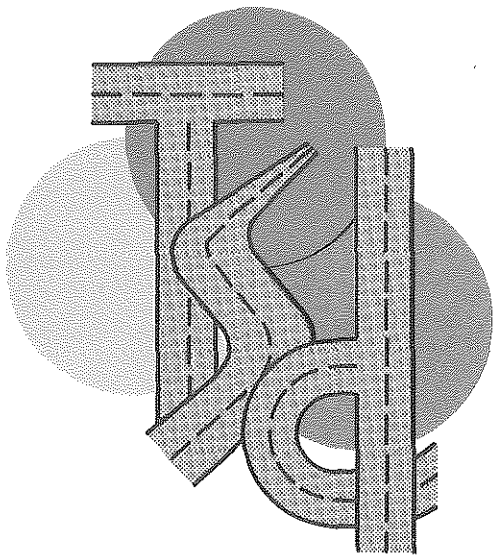
THE MARKING AND SIGNING OF THREE-LANE, TWO-WAY HIGHWAYS
TSD - 238 - 74



TRAFFIC and SAFETY DIVISION

DEPARTMENT OF STATE HIGHWAYS
STATE OF MICHIGAN

MICHIGAN DEPARTMENT
OF
STATE HIGHWAYS AND TRANSPORTATION

THE MARKING AND SIGNING OF THREE-LANE, TWO-WAY HIGHWAYS

TSD - 238 - 74

by
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Information Retrieval Data

KEY WORDS: Accidents, Traffic Markings, Traffic Signs - Regulatory, Three Lane Highways

ABSTRACT: The operations of three-lane, two-way pavements were evaluated to determine: 1) the warrants for allowing or disallowing passing in the center lane and 2) the pavement marking and signing schemes that best convey the applicable message to drivers. The procedure used were observations of the operations at different sites under different marking and signing schemes, review of the accident histories of the sites, and a questionnaire asking drivers to interpete the various marking schemes. Guidelines for determining if passing may be allowed are given. The report recommends that conventional marking and signing be used when passing is not allowed and that a single skip yellow marking with sign legend CENTER LANE/LEFT TURN OR PASSING be used when passing is allowed.

REFERENCE: Mercer, Donald J., The Marking and Signing of Three-Lane, Two-Way Highways Report TSD-238-74, Michigan Department of State Highways and Transportation, Lansing, June 1974.

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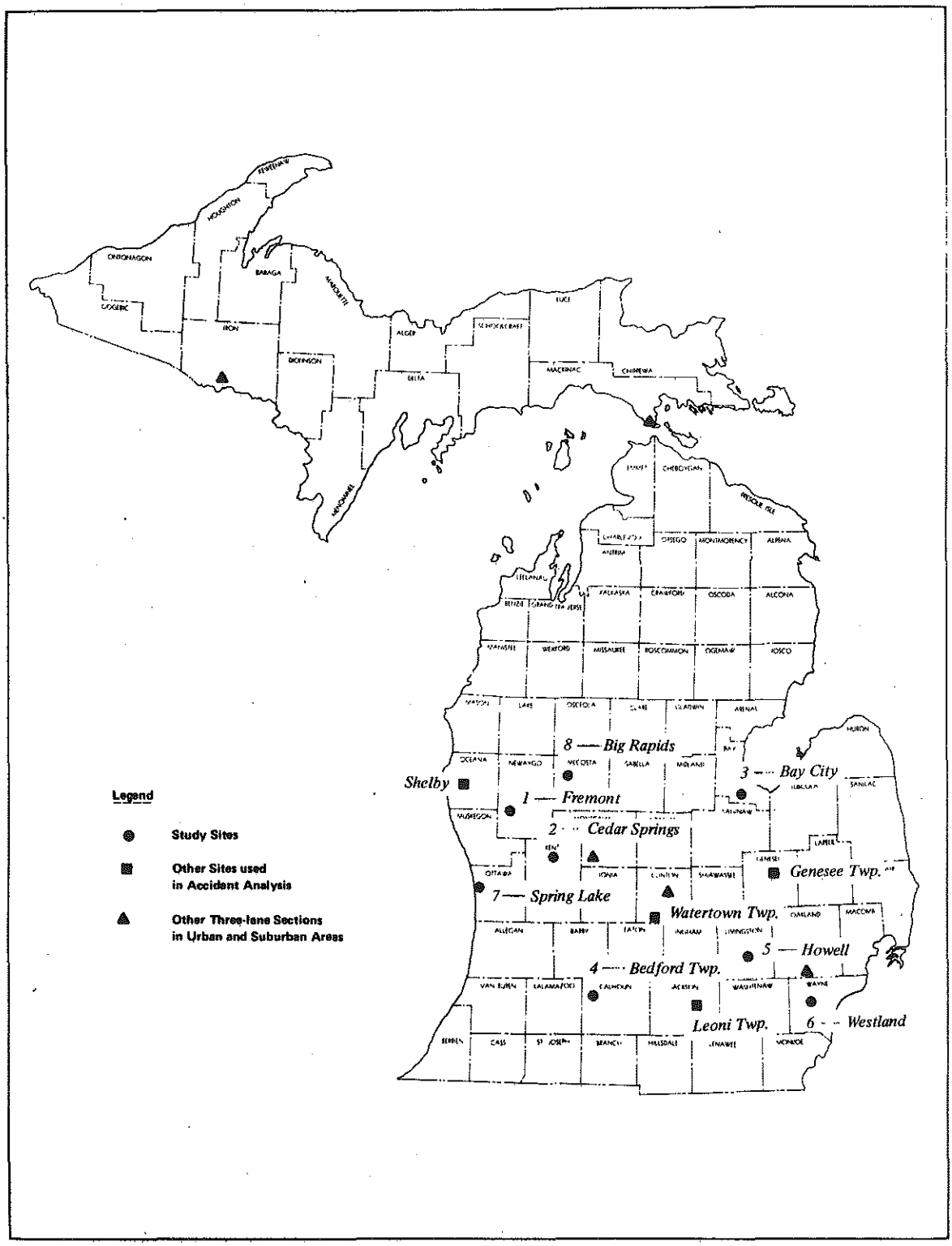


FIGURE 1. Location Map

Introduction

PURPOSE OF THE STUDY

The operations of three-lane, two-way highways in urban and suburban areas were evaluated to determine:

1. Warrants for specifying the use of the center lane
   a) for traffic in one direction only
   b) for left turns only in both directions
   c) for left turns and passing in both directions
2. The pavement marking and signing schemes that best convey the applicable message to drivers.

The warrants may be a function of speed, left turn rate, traffic volumes, alignment, and environment. They are established from the tradeoff between (1) the increased accident potential resulting from opposing passes in the center lane and (2) the increased accident potential resulting from the congestion caused by restricting passes in the center lane. These accident potentials are measured by tabulating accidents, conflicts, and erratic movements.

The preferred marking and signing schemes are determined by observing driver behavior under a variety of markings and signs at eight study sites (Figure 1).

BACKGROUND

Michigan's Vehicle Code, (15) Section 642 (Appendix 1) specifies three situations in which a vehicle may be driven

in the center lane; 1) "...when overtaking and passing another vehicle...", 2)"... in preparation for a left turn...", or 3)"...where such center lane is at the time allocated exclusively to traffic moving in the direction the vehicle is proceeding...." The Uniform Vehicle Code, and the vehicle codes of 40 other states and Canada have a similar provision (18, pp 239-240) for three-lane roadways.

The 1970 Manual on Uniform Traffic Control Devices (MUTCD) (21, pp 179-180, and 182) does not provide a marking scheme to accomodate the first situation, permitting passing from both directions. Its marking scheme (Figure 3-1b) allows passing in one direction only. The 1973 Michigan Manual of Uniform Traffic Control Devices (MMUTCD) specifies (17, p 223) that when two-way passing is allowed the pavement will be marked with a single yellow skip line between lanes.

The Federal Highway Administration approved that provision with the stipulation that the Department of State Highways and Transportation conduct an experiment of three-lane pavement markings.

The Department requested, through the National Advisory Committee of the American Association of State Highway and Transportation Officials, permission to conduct such an experiment; this request was approved by the Federal Highway Administration, Office of Traffic Operations, (5) in official ruling M-20 (Expr.).

Before passing can be prohibited on a section of highway in Michigan, the highway authority must determine that such passing would be "especially hazardous...based upon a traffic survey and engineering study" (Section 640, Michigan Vehicle Code, Appendix 1). For that reason, passing cannot be arbitrarily prohibited on three-lane, two-way highways. Passing, in fact, may be desirable to maintain capacity of these sections; if it is prohibited, a slow-moving vehicle can cause considerable congestion and resulting conflicts.

On suburban sections, there is generally little opportunity or desire to turn left, so the center lane is used primarily for passing. If passing were prohibited, the slowest vehicle would determine the running speed. These sections often carry high peak hour flows and are usually one to three miles long; a slow-moving vehicle in that environment can induce erratic and unsafe movements by reducing capacity.

On urban sections, the center lane is used almost exclusively for making left turns; but there is occasionally a need to pass a slow-moving vehicle, such as one attempting to park, waiting for pedestrians before turning right, or searching for a particular address. The thru lanes of a curbed three-lane section will frequently be blocked temporarily by a public service vehicle or a stalled, standing or parked vehicle. Passing of such non-moving vehicles is permitted under section 634 (a)(2) of the Michigan Vehicle Code, "...when an obstruction exists making it necessary to

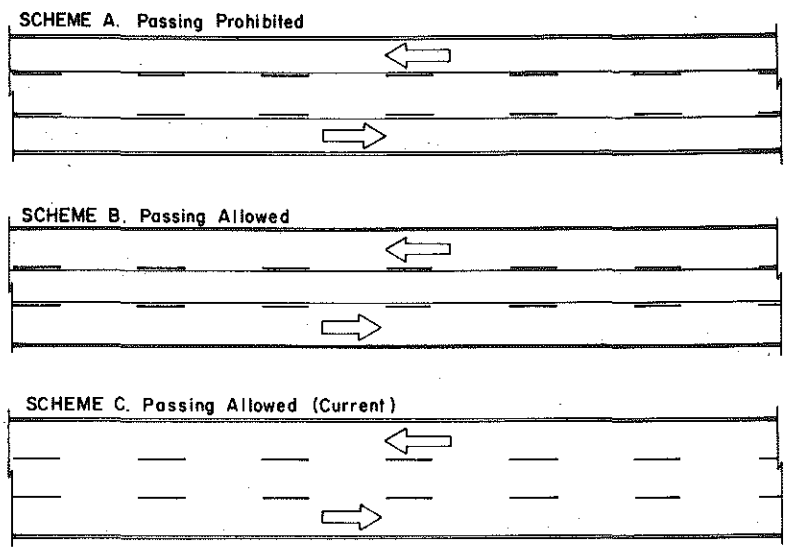


FIGURE 2. Pavement Marking Schemes Studied

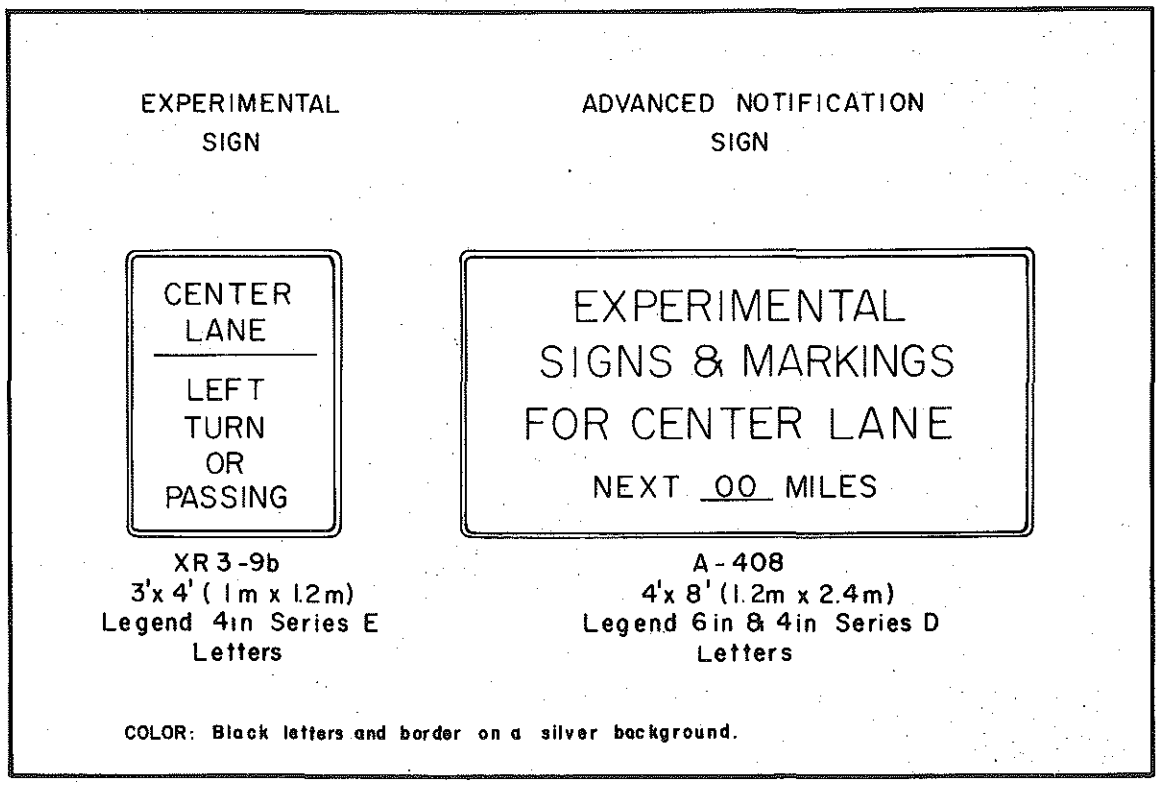


FIGURE 3. Experimental XR3-9b and Advance Notification Signs

drive left of the center of the highway...." (15, p. 120)

Local officials generally support the three-lane concept, evaluating their sections with statements such as "a definite improvement over the two-lane pavement". (2) While most local police don't object to low speed passing on urban sections, they oppose high speed passing and, in particular, drivers using the center lane as a thru lane. That move is not permitted under the law or any marking and signing scheme.

MARKING AND SIGNING SCHEMES TESTED

Three marking schemes were used (Figure 2):

Scheme A is the scheme most commonly used on five-lane sections, where passing in the center lane is prohibited. It is identical to Figure 3-4a of MUTCD (21, p 185) and of 1973 MMUTCD (17, p 225). It was first applied in 1972 to five-lane sections and to three-lane sections where passing is prohibited.*

Scheme B is designed to resemble what a thru driver would see on a two-lane road where he may pass but oncoming traffic is prohibited from passing. It is used by Ontario to denote that passing is permitted in the center lane.** It was tested at six sites where passing is permitted.

Scheme C is the scheme that is recommended by the Federal Highway Administration, Office of Traffic Operations (4), to

*Under 1963 MMUTCD (16, p 288), Figures 3.4 and 3.5, a single solid white line was used to denote a center lane where passing was not allowed and a single skip white line was used to denote one where passing was allowed.

**The accompanying ground-mounted sign carried a legend similiar to USE CENTRE LANE TO PASS ONLY WHEN CLEAR OF TRAFFIC.

denote that passing is allowed; that Ontario may be using on some sections where passing is allowed (6); that Michigan first used in 1972 on such sections; and that 1973 MMUTCD, Figure 3-2c (17, p 223), specifies for such sections.

Conventional signing (R3-9 and R3-9a) was used with Scheme A. A variation of the R3-9 legend, CENTER LANE/LEFT TURN OR PASSING (Figure 3), was tested with Schemes B and C. That sign legend is denoted "XR3-9b" in this report. For the protection of the public, an advance notification sign (Figure 3) was also erected whenever either Scheme B markings or sign XR3-9b was first installed.

METHOD OF STUDY

The study was conducted in three phases: 1) observations of driver behavior under a variety of marking and signings, 2) a review of the number and types of accidents on three-lane sections, and 3) the evaluation of a questionnaire that asked drivers to interpret the various marking schemes.

The primary task was the observations, made at eight study sites. Except at Site 8, none of the changes in markings or signings resulted in a change in the legality of any move. At Site 8, the signing change had the effect of legalizing passing for both directions. Four types of sites were studied:

Sites 1 and 2 were urban curbed highways, through the Central Business District of a community, operating at 25 to 30 mph. The center lane is used more for left

turns than for passing.

Sites 3 and 4 were higher speed suburban uncurbed highways, where the center lane is used primarily for passing.

Sites 5 and 6 were previously marked and signed to prohibit passing in the center lane. These observations measured the effect of slow vehicles under a no-pass condition and obedience to the signing.

