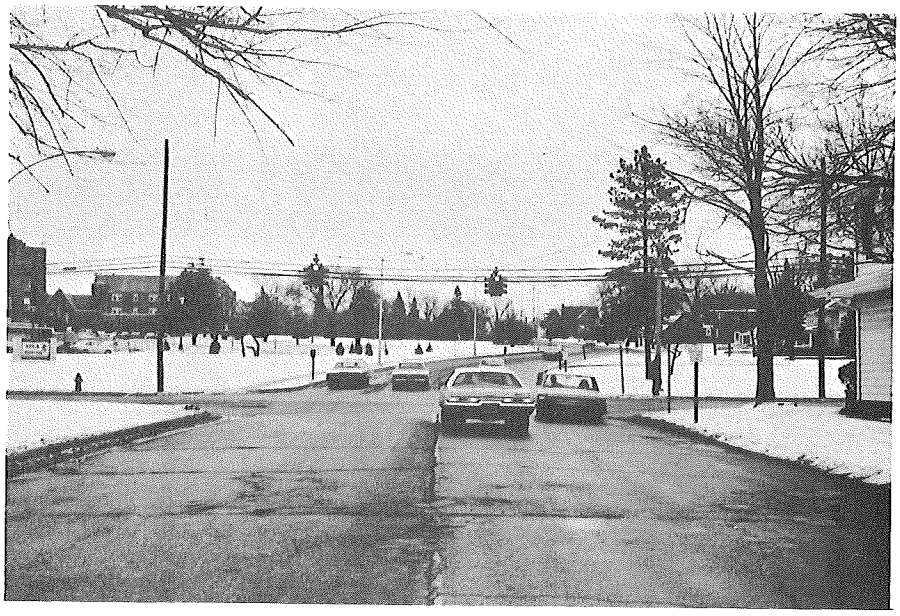
Location EMMETT AT NORTH
CITY OF BATTLE CREEK
CALHOUN CO.

FORM NO. 1547 REV. 5-71

NORTHBOUND NORTH AVENUE

SOUTHBOUND NORTH AVENUE

Figure 10b



EASTBOUND EMMETT STREET

WESTBOUND EMMETT STREET

Figure 10c

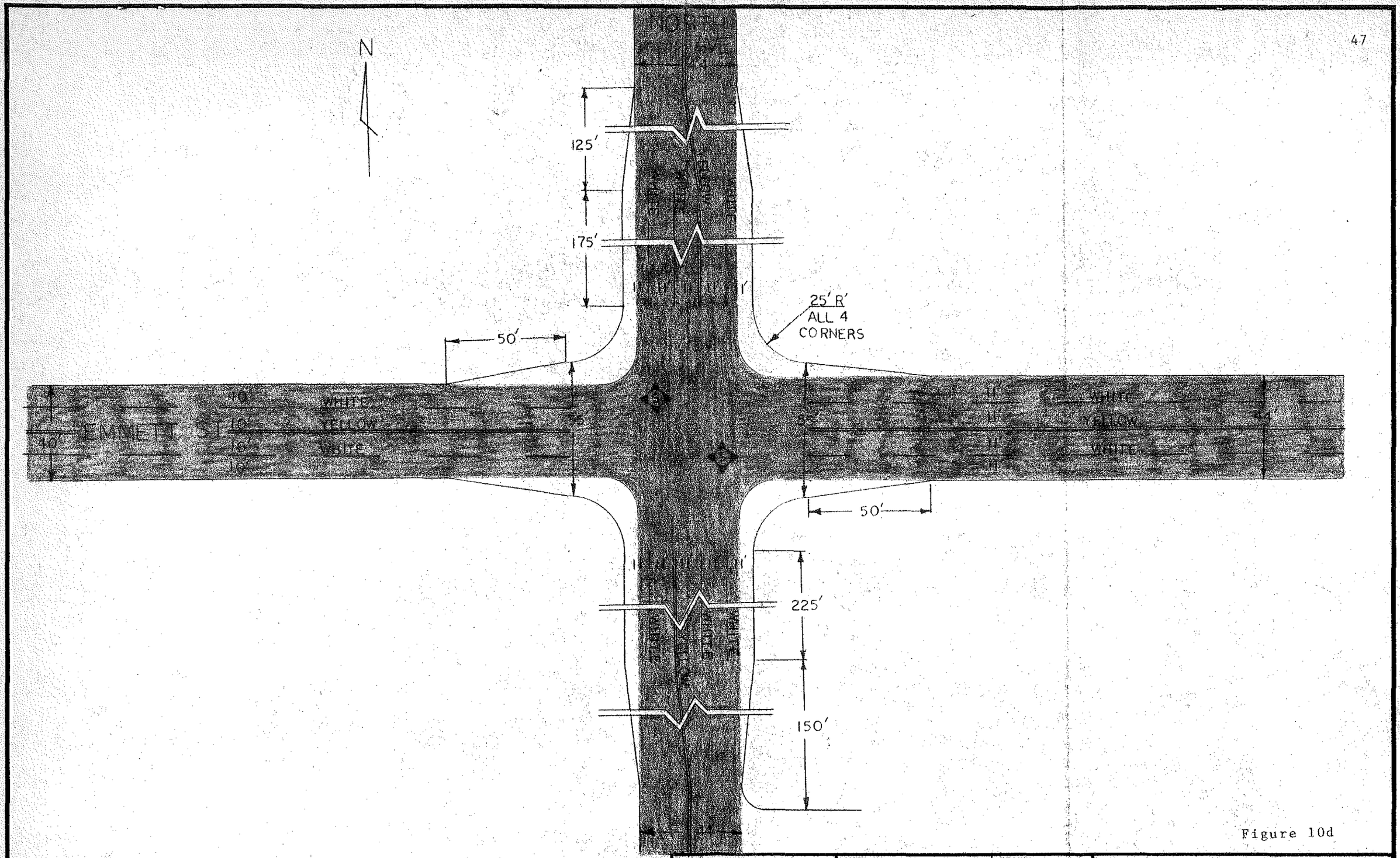


Figure 10d

STATE OF MICHIGAN DEPARTMENT OF STATE HIGHWAYS TRAFFIC & SAFETY DIVISION	AUTH. NO.	DRAWN DJM	PROPOSED WIDENING AND PAVT. MARKINGS.
	CONT. SEC.	DATE	
	REF.	SCALE	
	SHEET OF	PLAN	

LOCATION 11 NORTH AVENUE AT McCAMLY STREET AND CALHOUN STREET

This location can be divided into two major intersections: North Avenue at Calhoun Street, a right angle intersection; and North Avenue at McCamly Street, a channelized "Y" intersection. Minor intersections in the immediate area are North Avenue at Adams Street just south of the above locations and Champion Street at McCamly Street west of the above locations. A new one way street recently constructed is located immediately west of the major intersections.

North Avenue is a 45 ft wide bituminous roadway south of Calhoun Street and a 42 ft wide bituminous roadway north of Calhoun Street. Parking on North Avenue is permitted south of McCamly Street and north of Calhoun Street. Calhoun Street is a 37 ft wide bituminous roadway.

McCamly Street is a 47 ft wide bituminous roadway. As McCamly Street approaches the "Y" intersection, it is divided into two one-way segments by a traffic island. Parking on McCamly Street is permitted on the east side only.

Traffic controls at the North Avenue-Calhoun Street intersection include a single overhead vehicular signal head, and a separate lens (green arrow) for left turns from northbound Worth Avenue to westbound Calhoun Street, and three "Move On Green Only" signs located on the signal head. At the McCamly Street-North Avenue intersection there is one overhead vehicular signal head, a "Stop On Red Then Turn Right", a "Do Not Enter", and a "Do Not Block The Intersection" sign for eastbound McCamly Street traffic. At the intersection of North Avenue and Adams Street there are two flashing beacons, one for northbound Adams Street (yellow lens) and one for northbound North Avenue (red lens). In addition there is a 24" stop sign for northbound North Avenue traffic. The one way connection between McCamly and Calhoun Street has a yield sign for southwestbound traffic.

The prevalent accident type at this location during the four-year study period was the right-angle accident accounting for 23 of the 58 accidents. Also, there were 16 rear ends, six improper backing, four improper turns, four sideswipes, two ran off roadways, two involving parked vehicles and one head-on accident. Twenty-one of the accidents at this location occurred on wet pavement.

Recommendations

There were a substantial number of right-angle accidents at the Calhoun Street-North Avenue intersection due to drivers making a left turn (northbound) from McCamly Street to North Avenue and then proceeding north through the Calhoun Street intersection without properly observing the given signal indication (red). It is our opinion that these accidents were caused by drivers who thought that this signal was in progression with the one at McCamly Street. Since existing geometrics at this location does not lend itself to good signalization or signal progression, it is recommended that this intersection be redesigned (Figure 11e) and the traffic movement from the west-north be made the predominant movement. In conjunction with the redesign of this intersection it is recommended that the existing signal at McCamly Street and North Avenue (Figure 11e) be relocated and that all signals have as a minimum one signal face per approach lane.

This change in geometrics will enable the signals at the Calhoun-North Avenue intersection and the McCamly Street-North Avenue intersection to operate as two phase signals (with a delayed clearance interval to clear vehicles entrapped between signals). In conjunction with the two phase operation it is recommended that at the McCamly Street-North Avenue intersection the left turn for southbound traffic be prohibited. This turn can be made farther south on McCamly Street at Jackson Avenue (M-37). It is also recommended that the left turn from southbound North Avenue at Calhoun Street be prohibited. This turn can be made north of this location on Groveland Street. It is further recommended that traffic northbound on North Avenue and northbound on Adams Street be required to turn right at the McCamly Street-North Avenue intersection. This turn can also be permitted during the green phase for McCamly Street traffic (flashing red arrow). In order to achieve the desired results of the prohibited left turns it is recommended that case signs be used at each location to indicate the prohibition. At the Calhoun Street-North Avenue intersection a two faced case sign with the legend "No Left Turn" for southbound traffic and "No Left Turn" 3:00 p.m.-6:00 p.m. for northbound traffic should be used. At the McCamly Street-North Avenue intersection a four-sided case sign with the legend "No Left Turn" for both north and southbound traffic and "Right Turn Only" for westbound traffic should be used.

Finally, it is recommended that a two lane approach be implemented on both legs of Calhoun Street by utilizing all of the existing pavement width. This can be done with pavement markings.

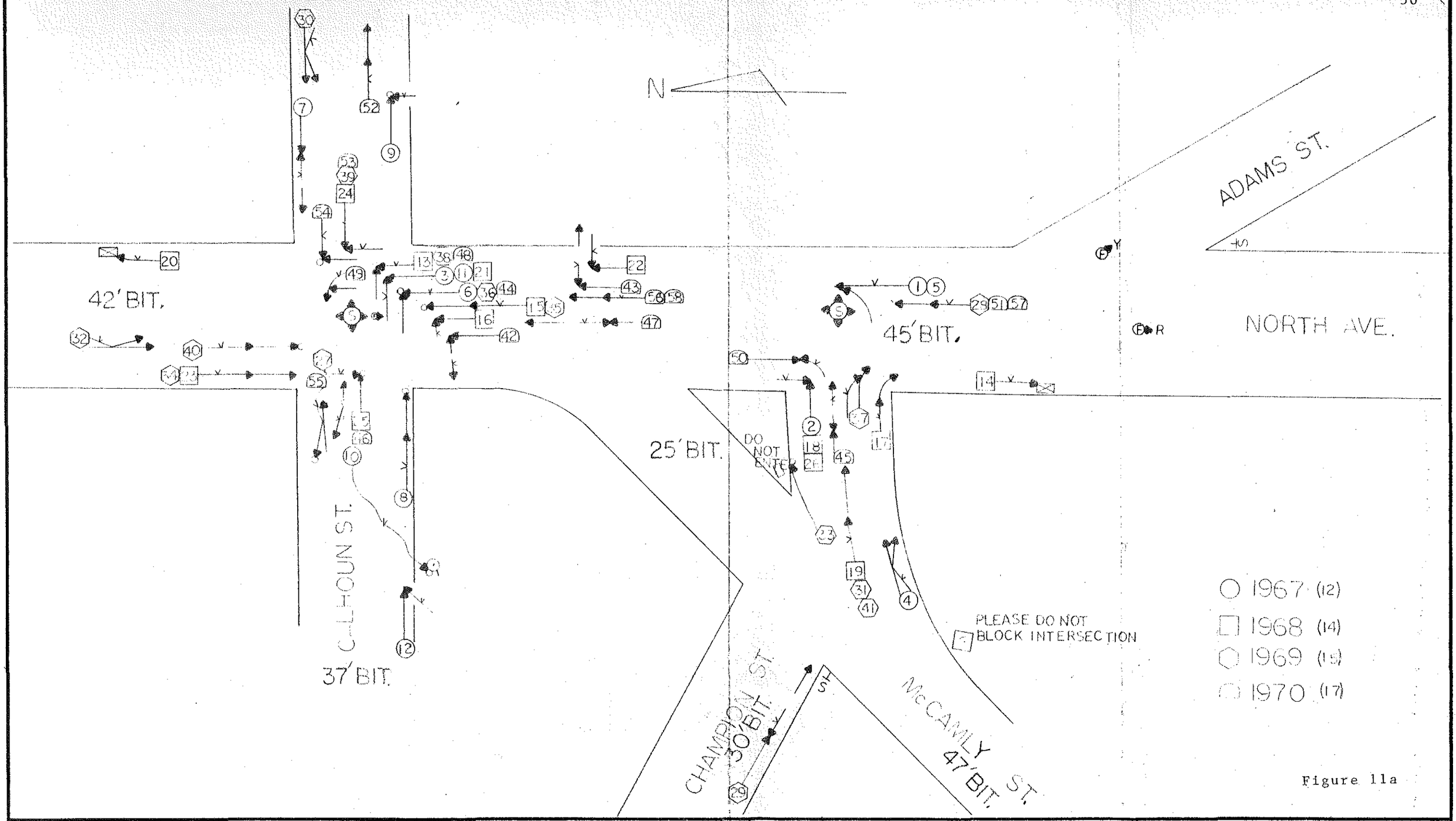


Figure 11a

LEGEND

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

Period: 1967 THRU 1970

Accidents – Total 58 P.D. 45

Injury 13 (18) Fatal 0 ( )

C.S. _____ Miles _____ Drawn DJM

Plan No. LOCATION 11 Date 1-5-72

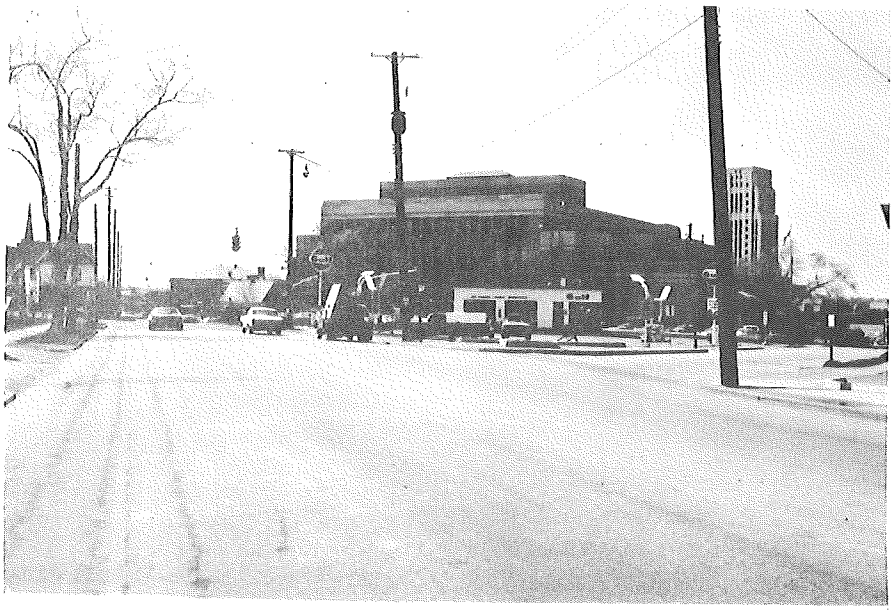
MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location NORTH AT MCCAMLY + CALHOUN
CITY OF BATTLE CREEK
CALHOUN CO.

FORM NO. 1547 REV. 5-71

SOUTHBOUND NORTH

AVENUE @ CALHOUN STREET



SOUTHBOUND NORTH

AVENUE @ McCAMLY STREET

SOUTHBOUND NORTH

AVENUE @ ADAMS STREET

Figure 11b

EASTBOUND

CALHOUN STREET

NORTHBOUND

NORTH AVENUE

WESTBOUND

CALHOUN STREET

Figure 11c

NORTHEASTBOUND

McCAMLY STREET

McCAMLY STREET AT

THE CROSSOVER

SOUTHWESTBOUND
McCAMLY STREET

Figure 11d

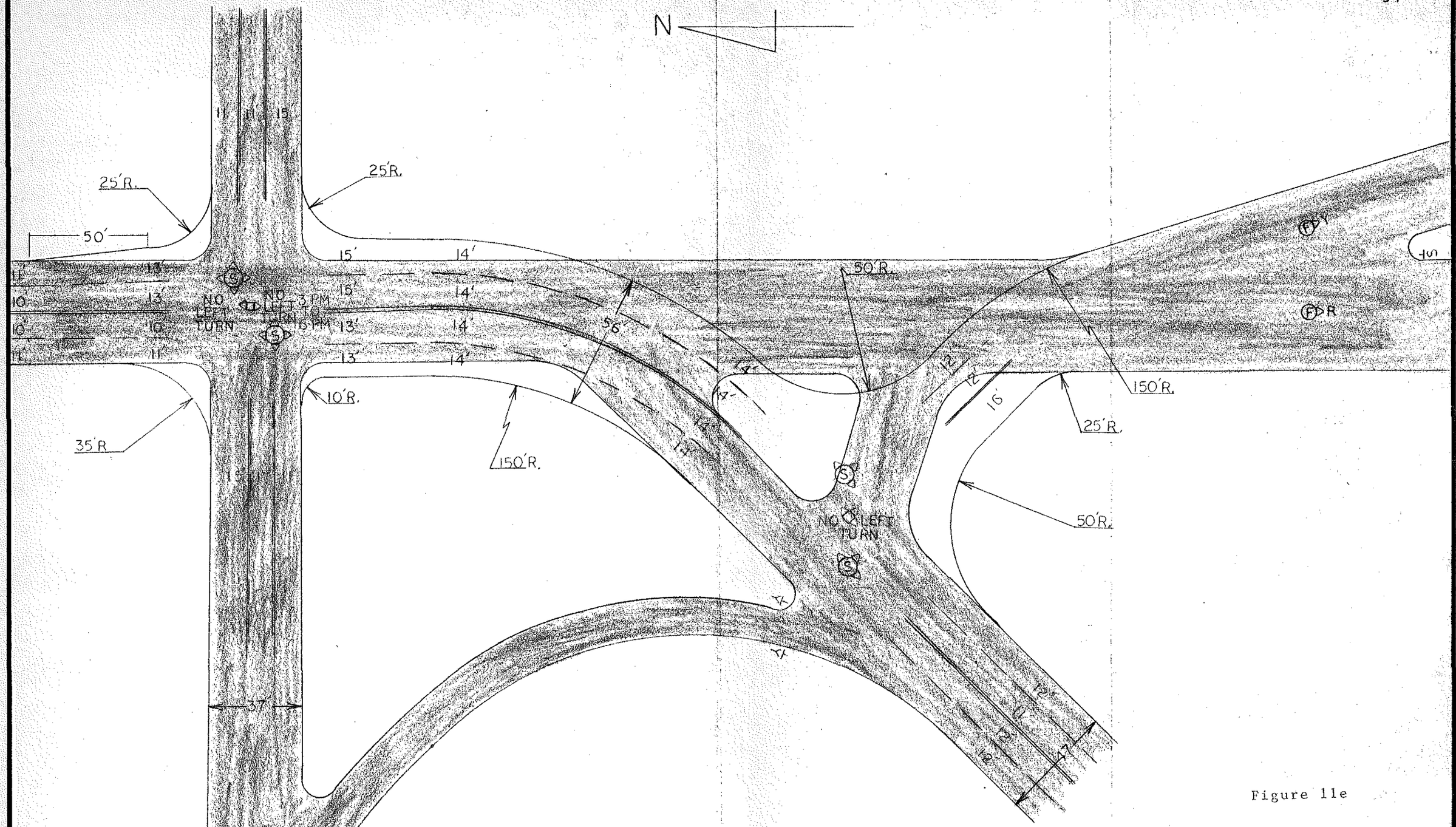


Figure 11e

STATE OF MICHIGAN DEPARTMENT OF STATE HIGHWAYS — TRAFFIC & SAFETY DIVISION	AUTH. NO.	DRAWN DJM	PROPOSED INTERSECTION APPROACH DIAGRAM
	CONT. SEC.	DATE	
	REF.	SCALE 1"=40'	
	SHEET OF	PLAN	

FORM 1595A (REV. 10-68)

W. Michigan Avenue (Angell-Jordan Street to Carlyle-State Street

This route includes: Locations #7,10,14,19

Michigan Avenue is a four lane roadway, providing two driving lanes through the City of Battle Creek. This segment of Michigan Avenue is located west of the Central Businesses District. Parking is permitted on both sides of Michigan Avenue from Angell-Jordan Street to Carlyle-State Street; however, it is prohibited in the immediate areas so that ample space remains for turning movements at each intersection.

It is recommended, however, that the City of Battle Creek restrict parking on Michigan Avenue during the peak periods. The signals on this segment of roadway should provide progressive traffic movement inbound and outbound during the peak periods.

It is further recommended that skidometer tests be conducted on the main intersections on this segment of Michigan Avenue, since a high percentage of the accidents along this segment occurred on wet pavement.

LOCATION 7 MICHIGAN AVENUE AT WASHINGTON AVENUE

Michigan Avenue and Washington Avenue intersect to form a right-angle intersection. This signalized location has two overhead vehicular signal heads.

Michigan Avenue is a two lane (moving traffic only), 46 ft wide bituminous roadway. Parking is permitted on Michigan Avenue. Washington Avenue is a four lane, 46 ft wide bituminous roadway north of the intersection and a four lane, 42 ft wide bituminous roadway south of the intersection. Parking is prohibited on Washington Avenue.

Additional traffic controls at this location include an internally illuminated 4-Way Case sign bearing the legend "No Left Turn". Also, there are "No Left Turn" signs on the northwest and southeast corners. Buses are permitted to make a left turn from southbound Washington Avenue to eastbound Michigan Avenue.

A tabulation of the accident reports for this intersection during the four-year study period indicated that there were 40 rear end accidents. Furthermore, 35 of the accidents that occurred at this location happened on wet pavement. The remaining accidents at this location consisted on 22 right-angles, seven sideswipes, six improper backing, five improper turns, three involving parked vehicles, two involving pedestrians and one ran off roadway.

Recommendations

Since a large number of accidents occurred on wet pavement, meeting the requirements for skidometer testing under Method #1 and Method #2 which is presented in the Traffic Engineering Analysis section, it is recommended that the city have skidometer tests conducted at this location.

It is also recommended that a two-second all red clearance interval be installed at this signalized intersection. The all red clearance interval should reduce the number of right-angle accidents.

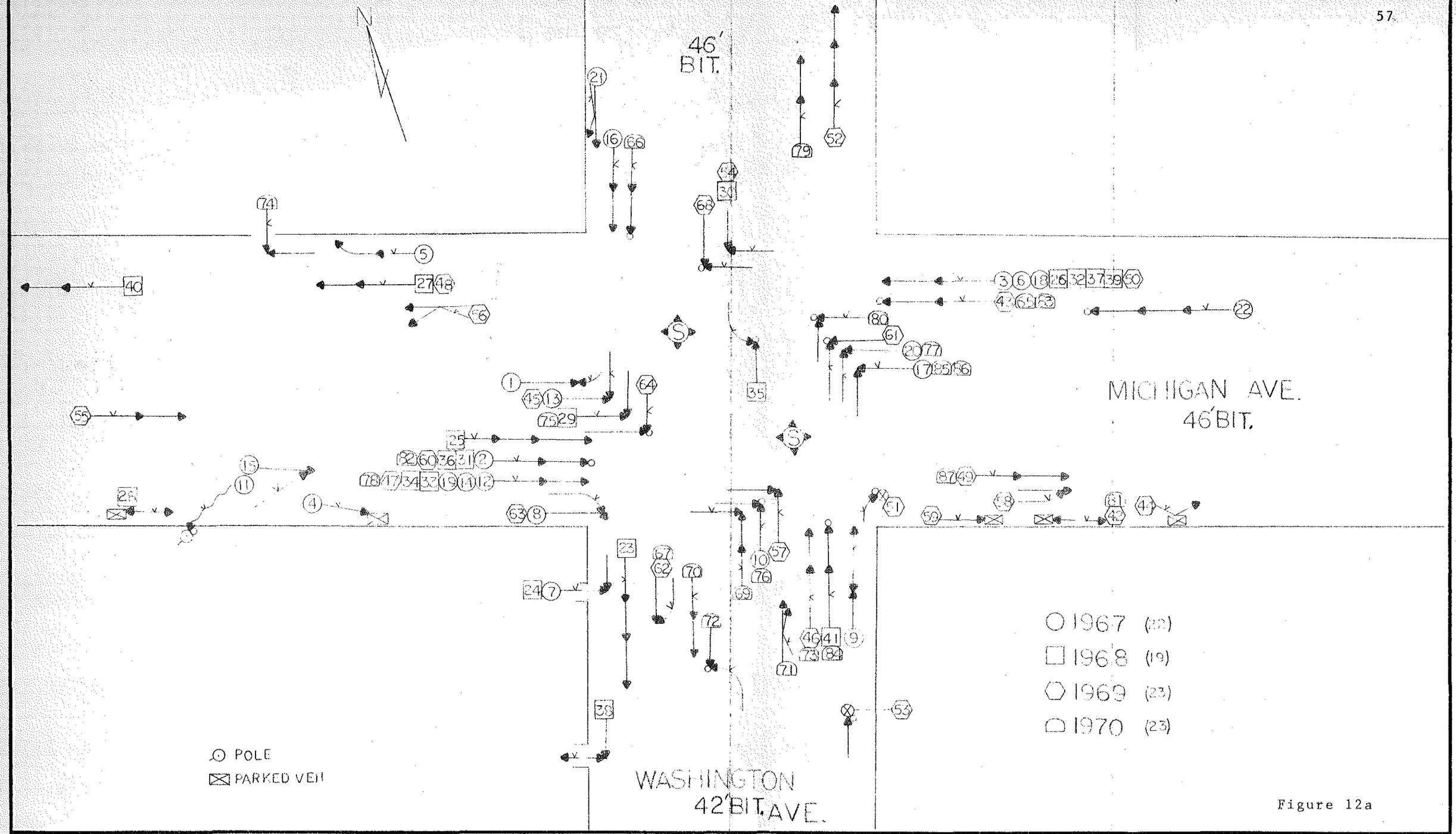


Figure 12a

LEGEND

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

Period: 1967 THRU 1970

Accidents – Total 87 P.D. 64

Injury 23 (25) Fatal 0 ( )

C.S. _____ Miles _____ Drawn DJM

Plan No. LOCATION 7 Date 1-13-72

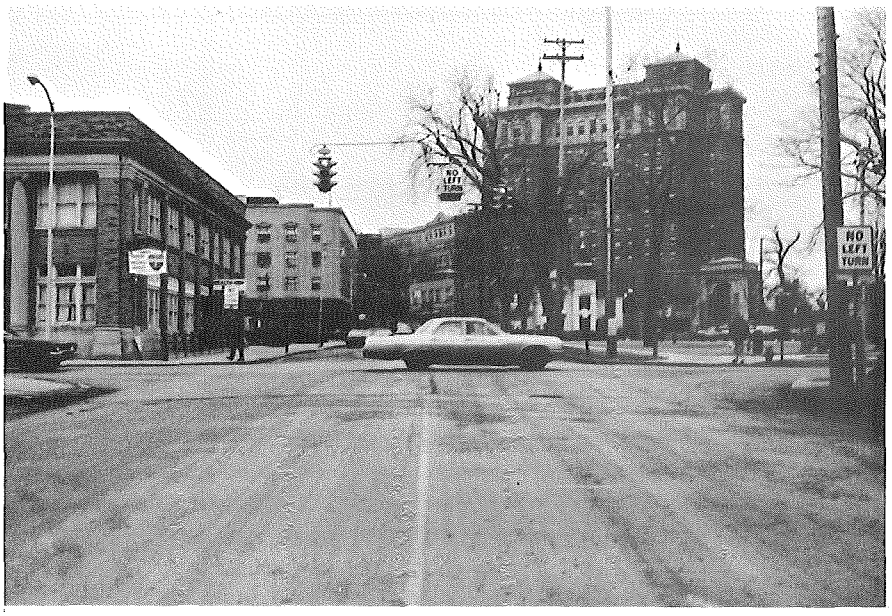
MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location MICHIGAN AT WASHINGTON
CITY OF BATTLE CREEK
CALHOUN CO.

EASTBOUND MICHIGAN AVENUE

WESTBOUND MICHIGAN AVENUE

Figure 12b



NORTHBOUND WASHINGTON AVENUE

SOUTHBOUND WASHINGTON AVENUE

Figure 12c

LOCATION 10 MICHIGAN AVENUE AT KENDALL STREET

Michigan Avenue intersects Kendall Street to form a right-angle signalized intersection. This location has two overhead vehicular signal heads in operation.

Michigan Avenue is a 42 ft wide bituminous roadway. Parking is permitted on each side of the street, except for the immediate intersection area so that it does not interfere with the turning movement at this location. Kendall Street is a 44 ft wide bituminous roadway south of the intersection and 42 ft wide bituminous roadway north of the intersection. Parking is not permitted on Kendall Street.

Other traffic control devices at this intersection are a "Stop On Red Then Turn Right" sign for westbound Michigan Avenue traffic east of the intersection; and west of the intersection, there is a "Speed Limit 25" sign for westbound Michigan Avenue traffic.

The prevalent accident at this location during the study period was the rear end type which accounted for 23 of 64 accidents. Additionally, there were 20 right-angles, 12 improper turns, three sideswipes, two improper backing, one ran off roadway, one involving a pedestrian, one involving a parked vehicle, and one bicycle accident.

Recommendations

Since there were 27 wet pavement accidents, an amount large enough to warrant skidometer testing under Method #1 and Method #2, it is, therefore, recommended that the City of Battle Creek have skidometer tests conducted at this intersection.

Since in 15 of the 19 right-angle accidents the violator was traveling on Michigan Avenue, it is recommended that progression be provided through interconnection of the signal system on this segment of roadway along with increasing the amber time of this signal to 7 percent. It is also recommended that a two-second all red clearance interval be installed at this signalized intersection. The all red clearance interval should reduce the number of right-angle accidents.

The Michigan Vehicle Code permits turns during the showing of the red light, when a modifying steady green or flashing red arrow is provided. Without such modifying arrow(s), turns during the red interval are not allowed. Therefore, if the city desires to permit right turns on the red interval from westbound Michigan Avenue, it is recommended that an additional signal lens (flashing red

arrow) be installed.

The approaches at this intersection are divided into a left turn lane, a thru lane and a right turn lane. Since the lanes are very narrow, it is recommended that two lane approaches be implemented on both Michigan Avenue and Kendall Street. These approach lanes would include a left turn lane (12 ft) and a thru and right turn lane (12 ft). The left turn lanes on both Michigan Avenue and Kendall Street should be aligned opposite each other.

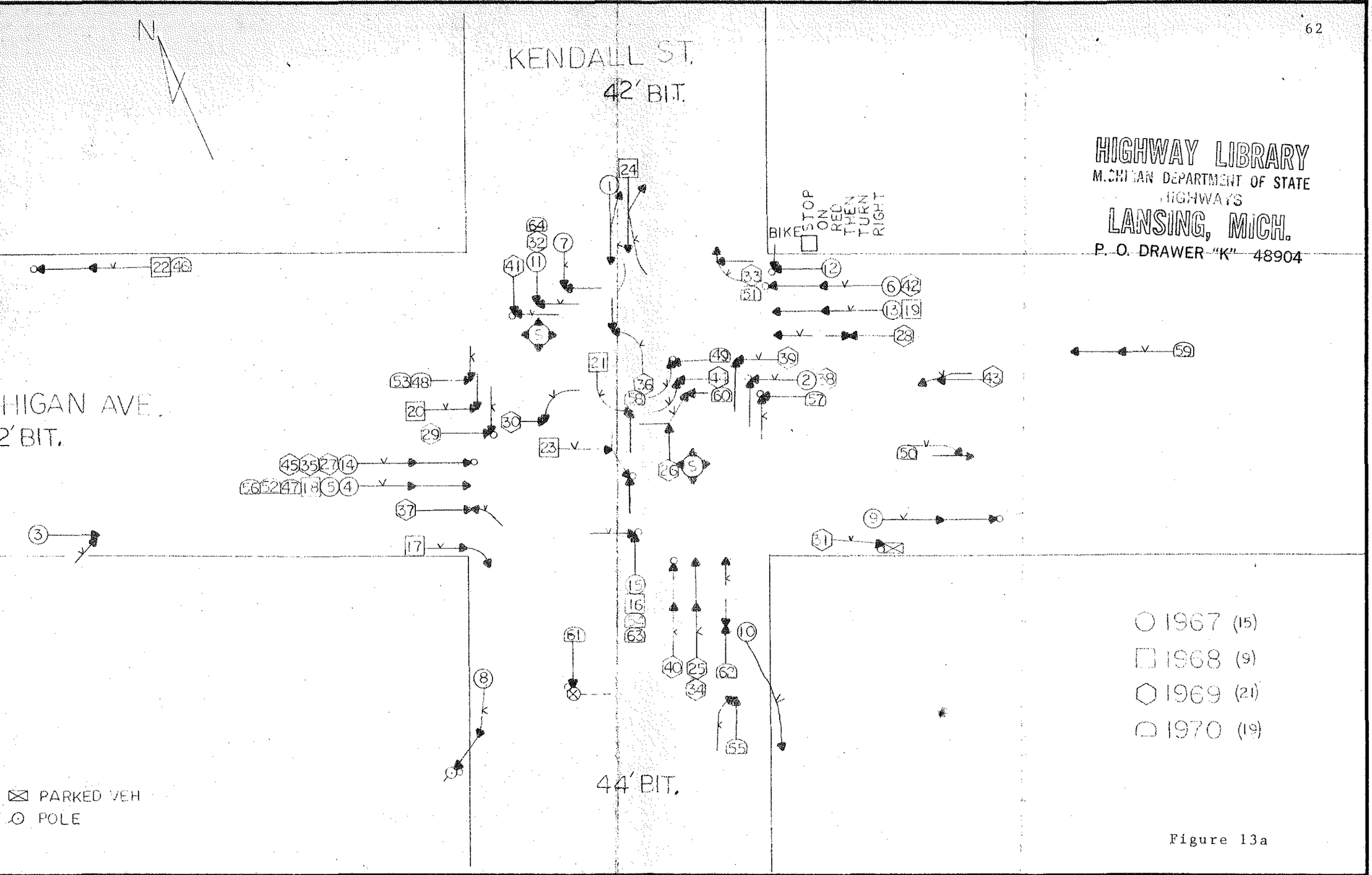


Figure 13a

LEGEND

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

Period: 1967 THRU 1970
Accidents – Total 64 P.D. 39
Injury 25 (40) Fatal 0 ( )
C.S. _____ Miles _____ Drawn DJM
Plan No. LOCATION 10 Date 1-7-72

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location MICHIGAN AT KENDALL
CITY OF BATTLE CREEK
CALHOUN CO.

EASTBOUND MICHIGAN AVENUE

WESTBOUND MICHIGAN AVENUE

Figure 13b

NORTHBOUND KENDALL STREET

SOUTHBOUND KENDALL STREET

Figure 13c

LOCATION 14 MICHIGAN AVENUE AT CASS STREET

Michigan Avenue and Cass Street intersect to form a right-angle intersection. Two 30 in. "Stop" signs control traffic at this location.

Michigan Avenue is a 42 ft wide bituminous roadway. Cass Street is a 32 ft wide bituminous roadway. Parking is permitted on Michigan Avenue and on Cass Street south of the intersection on the west side of the street.

The collision diagram indicates that the right-angle accident accounted for 13 of 37 accidents at this location. Additional accidents at this location during the study period included eleven rear ends, four sideswipes, three improper turns, two ran off roadways, two involving parked vehicles, one involving a pedestrian and one improper backing.

Recommendations

It is recommended that the first parking stall on the south side of Michigan Avenue west of the intersection be removed and that parking on the north side of Michigan Avenue be prohibited for 100 ft both east and west of the intersection. This will provide adequate visibility for vehicle operators stopped at the "Stop" signs at this intersection.

It is also recommended that skidometer tests be conducted at this location, since over 50 percent of the accidents occurred on wet pavement.

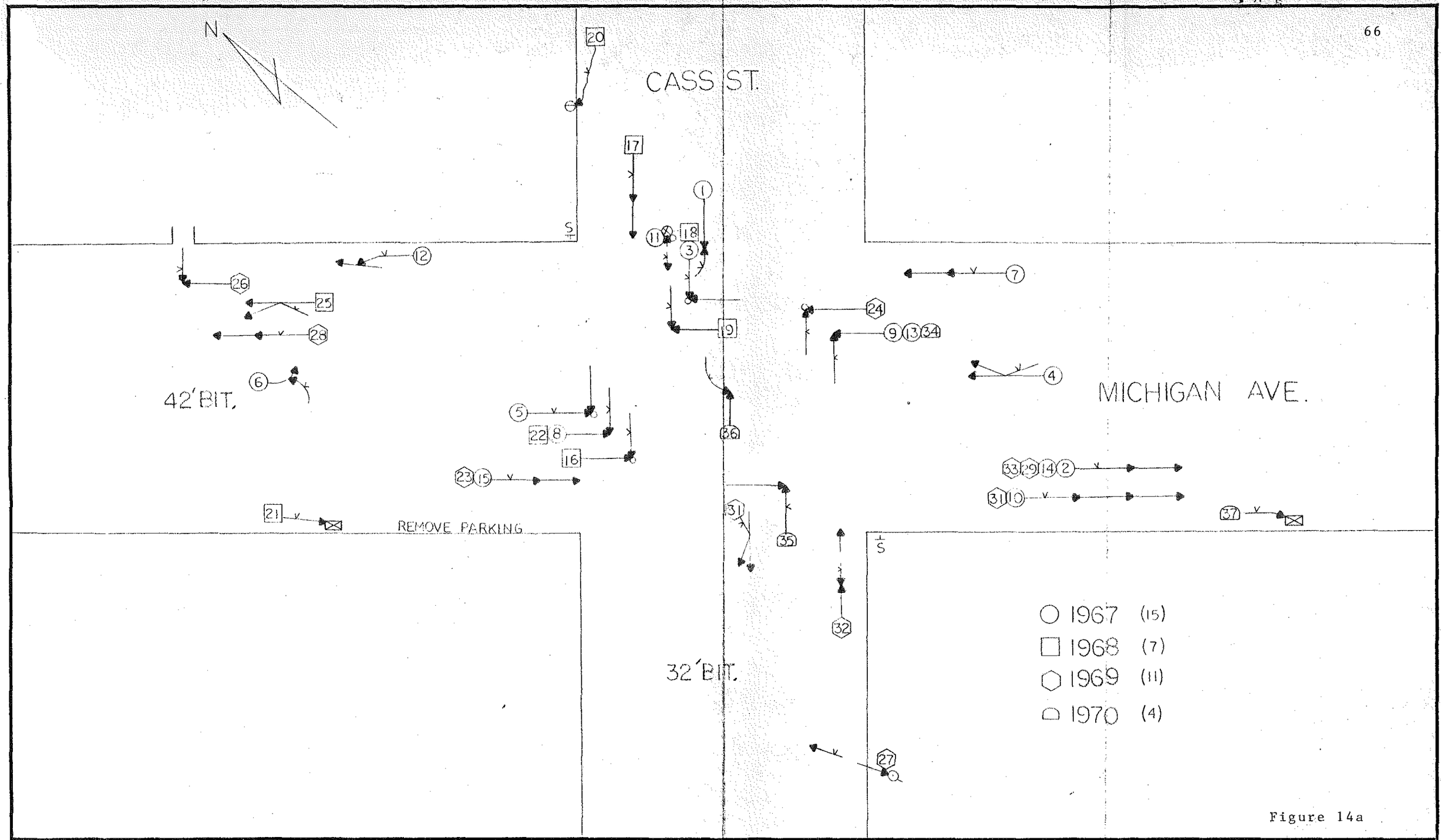


Figure 14a

LEGEND

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

Period: 1967 THRU 1970

Accidents – Total 37 P.D. 31

Injury 6 (7) Fatal 0 ( )

C.S. _____ Miles _____ Drawn D J M

Plan No. LOCATION 14 Date 12-3-71

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location MICHIGAN AVE. AT CASS ST.
CITY OF BATTLE CREEK
CALHOUN CO.

FORM NO. 1547 REV. 5-71

EASTBOUND MICHIGAN AVENUE

WESTBOUND MICHIGAN AVENUE

Figure 14b

NORTHBOUND CASS STREET

SOUTHBOUND CASS STREET

Figure 14c

LOCATION 19 GOULD STREET AT MICHIGAN AVENUE
(See Appendix I, p. 112)

Total	P.D.	Inj.	Fatal
23	19	4	0

Michigan Avenue (Carlyle-State Street to Division Street)

This route includes: Locations #1, 5, 12

Michigan Avenue is the principal street in the Central Business District. On this section of Michigan Avenue parking is permitted on both sides of the street.

It is recommended that parking be prohibited on Michigan Avenue through the Central Business District. Also, the congestion that exists on Michigan Avenue can be improved by creating a progressive movement of traffic through this section of roadway. This can be accomplished by interconnecting the signals along Michigan Avenue including the crosswalk signal which is located midway between McCamly Street and Capital Avenue.