Sites 7 and 8 tested specific items. At Site 7, the overhead signs were revised from BEGIN/END CENTER LANE FOR LEFT TURN ONLY to lane-assignment arrows. At Site 8 a no-passing restriction in one direction was changed to permit passing, to reduce congestion caused by slow-moving trucks.

Generally three tests were conducted in this sequence:

Test 1 observed the operation under the original signing and marking. The markings were ineffective at most sites, having been obliterated over the winter. These first tests were conducted in April 1973.

Test 2 observed the operation after one element, either markings or signing, had been changed. This measured the separate effect of each element on driver behavior.

Test 3 observed the operation after the other element had been changed. This measured the total effect of the proposed schemes.

Summary and Results

To determine warrants for various uses of the center lane of three-lane two-way highways and to determine the appropriate signing and marking schemes, this study observed the operation of eight such highways, reviewed the accident experience of twelve, and queried a group of drivers on their understanding of the various marking schemes.

DRIVER PERFORMANCE

The driver-performance phase consisted of a number of observations, usually three, at each study site (about 0.6 mile [1 km] in length). With a few exceptions the observations were of six-hour duration. The first of these tests at each site was made under the original signing and whatever markings remained. The second test was made after one of those elements was changed; the third was made after the other element was changed. The factors measured in the tests were the frequency of use of the center lane, the distance travelled in the center lane, and any conflict resulting from that use.

Urban with Passing (Fremont and Cedar Springs). The tests at Fremont demonstrated the importance of markings; drivers operated the road as a two-lane highway, using the center joint as divider, without the markings. Though Scheme B markings were used, Scheme C markings would have

effected the same result; the prime benefit of Scheme B is that, since it contains 3.5 times as much yellow line as does Scheme C, the markings are apt to be effective for a larger period of time. That could be important: The most hazardous situation would be when the lines have badly faded and drivers' behavior is transitioning between two and three-lane operation. The placement of XR3-9b signs was followed by a decrease in the passing rates.

At Cedar Springs, the placement of the signs met with immediate opposition from local officials, resulting in incomplete study at that site. Under Scheme B markings, no signing, and high volumes, center lane use for movements other than left turns was nearly non-existent.

Suburban with Passing (Bay City and Bedford Township)

The placement of XR3-9b signs at Bay City was followed by a significant reduction in the rate of left turn onto the highway using the center lane. The application of Scheme B markings was followed by a significant reduction in the passing rate in one direction and an insignificant reduction in the other.

The placement of Scheme B markings at Bedford Township reduced the number of eastbound strays, mostly occurring at a 3-degree curve, and the number of left turns onto the highway using the center lane. The placement of XR3-9b signs did not significantly affect the operation of the highway.

Urban and Suburban without Passing (Howell and Westland)

The re-application of Scheme A markings at Howell resulted in a reduction in the frequency and the distance trav-

elled for passes in both directions. The installation of R3-9a overhead signing did not result in a change in the operation of this highway.

At Westland there was little use of the center lane for any purpose. Volumes here high, reaching peak 15-min flows of 502 vehicles both directions and 278 vehicles one direction, with little congestion observed. Because it was not possible to erect overhead signing as proposed in the study plan, only one test was conducted at Westland.

Specific Sites (Spring Lake and Big Rapids). At Spring Lake, the signing tested was overhead lane-assignment arrows at the ends of the three-lane section, with no interior signing. That signing did eliminate one undesired move: vehicles entering the three-lane section would violate a mandatory left-turn provision and enter via the center lane. The passing rates at Spring Lake were significantly reduced following the application of Scheme B markings.

The tests at Big Rapids were intended to measure the improvement in flow resulting from changing from no-passing to passing. The application of Scheme B markings was followed by a decrease in the passing rate in one direction and in the distance required to complete the passes. The change in the signing legalizing the passing movement in one direction (passing already being allowed in the other direction) had no effect on the passing rates.

ACCIDENTS

The 2-year accident histories of the eight study sites and of four other sites were evaluated. About thirty percent of the head-on and side-swipe-opposite accidents involved an intended use of the center lane. The others involved a vehicle crossing from one thru lane to the other. There was one fatal accident resulting from a head-on conflict; the passing vehicle made a hurried return pass, and hit the passed vehicle. The most common type of accident involving center lane use resulted from an improper lane change into the center lane.

QUESTIONNAIRE

A group of non-technical Department employees were polled on their interpretation of the various marking schemes. Of three schemes designed to indicate that passing is permitted, Scheme C (the current standard) had the greatest number of correct answers. For Scheme B markings there was a tendency to not allow passing. However, even Scheme A, to which the respondents should have been familiar, had a low rate of correct responses.

Conclusions

At the four urban study sites where passing is permitted, no serious operational problems appeared that could be attributed to the passing movements. In nearly all cases the vehicle being passed was a slow-moving vehicle, either in the process of turning right or parking. Only rarely did a vehicle attempt to pass another vehicle travelling near the speed limit. It is such high-speed passes that local officials generally object to; however, there is no practical way to differentiate by law between a high-speed and a low-speed pass. All of these sites had frequent passing of stopped vehicles. Such moves are legal, since the stopped vehicle constitutes an obstruction. At all sites there were conflicts involving passing vehicles, but they were minor; none presented immediate danger to drivers.

At the two suburban study sites where passing is permitted, the passes were far more frequent than at the urban sites and were generally high-speed passes. Likewise the conflicts observed were more severe, with near-accidents occurring at both sites. This was more prevalent at a three-degree curve in Site 4, indicating that such curves should be analyzed for potential no-passing zones. The warrants for that no-passing zone would be different from those on a two-lane, two-way highway: It is important not only to know that there is an approaching vehicle, but also to know which

lane that vehicle is in. It should be noted that there were no accidents at that curve during the two-year period.

At the two sites where passing is prohibited, and that prohibition is rigidly enforced, there remains occasional passing, generally slow-speed passing. The passing resulted in two minor conflicts at the urban site (Site 5). Following the pattern of the sites with passing, the suburban site had more severe conflicts than did the urban site, including a near-accident.

Peak flows at the study sites reached about 1100 vph in one direction, 2000 vph total. The quality of operation under those flows might be described as level of service C, based solely on visual interpretation. As the Highway Capacity Manual mentions (9, p 318), three-lane highways operating under special controls, such as left-turn-only, are specialized cases requiring local analysis; the general capacity criteria do not apply. A more rigorous determination of capacity, therefore, would require not only more and different data than was collected but also the formalization of new equations, all falling outside the scope of this work. Without that information, and with accident and conflict rates too low to measure relative accident potentials, the warrants being sought for use of the center lane must be reduced to guidelines.

Reaction to the XR3-9b sign legend, CENTER LANE/LEFT TURN OR PASSING, paralleled the general attitudes of local officials toward the use of the center lane. Those who

oppose passing also opposed the legend; they may tolerate passing but they prefer to not advertise it. The driver expectancy viewpoint takes the opposite approach: if there are to be passing movements in the vicinity of a driver, he should be alerted to that fact and expect them. At those sites where passing is the accepted norm, the experimental legend was met with no opposition. Drivers' reaction to the legend, as measured by the change in the rate of passing following erection of the signs, was minimal. At four sites where the change could be measured, three had no change in the passing rate and one had a lower rate. The average distance traveled during a pass increased at two sites and was unchanged at the other two.

The experimental Scheme B markings were not well understood. Local police officials, who presumably know the pavement marking code, could not correctly interpret Scheme B, nor could most respondents to the questionnaire, who had a tendency to disallow passing. That tendency was reflected in the observations: at four sites where change could be measured, the passing rates decreased for three of them and was unchanged in the other. It may be that the pavement marking code has not been well promulgated. The 1973 Michigan Official Highway Map carried a display of the new symbol signs, but made no mention of markings.

Marking changes had a greater effect on driver behavior than did sign changes. But markings alone do not adequately convey the intended use of the center lane to drivers; both signs and markings should be used.

There was no accident pattern developed at the sites studied that could be attributed to center lane usage. Except at the two rural sites, four out of five accidents occurred at intersections. At the rural sites there were few total accidents, of which one-third involved a parked car or an animal. The head-on accidents did not stem from center-lane usage. In fact the center lane, acting as a narrow paved median separating the two streams of traffic, may have helped reduce the severity of the impacts and eliminated similar accidents by providing additional time and refuge area to take evasive action.

Recommendations

Based on the findings of this study, it is recommended:

1. That the following guidelines be used as guides in choosing between permitting or prohibiting passing in the center lane of three-lane, two-way highways in urban and suburban areas:
   a) At urban sites where there exists some factor to continually produce a number of abnormally slow-moving vehicles, passing may be permitted to provide a means of maintaining the flow. Such factors would include parking or numerous right turns.
   b) At suburban sites where there is little left-turn demand passing may be permitted.
   c) Use of the center lane for passing can be expected to decrease as the total flow approaches capacity. If the anticipated number of passing movements is low, less than 10 passes per hour in each direction, passing should be prohibited.
   d) To provide continuity in the operation of the center lane, passing should be prohibited throughout the entire section when the three-lane section is adjacent to a five-lane section of highway or when the three-lane section would have substantial no-passing provision.

e) At the ends of the three-lane section, the markings and signs should be designed to lead center lane users properly.

2. That the experimental XR3-9b sign legend CENTER LANE/ LEFT TURN OR PASSING be made standard, for use when that type of operation is used; and that the Michigan Manual on Uniform Traffic Control Devices be revised to include this treatment.
3. That Scheme C markings continue to be used on those sections of three-lane pavements where passing is to be permitted.
4. That on any three-lane two-way section, the appropriate signing be spaced intermittently so that drivers entering at points within the section are made aware of the intended operation.
5. That the capacity of three-lane two-way highways be studied so that warrants for the use of that treatment, compared to two-, four-, and five-lane treatments, can be developed.
6. That no-passing zone criteria for three-lane pavements be developed, based on the driver's need to know if the portion of the center lane he intends to use is in fact already being used by another vehicle.

This study found insufficient information to comment on the use of the center lane in rural areas or on designating the center lane for use exclusively by one direction of travel.

Driver Performance

PROCEDURE USED

To determine how drivers are affected by the various marking and signing schemes, observations were taken at eight different study sites. Each use of the center lane was recorded; the information tabulated was the direction, the time, the purpose for using the center lane, the distance traveled in the center lane, and any resulting conflit and the outcome of the conflict. The data collection form is shown in Appendix 2.

Observations were generally made over three two-hour periods covering the morning, noon-hour and afternoon peaks. Machine counts were taken of the thru flow in each direction and recorded in 15-minute increments. The counters were placed near the center of the study sites.

Generally three observers were used, each watching a zone about 1000 ft (300 m) long. This was sufficient to fully include most study sites; at sites considerably longer than 3000 ft (1 km), only a representative portion of the site was observed. To trace a vehicle that passed from one observer's zone to another in the center lane, the observers noted all such moves and gave a brief description of the vehicle (make and color).

The data on type of use and distance traveled was then coded and tabulated to show for each direction the number of

occurrences of each type of move per 15-minute period and the basic statistics for distance traveled in the center lane: mean, median, mode and standard deviation. This tabulation was performed by the Department's Burroughs B5700 computer using a program written in COBOL. The data from all zones were combined to build the tabulation. This tabulation, when combined with the flows, allowed for further analysis, such as determining the proportions of total vehicles using the center lane for each purpose and computing regression lines for the various uses as a function of the volumes and of other uses of the center lane. The computations were performed using the BASIS (Burroughs Advanced Statistical Inquiry System) package. A 95 percent confidence level was used in analyzing the data.

The local police agencies were contacted 1) before the initial observations to obtain their comments on the original operation of the three-lane sections and 2) after the signing and markings had been changed to determine if they had observed changes in the operation.

The initial observations were made before any changes were made; subsequent observations were delayed until at least one month after a change was made to allow time for drivers to adjust. As much as possible, all observations at each site were made on the same day of the week. At sites requiring two hours travel time the afternoon counts were actually taken the day before the morning and noon-hour counts.

RELIABILITY OF THE PROCEDURE

This procedure produced a reliable accounting of the number of uses of the center lane. The observers were able to keep pace with the movements by tallying, in the remarks column, the number of times each type of move occurred in each 15-minute period. Some vehicles recorded as leaving or entering an observer's zone could not later be traced in the adjacent zone. The result could be that a vehicle would be recorded twice, once by each observer, and that the actual distance it traveled in the center lane would be longer than recorded (a single 2000 ft movement might be recorded as two 1000 ft movements). At one site where this problem occurred, the vehicles were leaving the center lane shortly after clearing one observer's zone and were not recorded by the second observer. So this problem is not regarded as significantly affecting the data.

For several reasons, the tabulations of distances traveled in the center lane was inaccurate. One source of error was the fact that the observer may not have detected the vehicle until it was already in the center lane, so he had to estimate where the vehicle began its maneuver. Another source of error was the innate inability of the observers to accurately estimate distances; some observers consistently recorded longer distances than did others. This is reflected in larger standard deviations calculated for the data, meaning that, to show a significant change in the distance traveled in the center lane, a large change in the mean distance

traveled is needed. The "average distance" presented in the Tables 1 through 8 is a value selected as most representative, based on the arithmetic mean, the median, the mode and the standard deviation. The value is rounded to the nearest 25 ft and that value is further rounded to the nearest 5 m. Due to this manner of rounding, the metric value could be as much as 6 m (20 ft) from the initial value.

The observers either stood beside the highway or sat in unmarked cars while collecting the data. In doing so they were conspicuous (especially when standing), as evidenced by a high proportion of passing motorists who looked or shouted at them and the number of passing pedestrians who would stop to chat or to air a comment of some aspect of the highway system. The latter problem may have resulted in some center lane usages not being recorded because the observer was detracted. The former problem had an unknown influence on driver behavior. Though the driver didn't know the purpose of the observations, it is speculated that they would strive to avoid making mistakes when they know they are being watched. Thus they may have slowed at least to the posted speed (inconsequential to this study) and may have shied from using the center lane if they were unsure that such a move was proper.

STUDY SITES

A description of each site, the changes made in the markings and signing, and the data obtained follow:

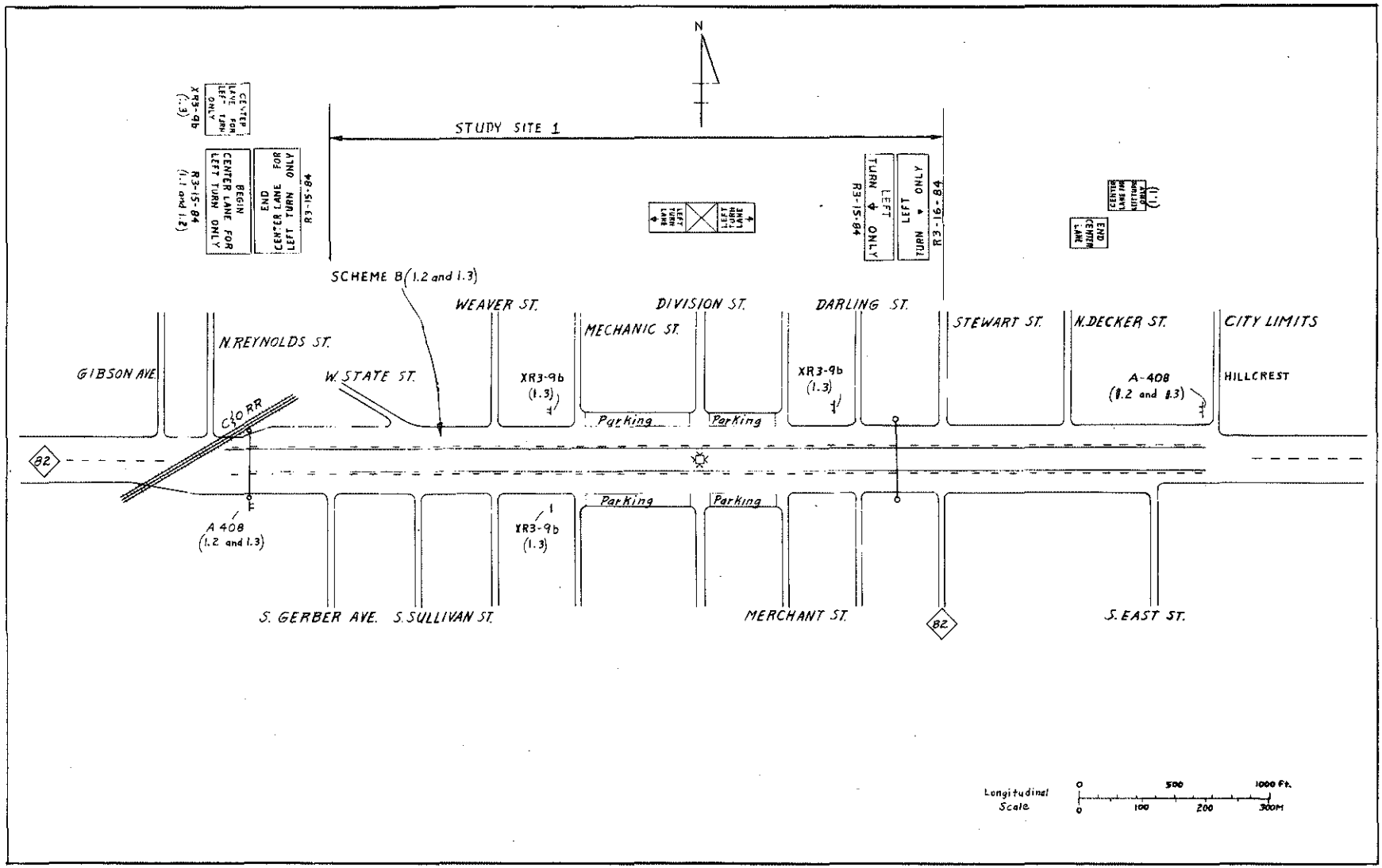


FIGURE 4. Geometrics of Site 1, Fremont

Site 1: M 82 (Main Street) Fremont. Fremont is a community of 3500 set in a rural area. M 82 is a 22-mile (35 km) long farm-to-city rural two-lane, two-way highway. The study site is the major east-west route through the city, with the city's major employer (a baby food processing plant) located near the west end of the three-lane section. Figure 4 shows the geometrics and the markings and signs used at this site. If a sign was not in place for all tests, the test numbers for which it did apply are shown in parenthesis. The three-lane section had a 1973 Sufficiency Rating of 17, made up as follows:

Item	Value	Sufficiency Rating	Maximum Score
Capacity (ADT)*	9,200		
(30HH)	1,070	2 (Critical)	10
Surface		4 (Critical)	30
Base		10	30
Safety (Acc/100MVM)	1,872	1 (Critical)	30

The major problem with this site is that the drivers tend to revert to two-lane operation when the pavement markings are worn off. This may stem from the driver's tendency to shy from parked cars in the CBD, which is reinforced by a joint line in the geometric center of the pavement. Another problem, as reported by Fremont Chief of Police Galen W. Brookens "...seems to be the conveying of the information regarding the center lane for left turn to those people entering this section from a point other than at the two ends, during darkness and inclement weather." (2)

The results of the three tests at Fremont are tabulated in Table 1.