Since Michigan Avenue has a brick surfaced pavement, it is also recommended that skidometer tests be conducted on Michigan Avenue.

As a permanent solution to the problem of congestion along this section of roadway, it is recommended that Michigan Avenue be turned into a pedestrian mall. Our opinion concurs with Harland Bartholomew and Associates who first made this recommendation in 1964. The mall concept is possible because adequate off-street parking is available in the Central Business District. This mall would extend from Carlyle-State Street to Division Street with the cross streets, McCamly Street, Capital Avenue, and Monroe Street, providing access to the pedestrian mall.

LOCATION 1 MICHIGAN AVENUE AT McCAMLY STREET

Michigan Avenue and McCamly Street intersect to form a right-angle signalized intersection located in the Central Business District. This signalized intersection has a single overhead vehicular signal head.

Michigan Avenue, the principal street in the Central Business District, is a 46 ft wide brick surfaced roadway. Parking is permitted on both sides of Michigan Avenue; however, parking is prohibited 135 ft from the corner in order to provide space for turning movements off Michigan Avenue. McCamly Street is a 40 ft wide bituminous roadway. Parking is prohibited on McCamly Street.

There are two mid-block pedestrian crosswalks located east and west of this intersection which affect the operation of this intersection. East of the intersection the crosswalk is signalized, while the crosswalk west of the intersection is nonsignalized.

The collision diagram indicates that the prevalent accident during the four-year study period was the rear end type which accounted for 92 of the 148 accidents. Other accidents which occurred at this location consisted of 21 sideswipes, 17 improper turns, eight involving parked vehicles, five right-angles, three involving pedestrians and two improper backing accidents. During the study period there were 38 accidents that occurred on wet pavement, 32 of which involved vehicles traveling on Michigan Avenue.

Recommendations

It is recommended that the City of Battle Creek follow the recommendations of the new MANUAL concerning two overhead vehicular signal heads, and install another overhead signal head for this location.

To improve capacity and reduce accidents (rear end and head-on left turn types) at this location, it is recommended that left turns be prohibited from both Michigan Avenue onto McCamly Street and from McCamly Street onto Michigan Avenue. The left turn can be accomplished either at Jackson Street, south of this intersection, or State Street, north of the intersection. Erection of a 24 in. x 30 in. (four-sided) internally illuminated Case sign, with the legend "No Left Turn" is recommended to help accomplish this goal.

The mid-block pedestrian crosswalk located east of the intersection is controlled by a pretimed signal. However, the installation of pedestrian signals at non-intersectional locations is to be avoided. When such signals are required the pedestrian-actuated type of

control, coordinated with adjacent signals, should be employed. It was observed by the field investigation team that pedestrian traffic seemed to ignore this crosswalk signal and would cross the street whenever a break occurred in the vehicular traffic. The effectiveness of the crosswalk's signal is questionable and its feasibility should be examined by the city. The crosswalk's signal would be effective if parking is removed from Michigan Avenue, thereby not permitting as many breaks in traffic and compelling the pedestrians to cross only at the signal. If the city desires to keep the crosswalk's signal in operation, it is recommended that the signal be converted to a pushbutton actuated signal and a second signal head be installed per the suggested recommendations of the MANUAL.

It is recommended that skidometer tests be made on Michigan Avenue's brick surfaced roadway, since a high percentage of accidents that happened on Michigan Avenue occurred on wet pavement.

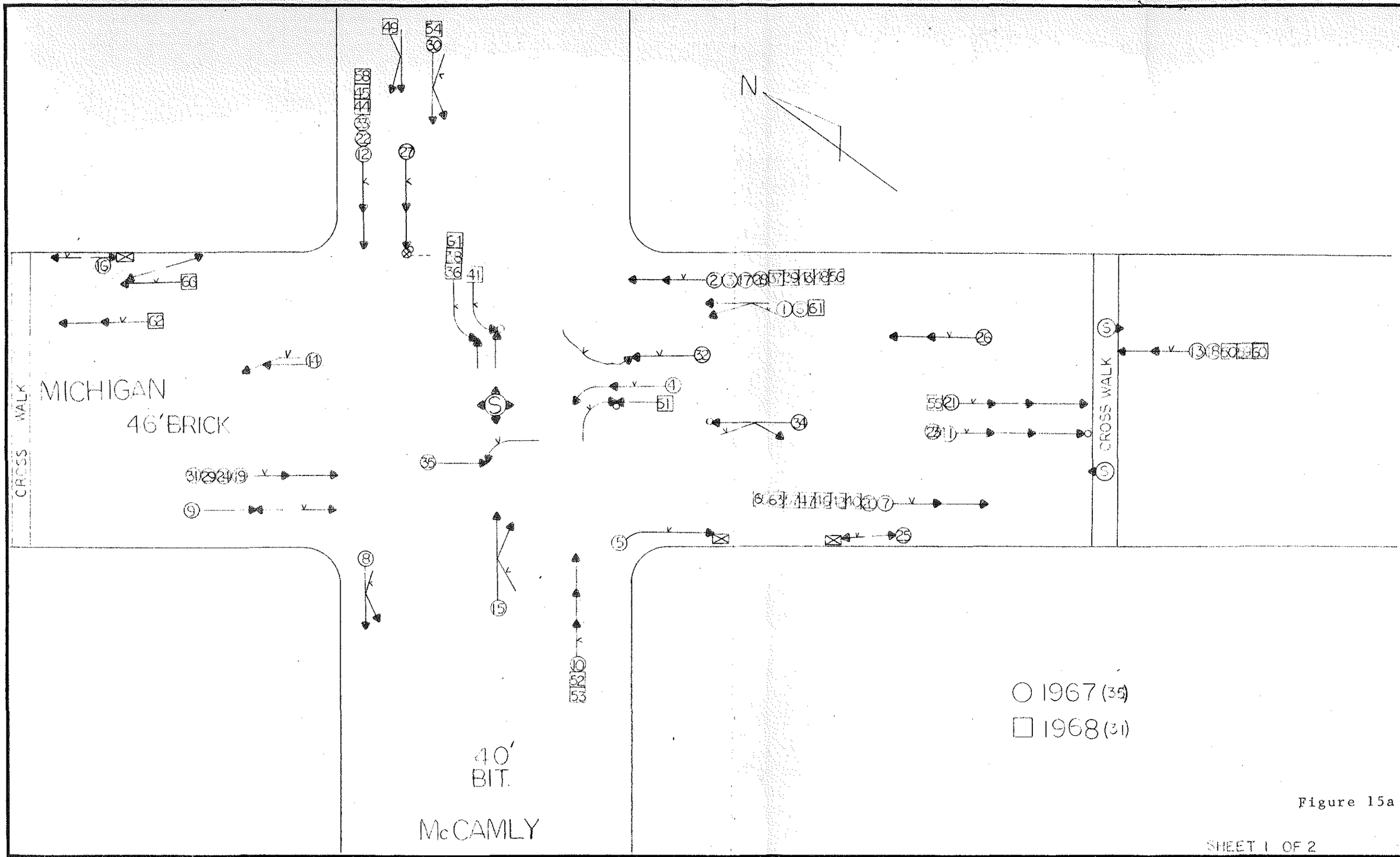


Figure 15a

SHEET 1 OF 2

LEGEND

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

Period: 1967 THRU 1970
Accidents – Total 148 P.D. 130
Injury 17 (26) Fatal 1 (1)
C.S. _____ Miles _____ Drawn DJM
Plan No. LOCATION 1 Date 7-17-72

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location MICHIGAN AT McCAMLY
CITY BATTLE CREEK
CALHOUN CO.

EDCO• 1964 6-71 46430•

74

N

CROSS WALK

MICHIGAN
46' BRICK

CROSS WALK

40'
BIT.

McCAMLY

LEGEND

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

1969 (40)

1970 (42)

Figure 15b

SHEET 2 OF 2

Period: _____

Accidents -- Total _____ P.D. _____

Injury _____ ( ) Fatal _____ ( )

C.S. _____ Miles _____ Drawn _____

Plan No. _____ Date _____

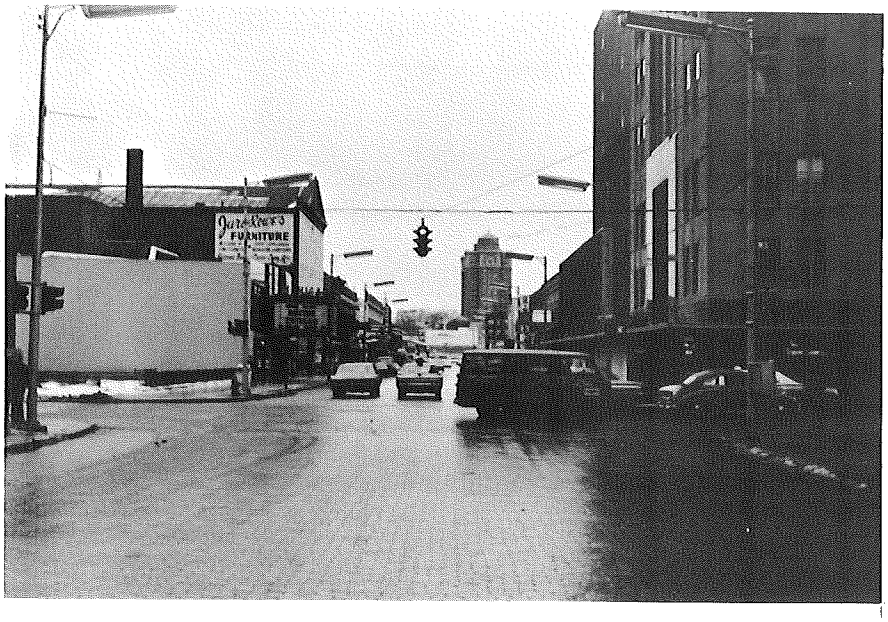
MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location

SEE SHEET ONE

FORM NO. 1547 REV. 5-71

EASTBOUND MICHIGAN AVENUE



WESTBOUND MICHIGAN AVENUE

Figure 15c

NORTHBOUND McCAMLY STREET

SOUTHBOUND McCAMLY STREET

Figure 15d

EASTBOUND MICHIGAN AVENUE
AT CROSSWALK

WESTBOUND MICHIGAN AVENUE
AT CROSSWALK

Figure 15e

LOCATION 5 CAPITAL AVENUE AT MICHIGAN AVENUE

Michigan Avenue intersects Capital Avenue to form a right-angle signalized intersection in the Central Business District. Two overhead vehicular signal heads control traffic at this location.

Michigan Avenue, which is the principal street in the Central Business District, is a 45 ft wide brick surfaced roadway with on-street parking permitted. Capital Avenue is a 46 ft wide bituminous roadway.

Additional traffic controls at this location are an internally illuminated 4-Way Case sign with the legend "No Left Turn" and four 24 in. x 30 in. "No Left Turn" signs. To the west of this intersection is the signalized crosswalk which is mentioned in Location 1.

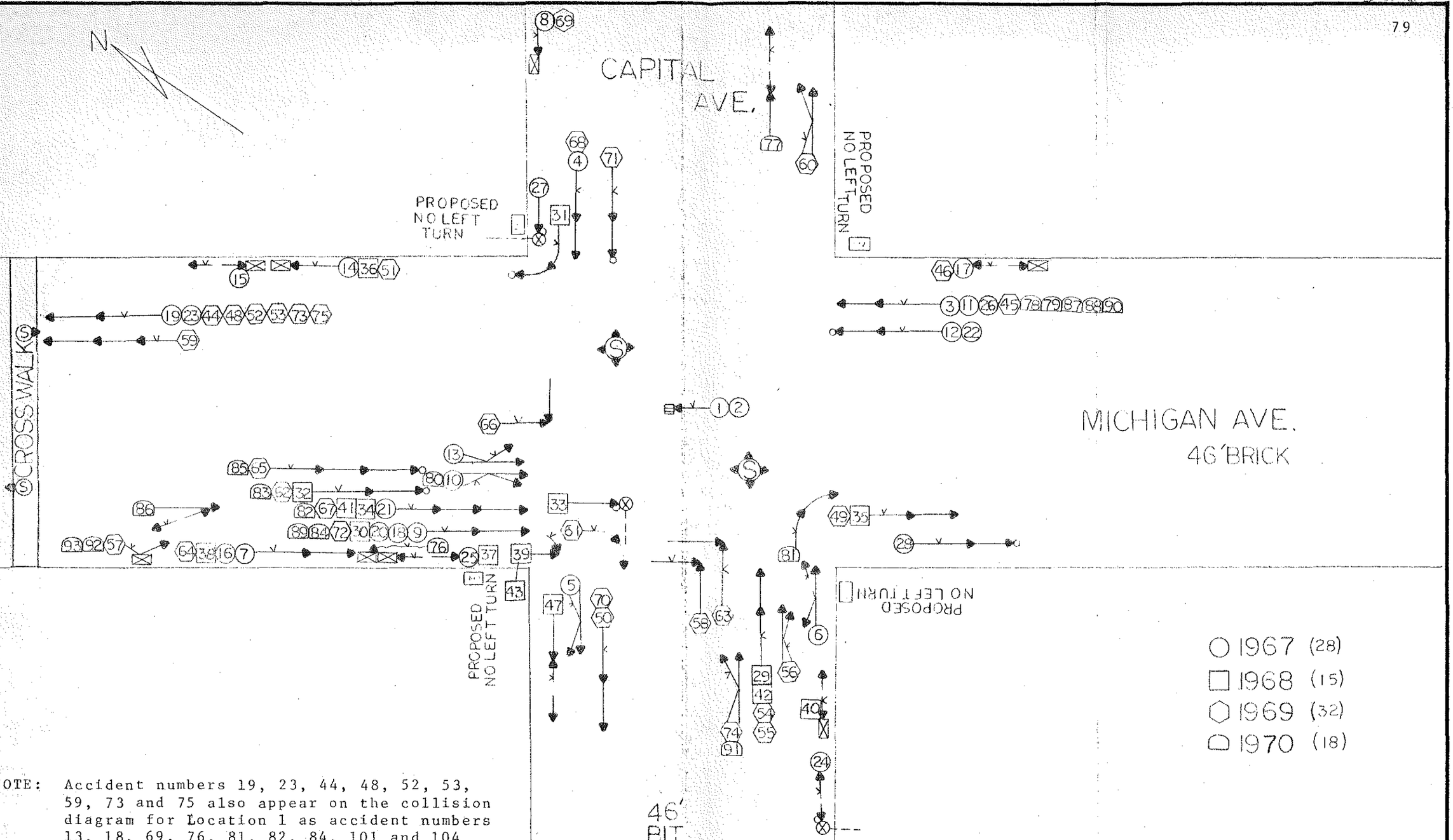
The collision diagram reveals that the prevalent type of accident at this location during the four-year study period was the rear end collision which accounted for 56 accidents. Additionally, there were ten improper backing, nine involving parked vehicles, seven sideswipes, three right-angles, three involving pedestrians, two improper turns, two vehicle struck fixed objects, and one ran off roadway accident.

Recommendations

The rear end accident which is so dominant at this location can partially be attributed to the one lane of moving traffic, and the conflicts that arise as vehicles enter and exit parking stalls. By removing parking on Michigan Avenue a reduction will occur in rear end accidents.

Also, since there are four "No Left Turn" signs at this intersection, it is recommended that they be rearranged so that each far left corner facing approaching traffic has a "No Left Turn" sign.

It is recommended that skidometer tests be made on Michigan Avenue's brick surfaced roadway, since a high percentage of accidents at this intersection occurred on wet pavement.



NOTE: Accident numbers 19, 23, 44, 48, 52, 53, 59, 73 and 75 also appear on the collision diagram for Location 1 as accident numbers 13, 18, 69, 76, 81, 82, 84, 101 and 104 because the crosswalk is discussed at that location.

○ 1967 (28)
□ 1968 (15)
⬡ 1969 (32)
▭ 1970 (18)

Figure 16a

LEGEND

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

Period: 1967 THRU 1970
Accidents – Total 93 P.D. 80
Injury 13 (17) Fatal 0 ( )
C.S. ____ Miles ____ Drawn DJM
Plan No. LOCATION 5 Date 1-26-72

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location CAPITAL AT MICHIGAN
CITY OF BATTLE CREEK
CALHOUN CO.

EASTBOUND MICHIGAN AVENUE

WESTBOUND MICHIGAN AVENUE

Figure 16b

NORTHBOUND CAPITAL AVENUE

SOUTHBOUND CAPITAL AVENUE

Figure 16c

LOCATION 12 CARLYLE-STATE STREET AT MICHIGAN AVENUE

Carlyle-State Street and Michigan Avenue intersect to form a right-angle signalized intersection at the west end of the Central Business District. This signalized intersection has a single overhead vehicular signal head.

Michigan Avenue is a 46 ft wide brick surfaced roadway. Parking is permitted on all but the north side of Michigan Avenue west of the intersection.

Carlyle-State Street, a 32 ft wide bituminous roadway, begins at the intersection and provides one-way vehicular movement in the southern direction. State Street, a 35 ft wide bituminous roadway, is one-way westbound. It parallels Michigan Avenue and curves toward the south to form the north leg of the intersection. Parking is permitted on all but the south and east sides of State Street.

Traffic controls at this location, other than the signal, include a "No Right Turn" sign suspended on the overhead signal and two Advance Railroad Warning signs for westbound Michigan Avenue, and a "No Left Turn" sign located on the overhead signal and a "Stop On Red Then Turn Right" sign for eastbound Michigan Avenue.

The prevalent accident type occurring at this location was the rear end collision which accounted for 17 of 53 accidents. Also, the collision diagram indicates that there were nine accidents involving parked vehicles, seven improper turns, six sideswipes, five improper backing, four right-angles, four ran off roadways, and one involving a pedestrian. There were 22 accidents that occurred on wet pavement.

Recommendations

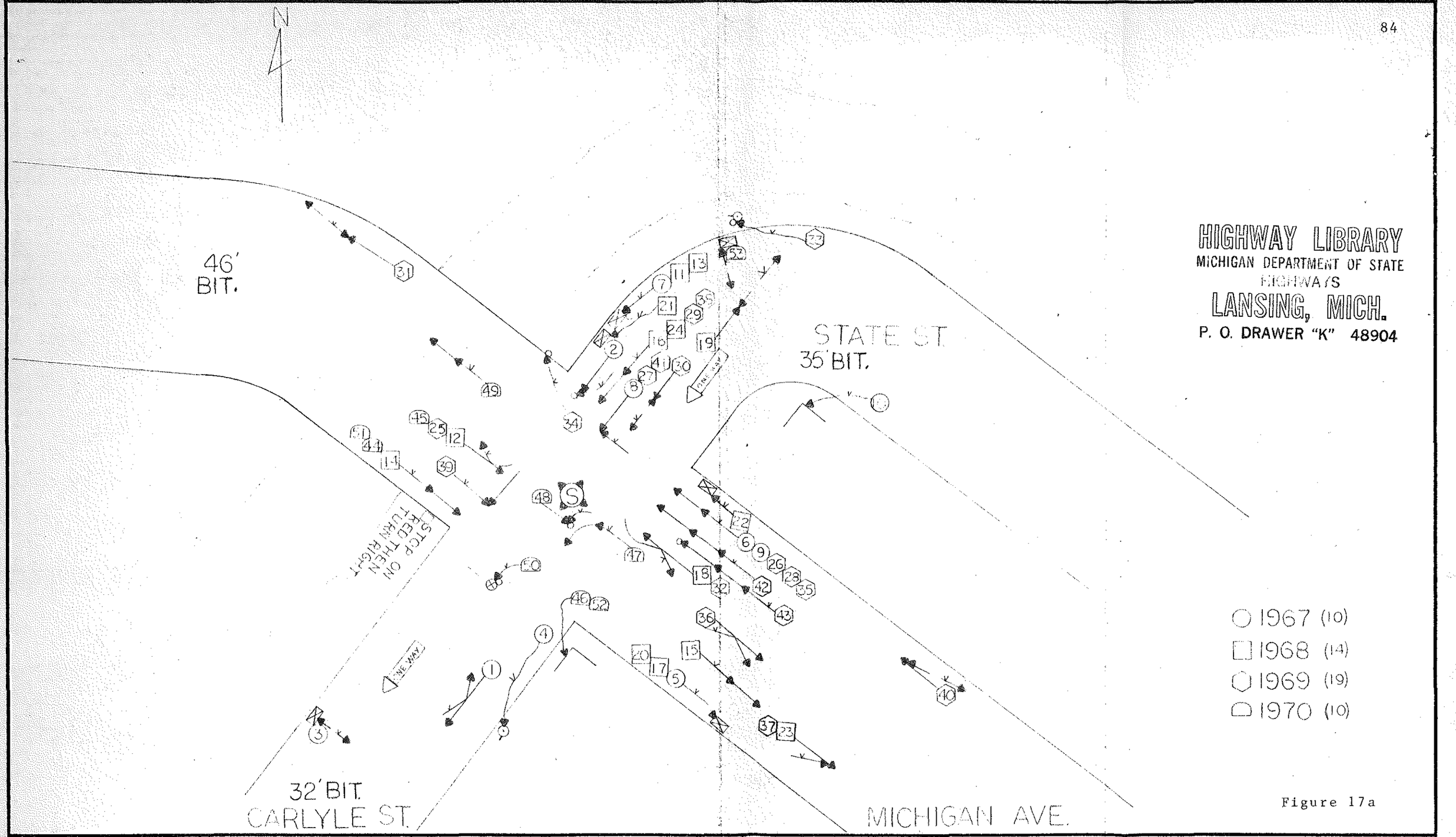
It is recommended that the City of Battle Creek follow the recommendation of the new MANUAL concerning two overhead vehicular signal heads. According to the Michigan Vehicle Code, turns during the showing of the red interval are allowed only when a modifying steady green or flashing red arrow are provided. Without such a modifying arrow, turns during the showing of the red interval are not permitted. Therefore, it is recommended that a flashing red arrow lens be used to indicate that a right turn off eastbound Michigan Avenue is authorized on the red interval.