Test 1.1 was conducted on Monday and Tuesday, April 2 and 3, 1973. Existing signing consisted of overhead BEGIN/ END CENTER LANE FOR LEFT TURN ONLY at the west end and overhead LEFT TURN ONLY near Steward Street (where M 82 turns south), with LEFT TURN LANE signs at the signal at Division Street. The Scheme C markings were completely worn away. Except at Division Street, where left-turn vehicles aligned themselves with the signs, the operation of this section was that of a two-lane highway. Virtually all vehicles could have been called Strays; the distance travelled in the center lane had little meaning.

The following conflicts were recorded:

M 82 (Main St) Fremont

Urban, 25 mph (40 km/hr) Passing Allowed

Curbed, 36 and 50 ft (11.0 and 15 m) width Parking allowed in middle 1/3

Movement	Test 1.1 4/2-3/73			Test 1.2 6/4-5/73			Test 1.3 9/11-12/73		
	No.	rate per 1000	Avg. Dist. ft (m)	No.	rate per 1000	Avg. Dist. ft (m)	No.	rate per 1000	Avg. Dist. ft (m)
East Bound Total Flow	2611			2661			2454		
1 Left Turn	491	188.1	200 (60)	683	256.7	175 (55)	763	310.9	200 (60)
2 Left Turn to Highway	0			2	0.8		16	6.5	75 (25)
3 LT to H'way (Backing)	0			4			3		
4 Pass Moving	6	2.3	75 (25)	36	13.5	150 (45)	21	8.6	400 (120)
5 Pass Parked	59	22.6	50 (15)	169	63.5	100 (30)	171	69.7	100 (30)
6 Pass Bicycle	3			7	2.6	200 (60)	11	4.5	75 (25)
7 Stray	--			51	19.1	200 (60)	13	5.3	500 (150)
8 Evasive	0			4	1.5		45	18.3	125 (40)
9 Left Turn From Thru	--			7	2.6		8	3.3	
West Bound Total Flow	2783			2968			2424		
1 Left Turn	385	138.3	175 (55)	535	180.3	175 (55)	324	133.7	200 (60)
2 Left Turn to Highway	1		150 (45)	1			4		
3 LT to H'way (Backing)	0			0			0		
4 Pass Moving	5	1.8	200 (60)	42	14.2	125 (40)	7	2.9	200 (60)
5 Pass Parked	61	21.9	50 (15)	143	48.2	75 (25)	132	54.5	100 (30)
6 Pass Bicycle	0			1			2		
7 Stray	--			12	4.0	200 (60)	7	2.9	175 (55)
8 Evasive	0			5	1.7		4	1.7	
9 Left Turn From Thru	--			31	10.4		14	5.8	

TABLE 1. Observed Center Lane Use at Fremont

Frequency	Conflicting Vehicles	Result of Conflict
64	LT from thru vs Thru	Thru flow Stopped or blocked momentarily
1	Opposing LTs	1 Aborted turn
2	Opposing LTs	Slowed in CL, completed turn
15	Passing Parked vs Parking	Parking encroached in CL, so Passing encroached on opposing thru

Test 1.2 was conducted on Monday and Tuesday, June 4 and 5, 1973. Scheme B pavement markings had been applied. The section was again operating as a three-lane section with no lane violations except to avoid vehicles in the process of parking or to shy from pedestrians stepping from between parked cars. The following conflicts were recorded.

Frequency	Conflicting Vehicles	Result of Conflict
1	LT from thru vs Thru	Thru flow stopped
2	LT from thru vs Thru	Thru passed LT on right
1	Pass vs Opposing LT	LT returned to thru, completed turn
1	Opposing LTs	1 Completed, other returned to thru, turned at next intersection

Test 1.3 was conducted on Tuesday and Wednesday, September 11 and 12, 1973. The former signing had been replaced with XR3-9b signs. Main Street was closed at the east end of the study site. That had little effect on this test; in the previous tests no passing was observed in that area. The following conflicts were observed:

Frequency	Conflicting Vehicles	Result of Conflict
1	Opposing LTs	1 completed, other aborted
1	Opposing LTs	Both completed
1	Opposing LTs	Both slowed, completed
2	Opposing LTs	1 stopped in thru, then completed
1	LT vs Wide Right Turn	Both completed
1	LT vs Opposing Pass	Both completed, LT partly from thru
2	2 Opposing Pass-parked	1 Completed, other stopped in C.L.
1	2 LTs, same	1 Stopped in C.L.
1	LT vs LT from thru	LT from thru cut off LT from CL
1	2 Pass Parked, same	Lead stopped in CL, other passed in opposing thru

In February 1974, Chief Brookens offered these comments (3):

> Because your final signing has been completed only a few months it would be very difficult to meaningfully assess its effect at this time...
>
> In analyzing the hazardous driving actions involved in these [42 accidentl reports, we discovered that there were only three accidents that might be linked in any way to the three-lane, two-way pavement. One of these involved improper lane usage and the other two made left turns from the right lane...
>
> We feel this [3-Lane] system has expedited the flow of traffic with much less congestion and confusion now that it is well signed and the lane markings are visible most of the time. It has been our experience that our local citizens generally comment on something only when it is unsatisfactory. In this respect we have not received any unfavorable comments on this system.

At Fremont, the application of pavement markings had a significant effect on the operation of the road. The number of vehicles passing increased significantly as a result of the opening up of a lane to accomodate the move. The actual number of passes recorded is misleading as it includes several multiple passes: of the 42 westbound passes during Test 1.2, 11 passed the same tractor and 7 passed a concrete mixer maneuvering to an off-road construction site. There was also a considerable increase in the number of passes of parked cars due to an increase in the amount of double parking. Again, one vehicle would be passed by many.

The signing change did not affect the operation of the road. Though the XR3-9b signs permitted passing, the actual number of passes decreased, due to a reduction in the number of multiple passes. The high number of eastbound Evasive moves consisted primarily of two types of moves: passes of parking vehicles that were in the process of backing, called "Pass Parked" in Test 1.2, and shying from crossroad vehicles that approached the thru lane to obtain better vision, called "Stray" in Test 1.2. Left turns from the thru lane, and accompanying conflicts, reduced from Test 1.2 to Test

1.3. This is most likely the result of the drivers becoming accustomed to the third lane.

The change in the types of conflicts between Tests 1.1 and 1.2 reflect the differences between two-lane and three-lane operations. There was no significant change in either the number or the types of conflicts between Tests 1.2 and 1.3, resulting from center lane use.

Efforts to relate the number of each type of center lane use to the flow were unsuccessful because the rates vary by time of day. For example, in Test 1.2 the eastbound left turn rate was 183 turns per 1000 vehicles in the morning count, 407 in the noon hour count, and 245 in the afternoon count, for an overall rate of 257. The left turn rate for each direction increased significantly with each test. The reason for this is unknown; the markings and signing should have minimal effort on the frequency of that move.

Site 2: US 131 (Main Street) Cedar Springs. Cedar Springs is a community of 2000 located 13 miles (20 km) north of the Grand Rapids metropolitan area. US 131 is a major north-south highway serving the west side of the state that carries high volumes of vacation traffic. It is a four and six-lane limited-access highway for a 75-mile (120-km) section ending 4 miles (6.5 km) south of the three-lane section. The freeway section has been extended beyond Cedar Springs since the completion of this study. Main Street is the major north-south route through Cedar Springs (Figure 5). Parking is permitted on the north bound side through the central

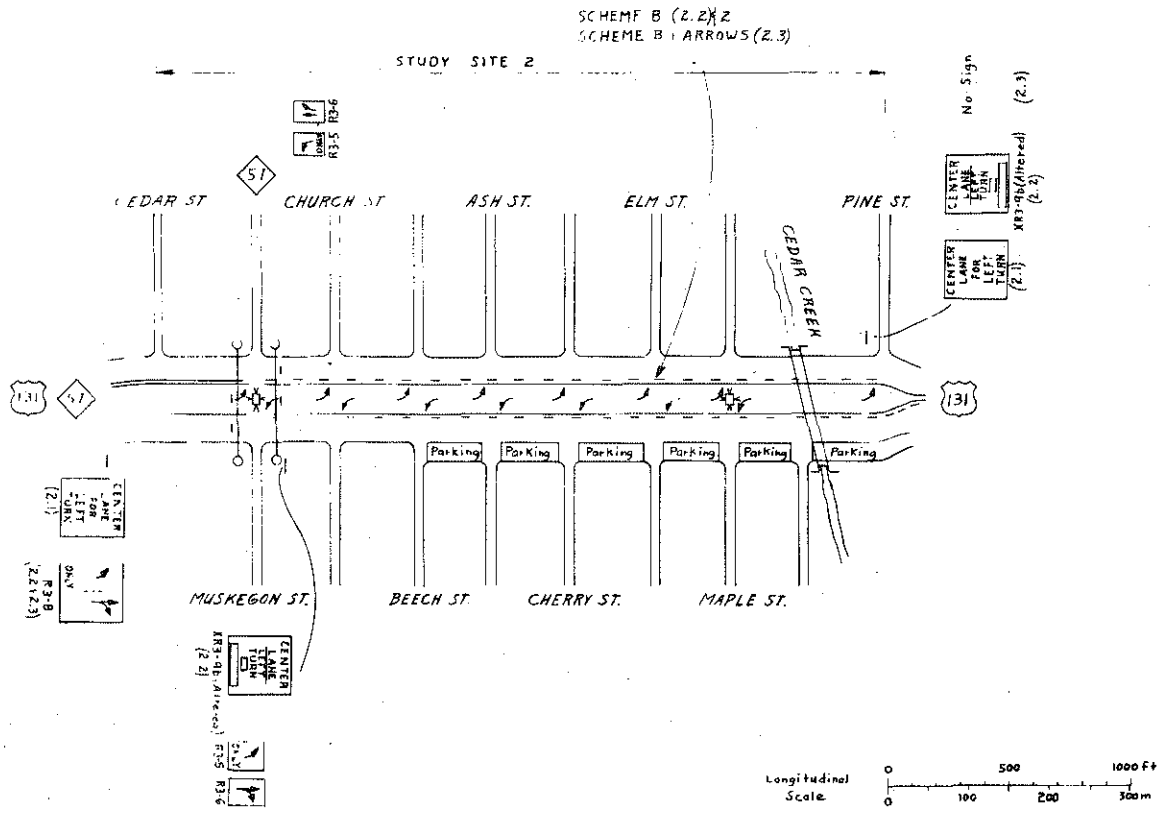


FIGURE 5. Geometrics of Site 2, Cedar Springs

business district. The major portion of the study site had a 1973 Sufficiency Rating of 16 (the rating of the remainder was 22):

Item	Value	Sufficiency Rating	Maximum Score
Capacity (ADT)	9,100		
(30HH)	1,360	1 (Critical)	30
Surface		8	15
Base		6	15
Safety (Acc/100MVM)	903	1 (Critical)	30

This three-lane system has been in operation for several years. Its performance as described by Cedar Springs Chief of Police George R. Seymour was (20):

> ...The establishing of the system here has cut our traffic accidents on Main Street about ninety percent. We had in the past numerous accidents which were caused by attempting to back into a parking space, or driving out of them into the line of traffic.
>
> The type of violation which the new system has brought with it is the use of the center lane for passing from one end of town to the other. This causes some danger and a lot of apprehension among the citizens...

The results of the three tests at Cedar Springs are shown in Table 2.

US 131 (Main St) Cedar Springs

Urban: Speed Limit 25 mph (40 km/hr) Curbed, 36 ft & 44 ft width (11.0 & 13.4 m)
Passing Allowed (Disputed) Parking allowed on northern 2/3 (NB only)

Movement	Test 2.1 4/26-27/73			Test 2.2a 6/15/73			Test 2.2b 6/17/73			Test 2.3 8/12/73		
	No.	rate per 1000	Avg. Dist ft (m)	No.	rate per 1000	Avg. Dist ft (m)	No.	rate per 1000	Avg. Dist ft (m)	No.	rate per 1000	Avg. Dist ft (m)
North Bound Total Flow	3111 (6 hr)			895 (1 hr)			401 (1 hr)			1656 (4 hr)		
1 Left Turn	365	117.3	250 (75)	56	62.6	100 (30)	33	82.3	150 (45)	219	132.2	125 (40)
2 Left Turn to H'way	89	28.6	50 (15)	0			0			0		
3 LT to H'way (Backing)	0			0			0			0		
4 Pass Moving	10	3.2	225 (70)	0			3	7.5	500 (150)	1	0.6	
5 Pass Parked	18	5.8	250 (75)	0			1			11	6.6	50 (15)
6 Pass Bicycle	0			0			0			0		
7 Stray	5	1.6	100 (30)	1		50 (15)	0			4	2.4	225 (70)
8 Evasive	2			0			0			0		
9 Left Turn From Thru	26	8.4		2			1			0		
South Bound Total Flow	2589 (6 hr)			475 (1 hr)			750* (1 hr)			1796 (4 hr)		
1 Left Turn	383	147.9	200 (60)	46	96.8	100 (30)	44	59	200 (60)	197	109.7	150 (45)
2 Left Turn to H'way	79	30.5	50 (15)	0			3	4	350 (110)	2		
3 LT to H'way (Backing)	0			0			0			0		
4 Pass Moving	17	6.6	425 (130)	1	2.1	150 (45)	2	3	150 (45)	15	8.4	475 (145)
5 Pass Parked	1			0			0			108	60.1	100 (30)
6 Pass Bicycle	0			0			0			0		
7 Stray	27	10.4	375 (115)	0			1		50 (15)	10	5.6	250 (75)
8 Evasive	2			0			0			0		
9 Left Turn From Thru	4			0			2			4		

* Approximate (Counter Failure)

TABLE 2. Observed Center Lane Use at Cedar Springs

Test 2.1 was conducted on Thursday and Friday, April 26 and 27, 1973. The signing north of Muskegon Street consisted of ground-mounted CENTER LANE FOR LEFT TURN; at Muskegon Street overhead lane assignment arrows were used. The Scheme C markings, with pavement turning arrows, were badly worn. The following conflicts were observed:

Frequency	Conflicting Vehicles	Result of Conflict
4	LT from thru vs Thru	Thru vehicle slowed or stopped
16	LT from thru vs Thru	Thru vehicle swerved to right
2	Erattic Stray, alone	Started LT, returned to thru
2	Stray vs LT, same	Stray returned to thru lane
1	Pass vs Thru	Aborted pass, Thru slowed to provide gap
1	Opposing LTs	One delayed entry into CL

On May 29 Scheme B markings were applied; on June 4, XR3-9b signs were erected. Local officials immediately covered the OR PASSING portion of the legend. Subsequently city officials and Department representative met to discuss the situation. The city felt that the full legend would cause drivers to over-react, especially on Friday and Sunday afternoons when the flow is highly directional. Vehicles in the heavy-flow direction, it was felt, would use the center lane as a thru lane, resulting in congestion at the end of the three-lane section. This would also cause vehicles in the light-flow direction to shy from the center lane resulting in a left-turn vehicle blocking the thru lane. Such a blockage would be extensive, since there would be a few gaps to permit completion of the turn.