It is also recommended that a two faced internally illuminated Case sign with the legend "One Way" for east and westbound Michigan Avenue traffic be erected and consequently, there will be no need for the signs suspended on the overhead signal. Since the present

two Advance Railroad Warning signs are non-standard (size), it is recommended that they be replaced with 36 in. signs (W10-1-36, Appendix II, p. 125).

Since a large number of accidents occurred on wet pavement, it is recommended that skidometer tests be conducted at this intersection. It is also recommended that the bituminous cap on State Street be repaired, because the brick subbase is visible.

Furthermore, parking is allowed too near the intersection on State Street. Five parking accidents occurred on State Street between the intersection and the curve. For this reason, it is recommended that parking on the west side of State Street be prohibited 100 ft from the crosswalk.



○ 1967 (10)
□ 1968 (14)
⬡ 1969 (19)
▭ 1970 (10)

Figure 17a

LEGEND

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

Period: 1967 THRU 1970
Accidents -- Total 53 P.D. 44
Injury 9 (12) Fatal 0 ( )
C.S. ____ Miles ____ Drawn DJM
Plan No. LOCATION 12 Date 12-10-71

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location MICHIGAN AVE AT STATE — CARLYLE
CITY OF BATTLE CREEK
CALHOUN CO.

EASTBOUND MICHIGAN AVENUE

WESTBOUND MICHIGAN AVENUE

Figure 17b

NORTHBOUND CARLYLE STREET

SOUTHBOUND CARLYLE STREET

AND STATE STREET

Figure 17c

Miscellaneous Locations

This section includes: Locations #9, 15, 16, 17 and 18

The following locations are not concentrated along any major route, but are scattered throughout the city.

LOCATION 9 WASHINGTON AVENUE AT CHAMPION STREET

Washington Avenue at Champion Street forms a four-legged signalized intersection. This location has a single overhead vehicular signal head.

Washington Avenue is a 44 ft wide bituminous roadway. Parking is permitted on the east side of the street both north and south (35 ft from the crosswalk) of the intersection. Champion Street is a 33 ft wide bituminous roadway west of the intersection and 29 ft wide bituminous roadway east of the intersection. Parking is permitted 33 ft from the crosswalk west of the intersection on the south side of the street.

Traffic controls at this location include two "Pedestrian Crossing" warning signs, one for each side of the flashing beacon, which is used as a crosswalk warning signal, located east of the intersection.

The prevalent accident at this high accident location during the four-year study period was the rear end collision accounting for 27 of 65 accidents. The remaining accidents included 13 improper turns, eight sideswipes, seven right-angles, four ran off roadways, three involving parked vehicles, one head-on left turn, one improper backing and one involving a pedestrian. Twenty-five of the accidents occurred on wet pavement.

Recommendations

It is recommended that the City of Battle Creek follow the recommendations of the MANUAL concerning the use of two overhead vehicular signal heads and install another signal head.

Since a substantial percentage of accidents occurred on wet pavement, it is recommended that the City of Battle Creek have skidometer tests conducted at this intersection.

A capacity analysis of this intersection indicates that to achieve Level of Service "C" the signal will be required to operate on a 60-40 percent cycle split with Washington Avenue having the extended green phase. It is also recommended that Champion Street be converted to a three lane roadway with a left turn (11 ft) and a right-thru (11 ft) lane. This can be accomplished by widening Champion Street to make it a 38 ft wide roadway, increasing the radius on the southeast corner and removing parking for 175 ft on the south side of Champion Street west of the intersection (Figure 18e).

It is further recommended that parking be removed for 75 ft from

the crosswalk on the east side of Washington Avenue south of the intersection.

Furthermore, the flasher east of this intersection should be removed, since it is acting as a pedestrian crosswalk warning signal. Instead of this overhead flashing beacon, it is recommended that flashing beacons be installed in the two "Pedestrian Crossing" warning signs and that a "Cross Walk" sign (R6-23-24, Appendix II, p. 121) be erected over the walk area. The flashing beacons located in the warning signs should operate only during the hours when the crosswalk is being used so that the flashers will not lose their effectiveness.

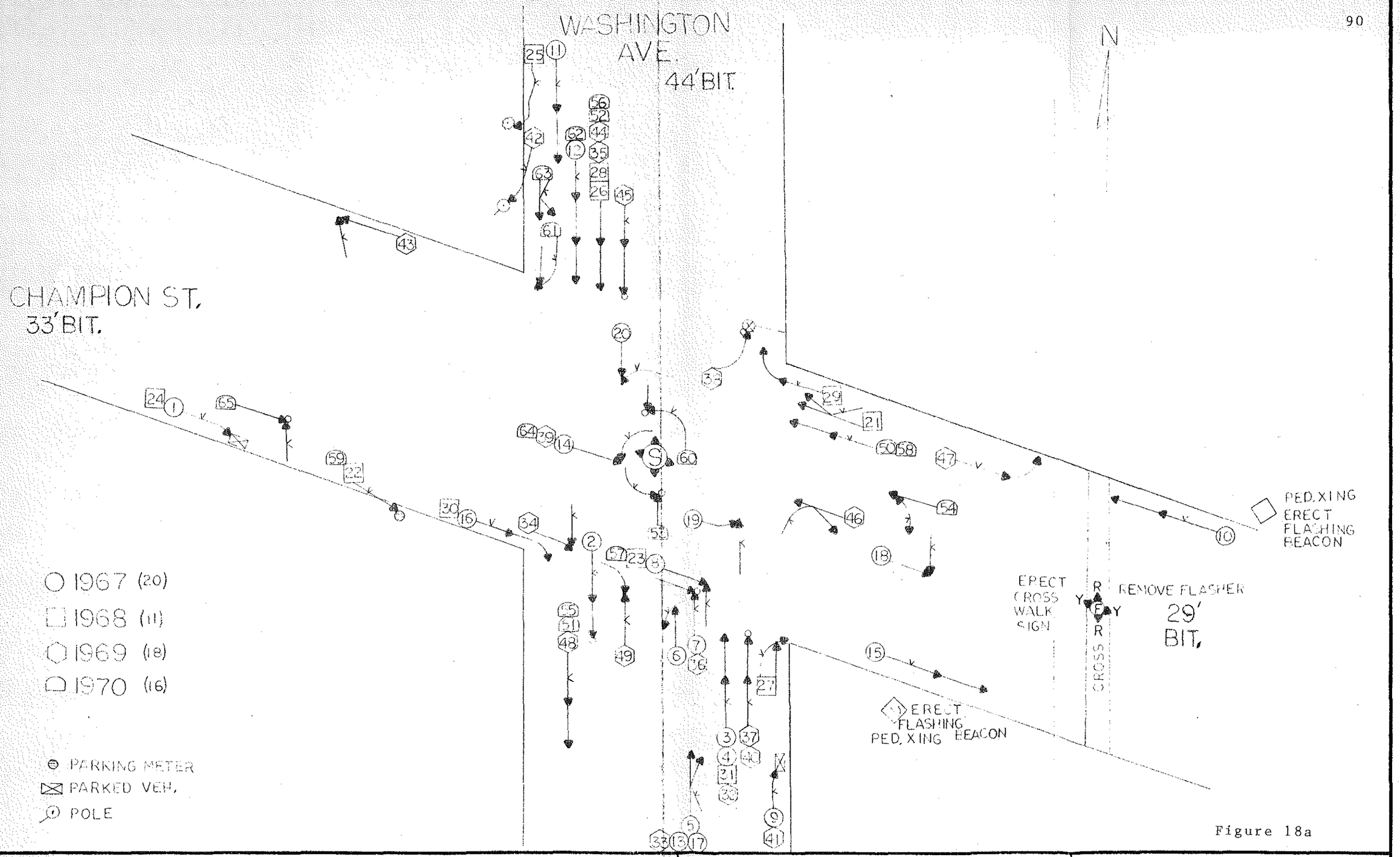


Figure 18a

LEGEND

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

Period: 1967 THRU 1970

Accidents -- Total 65 P.D. 56

Injury 9 (15) Fatal 0 ( )

C.S. _____ Miles _____ Drawn DJM

Plan No. LOCATION 9 Date 1-11-72

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location CHAMPION AT WASHINGTON
CITY OF BATTLE CREEK
CALHOUN CO.

FORM NO. 1547 REV. 5-71

NORTHBOUND WASHINGTON AVENUE

SOUTHBOUND WASHINGTON AVENUE

Figure 18b

EASTBOUND CHAMPION STREET

WESTBOUND CHAMPION STREET

Figure 18c

EASTBOUND CHAMPION STREET @ FLASHER

WESTBOUND CHAMPION STREET @ FLASHER

Figure 18d

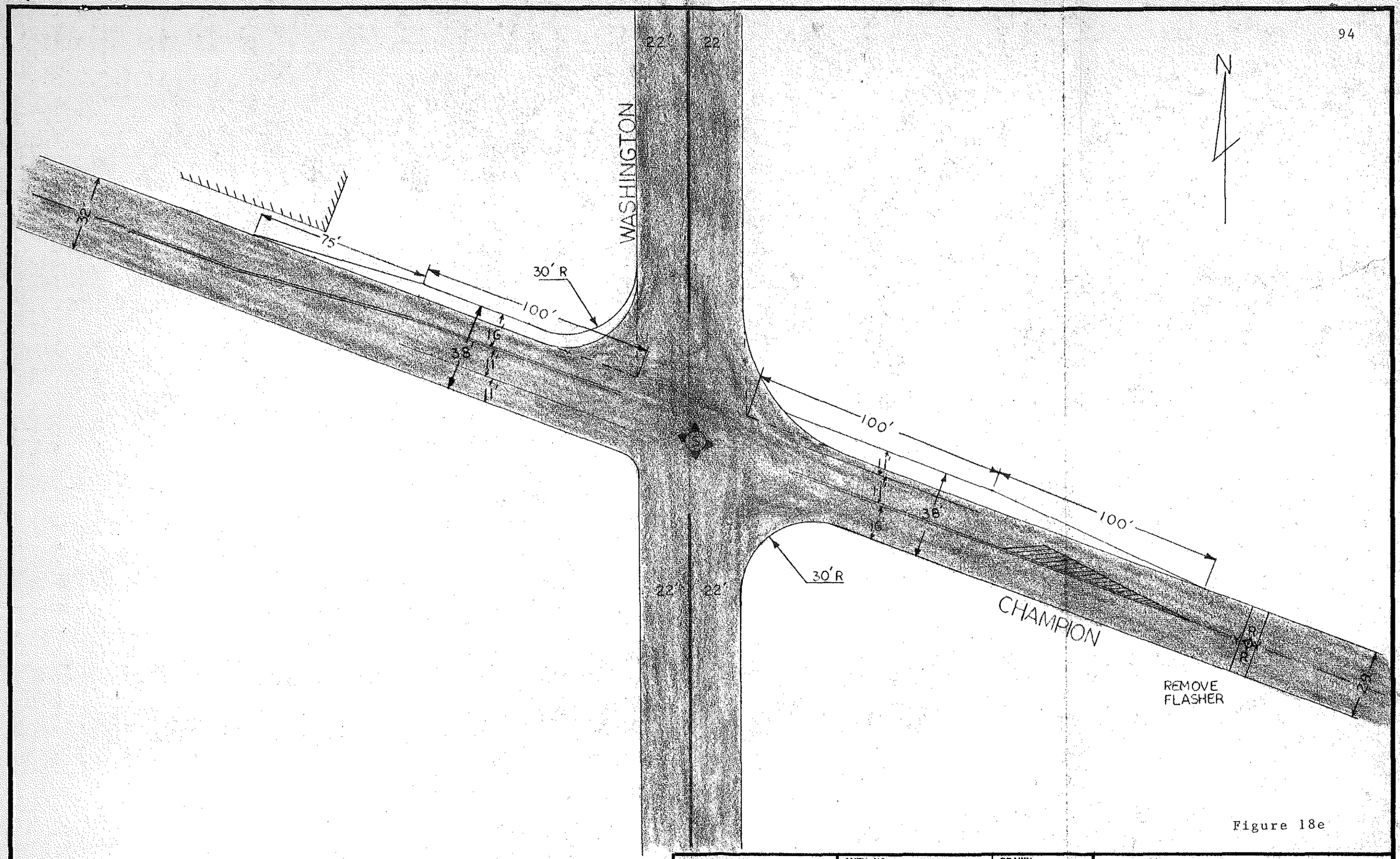


Figure 18e

STATE OF MICHIGAN DEPARTMENT OF STATE HIGHWAYS TRAFFIC & SAFETY DIVISION	AUTH. NO.	DRAWN DJM	PROPOSED WIDENING AND PAVEMENT MARKING
	CONT. SEC.	DATE	
	REF.	SCALE	
	SHEET OF	PLAN	

FORM 1595A (REV. 10-68)

LOCATION 15 EAST AVENUE AT EMMETT STREET

East Avenue and Emmett Street form a right-angle signalized intersection located in a residential neighborhood in the east section of Battle Creek. Only one overhead vehicular signal head is located at this intersection.

East Avenue is a 35 ft wide bituminous roadway. Emmett Street is a 42 ft wide bituminous roadway with eastbound Emmett Street offset to the south in relation to westbound Emmett Street. Parking is permitted on all legs of this intersection.

There are two other traffic control devices at this location, a "Speed Limit 35" sign for westbound Emmett Street traffic and a 36 in. Reverse Turn warning sign (employed to indicate the offset) for eastbound Emmett Street traffic.

The prevalent type of accident at this location during the study period was the rear end collision which accounted for 16 of the 33 accidents. The remaining accidents include seven head-on left turns, four right-angles, three sideswipes, two involving parked vehicles and one improper backing type.

Recommendations

It is recommended that the City of Battle Creek follow the new MANUAL's requirements that all signalized intersections have two overhead vehicular signal heads.

It is further recommended that parking on Emmett Street be prohibited for 200 ft. Also, the parking on East Avenue should be prohibited at least 200 ft from the intersection to provide for a two lane approach, a thru-right turn lane and a left turn lane.

The Reverse Turn sign at this high accident location does not meet the requirements of the MANUAL and it is recommended that it be removed. The Reverse Turn sign is to be used where two curves or a curve and a turn in opposite directions are separated by a tangent of less than 400 ft.

Since the offset makes negotiating this intersection difficult, it is recommended that the City of Battle Creek, through construction, realign this intersection. A suggested realignment can be found on p. 98 (Figure 19c).

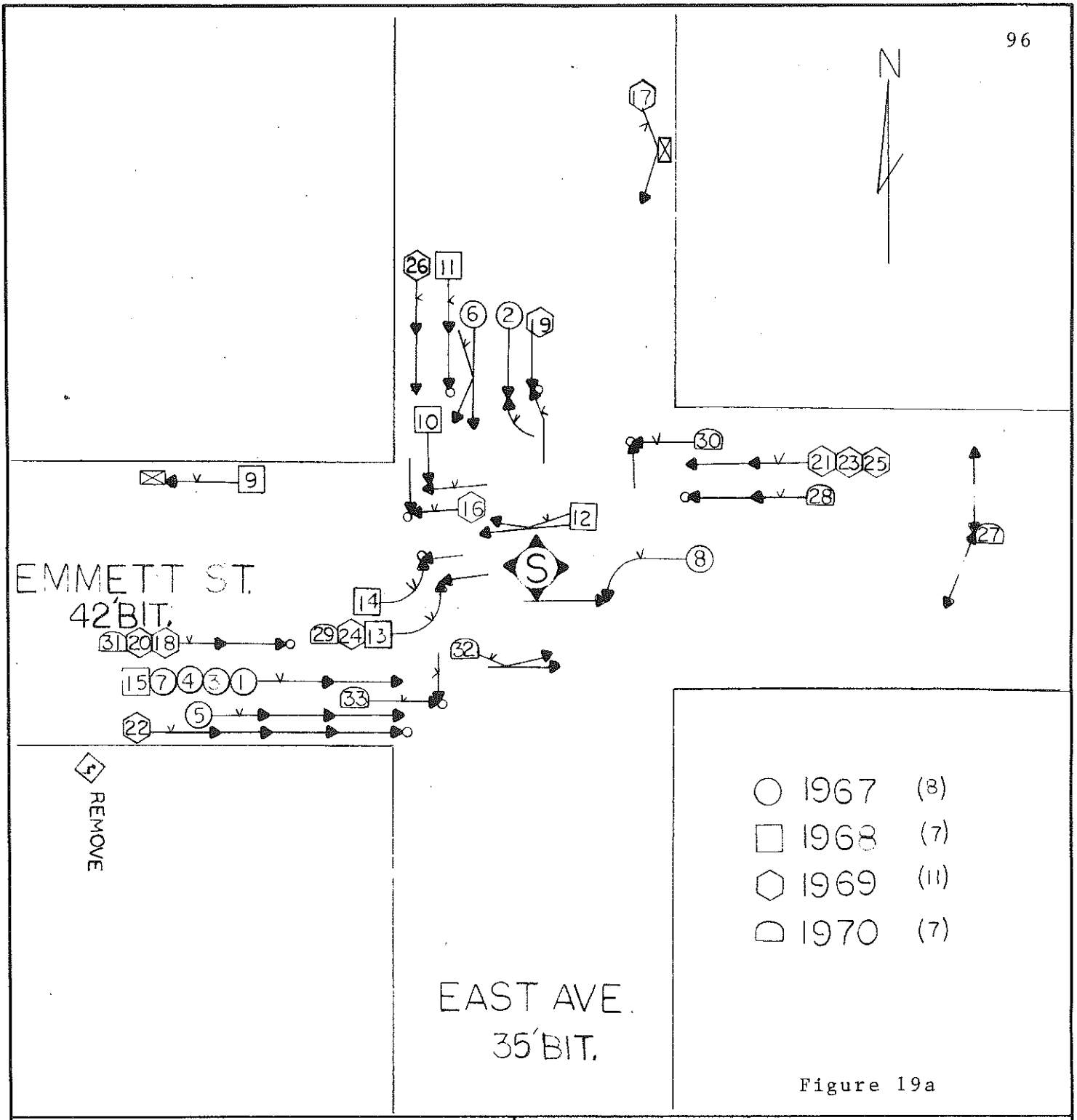


Figure 19a

LEGEND

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

Fatal
Injury
Skidding
Jackknife
Overturned
Backing

Pedestrian
Tree
Out of Control
Driver Intent
Deer
Violator

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location EAST AVE. AT EMMETT ST.
CITY OF BATTLE CREEK
CALHOUN CO.