Test 2.2 was conducted on Friday and Sunday, June 15 and 17, 1973, to test the city's hypothesis. The altered XR3-9b signs were still in place. This was an abbreviated test, not following the format for other tests: two observers

were used for an hour on Friday (heavy flow was northbound) one observer was used for one-half hour at each of two zones on Sunday (heavy flow was southbound). The data obtained are separated by days in Table 2 and are denoted as Tests 2.2a and 2.2b. One conflict was recorded: On Sunday a northbound left-turn vehicle, waiting in the thru lane, aborted the turn and continued northbound.

Because the altered legend on the signs was in conflict with the intended meaning of the markings, the signs were removed after Test 2.2.

Test 2.3 was conducted on Sunday, August 12, 1973, over a four-hour period. The following conflicts were observed:

Frequency	Conflicting Vehicles	Result of Conflict
1	Pass vs Opposing LT	Aborted pass, returned to thru lane; turn completed
1	Stray alone in center lane	Returned to thru lane
1	Stray alone in center lane	Made undesired turn
2	LT vs Opposing thru flow	Aborted left turn, returned to thru

The altered experimental sign legend did not result in an increase in the amount of passing; although the proportion increased for northbound passes between Tests 2.1 and 2.2b, the change is not statistically significant. Of those three passes, one was a motorcycle passing a right-turn vehicle and the other two came in succession, indicating that one inspired the other. Of the 15 southbound passes recorded in Test 2.3, 12 occurred in the first two-hour period, when there were 618 southbound vehicles, a rate of 19.4 passes per 1000 vehicles. In the second observation period these were 3 passes out of 1796 vehicles, a rate of 1.7. The comparable values for stray vehicles were 8 out of 618 vehicles (12.9 per 1000) and 2 out of 1796 (1.1 per 1000).

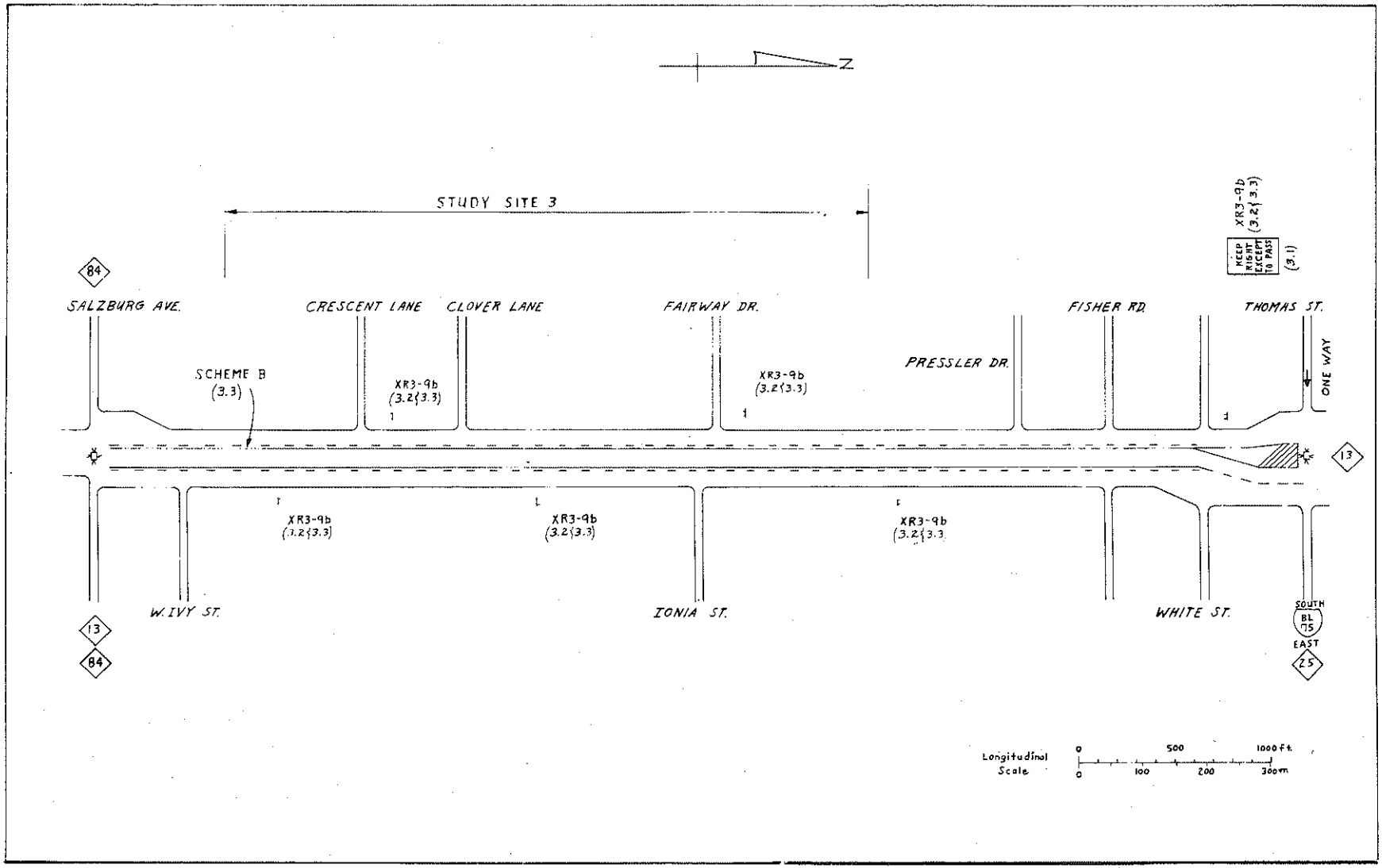


FIGURE 6. Geometrics of Site 3, Bay City

That supports the theory that the use of the center lane decreases as the flow increases, due to the limited availability of gaps to return to the thru lanes. At the north end of the three-lane section, left turns from the thru lane occurred during Test 2.1 and were eliminated in tests after the markings were applied. The signalized intersection at Muskegon Street accomodates 64 percent of the northbound left turns during Test 2.3 and 21 percent of the southbound left turns. Local traffic also tended to use that intersection to cross US 131. The signal split was 80 sec green and amber for US 131, 20 sec green and amber for Muskegon Street.

The light would accomodate 24 to 32 vehicles southbound for each loaded cycle (mean of 28.1), for a computed capacity of 1010 thru vehicle per hour in each direction.

Site 3: M 13 (Euclid Avenue) Bay City. Bay City is an industrial community of 50,000; M 13 is 72-mile (115 km) north-south highway that serves as one of the connecting highways between Bay City and Saginaw. North of Bay City M 13 follows the alignment of old US 23. The study site (Figure 6) is located at the west city limit of Bay City. It has a 1973 Sufficiency Rating of 15;

Item	Value	Sufficiency Rating	Maximum Score
Capacity (ADT)	16,500		
(30HH)	1,730	1 (Critical)	25
Surface		5 (Critical)	25
Base		8	20
Safety (Acc/100MVM)	706	1 (Critical)	30

This portion of M 13 is a suburban arterial in a commercial environment. Driveways are spaced intermittently along both sides of the road with few intersecting streets to induce turning movements.

The data obtained at Bay City is tabulated in Table 3. Test 3.1 was conducted on Monday and Tuesday, April 23 and 24, 1973. Signing consisted of one KEEP RIGHT EXCEPT TO PASS sign for southbound traffic of the beginning of the section. The Scheme C markings were worn. The following conflicts were observed:

Frequency	Conflicting Vehicles	Result of Conflict
1	Opposing Passing	1 Aborted pass, other Hurried to complete pass
2	Opposing LTs	Both completed turns
1	Pass vs LT, same	Hurried to complete pass; turn completed
1	Pass vs Opposing LT	Hurried to complete pass; turn completed
1	Pass vs Opposing LT	Aborted pass; turn completed

Test 3.2 was conducted on Tuesday and Wednesday, June 26-27, 1973. The experimental signs had been erected. The following conflicts were observed:

Frequency	Conflicting Vehicles	Result of Conflict
4	2 LTs, same	Both stopped Center Lane, completed turns
5	Opposing LTs	Completed turns
1	Opposing LTs	One turned from thru lane, other from CL

M 13 (Euclid Av) Bay City

Suburban, 40 mph (64 km/hr)
Passing Allowed

Uncurbed, 31 ft width (9.4 m)
Parking on shoulder

Movement	Test 3.1 4/23-24/73			Test 3.2 6/26-27/73			Test 3.3 9/6-7/73		
	No.	rate per 1000	Avg. Dist. ft (m)	No.	rate per 1000	Avg. Dist. ft (m)	No.	rate per 1000	Avg. Dist. ft (m)
North Bound Total Flow	3204			1549*			3148		
1 Left Turn	182	56.8	200 (60)	157	101.4	200 (60)	79	25.1	200 (60)
2 Left Turn to Highway	70	21.8	150 (45)	6	3.9	150 (45)	8	2.5	300 (90)
3 Left Turn to H'way, B	0			1			0		
4 Pass Moving	207	64.6	450 (135)	234	151.1	425 (130)	163	51.8	425 (130)
5 Pass Parked	15	4.7	150 (45)	0			0		
6 Pass Bicycle	10	3.2	150 (45)	2		150 (45)	3		300 (90)
7 Stray	1		900 (275)	5	3.2	--**	1		50 (15)
8 Evasive	0			0			0		
9 Left Turn From Thru	1			2			1		
South Bound Total Flow	2840			2840			2966		
1 Left Turn	426	150.0	200 (60)	327	115.1	150 (45)	369	124.4	200 (60)
2 Left Turn to H'way	30	10.6	200 (60)	9	3.2	300 (90)	5	1.7	225 (70)
3 LT to H'way (Backing)	0			0			1		
4 Pass Moving	102	35.9	450 (135)	108	38.0	400 (120)	85	28.7	450 (135)
5 Pass Parked	0			1			1		
6 Pass Bicycle	27	9.5	150 (45)	6	2.1	100 (30)	0		
7 Stray	7	2.5	500 (150)	5	1.8	--**	4	1.3	--**
8 Evasive	0			0			1		
9 Left Turn From Thru	5	1.8		5	1.8		8	2.7	

*Accuracy questioned; possible machine malfunction **Variation too great to be represented by a single value

TABLE 3. Observed Center Lane Use at Bay City

1	Stray alone in center lane	Apparently aborted left turn
1	Pass vs LT, same	Slowed in CL, completed pass
1	LT from thru vs Thru	Blocked thru lane
1	2 Passing, same	1 hurried pass, other slowed in CL, completed pass.

Test 3.3 was conducted on Thursday and Friday, September 6 and 7, 1973. Scheme B markings had been placed. One conflict was observed: a vehicle being passed pulled out to pass another vehicle, nearly causing a sideswipe accident.

In the three tests at Bay City, each of the southbound volume counts followed the same pattern, as did the northbound flow for Tests 3.1 and 3.3. The northbound flow in Test 3.2 started to follow that pattern, then suddenly dropped off and remained low, so the accuracy of that count is questioned; the actual flow may have been considerably higher.

The erection of XR3-9b signing did not increase the southbound passing rate, nor the northbound rate if the northbound flow is arbitrarily doubled. Several Stray vehicles travelled all or nearly all of the full length of the study site in the center lane. There was a significant decrease in the number of left turns onto M 13 that travelled in the center lane.

The application of Scheme B markings did not result in any change in the operation for the southbound flow. Of the four southbound strays recorded, two travelled less than 400 ft (120 m) in the center lane; the other two were in the center lane for about 2000 ft (600 m). For northbound traffic both the passing and the left turn rates decreased significantly between Tests 3.1 and 3.3. There were conflicts involving passing vehicles during each of the three tests.

Six potential linear relationships were investigated, using the data from Test 3.1:

NB Left as a function of NB 15-min Flow	$R^2 = 0.07$
NB Pass as a function of NB 15-min Flow	$R^2 = 0.0059$
SB Left as a function of SB 15-min Flow	$R^2 = 0.33$
SB Pass as a function of SB 15-min Flow	$R^2 = 0.0007$
NB Pass as a function of NB Left Flow	$R^2 = 0.08$
SB Pass as a function of SB Left Flow	$R^2 = 0.06$

Of those, only one significant relationship was found, and that produced a poor prediction equation:

SB Left Turns = 0.21 (SB Flow) - 7.61
Standard Error of the mean = 7.81

Two multiple regressions were calculated, relating the number of passes (per 15 minutes) in each direction to: a) the flow in the same direction, b) the flow in the opposite direction, c) the number of left turns in the same direction, d) the number of strays in the same direction, and e) the total center lane use (passes plus left turns plus strays) in the opposite direction. Neither analysis showed significance. That does not imply that the relationships do not exist, only that the manner of testing was unable to detect them. These relationships, if they exist, are also a function of trip purpose which in turn is a function of time of day. Thus, grouping the data from all three observation periods was incorrect. But each observation period has too few data points (8) and too small variations in the different flows to show significance. Since the development of such relationships is secondary to the purpose of this study, that phase of the work was terminated.

Site 4: M 89 (Michigan Avenue) Bedford Township.

Bedford Township is a suburban area adjacent to Battle

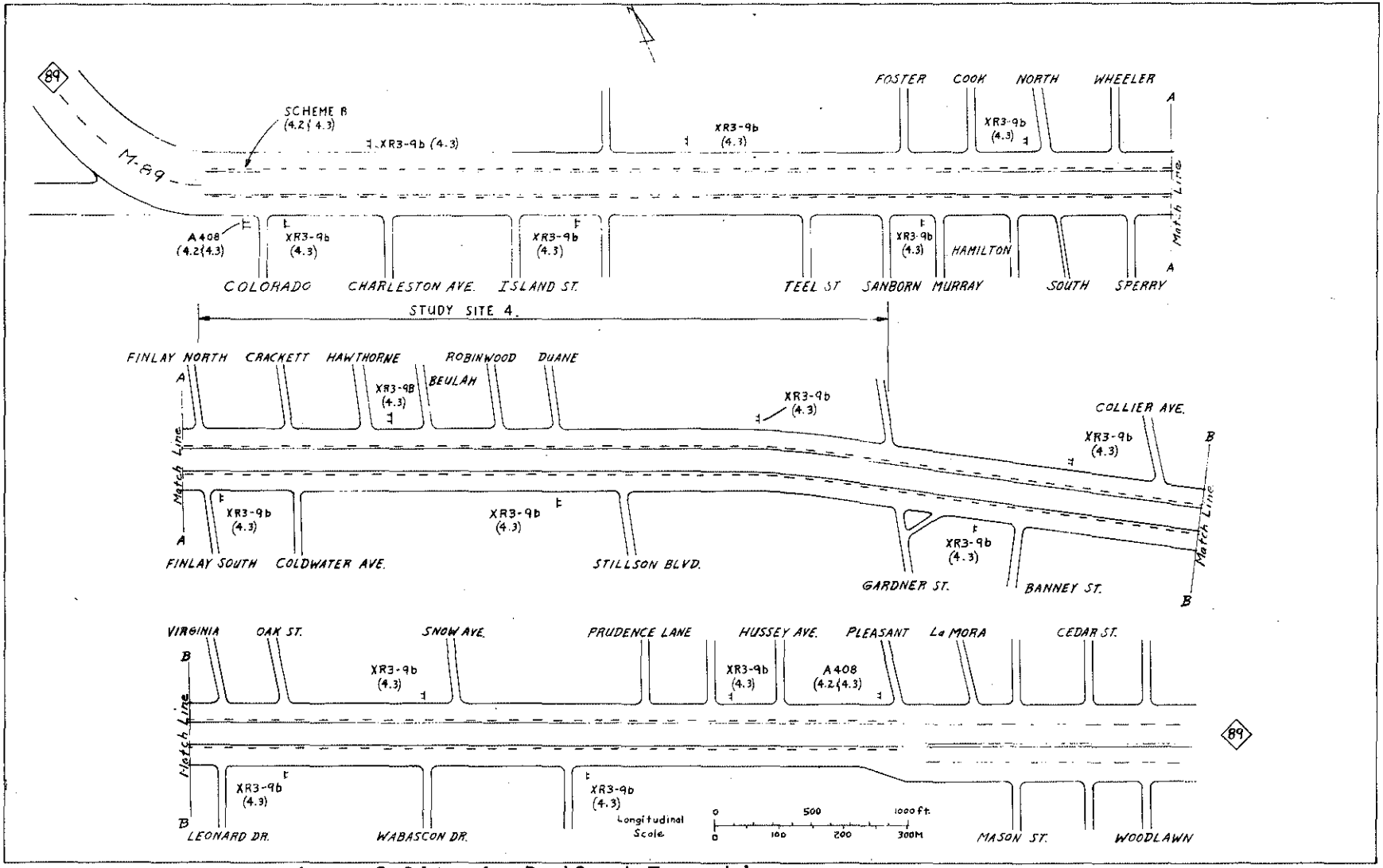


FIGURE 7. Geometrics of Site 4, Bedford Township

Creek (population 39,000). M 89 is a 58-mile (94-km) east-west rural two-lane highway with its eastern terminus in Battle Creek. The three-lane section is 2.7 miles (4.3 km) long. The study site (3000 ft; 910 m) was selected specifically to include a 3-degree curve. The study site had a 1973 Sufficiency Rating of 19, made up as follows:

Item	Value	Sufficiency Rating	Maximum Score
Capacity (ADT)	10,500		
(30HH)	1,260	3 (Critical)	25
Surface		7 (Critical)	25
Base		8	20
Safety (Acc/100MVM)	1,124	1 (Critical)	30

The study site (Figure 7) is a suburban arterial fronted by a few commercial establishments, homes, and open fields.

The data obtained at Bedford Township is tabulated in Table 4. Test 4.1 was conducted on Tuesday, April 17, 1973. There was no signing and the Scheme C markings were badly

M 89 (Michigan Ave) Bedford Twp

Suburban, 45 mph (72 km/hr) Passing Allowed — Curbed WB(Part), rest uncurbed, 36 ft width (11.0 m) No Parking

Movement	Test 4.1 4/17/73			Test 4.2 6/21/73			Test 4.3 9/25/73		
	No.	rate per 1000	Avg. Dist. ft (m)	No.	rate per 1000	Avg. Dist ft (m)	No.	rate per 1000	Avg. Dist. ft (m)
East Bound Total Flow	1807			1900			1832		
1 Left Turn	66	36.5	300 (90)	82	43.2	225 (70)	51	27.8	200 (60)
2 Left Turn to Highway	18	10.0	200 (60)	4	2.1	150 (45)	0		
3 LT to H'way (Backing)	2			2			0		
4 Pass Moving	120	66.4	450 (135)	133	70.0	325 (100)	117	63.9	400 (120)
5 Pass Parked	3		50 (45)	1			0		
6 Pass Bicycle	0			0			0		
7 Stray	34	18.8	150 (45)	3	1.6		0		
8 Evasive	0			0			0		
9 Left Turn From Thru	2			8			3		
West Bound Total Flow	1864			1881			1658		
1 Left Turn	190	101.9	250 (75)	195	103.7	200 (60)	151	91.0	200 (60)
2 Left Turn to Highway	101	54.2	200 (60)	3	1.6	300 (90)	1		
3 LT to H'way (Backing)	0			1			0		
4 Pass Moving	149	79.9	450 (135)	164	87.2	400 (120)	145	87.5	350 (105)
5 Pass Parked	24		300 (90)	0			0		
6 Pass Bicycle	0			9		150 (45)	0		
7 Stray	20	10.7	--*	22	11.7	--*	21	12.7	200 (60)
8 Evasive	0			2			0		
9 Left Turn From Thru	1			2			2		

*Variation too great to be represented by a single value

TABLE 4. Observed Center Lane Use at Bedford Township

worn. The following conflicts were observed;

Frequency	Conflicting Vehicles	Result of Conflict
1	2 Opposing Pass	Both stopped in CL, returned to thru (near collision)
1	2 Opposing Pass	1 vehicle slowed
1	Pass vs LT, same	Passing movement aborted
1	LT from thru lane vs Thru	Thru lane blocked

Test 4.2 was conducted on Thursday, June 21, 1973. Scheme B markings had been applied. During the course of this test a local police officer reported that many people were questioning the meaning of the markings. The following conflicts were recorded:

Frequency	Conflicting Vehicles	Result of Conflict
1	Pass vs LT, same	Pass slowed in CL
1	2 Opposing Pass	1 returned to thru, other completed pass
1	2 Opposing Pass	Both returned to thru

Test 4.3 was conducted on Tuesday, September 15, 1973. XR3-9b signs had been erected. The following conflicts were observed:

Frequency	Conflicting Vehicles	Result of Conflict
1	Pass vs opposing LT	Pass straddled lane line, turn completed
1	Pass vs opposing LT	Pass stopped in CL, turn completed

Two encroachment-type movements were reduced by the Scheme B markings: left turns to the highway and eastbound strays. Those strays occurred principally at the beginning of the 3-degree right curve (1910 ft [582 m] radius); drivers were beginning their curve late. Neither passing rate nor the westbound stray rate were affected by the markings.

After the experimental signs were erected, the only significant rate change observed was a slight decrease in the distance travelled by westbound strays due to the elimination of long-distance strays (more than 1000 ft [300 m]). The Calhoun County Sheriff's Department reported "no comments

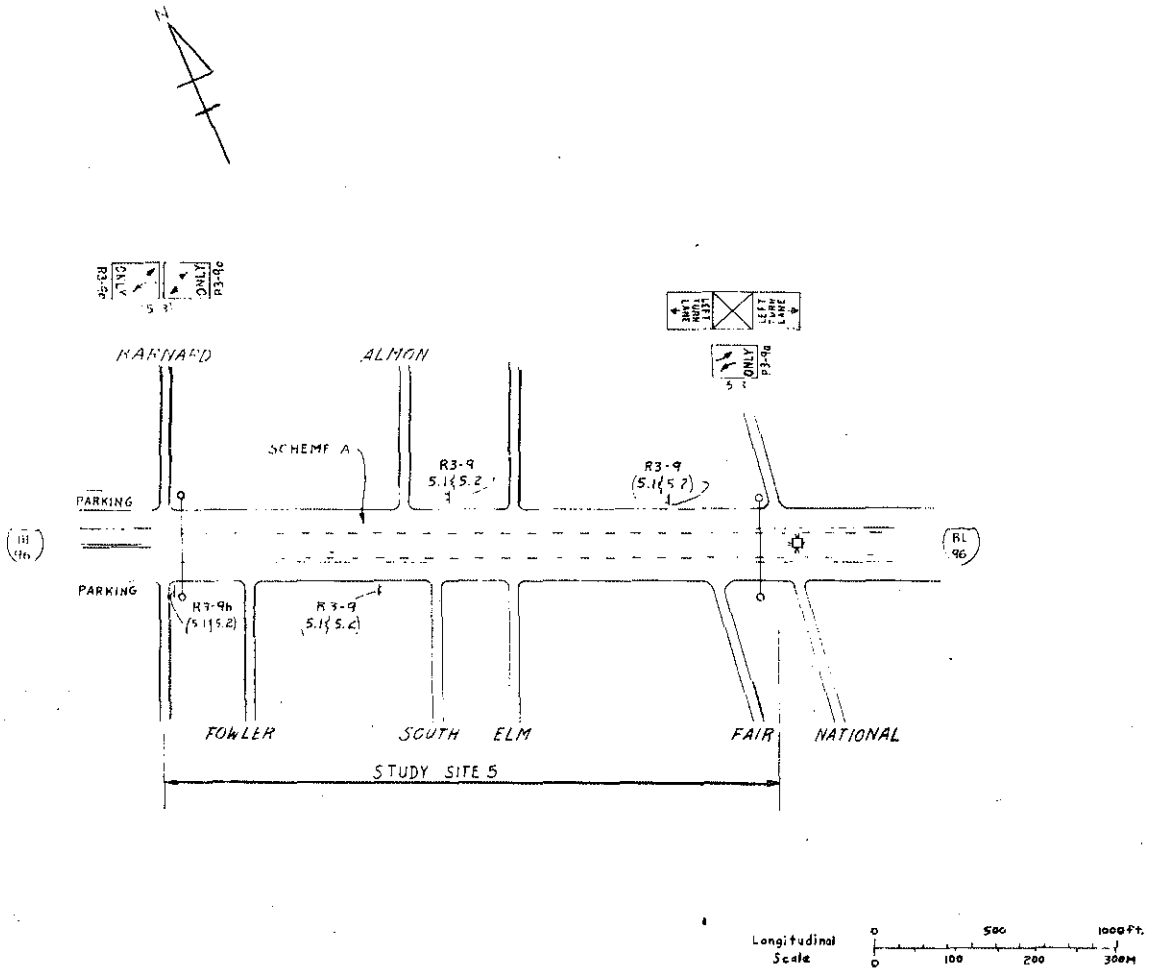


FIGURE 8. Geometrics of Site 5, Howell

received either positive or negative regarding the signs or markings" (1)

During all three tests, conflicts were observed involving passing vehicles at the 3-degree curve. Several were severe conflicts; in Test 4.1 the two opposing pass vehicles both made panic stops finishing with just a few feet between the two vehicles.

Site 5: 96 BL (Grand River Avenue), Howell. Howell is a community of 5200 located midway between the Detroit and Lansing metropolitan areas. 96 BL is an 8-mile (13-km) business loop to Howell from I 96. The study site (Figure 8) is immediately east of the central business district (where the road is a 5-lane section with parking on each side). The

96 BL (Grand River Ave) Howell

Urban, 35 mph (56 km/hr) No Passing — Curbed, 36 ft width (11.0 m) No Parking

Movement	Test 5.1 4/13/73			Test 5.2 5/18/73			Test 5.3 7/13/73		
	No.	rate per 1000	Avg. Dist. ft (m)	No.	rate per 1000	Avg. Dist ft (m)	No.	rate per 1000	Avg. Dist. ft (m)
East Bound Total Flow	4455			4042			3505		
1 Left Turn	469	105.3	175 (55)	469	116.0	200 (60)	424	121.0	250 (75)
2 Left Turn to Highway	2			2		150 (45)	7		150 (45)
3 LT to H'way (Backing)	1			8		200 (60)	5		175 (55)
4 Pass Moving	18	4.0	--*	5	1.2	275 (85)	6	1.7	300 (90)
5 Pass Parked	2	0.4		201	49.7	50 (15)	38	10.8	50 (15)
6 Pass Bicycle	0			3			4		75 (25)
7 Stray	2	0.4	--*	4	1.0	--*	9	2.6	150 (45)
8 Evasive	1			1			0		
9 Left Turn From Thru	0			3			4		
West Bound Total Flow	4107			3795 (3960)**			3863		
1 Left Turn	708	172.4	175 (55)	506	127.8	125 (40)	671	173.7	200 (60)
2 Left Turn to H'way	10	2.4	150 (45)	1		300 (90)	5	1.3	225 (70)
3 LT to H'way (Backing)	2			1			1		
4 Pass Moving	18	4.4	325 (100)	5	1.3	150 (45)	5	1.3	150 (45)
5 Pass Parked	7	1.7		38	9.6	125 (40)	3	0.8	150 (45)
6 Pass Bicycle	0			0			3		
7 Stray	6	1.5	--*	13	3.3	150 (45)	13	3.4	250 (75)
8 Evasive	0			5			2		
9 Left Turn from Thru	3			1			2		

*Variation too great to be represented by a single value **Adjusted from 5 3/4 to 6 hours.

TABLE 5. Observed Center Lane Use at Howell

site had a 1973 Sufficiency Rating of 28:

Item	Value	Sufficiency Rating	Maximum Score
Capacity (ADT)	12,000		
(30HH)	1,260	4 (Critical)	25
Surface		20	25
Base		3 (Critical)	20
Safety (Acc/100MVM)	1,674	1 (Critical)	30

The major problem with this section, according to Howell Chief of Police Charles F. Mason, is "...a good share of the people are using this lane as a passing lane. We do feel, however, that the signs indicating that the center lane is for left turns only are insufficient and difficult to see ..." (13).

The data obtained at Howell is tabulated in Table 5. Test 5.1 was conducted on Friday, April 13, 1973. Signing consisted of ground-mounted CENTER LANE FOR LEFT TURN ONLY signs with overhead LEFT TURN LANE signs at the signal at National Avenue. The Scheme A markings were faint, but visible. Two types of conflicts were observed: 1) A left-turn vehicle stood wholly or partly in the thru lane, thus blocking the thru flow (7 occurrences); 2) A left-turn vehicle in the center lane blocked the lane for a pass in the same direction; resulting in an aborted pass (2 occurrences). There were, in addition, numerous right-turn vehicles that encroached on the center lane during their turning maneuver.

Test 5.2 was conducted on Friday, May 18, 1973. The Scheme A pavement markings had been reapplied. Right-turn vehicles continued to encroach on the center lane. A small number of standing or parked cars were passed by many other vehicles.

There were several vehicles that passed another in the process of turning right. Such passes are not permitted at this site. Two conflicts were recorded, both between opposing left turns. In one case each aborted its turn and returned to the thru lane; in the other, one turned from the thru lane, the other from the center lane.

Test 5.3 was conducted on Friday, July 13, 1973. The ground mounted signs had been replaced with overhead R3-9a signs. The problem of wide right turns continued, with the addition of right-turns to the highway by trucks encroaching on the center lane. The following conflicts were observed:

Frequency	Conflicting Vehicles	Result of Conflict
1	LT to highway vs thru flow	Vehicle waited CL for gap
1	RT to highway (encroaching on CL) vs Opposing LT	LT vehicle stopped
1	LT vs RT, same	RT encroached on CL, almost hit LT
1	Opposing LTs	1 slowed, completed turn other aborted turn

In February 1974, Chief Mason wrote (13):

> Our officers have noted and commented on the decrease of traffic violations where the overhead left turn symbols have been erected on the three-lane, two-way pavement.
>
> Due to the signs erected, the incidence of use of the left turn lane as a passing lane has become nearly nonexistent...As most of our accidents on Grand River Avenue are at intersections, it is difficult to say what influence the overhead signs have on them...
>
> We also find the overhead signs have been extremely effective, particularly this time of the year when the pavement markings are beginning to wear off or the pavement is snow covered...
>
> The citizens of the City who have commented on the signs find them, for the most part quite helpful.

Following the re-application of Scheme A markings, the passing rate for each direction decreased substantially. There was also a decrease in the westbound left turn rate, not attributed to the markings. A street-lighting repair truck was the source of most of the westbound Passing Parked movements.

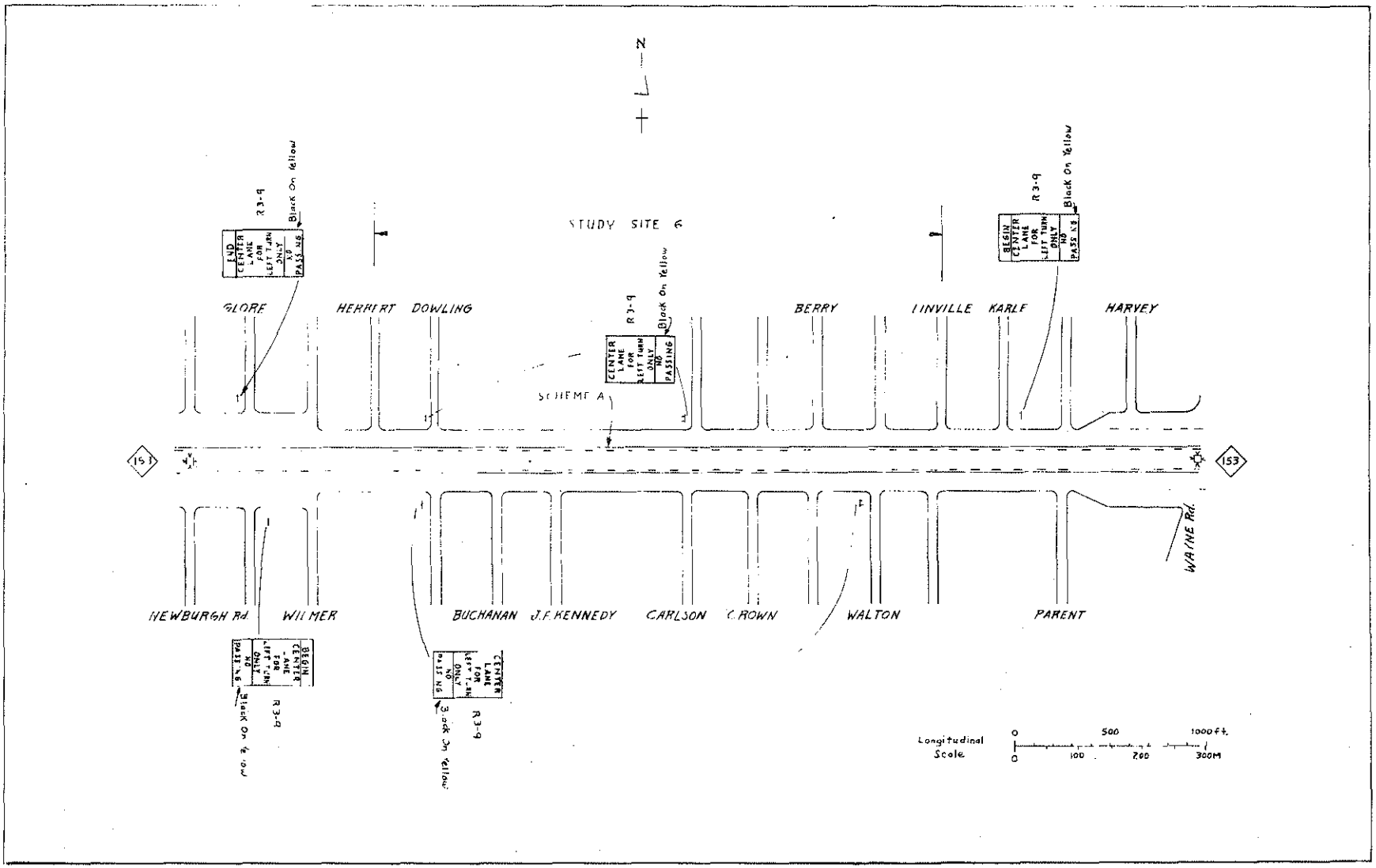


FIGURE 9. Geometrics of Site 6, Westland

Because the actual number and the low proportion of drivers passing during Test 5.2 (about 1 per 800), it would not be possible to show a further significant decrease resulting from the overhead signing. The westbound left turn rate returned to the rate found in Test 5.1. Other than the number of passes of parked cars, no other changes were observed.