Period: 1967 THRU 1970
Accidents – Total 33 P.D. 22
Injury 11 (16) Fatal 0 ( )
C.S. ____ Miles ____ Drawn DJM
Plan No. LOCATION 15 Date 11-30-71

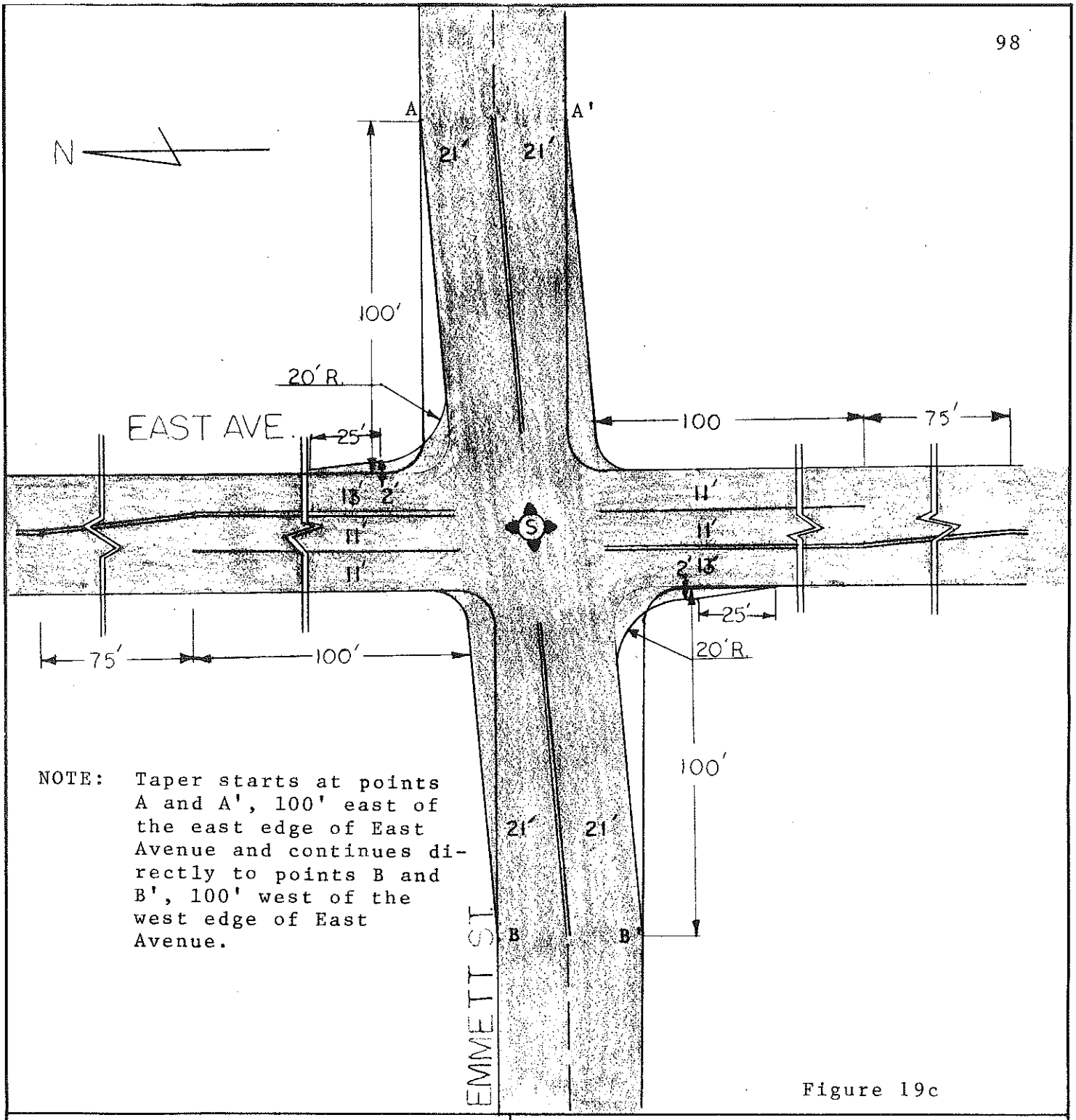
Form 1547 B (Rev. 11/70)

EASTBOUND EMMETT STREET

SOUTHBOUND EAST AVENUE

WESTBOUND EMMETT STREET

Figure 19b



NOTE: Taper starts at points A and A', 100' east of the east edge of East Avenue and continues directly to points B and B', 100' west of the west edge of East Avenue.

Figure 19c

LEGEND

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

Fatal
Injury
Skidding
Jackknife
Overturned
Backing

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

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location

Proposed Realignment

Period: _____

Accidents – Total _____ P.D. _____

Injury _____ ( ) Fatal _____ ( )

C.S. _____ Miles _____ Drawn DJM

Plan No. _____ Date _____

Form 1547 B (Rev. 11/70)

LOCATION 16 CLIFF STREET AT MAIN STREET

Cliff Street intersects Main Street to form a "Y" intersection. Cliff Street is a 32 ft wide bituminous roadway. Main Street is a 41 ft wide brick surfaced roadway. Parking is permitted on Main Street except for a 100 ft segment directly across from Cliff Street.

The traffic controls at this intersection include a 24 in. "Stop" sign and a flashing beacon (8 in. lenses) for Cliff Street.

The collision diagram indicates that the rear end collision was the prevalent accident accounting for 17 of 31 accidents. The remaining types were five improper backing, four right-angles, three ran off roadways and two improper turns. Twelve of the accidents at this location occurred on wet pavement.

Recommendations

Since 40 percent of the accidents occurred on wet pavement and since Main Street is a brick surfaced roadway, it is recommended that the City of Battle Creek have skidometer tests conducted at this location.

In order to reduce the rear end accidents on westbound Cliff Street, it is recommended that a 30 in. "Stop Ahead" warning sign (W3-1-30, Appendix II, p. 124) be erected for westbound Cliff Street and the lens size for the flasher on Cliff Street be increased from 8 in. to 12 in. Also, since the 24 in. "Stop" sign has lost its reflectivity, it is recommended that this "Stop" sign (R1-2-24, Appendix II, p. 116) be replaced.

It is further recommended that the southeast corner of this intersection's radius be increased through construction so that vehicles turning right from Main Street to Cliff Street can turn without crossing into the left turn lane.

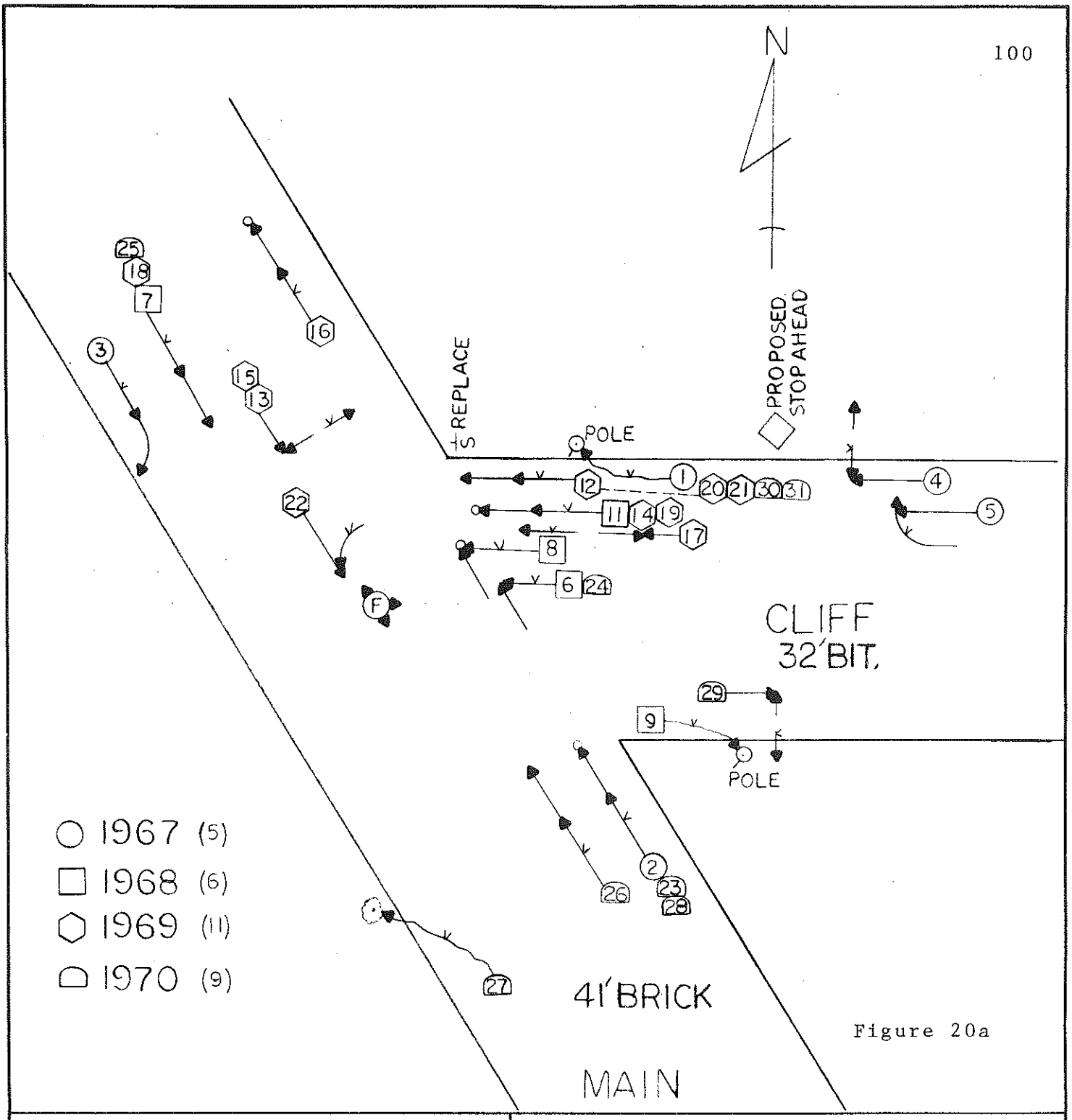


Figure 20a

LEGEND

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

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

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location CLIFF AT MAIN
CITY OF BATTLE CREEK
CALHOUN CO.

Period: 1967 THRU 1970
Accidents – Total 31 P.D. 23
Injury 8 (12) Fatal 0 ( )
C.S. ____ Miles ____ Drawn DJM
Plan No. LOCATION 16 Date 11-26-71

Form 1547 B (Rev. 11/70)

NORTHWESTBOUND MAIN STREET

WESTBOUND CLIFF STREET

SOUTHEASTBOUND MAIN STREET

Figure 20b

LOCATION 17 FREMONT STREET AT CALHOUN STREET

Fremont Street and Calhoun Street intersect to form a right-angle intersection in a residential neighborhood. Fremont Street is a 35 ft wide bituminous roadway and Calhoun Street is a 30 ft wide bituminous roadway. Parking is permitted on each side of Fremont Street (60 ft from the crosswalk), however, parking is prohibited on Calhoun Street.

Traffic controls at this location consist of 24 in. "Stop" signs for north and southbound Fremont Street traffic. Also, this location has a flashing beacon (8 in. lenses) which is used to supplement the "Stop" signs.

The collision diagram indicates that the right-angle type accounted for 20 (71 percent) accidents during the study period. Eleven percent were rear end accidents and 18 percent formed no specific pattern.

Recommendations

Since 75 percent of the right-angle accidents involved drivers who ran the "Stop" sign (these drivers never attempted to stop, as opposed to drivers who failed to yield, which means that they stopped and then entered the intersection), it is recommended that the standard lens size (8 in.) on the flashing beacon for Fremont Street traffic be increased to an oversized lens (12 in.) to emphasize the stop. It is also recommended that two 36 in. "Stop" signs (R1-1-36, Appendix II, p. 116) replace the two 24 in. signs. Furthermore, it is recommended that parking on Fremont Street be prohibited 100 ft from the crosswalk on each side of the street so that the "Stop" signs will be clearly visible.

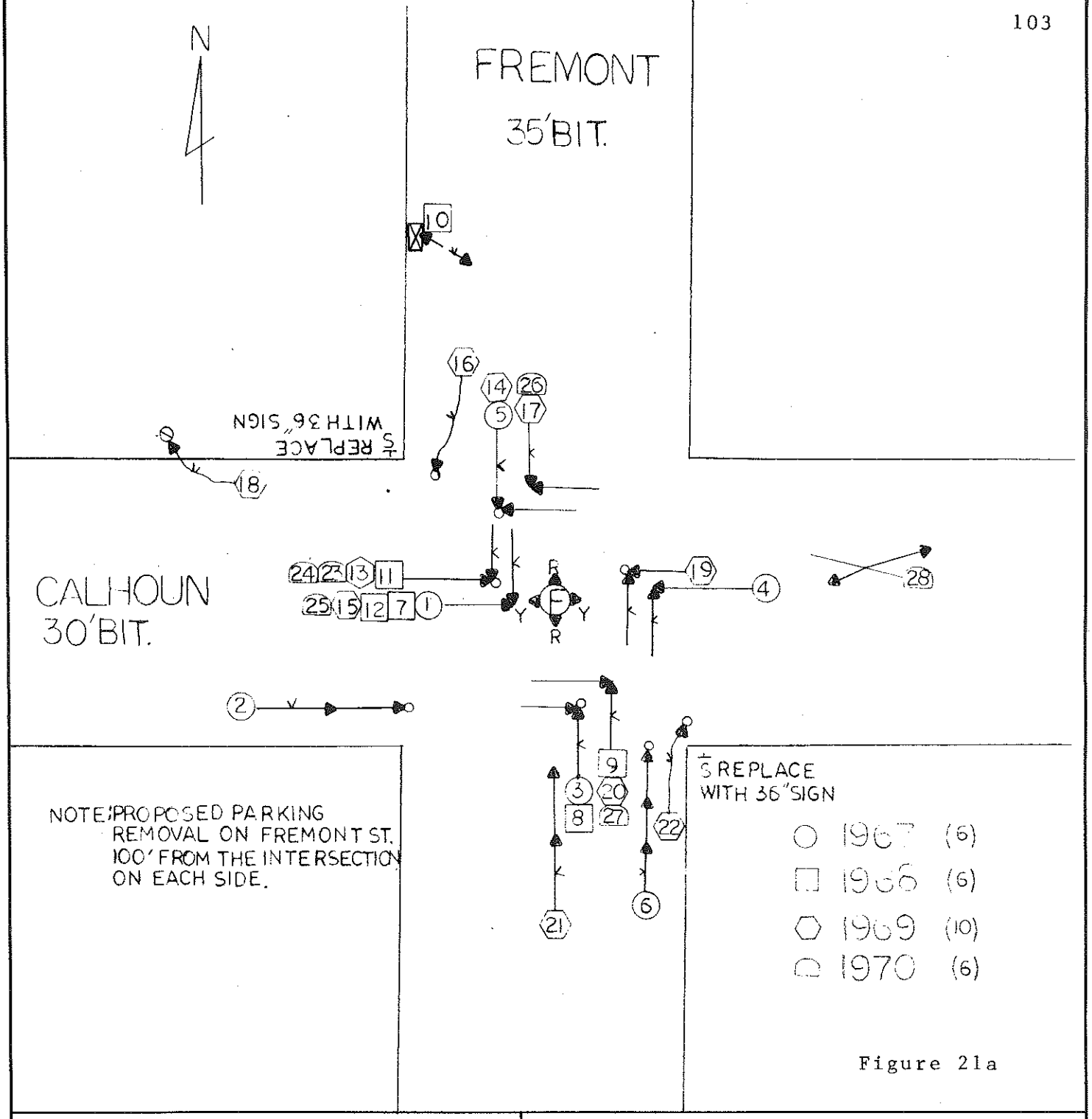


Figure 21a

LEGEND

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

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

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location CALHOUN AT FREMONT
CITY OF BATTLE CREEK
CALHOUN CO.

Period: 1967 THRU 1970
Accidents – Total 28 P.D. 15
Injury 13 (21) Fatal 0 ( )
C.S. ____ Miles ____ Drawn DJY
Plan No. LOCATION 17 Date 11-8-71

Form 1547 B (Rev. 11/70)

NORTHBOUND FREMONT STREET

WESTBOUND CALHOUN STREET

SOUTHBOUND FREMONT STREET

Figure 21b

LOCATION 18 WASHINGTON AVENUE AT EMMETT STREET
(See Appendix I, p. 110)

Total	P.D.	Inj.	Fatal
24	20	4	0

SUMMARY

The Department of State Police submitted 19 high accident locations for the City of Battle Creek to the Michigan Department of State Highways. After an indepth study of these locations, we formulated recommendations for sixteen of them. The locations and their recommendations are as follows:

Location Number	Location Description	Quantity	Recommendations
1	Michigan Avenue at McCamly Street	1 1	Signal Head 4-Way Case Sign Change Crosswalk Signal Skidometer Tests Remove Parking
2	Capital Avenue at Columbia Avenue		Resurface, Realign and Pavement Mark Intersection Remove left turn phase for Columbia Ave.
3	Roosevelt Avenue at North Avenue	1	Left Turn Signal Head Construction of 15 ft. Flare and Taper
4	W. Territorial Road at Capital Avenue	1	Right Turn Signal Remove Angle Parking Lane Line Markings Construction of 12 ft. Flare and Taper Remove Parking for 175 ft.
5	Capital Avenue at Michigan Avenue		Remove Parking Skidometer Tests
6	Capital Avenue at Fountain Street	1 2	2-Way Case Sign R3-1-36 Lane Line Through Intersection
7	Michigan Avenue at Washington Avenue		Skidometer Tests All Red Clearance Interval for the Signal
8	Emmett Street at North Avenue	 1	Construct Left Turn Lane Skidometer Tests Left Turn Signal Head

Location Number	Location Description	Quantity	Recommendations
9	Washington Avenue at Champion Street	1	Signal Head Remove Parking Skidometer Tests Remove Overhead Flasher Install Flashing Beacon in "Pedestrian Crossing" Signs Widen Champion Street
10	Michigan Avenue at Kendall Street	1	Flashing Red Right Turn Arrow Skidometer Tests Realign Michigan Avenue and Kendall Street for Two Lane Approaches
11	North Avenue at McCamly Street and Calhoun Street	2	Signal Heads Realign North Avenue and McCamly Street
12	Carlyle-State Street at Michigan Avenue	2 1 1 1	W10-1-36 Signal Head Right Turn Signal 4-Way Case Sign Skidometer Tests Resurface State Street Remove Parking
13	Capital Avenue, Bidwell Street and Meacham Avenue	3 2 2	Signal Faces Lane Use Control Signs R3-1-36 Remove Parking Widen Capital Avenue
14	Michigan Avenue at Cass Street		Remove Parking Skidometer Tests
15	East Avenue at Emmett Street	1	Signal Head Remove Parking Realign Emmett Street Lane Line Markings
16	Cliff Street at Main Street	1 1	W3-1-30 R1-1-24 Skidometer Tests Increase Radius for Southeast Corner Increase Lens Size (8 in. to 12 in.)

Location Number	Location Description	Quantity	Recommendations
17	Fremont Street at Calhoun Street	2	R1-1-36 Remove Parking Increase Lens Size (8 in. to 12 in.)

Furthermore, a few general recommendations were formulated that should be implemented by the City of Battle Creek.

1. As soon as it is feasible, the City of Battle Creek should install two signal heads at all of their single signal head signalized locations.

2. Skidometer tests should be conducted at all locations where a substantial amount of accidents occurred on wet pavement (Criteria in Traffic Engineering Analysis).

3. The city should have their signal system interconnected to provide inbound and outbound progressive movement during the peak periods.

4. On-street parking should be restricted on major city streets during the peak periods.

5. To improve capacity the City of Battle Creek should convert the exclusive right turn lane to a thru and right turn lane at locations where this is permissible.

APPENDIX I

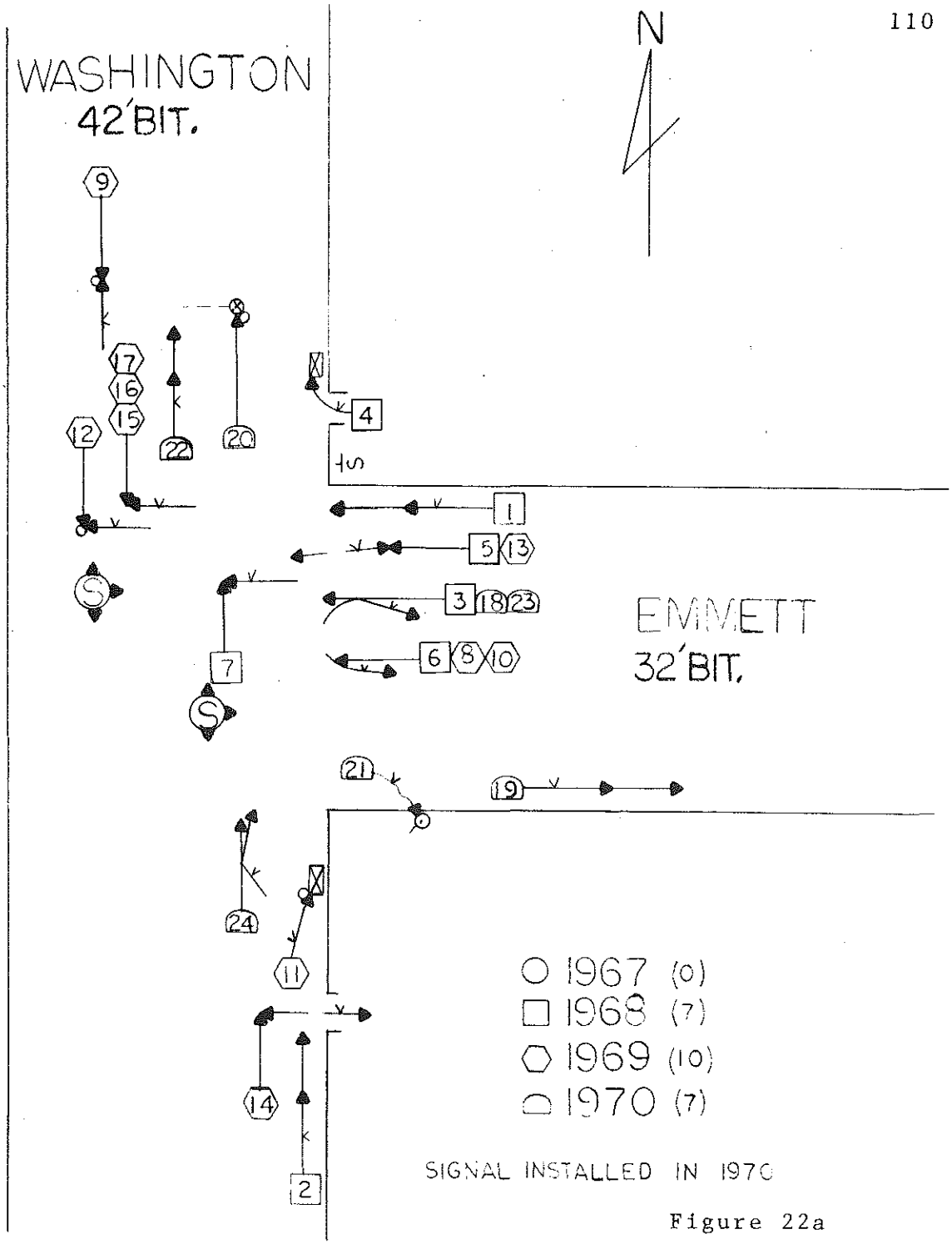


Figure 22a

LEGEND

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

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location WASHINGTON AT EMMETT
CITY OF BATTLE CREEK
CALHOUN CO.

Period: 1967 THRU 1970

Accidents – Total 24 **P.D.** 20

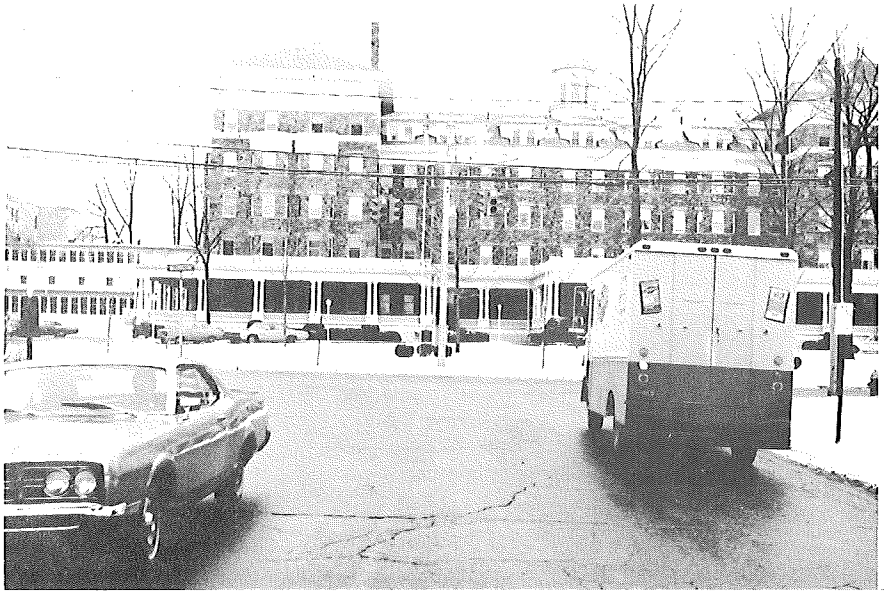
Injury 4 (4) **Fatal** 0 ( )

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

Plan No. LOCATION 18 **Date** 11-12-71

Form 1547 B (Rev. 11/70)

NORTHBOUND WASHINGTON AVENUE



WESTBOUND EMMETT STREET

SOUTHBOUND WASHINGTON AVENUE

Figure 22b

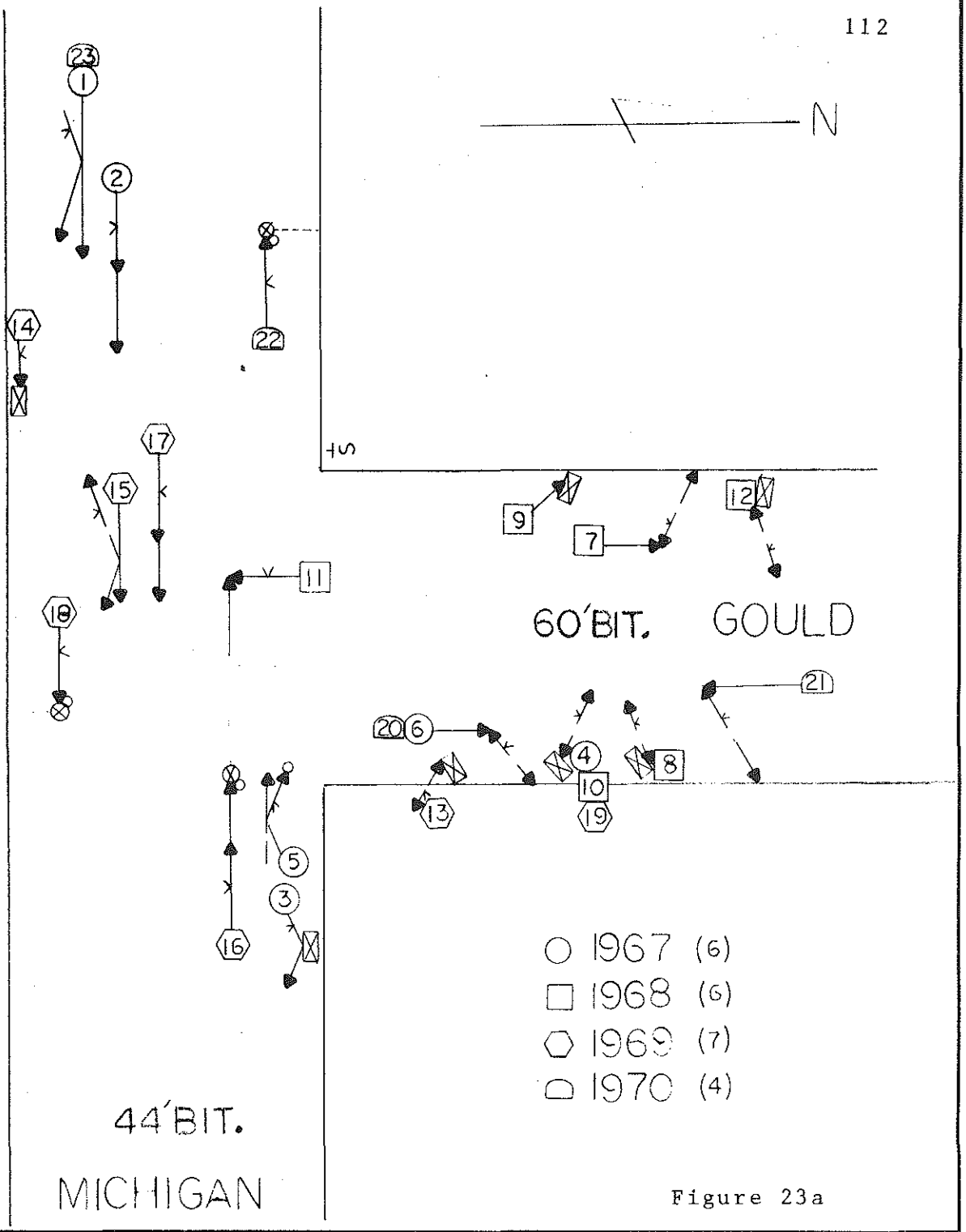


Figure 23a

LEGEND

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

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

MICHIGAN DEPARTMENT OF STATE HIGHWAYS
TRAFFIC AND SAFETY DIVISION

Location GOULD AT MICHIGAN
CITY OF BATTLE CREEK
CALHOUN CO.

Period: 1967 THRU 1970

Accidents – Total 23 **P.D.** 19

Injury 4 (5) **Fatal** 0 ( )

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

Plan No. LOCATION 19 **Date** 11-12-71

Form 1547 B (Rev. 11/70)

EASTBOUND MICHIGAN AVENUE

SOUTHBOUND GOULD STREET

WESTBOUND MICHIGAN AVENUE

Figure 23b

APPENDIX II

Section B. Regulatory Signs

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

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

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

Regulatory signs are classified in the following groups:

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

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

STOP SIGN

Reflectorized

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

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

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

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

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

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

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

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

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

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

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

YIELD SIGN

Reflectorized

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

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

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

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

NO LEFT TURN SIGN

Reflectorized

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

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

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

(1) Internally illuminated disappearing legend signs.

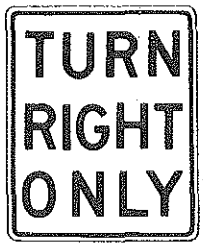
(2) Permanently mounted signs incorporating a supplementary legend showing the hours during which the prohibition is in effect.

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

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

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

TURN RIGHT ONLY SIGN



Reflectorized

R3-6-24 24″ x 30″ (6″ letters)

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

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

LANE-USE CONTROL (ROADSIDE SIGN)

Reflectorized

R3-7-30 30″ x 30″ (4″ and 5″ letters)

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

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

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

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

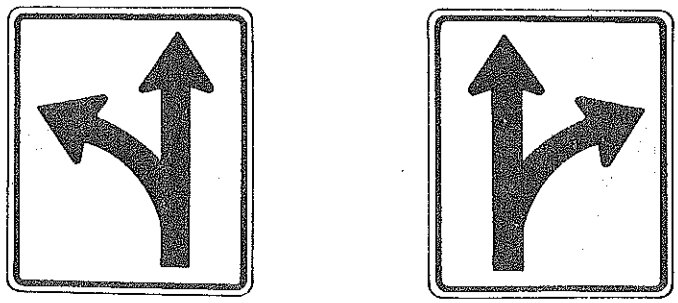
For placement see figures 1-5 and 1-6.

LANE USE CONTROL SIGNS

Reflectorized

R3-8-30 30″ x 36″ (6″ letters)

(Overhead)



Reflectorized

R3-9-30 30″ x 36″

(Overhead)

CROSS WALK (OVERHEAD) SIGN

Internally Illuminated

R6-23-24 24″ x 30″ (6″ letters)

This sign may be used in conjunction with a mid-block pedestrian crosswalk.

Where used, it should be positioned over the centerline of the highway.

For placement, see figure 1-5.

LIMITED ACCESS PROTECTION SIGNS

These signs may be used to inform the public of certain limited access control features in effect on a highway.

Where used, they shall be located as outlined below:

R6-24; Double-faced signs near the right-of-way at intervals determined by the agency having jurisdiction over the highway.

R6-25; On or adjacent to the physical barrier at the point where a highway has been closed by highway construction.

R6-26; In each quadrant of an appropriate intersection near the edge of the right-of-way.

R6-27; In the same manner as the R6-26.

R6-28; In the same manner as the R6-24.

The Limited Access Protection Signs are illustrated on Page 72.

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.

STOP AHEAD SIGN

Reflectorized

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

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

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

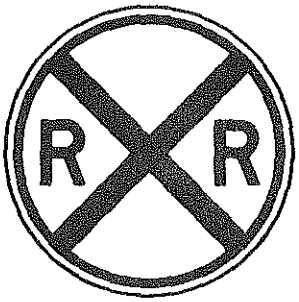
Except where used on State trunkline highways at junctions with other State trunkline highways, it shall be located in advance of the required stop at the approximate distance indicated below:

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

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

For placement see figure 1-11.

RAILROAD ADVANCE WARNING SIGN



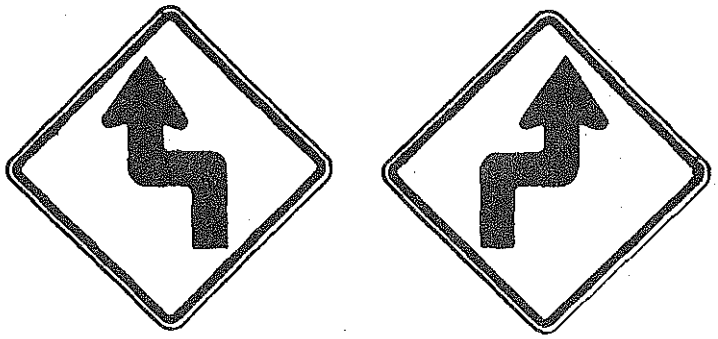
Reflectorized

W10-1-36 36″ diameter (8″ letters)

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

For placement see figure 1-11.

REVERSE TURN SIGN



Reflectorized

W1-3-30 30″ x 30″
W1-3-36 36″ x 36″
W1-3-48 48″ x 48″

Where two turns or a curve and a turn in opposite directions are separated by a tangent of less than 400 feet a Reverse Turn sign shall be used. 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.

Section B. Pavement and Curb Markings

Materials

Pavement and curb markings are generally placed with paint, however, a number of substitutes, such as thermoplastics, flat units, and metal inserts may be used. Paint substitutes, when used, shall conform to the color, reflectorization, and dimension specifications for paint markings.

Paint substitutes on or in the pavement surface shall be set so that their upper surfaces are essentially flush with the pavement surface. They may be placed in continuous contact or separated by small spaces, approximately equal to the length of a single unit. Either type of line may be used where a solid line is prescribed in this Manual. Particular care shall be taken to assure accurate alinement and spacing.

Paint substitutes shall be not less than 4″ in diameter, if round, or not less than 4″ in width and of equivalent minimum area if of other shape. They shall be spaced not more than 16″ apart, center to center, on transverse lines and not more than 36″ apart on longitudinal lines. They shall have rounded surfaces that present a smooth contour to the wheels of vehicles and shall not project more than ¾ of an inch above the level of the pavement. They shall be permanently fixed in place.

The use of raised bars (commonly known as "jiggle bars") to discourage the use of certain pavement areas is allowed.

Built-in pavement markings of white or colored concrete or inlaid bricks or blocks are not adaptable to reflectorization nor to any change in layout for traffic conditions and their use is not recommended.

Large mushroom buttons or bars of cast iron or concrete several inches high, with or without reflectors, light symbols, or messages, shall not be used for pavement markings. In their application, they are in effect, curbs or islands and are restricted to such applications.

Colors

Pavement markings shall be white or highway yellow in color. The use of black between the white segments of a broken pavement line is permissible where the pavement itself does not provide sufficient contrast. This use of black does not establish

it as a standard color for pavement marking, but is only a means of achieving contrast on a light colored pavement.

White shall be used for:

1. Centerlines on two-lane rural roads and city streets.
2. Lane lines.
3. Pavement edge lines.
4. Paved shoulder markings.
5. Channelizing lines.
6. Approaches to obstructions which may be passed on either side.
7. Special markings at interchanges.
8. Turn markings.
9. Stop lines.
10. Crosswalk lines.
11. Parking space limit lines.
12. Word and symbol markings.

Yellow shall be used for:

1. Barrier lines:
   a. Double center lines on multi-lane pavements.
   b. No passing zones on two and three lane roads.
   c. Pavement width transitions.
   d. Approaches to obstructions which must be passed on the right.
   e. Excluded areas within the roadway.
2. Curb markings:
   a. Parking prohibitions.
   b. Traffic islands.

Width of Lines

Center lines, lane lines, and barrier lines shall be 4 to 6 inches wide. The width of a channelizing line may vary from a minimum of 4″ to a maximum of 12″, depending on the emphasis required. Pavement edge lines shall be 4″ wide. Transverse lines on pavements must be wider than longitudinal lines to be equally visible.

Reflectorization

All pavement markings having application at night shall be reflectorized.

Maintenance

All markings shall be maintained in effective condition at all times. The frequency of repainting depends on the type of surface, composition, and rate of application of paint, climate, and volume of traffic. Particular care should be taken, especially in the case of broken lines, to paint over the old markings as exactly as possible. Otherwise, they will appear increasingly ragged after successive repaintings.

Center Lines*

A center line is used to designate the center of the traveled part of a roadway carrying traffic in both directions. Under some circumstances, as at a pavement-width transition, where parking is allowed on one side, or where a truck lane is provided, it need not be at the geometrical center of the pavement. On all major rural highways having an even number of lanes, and on many urban streets and less important rural roads, center lines are necessary and should be applied throughout the entire length of the pavement. In urban locations and on some rural roads where a continuous center line is not provided, short sections of center line are useful on approaches to busy intersections, marked crosswalks, railroad crossings, around curves or at hillcrests. When so used, the center line serves both to warn of any unusual conditions and to organize and control traffic through a hazardous or congested zone.

The center line on a two-lane paved rural highway shall be a broken white line, 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. On four-lane undivided rural pavements, or on pavements of a greater even number of lanes, the center line shall consist of two solid yellow lines, each not less than 4″ nor more than 6″ wide, separated by a space of not less than 3″. Lines dividing a one-way roadway into two or more lanes are lane lines.

* See Change Memorandum No. 5, p. 149.

As a guide to the application of center line markings, the following warrants are suggested:

1. Center lines are desirable on all paved highways and as a minimum should be placed throughout the length of:
   a. Two-lane pavements carrying an ADT (Average Daily Traffic) in excess of 1,000 vehicles.
   b. Two-lane pavements narrower than 20′ carrying an ADT in excess of 500 vehicles.
   c. Two-lane pavements narrower than 18′ but not less than 16′ in width carrying an ADT in excess of 300 vehicles. Center lines should not be used on pavements narrower than 16′.
   d. All four, six, and eight lane undivided pavements.
2. Center lines should be placed at other locations where accident experience indicates their need, and on hard surface roads in areas where driver visibility is likely to be reduced frequently as by fog.

The center line on a two-way city street having only one lane for moving traffic in each direction shall be a solid white line. Such line shall be not less than 4 nor more than 6 inches wide.

A double solid yellow line shall be used on a two-way street with four or more lanes for moving traffic except where a single lane has been reserved for left turning vehicles or where one or more lanes are in use for reversible lane control. In such cases, a solid white line shall be used as shown in figure 3-16.

On a two way street, where it is desired to exclude traffic from a portion of pavement between traffic moving in opposite directions the double solid yellow line shall be used.

Lane Lines

Lane lines are helpful in the organization of traffic in its proper channels, and in increasing the efficiency of the use of the roadway surface at congested locations. They should be used:

1. On all rural highways with an odd number of traffic lanes.
2. In addition to the center line, on all undivided rural highways of four or more lanes.
3. At the approaches to important intersections and cross-

walks, and in dangerous locations on both rural highways and city streets.

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.

No lane which is occupied by legally parked vehicles should 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).

No Passing Zones

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

Under the Michigan Vehicle Code, the State Highway Commission 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.

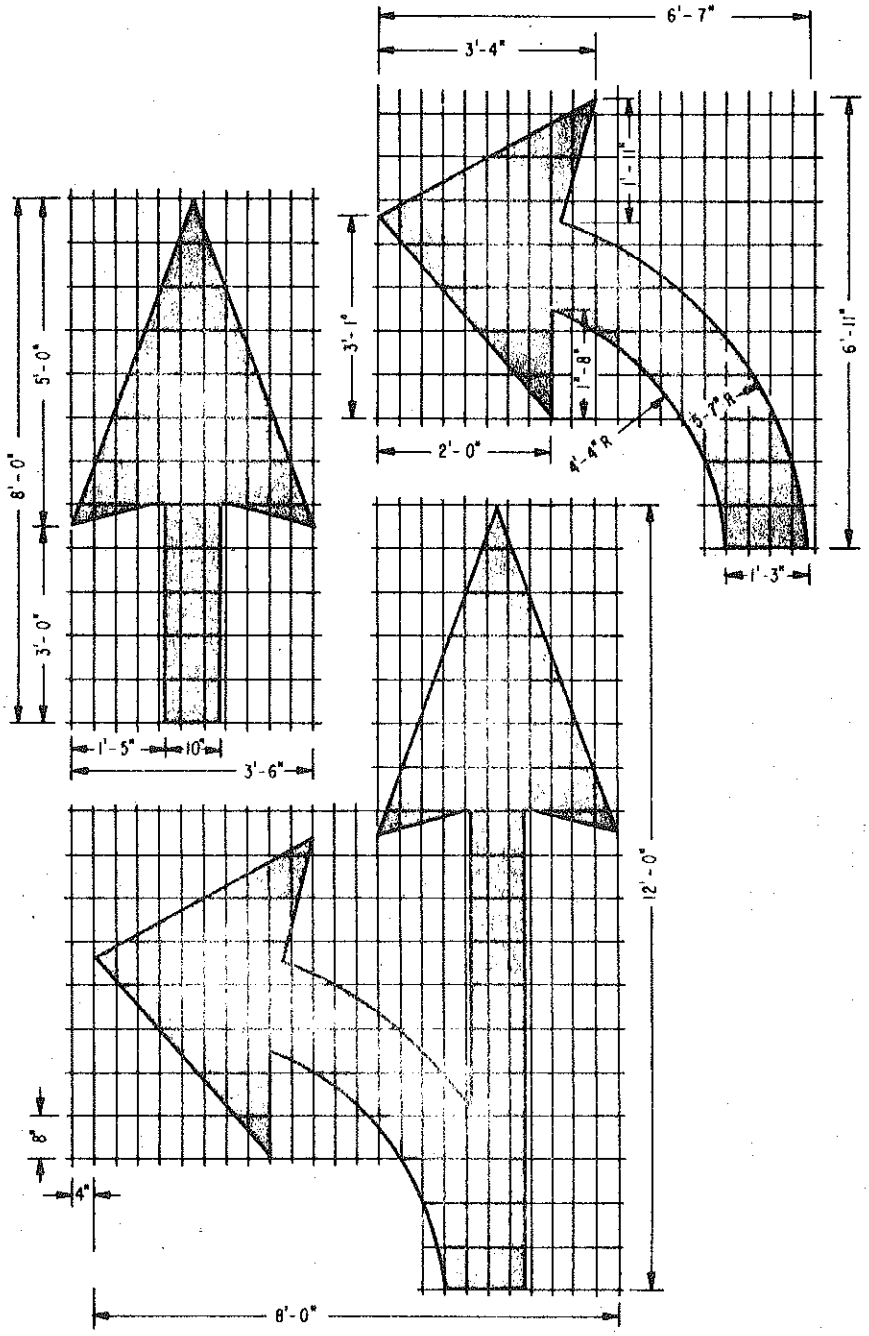


Figure 3-15. Elongated arrows for pavement markings.