Just two conflicts involving a passing vehicle were observed. But drivers appear to have unusual difficulty negotiating right turns, making such moves at a slow speed and often encroaching on the center lane. This resulted in several conflicts and undesirable moves by other drivers.

Site 6: M 153 (Ford Road) Westland. Westland is a suburban community of 87,000 on the west edge of the Detroit metropolitan area. M 153 is a major 24-mile (39-km) east-west arterial connecting downtown Detroit with the north portion of Ann Arbor; the study site is midway between the two endings (Figure 9). M 153 is a four-lane highway immediately east of the study site and a two-lane highway immediately west. Passing is not permitted on this study site, which had Scheme A markings and groundmounted standard CENTER LANE FOR LEFT TURN ONLY signing with a non-standard black on yellow NO PASSING supplemental panel. The study site had a 1973 Sufficency rate of 32:

Item	Value	Sufficiency Rating	Maximum Score
Capacity (ADT)	23,200		
(30HH)	1,800	1 (Critical)	25
Surface		25	25
Base		1 (Critical	20
Safety (Acc/100MVM)	1,518	1 (Critical)	30

Westland Chief of Police William L. Rechlin reported (19):

> ...at the unsignaled intersections the most prevalent violation are Fail to Yield and Improper Lane Usage. These violations are also the hazardous actions that contribute to the accidents along the highway.
>
> The lanes have been recently re-painted to conform with the Federal standards. [Scheme A; previous marking was solid white line.]
>
> This, as expected, has caused some confusion to motorists as to what the center lane is to be used for.
>
> ...the Courts contend that due to the combination of slow moving vehicles, the speed limit of 45 mph and the manner of posting of the signs, the motorist does not see the sign....

Test 6.1 was conducted on Tuesday, May 2, 1973. Scheme A markings had recently been reapplied. The data obtained is summarized in Table 6.

M 153 (Ford Rd) Westland

Suburban, 45 mph (72 km/hr)
No Passing

Uncurbed, 36 ft (11.0 m) width
Parking on shoulder, offset 10 ft (3 m)

Movement	Test 6.1 5/2/73 No.	rate per 1000	Avg. Dist. ft (m)
East Bound Total Flow	4779		
1 Left Turn	102	21.3	150 (45)
2 Left Turn to Highway	19	4.0	175 (55)
3 LT to H'way (Backing)	0		
4 Pass Moving	7	1.5	500 (150)
5 Pass Parked	0		
6 Pass Bicycle	0		
7 Stray	3	0.6	200 (60)
8 Evasive	1		
9 Left Turn From Thru	2		
West Bound Total Flow	4338		
1 Left Turn	328	75.6	150 (45)
2 Left Turn to Highway	19	4.4	150 (45)
3 LT to H'way (Backing)	0		
4 Pass Moving	9	2.1	375 (115)
5 Pass Parked	0		
6 Pass Bicycle	0		
7 Stray	2	0.5	225 (70)
8 Evasive	0		
9 Left Turn From Thru	9		

TABLE 6. Observed Center Lane Use at Westland

The following conflicts were observed:

Frequency	Conflicting Vehicles	Result of Conflict
4	LT to highway vs thru flow	LT stopped in CL, waited for gap
5	LT in thru vs Thru flow	Thru traffic stopped or slowed
1	LT vs LT, same	Second LT stopped in CL
1	Opposing LTs to highway	One stopped, other skidded, spun a full circle, no contact
1	LT in thru vs thru flow	Thru flow passed on shoulder

The following peak flows were recorded:

Flow	Time Period	Volume	flow/hour	avg headway
EB	15 min	278	1112	3.25 sec
WB	15 min	257	1028	3.52
Total	15 min	502	2008	3.59
EB	hour	986		3.65
WB	hour	854		4.22
Total	hour	1824		3.95

There were few congestion problems resulting from this flow.

The next phase of the testing at this study site was to have been the erection of overhead signing. However, since the Department anticipates early reconstruction of this section of M 153, and since the Wayne County Road Commission could not include the signing erection in its work schedule, that phase was cancelled and the testing at Site 6 was terminated.

This section accommodates high volumes of thru traffic, with very little use of the center lane for any purpose (used by about 5 percent of the vehicles).

Of the 16 passes recorded, there were two instances of four vehicles passing a slow-moving truck (accounting for all the passes over 400 ft [120m]) and one pass of a school bus that had just turned off its flashing lights.

Site 7: M 104 (Savidge Street) Spring Lake. Spring Lake is a community of 3000 just west of Grand Haven (11,800), a recreation area along Lake Michigan; M 104 is a 7-mile (12-km) east-west connector between Grand Haven and I96. West of the study site (Figure 10) M 104 is a four-lane highway with

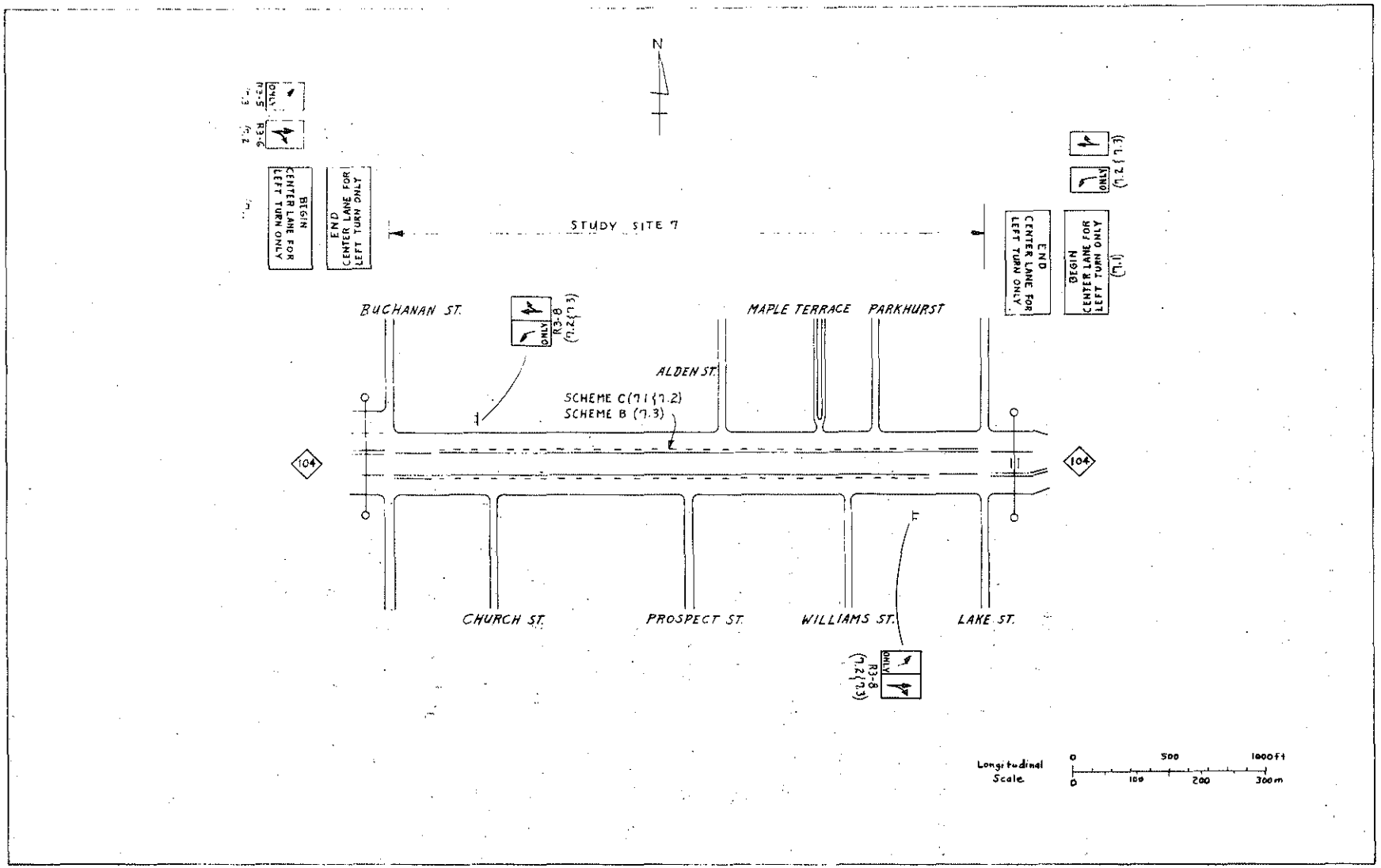


FIGURE 10. Geometrics of Site 7, Spring Lake

parking through the Spring Lake CBD. East of the study site it is a two-lane rural highway. The study site had a 1973 Sufficency Rating of 19:

Item	Value	Sufficiency Rating	Maximum Score
Capacity (ADT)	14,000		
(30HH)	1,770	1 (Critical)	25
Surface		5 (Critical)	25
Base		12	20
Safety (Acc/100MVM)	739	1 (Critical)	30

The mode of operation of this three-lane section has been a point of contention since it began in 1969 (formerly it was a two-lane, two-way highway with parking.) Village officials have been adamant in their belief that passing should not be allowed, and have once formally and often informally conveyed that conviction to the Department. Spring Lake Chief of Police Leon Langeland summarized the Village's stand as, "we here feel this area must have solid yellow lines

M 104 (Savidge St) Spring Lake

Urban, 35 mph (56 km/hr)
Passing Allowed

Curbed, 36 ft (11.0 m) width
No Parking

Movement	Test 7.1 8/17/72			Test 7.2 9/14/72			Test 7.3 8/15-16/73		
	No.	rate per 1000	Avg. Dist. ft (m)	No.	rate per 1000	Avg. Dist. ft (m)	No.	rate per 1000	Avg. Dist. ft (m)
East Bound Total Flow	3905 (7 hr)			2895 (4 1/2 hr)			3390 (6 hr)		
1 Left Turn	333	85.3	125 (40)	94	26.6*	225 (70)	247	72.9	150 (45)
2 Left Turn to Highway	7	1.8	175 (55)	8	1.4	425 (130)	1		
3 LT to H'way (Backing)	3			3			0		
4 Pass Moving	52	13.3	350 (110)	42	11.1	400 (120)	23	6.8	325 (100)
5 Pass Parked	186		100 (30)	16	1.7	125 (40)	130	38.3	75 (25)
6 Pass Bicycle	9			1			17	5.0	
7 Stray	56	14.3	325 (100)	1	0.3		11	3.2	250 (75)
8 Evasive	0			5			3		
9 Left Turn From Thru	0			0			3		
West Bound Total Flow	3326 (7 hr)			1928 (4 1/2 hr)			2977 (6 hr)		
1 Left Turn	158	47.5	150 (45)	120	46.7*	175 (55)	161	54.1	125 (40)
2 Left Turn to H'way	4	1.2	100 (30)	9	2.6	400 (120)	3	1.0	
3 LT to H'way (Backing)	6			2			5		
4 Pass Moving	33	9.9	225 (70)	32	8.8	400 (120)	13	4.4	375 (115)
5 Pass Parked	4	1.2		5	1.6		26	8.7	50 (15)
6 Pass Bicycle	5			2			17		
7 Stray	1			2			2		
8 Evasive	0			4			0		
9 Left Turn From Thru	0			2			12	4.0	

*rates computed from flow and number of moves during test 4 1/2 hours only.

TABLE 7. Observed Center Lane Use at Spring Lake

painted on M 104 or someone will either be severely injured or killed because of the passing allowed without such lines." (11) The Department has contended that "passing should be permitted due to sanitary trucks making pick ups, bicyclists going 5 to 10 mph and cars slowing or stopped in the right lane of the roadway, providing the passing can be done in a manner as prescribed in the Michigan Vehicle Code." (10)

Test 7.1 was conducted on Thursday, August 17, 1972. (Table 7) The signing consisted of then-standard R3-15-84 signs on each end (white on black BEGIN/END CENTER LANE FOR LEFT TURN ONLY); Scheme C markings were in place. The following conflicts were observed:

Frequency	Conflicting Vehicles	Result of Conflict
1	Passing stopped vs stopped	Stopped began to move Passing returned to thru lane
1	Passing vs Opposing LT	Passing slowed, completed pass LT delayed entry to lane
2	Passing vs Passed	Passed sped up Passing returned to thru lane
1	Passing vs LT, same	Passing returned to thru lane
1	Passing Stopped vs Opposing thru flow	Passing returned to thru lane, apparently anticipated opposing usage
1	LT vs Opposing thru flow	LT returned to thru, then returned to center and completed pass; apparently anticipated opposing usage
1	2 Passing stopped, same	First weaved to center, second stopped to avoid rear-end collision
1	Stray vs Opposing LT	Stray sounded horn, returned to thru lane, then returned to center
1	LT vs Opposing LT	One LT aborted turn returned to thru, did not return
3	LT from thru vs Thru	Thru flow stopped momentarily

Test 7.2 was conducted on Thursday, September 14, 1972. The signing had been replaced with R3-5 and R3-6 (21, p 41; 17, p 45) overhead lane-use control signs. In the month between the two tests, however, the school year had begun, thus decreasing the amount of tourist traffic and changing the character of the flow. The eastbound lane was closed at the east end of the section, so usable data was obtained

for the first two zones only. The lane closure extended into the other zones at 8:30, forcing the premature termination of the morning observation. One type of conflict was observed (occurred twice): A vehicle being passed entered the center lane in front of the passing vehicle to pass a right-turn vehicle, the passing vehicle failed to complete its move.

Test 7.3 was conducted on Wednesday and Thursday, August 15 and 16, 1973. The signing was unchanged from Test 7.2 and Scheme B markings had been applied. The following conflicts were observed:

Frequency	Conflicting Vehicles	Result of Conflict
1	LT to highway vs LT, same	LT to highway stopped behind LT
1	Opposing LTs	1 returned to thru, other stopped then completed turn
3	Passing vs Passed	Passed entered CL to pass another, passing aborted its pass
1	Opposing LTs	Both returned partly to CL, completed turns

When Chief Langeland was asked if he noted any operational change under the Scheme B markings he responded (12):

> Yes I have noticed a change in the operation of Savidge Street (M 104) since you have tried your experimental markings. However, this change has not, as we expected, reached the proportions we eventually think it will. You see, presently there is considerable confusion yet existing in the minds of numerous local motorists about this. Let me explain more fully. Presently it seems a great number of drivers feel they cannot yet pass anywhere in the area in question. Obviously, more and more people are learning of their right to do this. In light of the latter, our policemen, our non-police Village employees and numbers of local citizens are distressed over witnessing increasingly more drivers going in opposite directions, pulling out to pass then suddenly jerking back to their right to prevent perceptible collisions. Of course, we then hear these bitter complaints and I guess someone should. Attached to this, we have purposely neglected to inform the general public that they indeed do have a right to pass in this area. The reason for withholding that information from the motoring public is because we felt if numerous drivers felt they could not pass there would not be the frequency of pulling out as there might be if everyone felt he-she could do this.