Turns During the Red Light

The only provision in the "Michigan Vehicle Code" permitting turns during the showing of the red light is when a modifying steady green or flashing red arrow is provided. Without such modifying arrow(s), turns during the showing of the red are not allowed. When turning arrows are shown during the interval when the through movement is stopped, they should always be illuminated in conjunction with the red signal which they modify. If shown alone there is always doubt as to whether other movements are forbidden during the indicated interval. Furthermore, drivers approaching an arrow signal may mistake it for the customary "GO" signal.

Experience has shown that greater efficiency is obtained with the steady green arrow, or the flashing red arrow, where there is a separate lane available for the movement so indicated.

Whenever it is intended to permit traffic on a certain thoroughfare in a given interval to make certain turning movements and prohibit it from making others, the regular circular red lens facing that traffic shall be illuminated together with a separate green arrow or flashing red arrow for each permitted movement.

The foregoing is not intended to prevent prohibition of turns at all times or during certain periods of the day by erection of signs.

The steady yellow indication shall be shown following each green or "GO" interval (both circular green and/or green arrow), unless the next interval allows such movement to continue.

In those cases where a turning movement is to be cut off while the straight through movement continues, a separate signal face shall be provided to control the turning movement. It shall be equipped with circular red and yellow lenses, a green turn arrow lens, and the appropriate "LEFT" (R3-11) or "RIGHT" (R3-13) sign. When the turn is to be cut off, a yellow clearance interval shall be shown, followed by a steady red indication. The purpose of a special signal face should be made clear by its location and by a "LEFT" (R3-11), "THRU" (R3-12) or "RIGHT" (R3-13), sign located directly above the signal.

The use of a steady yellow as a caution signal is prohibited.

Vehicular Signal Lenses

The optical unit of a signal consists of a lens, reflector, lamp, and lamp socket. The lens is that part of the unit which redirects to the desired area the light from the lamp and its reflector.

Specific instruction and performance data is given in the traffic signal head specification of the Michigan State Highway Department, but the general requirements are as follows:

All vehicular signal lenses shall be circular in shape with a standard lens size of 8″. An oversize (12″) is approved for use at locations where greater emphasis is desired. Normally when the oversize signal is used, all three lenses are the 12″ size. However, a single 12″ red lens may be used in conjunction with the standard size yellow and green lenses to give special emphasis. The 12″ lens provides an important increase in the target value of the signal at locations where signal indications tend to be overlooked. Among the situations where the 12″ lenses have been applied are:

1. Intersections with high approach speeds.
2. Isolated intersections or those where signalization might be unexpected, such as the first signal beyond a freeway terminus.
3. Special problem locations such as those with conflicting or competing backgrounds.
4. Intersections where drivers view both traffic control and lane direction control signals simultaneously.
5. Signalized intersections where there is an unusual preponderance of rear end and/or right angle type accidents after other corrective measures have failed to reduce the number of accidents.

An arrow lens shall be so designed that its shape is distinctly visible at a distance of 200 feet. It is very important that approaching drivers recognize the arrow shape at a sufficient distance to govern their actions accordingly.

Where an arrow is suspended separately from the standard signal, as in the case of a right turn lane or a continuous free flow movement, it shall have a minimum size of 12 inches. Use of a larger neon arrow for a continuous movement is permissible.

Each arrow lens shall show only one arrow direction. Double headed arrows are not acceptable. The arrow shall be the only illuminated part of the lens and shall be reproduced on the lens in conformance with the appropriate Michigan State Highway Department specifications.

Lettering shall in no case be used on the visible part of vehicular signal lenses. The practice of embossing words such

as "GO" and "STOP" on vehicular signal lenses reduces their effectiveness.

Each lens shall be illuminated independently. This is essential to permit uniform positioning of lenses, to give satisfactory brilliance, and to provide necessary flexibility in signal indications. Such illumination shall be by a clear lamp of not less than 67 watt capacity, especially designed for traffic signals.

Lamps of not less than 100 and not more than 150 watt capacity shall be used with the 12" lens. In areas with high ambient light level 150 watt lamps have proved successful in providing the intensity necessary to compete with other lighting. In areas with low ambient light levels the high wattage lamps, while providing high intensity during the day, tend to blind the motorist at night. This is especially true with a flashing beacon or a signal on flasher operation. Nighttime voltage reduction (to approximately 85 volts) by means of a transformer, switched into the circuit by photo-electric control has minimized the blinding characteristics.

When a vehicular traffic signal lens is illuminated and the view of such indication is not otherwise physically obstructed, it shall be clearly visible to drivers it controls at distances up to 1,000 feet under all atmospheric conditions except dense fog.

Each signal face shall be so adjusted that its beams will be of maximum effectiveness to the applicable approaching traffic. Each signal face shall, to the extent possible, be so shielded by a visor, louver, or screen that an approaching driver can see only the signal face or faces intended for his observance. Back plates may improve a signal's effectiveness.

In general, vehicular signals should be so aimed as to have the maximum effectiveness for approaching drivers at a distance from the stop line equal to the average distance they would travel while reacting to the stop indication and stopping their vehicles from a normal operating speed. The influence of curves, grades, obstructions, and adjacent signals should be considered in directing and locating signals.

Streets which intersect at acute angles frequently necessitate placing signal faces so that there is a comparatively small angle between their beams. In these cases, each signal face shall, to the extent practicable, be so shielded by visors or louvers that an approaching driver can see only the indication intended for him to obey.

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

Types of Mountings for Signal Heads

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

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

Number of Signal Faces

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

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

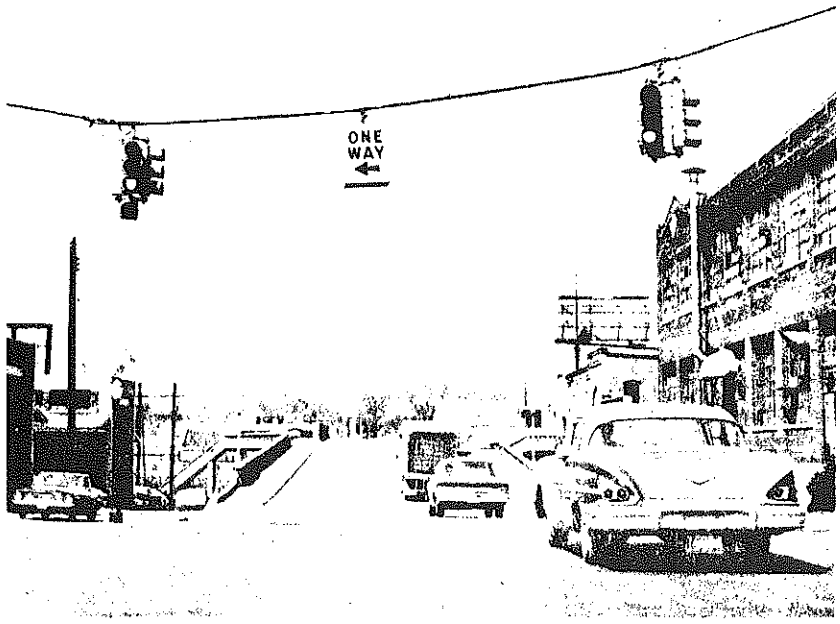


Figure 4-3. Traffic control signal installation with delayed left turn arrow.

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

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

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

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

Signal faces shall be located at the intersection so as to give drivers and pedestrians a clear, unmistakeable indication of the right-of-way assignment from their normal positions on the approaches and as they pass through the intersection area. At intersections where signals are installed on the basis of the pedestrian volume warrant, or at other signalized locations where the pedestrian volume equals or exceeds the warrant, pedestrian signals shall be installed.

Pedestals in the roadway to carry signals are driving hazards, and are prohibited despite any advantages as a conspicuous signal location. This is not intended however, to preclude the use of signals on pedestals or posts within the area of properly designed channelized islands or in the median strip of divided roadways.

Where physical conditions prevent the driver from having a continuous view of at least one signal indication for approximately ten seconds before reaching the stop line, consideration may be given to the use of a supplementary signal to improve this visibility.

Advance warning of a signal may be provided by the use of a W3-3 (Signal Ahead) sign. For greater emphasis flashing yellow beacons may be used in conjunction with this sign as provided in Part V, Miscellaneous Electrical Devices.

Height of Vehicular Signal Faces

The vertical clearance of overhead signals shall not be less than 15 feet or normally more than 17 feet. Where used, supplementary pedestal or pole mounted signals shall have a bottom height of not less than 8 feet nor more than 15 feet.

Maximum visibility and adequate clearance should be the guiding consideration in deciding signal height. Grades on approaching streets may be important factors, however, in determining the most appropriate height.

Transverse Location of Signal Faces

Where dual overhead signal faces are provided over the approach to a signal they should normally be centered on the approach with a minimum of 14 foot separation from each other. Transverse spacing, however, should be carefully checked by the Engineer to provide prominent and conspicuous location.

Section F. Pedestrian Signals

Definition

Pedestrian signals are traffic signals erected for the exclusive purpose of directing pedestrian traffic at signalized locations.

Warrants

Pedestrian signals shall be installed in conjunction with vehicular traffic signals already meeting one or more of the minimum warrants previously set forth for pretimed or traffic-actuated signals under any of the following conditions:

1. When a traffic signal is installed under the pedestrian volume warrant.
2. When pedestrians and vehicles move during the same phase and properly adjusted pedestrian clearance intervals are needed to minimize vehicle-pedestrian conflicts.
3. When an exclusive phase is provided or made available for pedestrian movement in one or more directions.
4. When pedestrian movement on one side of an intersection is permissible while through vehicular traffic is stopped to protect a vehicular turning movement on the other side of the intersection.
5. When an intersection is so large and complicated or a street so wide that vehicular signals would not adequately serve pedestrians.
6. When the minimum green intervals for vehicles at intersections with traffic-actuated controls is less than the minimum crossing time for pedestrians, and equipment is provided which extends the vehicular green time upon pedestrian actuation.
7. When multiphase or split-phase timing would tend to confuse pedestrians guided only by vehicle signal indications.
8. When pedestrians cross only part of the street, to or from an island, during a particular phase.

Type of Control

The control of pedestrian signal indications may be accomplished with the timing mechanism normally employed with traffic signals, in which case the pedestrian phase or indication is given at a predetermined point during each cycle; or the control may be such as to permit the use of a push-button to introduce the pedestrian phase or indication in accordance with the needs of pedestrian traffic.

As a general rule, the installation of pedestrian signals at non-intersectional locations is to be avoided. However, when such signals are required the pedestrian-actuated type of control, coordinated with adjacent signals, should be employed.

General Design Requirements

Pedestrian signal indications should attract the attention of and be clearly readable or understandable to the pedestrian both day and night and at all distances from 10 feet to the full width of the area to be crossed.

All pedestrian signals shall be rectangular in shape and shall contain the lettered messages WALK and WAIT or WALK and DON'T WALK. The two basic types described below and shown in figure 4-9 are approved as standard for pedestrian signals.

Gas-Filled Tubing Type: The letters shall be at least 4½ inches in height and shall be in two lines. The WALK indication shall be green and the DON'T WALK shall be red. The messages shall consist of (a) gas-filled formed tubing, or (b) cut-out letters illuminated by gas-filled tubing.

Incandescent Type: The letters shall be at least 3 inches high. The WALK and the WAIT (WALK and DON'T WALK) indications shall be in separate signal sections. The WALK lens shall be white glass with an opaque band at least 5⅝ inches high across the center of the lens obscuring all except the letters and a band of white at the top and bottom. The WAIT lens shall be orange glass with an opaque band which is similar to that used on the WALK lens. Where the legend DON'T WALK is used in lieu of the WAIT, the lens shall be orange glass with all except the letters obscured by an opaque material.

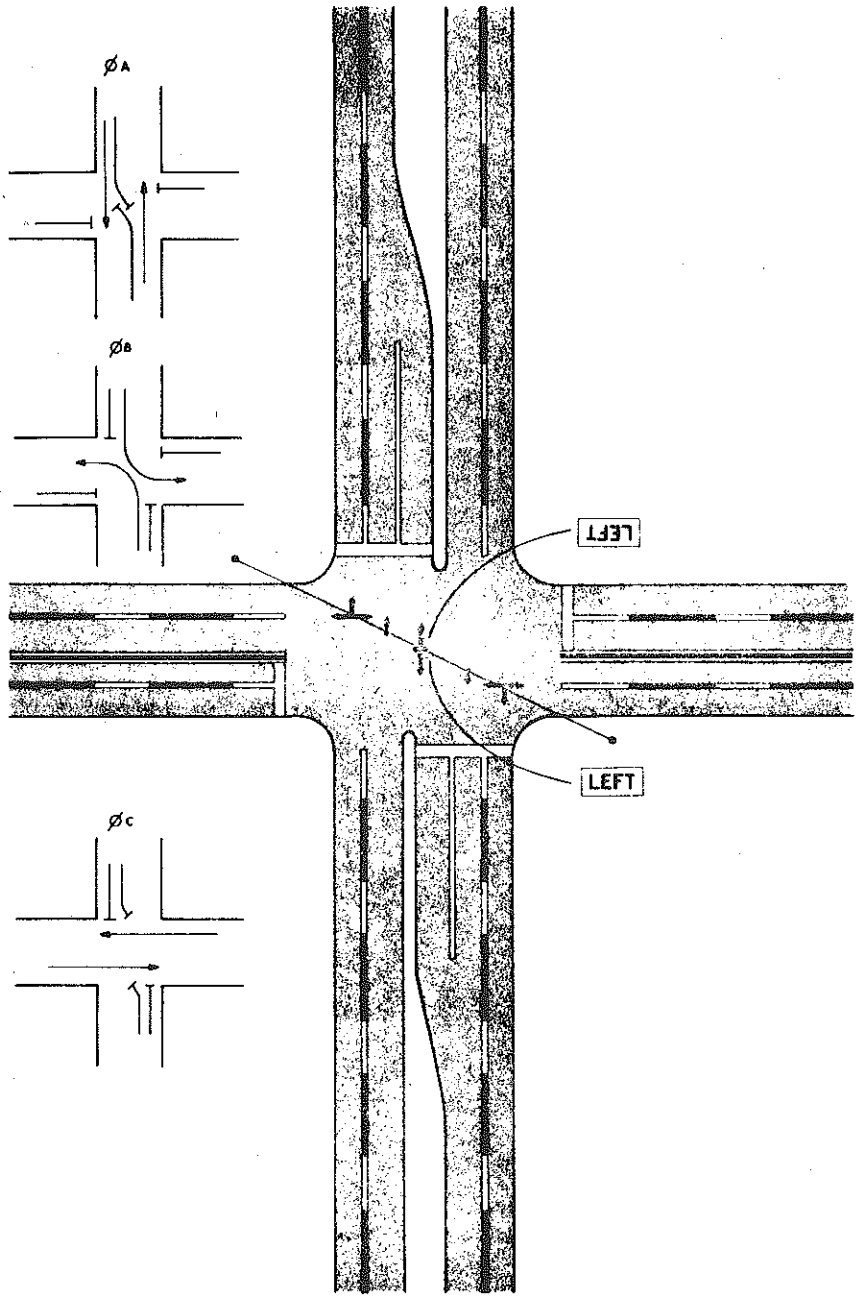


Figure 4-13. Typical signal layout—left turn phase.

PART V. MISCELLANEOUS ELECTRICAL DEVICES

Section A. Introduction

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

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

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

Section B. Flashing Beacons

Definition and Application

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

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

Warrants for Flashing Beacons at Intersections

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

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

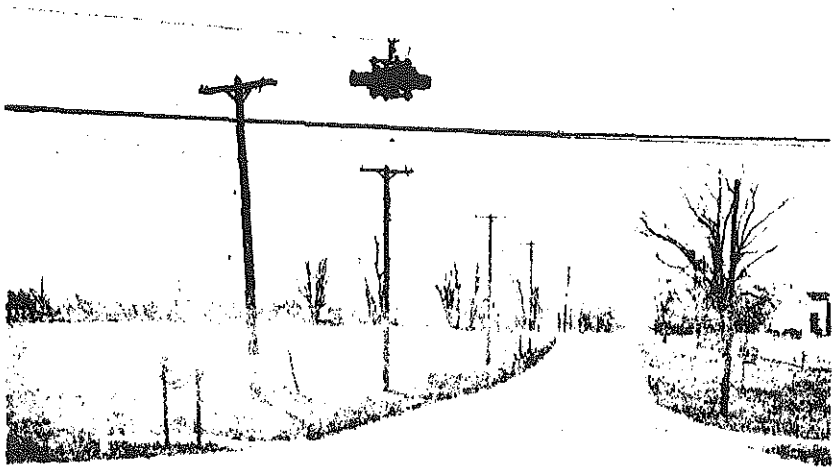


Figure 5-1. Overhead flashing beacon.

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

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

Design

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

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

3. The color of the lens shall be red for stop or yellow for caution, in accordance with specifications of the Michigan State Highway Department.

The flashing beacon is controlled by a flasher device which is located in a separate housing. The flasher device provides the continuous intermittent illumination of the lenses of the beacon. All flashing contacts should be equipped with filters for suppression of radio interference.

Location

The intersectional flashing beacon is installed over the intersection of the centerlines of two highways with a minimum vertical clearance of 15 feet. Normally, the clearance should not exceed 17 feet. If it is suspected that a traffic control signal may be required within the next few years the span supporting the beacon should be installed so that it is in the proper position and at the proper height to allow proper minimum clearance after the signals have been installed.

Operation

The illuminating element in a flashing yellow (caution) or flashing red (stop) beacon shall be flashed at a rate of not less than 49 nor more than 59 times per minute. The illuminated period of each flash shall be not less than half nor more than two-thirds of the total cycle. Intersection flashing beacons shall be operated continuously throughout the 24 hours of the day.

Other Application of the Flashing Beacon

Flashing beacons are effectively used in many applications. These applications include:

1. In conjunction with warning signs.
2. In conjunction with "STOP" signs.
3. In the School Speed Limit sign.
4. Route Turn Beacon.
5. Overhead Barricade Beacon.

Warning Signs

Yellow flashing beacons may be used with almost any warning sign to give additional emphasis. Either one or two beacons may

Figure 5-4. Flashing beacons in a stop sign.

be used. Where one beacon is used, it shall be positioned immediately above the sign. Where two are used, they shall flash alternately and shall be positioned in the sign itself as shown in figure 5-2. Typical applications are with the "STOP AHEAD" (W3-1), the "SIGNAL AHEAD" (W3-3), and the "SCHOOL" (W9-1) signs.

Where a hazard is present for only certain hours of the day the flashing beacon should operate only during those hours.

A conscientious effort must be made on the part of the Engineer, to keep the use of the flashing beacon to a minimum. Excessive use of this device should be avoided so that it will not lose its effectiveness.

Stop Signs

Two alternately flashing red beacons may be installed in a reflectorized "STOP" sign (R1-1) to give the sign added emphasis. This device is particularly helpful where the "STOP" sign cannot be located in a conspicuous place. It is also beneficial if a stop is required at a location where the motorist would not normally expect to stop, such as at an intersection one block from a traffic control signal.

Section C. Illuminated Signs

Introduction

All signs which have night time application should be either reflectorized or illuminated. Illuminated signs are a most useful tool, especially in metropolitan areas, for providing added emphasis of a sign message.

Illuminated signs can be divided into two groups. They are:

1. Internally Illuminated
   A. Full Time
   B. Part-Time Disappearing Legend
2. Externally Illuminated

Most illuminated signs are of the regulatory type, however, this does not preclude their use for other sign types.

Internally Illuminated Signs

Internally illuminated signs in common use fall into two general categories: those intended for full time operation and those intended for part time operation. The latter are known as disappearing legend signs.

For signs having full time application, the most frequently used sizes are the 27″ x 12″, the two face 24″ x 30″ and the four face 24″ x 30″. Specifications for these cases are available from the Michigan Department of State Highways. Internally illuminated signs may also be used in other sizes.

The 27″ x 12″ case normally is used with the "LEFT" (R3-11), "THRU" (R3-12), or "RIGHT" (R3-13) signs, however, it can accommodate any other short legend, such as a route number. This sign is mounted directly above the traffic control signal or flashing beacon to which it applies.

The two and four face 24″ x 30″ cases are normally used in conjunction with traffic control signals. When used in this application they shall be positioned as close as practicable to the centerline of the applicable street or highway.

The following are some suggested signs:

R1-1 "STOP"
R1-2 "YIELD"
R3-1 "NO LEFT TURN"
R3-2 "NO RIGHT TURN"
R3-3 "NO TURNS"
R3-5 "TURN LEFT ONLY"
R3-6 "TURN RIGHT ONLY"
R3-24 "ONE WAY" (with arrow)
R3-36 "BULLSEYE"
R6-23 "CROSSWALK"

When the Engineer has the choice of using either a positive ("ONE WAY") or a negative ("NO LEFT TURN") message in the case sign, he should always choose the positive legend, as this gives the motorist more information.

Where the sign message is applicable only during certain hours, such as with a part time turn prohibition, a disappearing legend sign may be used with either manual or automatic control.

Although neon, fluorescent and incandescent lighting have been used for case signs, the latest standards of the Michigan Department of State Highways call for the use of fluorescent illumination.

Disappearing Legend Signs

A type of sign that is of growing importance is the Disappearing Legend Sign, that when activated will display emergency warnings or impose special regulations. A method presently in use involves translucent panels mounted in the face of case signs. These panels have legends visible only when lighted from behind.

Disappearing Legend Signs, whenever practicable, should conform to the standards applicable to standard signs. Because of their features however, it may not be possible to make them conform to standards of shape or color without loss of their effectiveness. They should meet the minimum standards for size and should be erected in accordance with the same requirements of height and clearance as other signs. Where required, a disappearing legend may form a message mounted on or within a standard sign background, and it may be necessary to use the device in conjunction with flashing beacons.

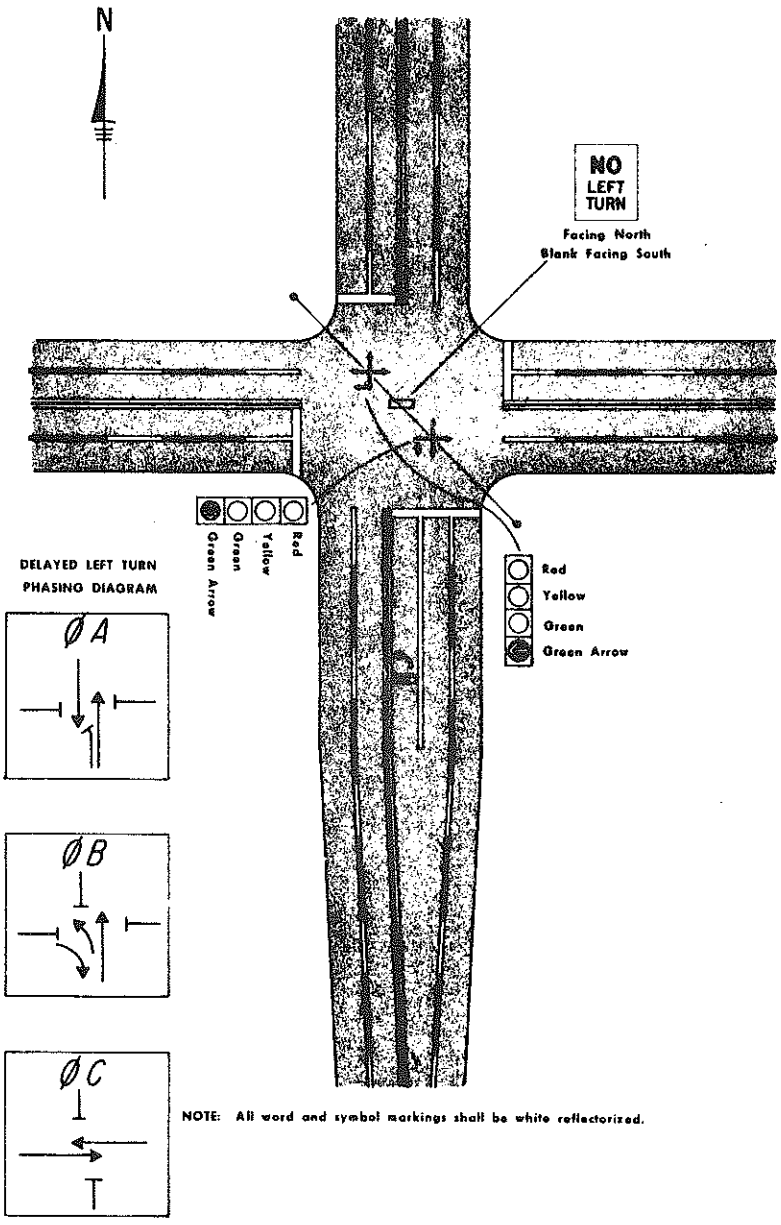


Figure 4-15. Typical signal layout—delayed left turn.

OFFICE MEMORANDUM

MICHIGAN
DEPARTMENT OF STATE HIGHWAYS NOV 10 1971

To: All Holders on Record This Date of the 1963 Edition of the "Michigan Manual of Uniform Traffic Control Devices"

From: Henrik E. Stafseth, Director
Michigan Department of State Highways

John R. Plants, Director
Michigan Department of State Police

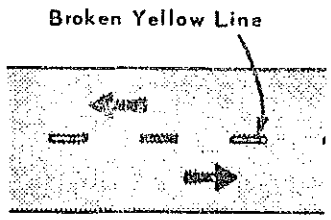
Subject: Change Memorandum No. 5

In order to more nearly conform to the design and application of traffic control devices prescribed by the 1971 edition of the National "Manual on Uniform Traffic Control Devices" (MUTCD) and to comply with recent revisions to the "Michigan Vehicle Code" (MVC), it is necessary that the following changes in the "Michigan Manual of Uniform Traffic Control Devices" (MMUTCD) be made. These and other changes to the 1963 edition of the MMUTCD will ultimately be encompassed in a revised edition of the MMUTCD. However, this Change Memorandum will serve to authorize interim changes of more urgent concern to state, county and municipal agencies.

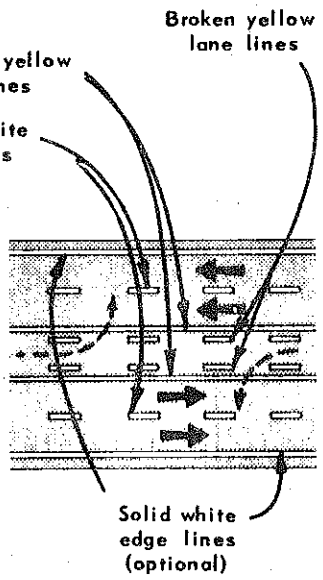
In instances where "may" is used in this memorandum, the 1971 edition of the MUTCD and forthcoming revised edition of the MMUTCD possibly will read "shall". The purpose of using "may" in this memorandum is to temporarily permit the extended use of existing sign inventories.

The interim changes, numerically designated, follow (code numbers shown beneath sign illustrations are from the MUTCD sign coding system):

1. On all two-lane, two-way, hard-surface roadways, beginning with the 1972 pavement-marking season, any centerline marking placed shall be a broken yellow line. Line width, segment length, and the marking of "no-passing" zones shall be the same as currently specified by the MMUTCD. *



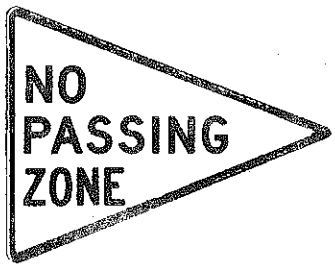
* See Typical Pavement Marking, p. 154.



2. Beginning with the 1972 pavement-marking season, on each two-way roadway consisting of three lanes or more, where a two-way, left-turn lane is to be designated, the two-way, left-turn lane shall be marked by a single-direction, no-passing markings (4-inch solid yellow line on the outside and 4-inch broken yellow line on the inside) on each edge of the center lane.

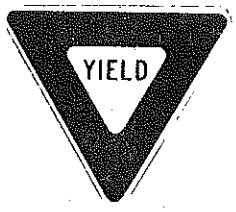
3. By December 31, 1972, the limits of no-passing zones at vertical curves, identified by pavement markings and/or "DO NOT PASS" and "PASS WITH CARE" signs, shall be established where the minimum sight distance measured between points 3.75 feet (maximum) above the roadway surface becomes less than that specified by the table on page 281 (MMUTCD).

4. In accordance with section 257.640 (MVC), a pennant-shaped sign, having a black legend "NO PASSING ZONE" and border on a yellow reflectorized background, shall be located on the left side of the roadway opposite the beginning of each no-passing zone identified by a "DO NOT PASS" sign and/or no-passing zone pavement markings. Consideration of item #3 should be taken into account when locating these signs.



W14-3
36" x 48" x 48"

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

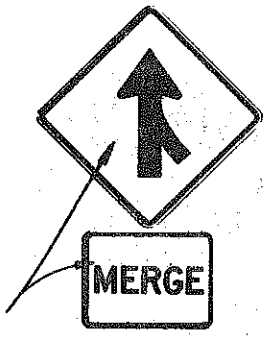


R1–2
36" x 36" x 36"

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

R5–1
30" x 30"

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



Black Legend
on a yellow
background

W4–1
30" x 30"
24" x 18"

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

S1–1
30" x 30"

replaced or added, a 30–inch–by 30–inch pentagon-shaped sign, with figures to represent school children, may be used. When such sign includes crosswalk markings, it shall only be used at or adjacent to an established crosswalk and shall be preceded by a pentagonal sign which excludes crosswalk markings (School Advance Sign).

S2–1
30" x 30"

9. Where a "PEDESTRIAN CROSSING" or a W9–6 "WATCH FOR PEDESTRIANS" sign is to be replaced or added, a 30–inch diamond-shaped sign, bearing a black stylized human shape on yellow reflectorized background, together with a 24–inch–by–18–inch "PED XING" panel, may be used.

W11–2
30" x 30"
24" x 18"

10. For construction, maintenance, or utility operations, warning signs may be designed with a black legend on a reflectorized orange background; barricades may be designed with alternate reflectorized orange and white stripes; barrels may be equipped with alternate reflectorized orange and white, circumferential stripes; and cones, having orange as a predominant color, may be used. The use of standard orange flags in conjunction with orange signs is permitted so long as they do not interfere with a clear view of the sign face. The use of the orange color devices, however, shall be limited to those operations where all warning signs, barricades, barrels, and cones pertaining to the same construction, maintenance, or utility operation are designed with the orange color.

11. On construction, maintenance, or utility operations, where orange is used for traffic control devices and flagmen are required, each flagman shall wear an orange vest and/or an orange cap, conforming to the designs specified by the 1971 edition of the MUTCD.

Standard plans for all signs described in this memorandum may be obtained from the Traffic and Safety Division, Michigan Department of State Highways.

We hereby certify that the provisions of this memorandum constitute an official change in the provisions of the "Michigan Manual of Uniform Traffic Control Devices", as adopted September 3, 1963 in accordance with Section 608, Act 300, P.A. 1949, as amended (MVC).

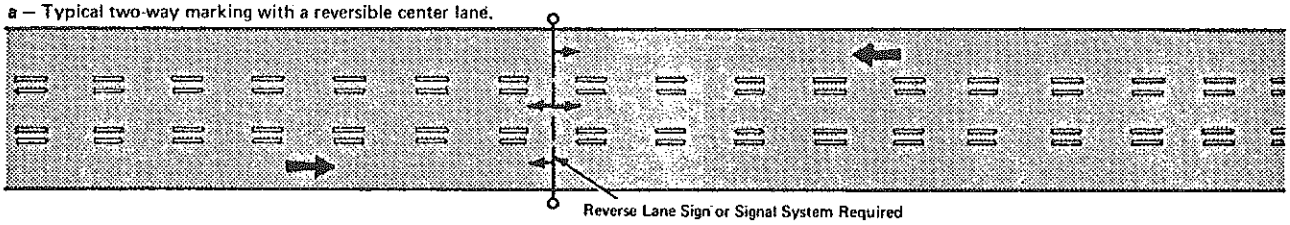
Director
Michigan Department of State Highways

Director
Michigan Department of State Police

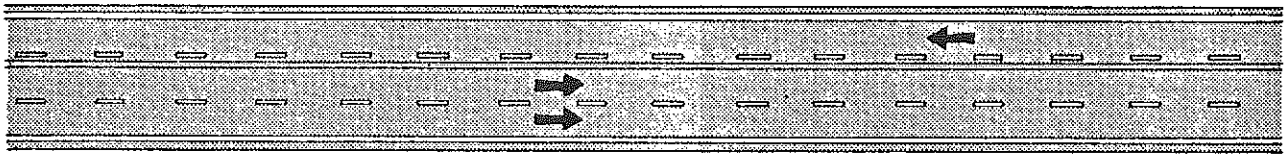
Note for Change Memorandums Only

This change will be reflected in the next Manual Edition. Therefore, this memorandum should be discarded when you receive that Edition.

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



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



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

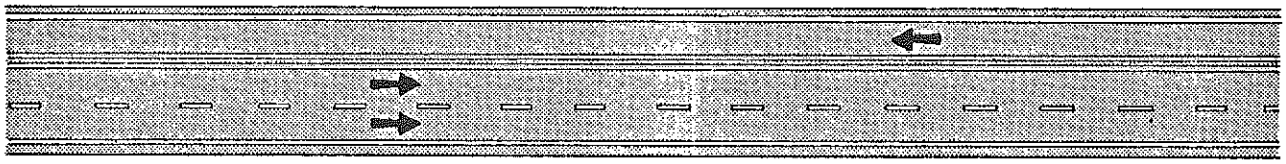
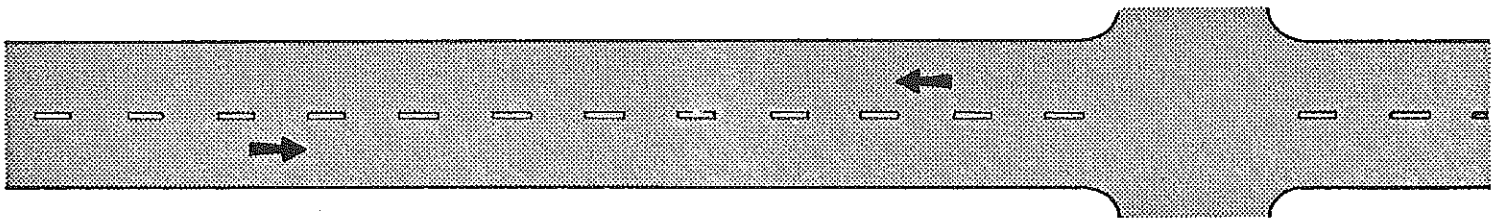


Figure 3–1. Typical two-way marking applications.

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



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

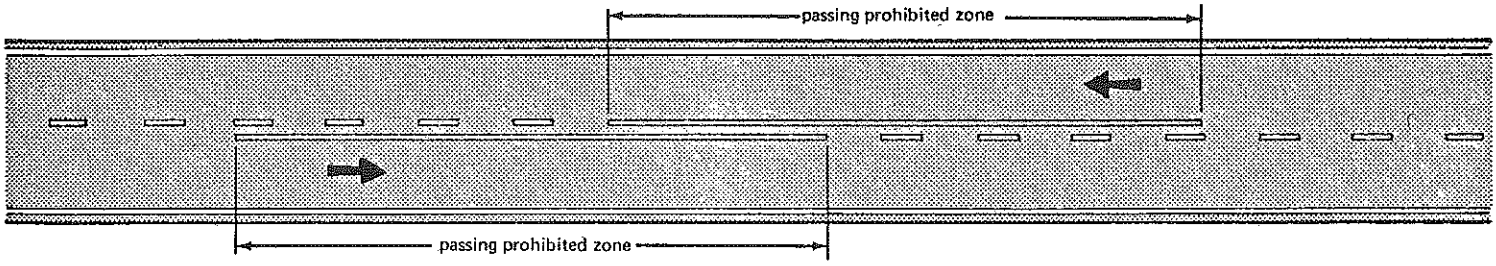
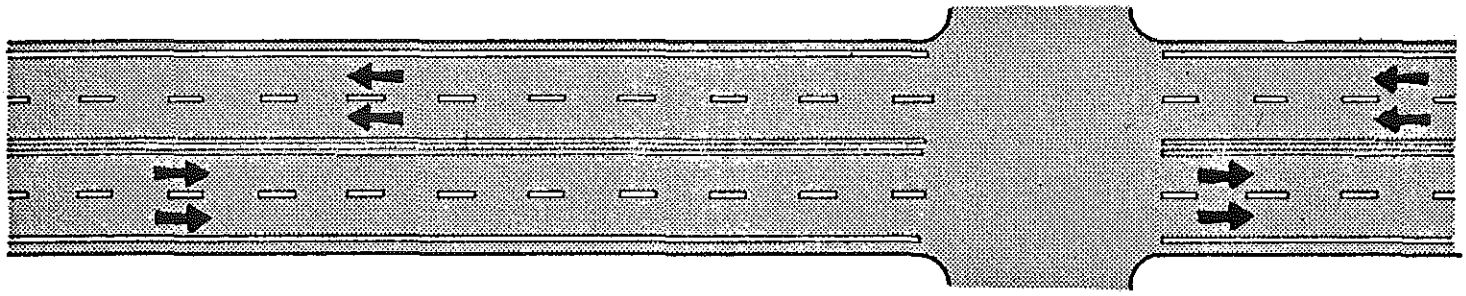


Figure 3–2. Typical 2-lane, two-way marking applications.

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



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

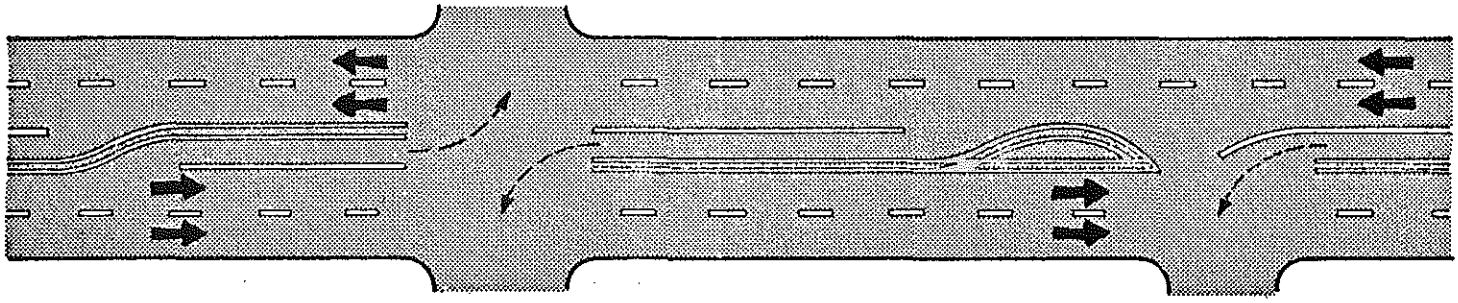
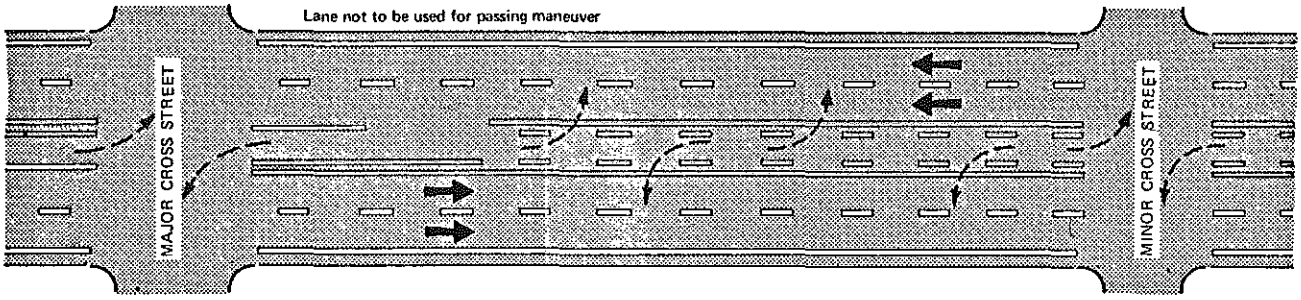


Figure 3–3. Typical multilane, two-way marking applications.

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



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

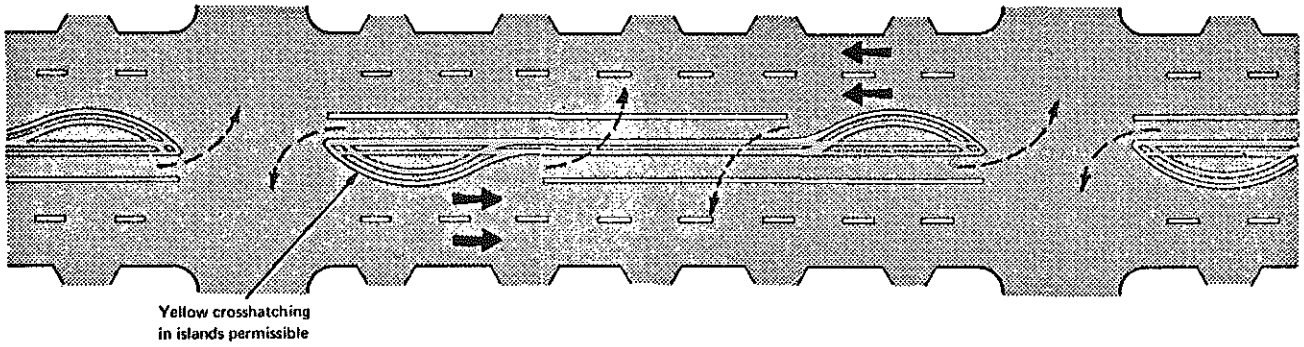


Figure 3–4. Typical multilane, two-way marking applications.