The signing change at Spring Lake had no effect on the passing rate, but did essentially eliminate the eastbound stray movement. That move was made at Buchanan, the west

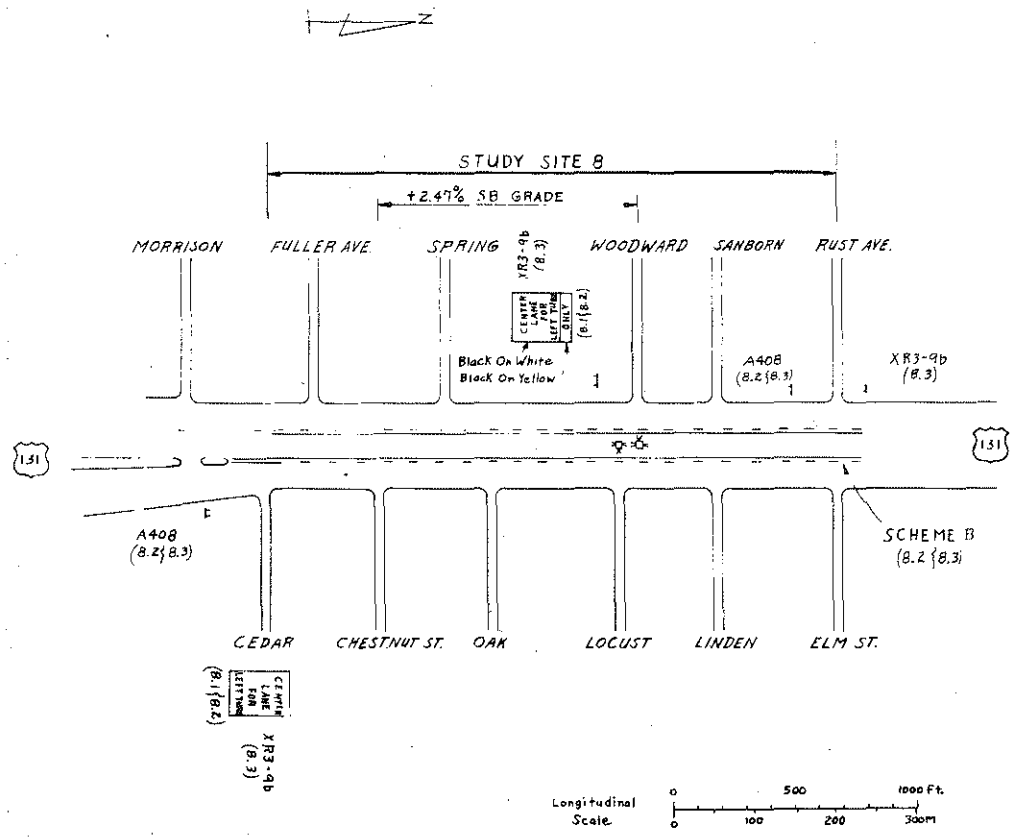


FIGURE 11. Geometrics of Site 8, Big Rapids

end of the three-lane section, where the inside eastbound lane becomes a mandatory left-turn lane. Drivers had been continuing thru in that lane, in violation of the left-turn provision, then merging into the thru lane.

The Scheme B markings resulted in the passing rates being reduced by about one-half. The reduction may be due in part to the fact that the city was painting crosswalks the day of the test, so portions of the center lane were closed for a short time. But such closings were not extensive enough to account for the bulk of the passing rate reduction. These closings were also responsible for an increase in left turn from the thru lane.

Site 8: US 131 (State Street), Big Rapids. Big Rapids is a community of 12,000 in west-central Michigan, a rural area. This study site of US 131 is 34 miles (54 km) north of Site 2, in Cedar Springs. Study Site 8 is a 2400-ft (730-m) section (Figure 11); immediately south of the site the pavement widens to a four-lane divided highway for 0.9 miles (1.5 km); north of it the road is a two-lane road with parking. Ferris State College (10,000 enrollment) is south of the study site and the Big Rapids CBD is north; thus the road serves as connector between the two. The study site had a 1973 Sufficiency Rating of 21:

Item	Value	Sufficiency Rating	Maximum Score
Capacity (ADT)	17,000		
(30HH)	1,780	2 (Critical)	40
Surface		12	15
Base		6	15
Safety (Acc/100MVM)	1,800	1 (Critical)	30

Big Rapids Chief of Police Max E. Harroun listed these comments on this site (7):

(a) Since the installation of traffic lights at the off-set intersections of Locust & State and Woodward & State, rear end type collisions have greatly increased.

(b) Southbound heavily loaded trucks having to stop at the light on Woodward & State hold up traffic to Fuller Avenue after starting up due to the 2.47% grade.

(c) At this traffic light there is also a sign CENTER LANE FOR LEFT TURN ONLY, making it impossible for other traffic to pass the trucks until reaching the top of the grade at Fuller Avenue.

To determine what effect the passing prohibition has on the flow, the operation of the section was observed under the existing conditions and again after the CENTER LANE FOR LEFT TURN ONLY sign had been removed.

The data obtained at Big Rapids is tabulated in Table 8. Test 8.1 was conducted on Thursday and Friday, June 14

US 131 (State St) Big Rapids

Urban, 25 mph (40 km/hr) Curbed, 36 ft (11.0 m) width
No passing SB (except Test 8.3) No parking

Movement	Test 8.1 6/14-15/74			Test 8.2 9/13-14/74			Test 8.3 12/10-11/74		
	No.	rate per 1000	Avg. Dist. ft (m)	No.	rate per 1000	Avg. Dist. ft (m)	No.	rate per 1000	Avg. Dist. ft (m)
North Bound Total Flow	3305 (5 hr)			4084			3770		
1 Left Turn	158	43.6*	75 (25)	286	70.0	100 (30)	213	56.5	150 (45)
2 Left Turn to Highway	3			2			0		
3 LT to H'way (Backing)	0			0			0		
4 Pass Moving	19	5.4	175 (55)	6	1.5	125 (40)	6	1.6	125 (40)
5 Pass Parked	19	3.6	75 (25)	0			0		
6 Pass Bicycle	0			2			0		
7 Stray	0			6	1.5	900 (275)	3	0.8	200 (60)
8 Evasive	0			0			0		
9 Left Turn From Thru	0			3			0		
South Bound Total Flow	3496			4653			3631		
1 Left Turn	265	75.8	75 (25)	412	88.5	125 (40)	406	111.8	150 (45)
2 Left Turn to H'way	4			1			0		
3 LT to H'way (Backing)	0			0			0		
4 Pass Moving	12	3.4	225 (70)	11	2.4	150 (45)	6	1.7	300 (90)
5 Pass Parked	25	7.2	150 (45)	18	3.9	50 (15)	5	1.4	50 (15)
6 Pass Bicycle	0			0			0		
7 Stray	1			4			0		
8 Evasive	0			0			0		
9 Left Turn From Thru	0			0			12	3.3	

*Rates computed from flow and number of moves during 5-hour period

TABLE 8. Observed Center Lane Use at Big Rapids

and 15, 1973. Northbound signing consisted of CENTER LANE FOR LEFT TURN; Southbound signing consisted of the same sign with a black-on-yellow ONLY panel located near the middle of the three-lane section. Traffic flows were lighter than expected, so no congestion developed. The original scheme C markings were almost completely worn away, consequently a large proportion of the vehicles encroached about 1 ft (0.3 m) into the center lane. The following conflicts were observed:

Frequency	Conflicting Vehicles	Result of Conflict
1	Passing vs Opposing LT	Passing returned to CL
1	Overwidth load vs Opposing LT	Overwidth straddled lane line, stopped to allow LT

Test 8.2 was conducted on Thursday and Friday, September 13 and 14, 1973. Scheme B markings had been applied. Volumes were higher; Headways measured at peak flows averaged about 2 sec:

	Number of Samples	Average Sample Size	Average Headway	Standard Deviation	Standard Error
Northbound	6	9	1.90 sec	0.13 sec	0.05 sec
Southbound	16	6.75	2.05 sec	0.24 sec	0.06 sec

Peak 15-min flows were: Northbound 251 vehicles, southbound 276 vehicles, Total 493 vehicles.

With the new markings, the encroachment in the center lane was eliminated.

Only one center-lane conflict was recorded: a vehicle travelling thru in the center lane stopped to allow an opposing left turn to complete its move. There was a minor rear-end collision in the southbound thru lane during the study period, not related to any center lane use, that obstructed the thru lane for less than a minute.

Test 8.3 was conducted on Monday and Tuesday, December

10 and 11, 1973. The signing had been replaced with XR3-9b signs, which had the effect of legalizing passing maneuvers for southbound traffic; northbound passing was previously permitted. Near the south end of the study site, the southbound thru lane was blocked by a utility crew during the first two-hour period (3:30-5:30 pm) limiting the potential for passing. No conflicts were recorded during Test 8.3.

Chief Harroun wrote in January 1974 (8):

> There seems to be no noticeable change in the traffic pattern during the time the southbound lane was opened for left turn or passing. This, I believe is due to the limited visibility caused by the grade from Woodward Avenue to Fuller Avenue.

During Test 8.1 there were four stopped vehicles; three northbound and one southbound, that accounted for all of the passes of parked vehicles. Many of the passing movement recorded involved the passing of right turn vehicles. Some northbound passes actually began in the divided portion of the road and were completed in the thru-lane portion.

There was a significant decrease in the northbound passing rate, a legitimate move, and in the distance used to complete those passes, between Tests 8.1 and 8.2. Northbound strays, using the center lane as a thru lane, began to appear in Test 8.2. There was one long southbound stray, less than 600 ft (180 m); other southbound strays were minor encroachments by trucks turning right onto the highway.

The experimental signs, which legalized southbound passing, had no effect on the passing rates. The left turn rates varied significantly between the tests at Big Rapids.

Accidents

To gain further insight into the operation of three-lane pavements, the two-year (1971 and 1972) accident histories of 12 different sites were tabulated (Table 9). The sites were divided into five highway categories: Urban with passing, Urban without Passing, Suburban with Passing, Suburban without Passing, and Rural with Passing. All eight study sites were included in this list. The accidents are divided by type and are analyzed on the basis of comparing the predominate types of accidents to the types of highway. The tabulations include all accidents within the limits of the three-lane roadway, not only the accidents that occurred in the center lane.

Highway Type	Urban Passing						Urban No Passing				Suburban Passing					Suburban No Passing		Rural Passing			
Site / Accident Type	1. Fremont	2. Cedar Springs	7. Spring Lake	8. Big Rapids	TOTAL	% of Total	5. Howell	Shelby	TOTAL	% of Total	3. Bay City	4. Bedford Twp	Genesee Twp	TOTAL	% of Total	6. Westland	%	Leoni Twp	Watertown Twp	TOTAL	% of Total
Head-on	0	0	1	0	1	0.3	0	1	1	1	3	2	6	11	4.4	5	1.7	2	2	4	7
Side-swipe, Same	3	1	1	0	5	1.7	0	1	1	1	4	4	3	11	4.4	4	1.4	3	1	4	7
Side-swipe, Opp.	0	0	0	0	0		0	0	0		1	2	0	3	1.2	1	0.3	0	0	0	
Angle	25	7	6	14	52	17.2	11	5	16	17	15	14	16	45	18.0	45	15.4	3	1	4	7
Left Turn	5	4	3	4	16	5.3	4	3	7	8	17	9	16	42	16.8	83	28.4	4	0	4	7
Right Turn	2	1	2	2	7	2.3	2	1	3	3	2	2	1	5	2.0	3	1.0	2	0	2	3
Rear-End	26	21	9	63	119	39.3	18	8	26	28	14	9	16	39	15.6	81	27.7	10	1	11	18
Backing	4	2	0	2	8	2.6	2	0	2	2	1	3	1	5	2.0	2	0.7	0	0	0	
Parking	20	7	3	4	34	11.2	14	5	19	20	13	14	7	34	13.6	45	15.4	9	1	10	17
Pedestrian	4	1	0	0	5	1.7	2	0	2	2	0	0	3	3	1.2	1	0.3	2	0	2	3
Animal	1	0	0	0	1	0.3	0	0	0		0	0	0	0		0		1	8	9	15
Fixed Object	7	6	3	9	25	8.3	2	4	6	6	5	13	10	28	11.2	4	1.4	3	1	4	7
Train	0	0	0	0	0		0	0	0		0	0	0	0		0		0	0	0	
Bike	0	0	0	0	0		0	0	0		1	1	0	2	0.8	1	0.3	0	0	0	
Other	8	4	2	15	29	9.6	5	2	7	8	7	7	7	21	8.4	15	5.1	4	2	6	10
TOTALS 1971-72 Accidents	105	54	30	113	302		60	30	90		83	80	86	249		290		43	17	60	

TABLE 9. Accident Histories of Twelve Three-Lane Sections

No attempt is made to relate accident experience and the various marking and signing schemes. Accidents are rare events and are not a sensitive measuring tool, so it would not be possible to detect changes in the accident experience during the short time periods between changes in the markings or signing.

Eighty percent of all the accidents at the twelve sites were intersectional accidents, rear-end and angle, in which the center lane was not a factor. The most common type of accident involving the center lane was one vehicle entering the center lane too close in front of another already in the lane.

The most obvious criticism of three-lane two-way highway is the inherent potential for head-on collisions. At the twelve sites there were 22 head-on and 3 side-swipe-opposite accidents (2 fatal, 12 injury and 11 property damage only), 7 of which involved use of the center lane (4 injury and 3 property damage only). Those 7 were:

1. Vehicle 1 in center lane, passing Vehicle X; drifted into oncoming thru lane and struck Vehicle 2.
2. Vehicle 1 in center lane, passing Vehicle X. Vehicle X drifted into center lane; Vehicle 1 swerved into oncoming thru lane and struck Vehicle 2. (PI, Bedford Township)
3. Vehicle 1 in center lane, passing Vehicle X; lost control on ice, slid into oncoming thru lane and struck Vehicle 2. (PD, Bedford Township)
4. Vehicle 1 in center lane; Vehicle X entered center lane just ahead of Vehicle 1, forcing Vehicle 1 to brake. Vehicle 1 swerved into oncoming thru lane, and struck Vehicle 2 (PD, Westland)
5. Vehicle 1 in center lane, passing Vehicle X. Vehicle 2 also in center lane (reason not stated) in opposite direction. Both swerved same direction and struck each other (PI, Leoni Township)
6. Vehicle X, entering from crossroad, was stopped partly on thru lane. Vehicle 1 swerved to center lane to avoid Vehicle X, skidded into oncoming thru lane, and struck Vehicle 2 (PI, Watertown Township)
7. Vehicle X stopped in thru lane waiting to turn left. Vehicle 1 swerved to center lane to avoid Vehicle X, drifted into oncoming thru lane, and struck Vehicle 2. (PD, Watertown Township).

The other 18 of these accidents involved incidents of one vehicle crossing from one thru lane to the other, with no intent of either driver to use the center lane.

There were 11 fatal accidents at the twelve sites. Since they represent the ultimate failure of the system they were further analyzed. Of these, one involved the use of the center lane:

> Vehicle 1 in center lane, passing Vehicle 2. Vehicle X, travelling in opposite direction, entered center lane (reason not stated). Vehicle 1 made hurried return, struck left front fender of Vehicle 2, lost control, left roadway, and overturned. (1 fatality, 1 Class A injury, Genesee Township).

In another, center lane usage was indirectly involved:

> Vehicle W (Police) was turning left from center lane. Vehicle 1, travelling in same direction, passed Vehicle X on the right, then struck pedestrian about 100 ft (30 m) later. Driver 1 said he was distracted by Vehicle W. It was snowing and dark at the time of the accident. (1 fatality, no injuries, Leoni Township).

The other fatality accidents were car-tree (2), rollover (1), loss of control, head-on collision (2), pedestrian (2), and angle (2).

Questionnaire

To get a direct driver response to the various marking scheme, a questionnaire showing five pavement marking schemes was distributed. For each scheme in this questionnaire (Appendix 3), six questions were asked: 1) first from the drivers viewpoint, would it be proper to use the center lane a) as a thru lane, b) to pass another vehicle, or c) to make a left turn; then 2) from the oncoming drivers viewpoint, the same

PHOTO 1	YES	NO	NO ANSWER	TOTAL RESPONSES
DRIVER STRAIGHT THRU	15	176*	1	192
DRIVER PASS ANOTHER	16	174*	2	
DRIVER MAKE LEFT TURN	121*	69	2	
ONCOMING STRAIGHT THRU	12	179*	1	
ONCOMING PASS ANOTHER	16	174*	2	
ONCOMING MAKE LEFT TURN	122*	69	1	

PHOTO 2	YES	NO	NO ANSWER	TOTAL RESPONSES
DRIVER STRAIGHT THRU	13	179*	0	192
DRIVER PASS ANOTHER	64*	126	2	
DRIVER MAKE LEFT TURN	101*	89	2	
ONCOMING STRAIGHT THRU	10	181*	1	
ONCOMING PASS ANOTHER	59*	132	1	
ONCOMING MAKE LEFT TURN	184*	8	0	

PHOTO 3	YES	NO	NO ANSWER	TOTAL RESPONSES
DRIVER STRAIGHT THRU	46	144*	2	192
DRIVER PASS ANOTHER	187*	5	0	
DRIVER MAKE LEFT TURN	178*	13	1	
ONCOMING STRAIGHT THRU	46	143*	3	
ONCOMING PASS ANOTHER	186*	6	0	
ONCOMING MAKE LEFT TURN	177*	14	1	

PHOTO 4	YES	NO	NO ANSWER	TOTAL RESPONSES
DRIVER STRAIGHT THRU	110	80*	2	192
DRIVER PASS ANOTHER	135	55*	2	
DRIVER MAKE LEFT TURN	190*	2	0	
ONCOMING STRAIGHT THRU	8	181*	3	
ONCOMING PASS ANOTHER	7	181*	4	
ONCOMING MAKE LEFT TURN	13	176*	3	

PHOTO 5	YES	NO	NO ANSWER	TOTAL RESPONSES
DRIVER STRAIGHT THRU	16	175*	1	192
DRIVER PASS ANOTHER	108*	83	1	
DRIVER MAKE LEFT TURN	148*	43	1	
ONCOMING STRAIGHT THRU	16	175*	1	
ONCOMING PASS ANOTHER	108*	83	1	
ONCOMING MAKE LEFT TURN	148*	43	1	

VEHICLE CODE	YES	NO	NO ANSWER	TOTAL RESPONSES
DRIVER STRAIGHT THRU	15	173*	4	192
DRIVER PASS ANOTHER	181*	8	3	
DRIVER MAKE LEFT TURN	179*	10	3	

* CORRECT ANSWER

TABLE 10. Responses Obtained from Questionnaire

PHOTO 1	DRIVER THRU	PASS	LEFT	T+P	T+L	P+L	TP+L	NONE	TOTL
O THRU ONLY	7	0	0	0	0	0	0	0	7
N PASS ONLY	0	3	0	0	0	0	0	0	3
C LEFT TURN ONLY	0	0	[103]	0	2	1	0	0	106
O THRU + PASS	0	0	0	1	0	0	0	0	1
M THRU + LEFT	0	0	0	0	2	0	0	0	2
I PASS + LEFT	0	1	1	0	0	9	0	0	11
N THRU,PASS,LEFT	0	0	0	0	0	0	1	0	1
G NO USE ALLOWED	1	0	0	0	0	0	0	56	57
TOTALS	8	4	104	1	4	10	1	56	188

PHOTO 2	DRIVER THRU	PASS	LEFT	T+P	T+L	P+L	TP+L	NONE	TOTL
O THRU ONLY	3	0	0	0	0	0	0	0	3
N PASS ONLY	0	1	0	0	0	0	0	0	1
C LEFT TURN ONLY	3	4	62	0	0	3	0	50	122
O THRU + PASS	0	0	0	0	0	0	0	0	0
M THRU + LEFT	2	0	0	0	0	0	0	0	2
I PASS + LEFT	0	20	0	0	0	[29]	1	2	52
N THRU,PASS,LEFT	0	0	0	1	0	1	3	0	5
G NO USE ALLOWED	0	1	1	0	0	0	0	2	4
TOTALS	8	26	63	1	0	33	4	54	189

PHOTO 3	DRIVER THRU	PASS	LEFT	T+P	T+L	P+L	TP+L	NONE	TOTL
O THRU ONLY	1	0	0	0	0	0	1	0	2
N PASS ONLY	0	11	0	0	0	0	0	0	11
C LEFT TURN ONLY	0	0	4	0	0	0	0	0	4
O THRU + PASS	0	0	0	1	0	0	0	0	1
M THRU + LEFT	0	0	0	0	0	0	0	0	0
I PASS + LEFT	0	0	0	0	0	[128]	0	0	128
N THRU,PASS,LEFT	0	0	0	0	0	0	43	0	43
G NO USE ALLOWED	0	0	0	0	0	0	0	0	0
TOTALS	1	11	4	1	0	128	44	0	189

PHOTO 4	DRIVER THRU	PASS	LEFT	T+P	T+L	P+L	TP+L	NONE	TOTL
O THRU ONLY	0	0	2	0	0	0	2	0	4
N PASS ONLY	0	0	0	0	0	1	0	0	1
C LEFT TURN ONLY	0	0	4	0	0	2	1	0	7
O THRU + PASS	0	0	0	0	0	0	1	0	1
M THRU + LEFT	0	0	0	0	0	0	0	0	0
I PASS + LEFT	0	0	0	0	0	2	0	1	3
N THRU,PASS,LEFT	0	0	0	0	0	1	1	0	2
G NO USE ALLOWED	0	1	[85]	0	3	21	100	0	170
TOTALS	0	1	91	0	3	27	105	1	188

PHOTO 5	DRIVER THRU	PASS	LEFT	T+P	T+L	P+L	TP+L	NONE	TOTL
O THRU ONLY	2	0	0	0	0	0	0	0	2
N PASS ONLY	0	16	0	0	0	1	0	0	17
C LEFT TURN ONLY	0	0	56	0	0	1	0	0	57
O THRU + PASS	0	0	0	2	0	0	8	0	2
M THRU + LEFT	0	0	0	0	1	0	0	0	1
I PASS + LEFT	0	0	1	0	0	[77]	0	0	78
N THRU,PASS,LEFT	0	0	0	1	0	0	10	0	11
G NO USE ALLOWED	0	0	0	0	0	0	0	22	22
TOTALS	2	16	57	3	1	79	10	22	190

PHOTO 6	DRIVER THRU	PASS	LEFT	T+P	T+L	P+L	TP+L	NONE	TOTL
LEGALLY PERMITTED	0	9	7	0	0	[155]	15	1	187

TABLE 11. Combinations of Moves Allowed by Respondents

three questions were asked. Finally to determine how well the three-lane law is understood, the same three questions were asked.

The five sketches shown were placed randomly on the questionnaire. They consisted of one of Scheme A, two of Scheme B (one with an advisory pavement arrow), one of Scheme C, and one scheme designed exclusively for left turns from the driver's direction.

The questionnaire was submitted to the "Driver Opinion Poll Participants", a group of non-technical Department personnel formed in 1973 for the sole purpose of answering questionnaire of this sort. Of the 230 questionnaires sent out, 192 were returned. Due to the nature of the group being questioned, this rate of response was expected.

0 CORRECT			TOTAL: 0
1 CORRECT			TOTAL: 22
1 = 3	3 = 2	5 = 1	
2 = 1	4 = 1	6 = 14	
2 CORRECT			TOTAL: 50
12 = 1	23 = 0	35 = 0	
13 = 7	24 = 1	36 = 23	
14 = 2	25 = 0	45 = 2	
15 = 1	26 = 0	46 = 2	
16 = 7	34 = 1	56 = 3	
3 CORRECT			TOTAL: 52
123 = 0	145 = 1	246 = 0	
124 = 0	146 = 0	256 = 2	
125 = 0	156 = 6	345 = 0	
126 = 3	234 = 0	346 = 9	
134 = 0	235 = 1	356 = 9	
135 = 4	236 = 1	456 = 0	
136 = 16	245 = 0		
4 CORRECT			TOTAL: 41
1234 = 0	1256 = 3	2345 = 0	
1235 = 0	1345 = 0	2346 = 0	
1236 = 3	1346 = 10	2356 = 4	
1245 = 0	1356 = 16	2456 = 0	
1246 = 0	1456 = 2	3456 = 3	
5 CORRECT			TOTAL: 19
12345 = 0	12356 = 8	13456 = 10	
12346 = 0	12456 = 0	23456 = 1	
6 CORRECT			TOTAL: 0

AVERAGE NUMBER CORRECT: 2.80

TABLE 12. Combinations of Sketches answered correctly

The responses received are summarized in three tables:

1. Table 10 shows the number of times each response was given. An asterisk signifies the "correct" answer for each of the 33 questions.
2. Table 11 shows the number of times each

particular combination of moves would be permitted by a respondent. For each viewpoint, driver's or oncoming vehicle's, there are eight possible combinations, ranging from allowing all three uses to prohibiting all three; yielding a matrix of 64 possible combinations, of which only one is correct. If a question was not answered, the entire response to that sketch is omitted from this table.

3. Table 12 shows the number of times each particular combination of correct and incorrect answers occurred. To be listed as "correct" the responses had to exactly match the previously-selected combination of yes/no answers for each sketch (6 per sketch). If any one answer was wrong or if no answer was given the entire sketch was considered to have been answered wrong.

Sketch 1 showed Scheme A markings; the center lane is to be used for left turns only, with no passing. This is the marking used on five-lane pavement. All respondents live or work in the greater Lansing area, where most major arterials have a section of continuous five-lane pavement, so they should have been familiar with these markings. This sketch was answered correctly by 55 percent of the respondents; another 30 percent would not allow any use of the center lane, and 5 percent would allow passing.

Sketch 2 showed Scheme B markings with an advisory turn arrow for the incoming driver. These markings are to indicate that the center lane is to accommodate both left turns and

passing; the turn arrow does not indicate that the turn is mandatory since it lacks the word ONLY. Scheme B is the experimental marking; unless respondents had traveled to one of the study sites, they would not be familiar with it. This sketch was answered correctly by 15 percent of the respondents. Other frequently-chosen combinations were: Left turns only by both directions (33 percent), left turn only by omcoming vehicles, no use by driver (26 percent), and pass only by driver, pass and left turn by oncoming vehicle (11 percent).

Sketch 3 showed Scheme C markings, the current Michigan standard for three-lane, two-way pavements. There are several locations, mostly rural, in the general vicinity of Lansing with such markings, so the respondents may have been familiar with them. This sketch was answered correctly by 68 percent of the respondents, with another 23 percent allowing all three types of moves by both directions and six percent allowing passing only by both directions.

Sketch 4 showed the markings for a center lane to be used exclusively for left turns in the driver's direction. This sketch may have been deceptive in that it did not show that the driver was approaching an intersection, also there should have been the word ONLY included with the left turn arrow. Such markings, usually without the pavement arrow, are found at numerous flared intersections around Lansing. This sketch was answered correctly by 24 percent of the respondents. Ninety percent would not allow any use by the oncoming

vehicle, which was correct; 56 percent would allow all moves by the driver, another 14 percent would allow the driver to pass or turn left, but not drive thru.

Sketch 5 showed Scheme B markings; it differs from Sketch 2 only in that it does not have a turn arrow. It was answered correctly by 41 percent of the respondents, with 29 percent allowing left turns only from both directions, 12 percent allowing no use, eight percent allowing passing only and five percent allowing all uses.

The sixth group of questions asked the respondents for their understanding of the vehicle code concerning three-lane pavement. Eighty-three percent were correct, eight percent would allow all movements, five percent would allow passing only, and four percent would allow left turns only.

The answers obtained from the questionnaire are interpreted from the standpoint of driver expectancy. A response that would not allow the oncoming vehicle to make a particular move that actually is a legal move is considered unsafe. It stimulates a dangerous real life situation, as presumedly the driver would not expect the move to be made. Similarly, not allowing himself to use the center lane to turn left is unsafe. Not allowing himself to pass might be considered a safe error; however, that may imply that he would not expect to be passed, an unsafe error. In a real life situation a driver would also get cues from the actions of other drivers and possibly from signing, so the number of errors would not be as great as suggested by the responses.

Sketches 2, 3 and 5 are the ones primarily being tested. They are all intended to convey the same message. Of these, Sketch 3 was the most successful. Of the 155 who gave a correct response to the sixth group of questions (the Vehicle Code) 73 percent also were correct for Sketch 3, compared to 43 percent for Sketch 5 and 16 percent for Sketch 2. Of the 113 who were correct for both Sketches 3 and 6, 45 percent were also correct for Sketch 5 and 15 percent for Sketch 2.

For Sketch 3, 92 percent of all responses and 74 percent of the incorrect responses correctly expected that oncoming vehicles would pass in the center lane. Those percentages were 57 and 27 percent for Sketch 5, and 31 and 18 percent for Sketch 2. For Sketches 3 and 5 nearly all responses gave the same answers for each direction; but for Sketch 2 the respondents tended to disallow legitimate movements, espe-ially for the driver: 47 percent would not use the center lane to turn left, but 96 percent would allow that move for oncoming traffic (65 percent would allow only that move for oncoming vehicles).

Considering the familiarity of the respondents to Scheme A markings, the percent answering Sketch 1 correctly is low. A significant number would not allow any use of the center lane, supporting an earlier contention of the Department that such markings should be interpreted as prohibiting any driv-ing to the left of the markings.

Appendix 1

Applicable State Statutes

APPLICABLE STATE STATUTES

Sources: Michigan Vehicle Code (15)
Uniform Vehicle Code (18)

257.642 Laned roadways, traffic rules. [MSA 9.2342]

Sec. 642. Whenever any roadway has been divided into 2 or more clearly marked lanes for traffic the following rules in addition to all others consistent herewith shall apply: . . .

(b) Upon a roadway which is divided into 3 lanes a vehicle shall not be driven to the left of the center lane except when making a left turn and shall not be driven in the center lane except when overtaking and passing another vehicle where the roadway is clearly visible and such center lane is clear of traffic within a safe distance, or in preparation for a left turn or where such center lane is at the time allocated exclusively to traffic moving in the direction the vehicle is proceeding and is signposted to give notice of such allocation. . . .

257.640 No passing zones, marking. [MSA 9.2340]

Sec. 640. (a) The state highway commission and county road commissions shall determine those portions of any highway under their jurisdiction where overtaking and passing or driving to the left of the roadway would be especially hazardous, and shall by appropriate signs or markings on the roadway indicate the beginning and end of such zones in such a manner that an ordinary observant driver of a vehicle will be able to observe the directions and obey them. Beginning January 1, 1973, a sign shall be placed to the left of the highway on those portions of a highway where additional notice is deemed necessary.

(b) The no-passing zones provided for by this section shall be based upon a traffic survey and engineering study. Traffic-control devices installed pursuant to this section shall conform to the state manual and specifications as provided for by section 608. . . .

Comparison with Uniform Vehicle Code

Sec. 642(b). Identical, except: (1) phase "to the left of center lane except when making a left turn" is not in UVC, (2) clause "is signposted to give notice of such allocation" is given in UVC as "such allocation is designated by official traffic control devices", (3) UVC specifics that 3-lane roadway "provides for two-way movement of traffic", and (4) UVC specifies that passed vehicle is "traveling in the same direction." (UVC § 11-309, p 239).

The states and province bordering Michigan all have similar statutes.

Sec. 640. UVC does not include a paragraph similar to 640 (b), requiring that no-passing zones be based on "a traffic survey and engineering study". (UVC § 11-307, p 227).

Appendix 2

Data Collection Form

STATE OF MICHIGAN
DEPARTMENT OF STATE HIGHWAYS
TRAFFIC & SAFETY DIVISION

3-LANE PAVEMENT MARKING STUDY

SHEET ____ OF ____

Form 1500 A
(New 3/73)

LOCATION _____ TEST _____ DATE ___/___/73

HOURS _____ STATION _____ OBSERVER _____

TIME	DIR	TYPE OF USE	ENCROACH		DISTANCE						ENTR ZONE IN CL	EXIT ZONE IN CL	CONFLICT	RESULT OF CONFLICT	NOTES
			FULL	PART	≤100 FT	101-200	201-400	401-600	601-800	>800 FT					
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															
11															
12															
13															
14															
15															
16															
17															
18															
19															
20															
21															
22															
23															
24															
25															

CODING

TYPE OF USE

1 LT TURN FROM HWY
2 LT TURN TO HWY (FWRD)
3 LT TURN TO HWY (BACK)
4 PASS MOVING VEH/NO.
5 PASS STOPPED VEH
6 PASS BICYCLE
7 STRAY
8 EVASIVE ACTION
9 LT TURN FROM THRU LANE
10 OTHER (DESCRIBE)

CONFLICT

1 LT TURN FROM HWY (SAME)
2 LT TURN FROM HWY (OPP)
3 LT TURN TO HWY (SAME)
4 LT TURN TO HWY (OPP)
5 PASS (SAME)
6 PASS (OPP)
7 OTHER (DESCRIBE)

RESULT OF CONFLICT

1 FRUSTRATED LT TURN
2 FRUSTRATED PASS
3 HURRIED-RETURN PASS
4 SLOWED IN CL, COMPLETED
5 STOPPED IN CL.
6 RETURNED TO THRU LANE
7 OTHER (DESCRIBE)

Appendix 3

3-Lane Pavement Marking Questionnaire

OFFICE MEMORANDUM

MICHIGAN
DEPARTMENT OF STATE HIGHWAYS
AND TRANSPORTATION

January 14, 1974

To: Driver Opinion Poll Participants

From: Max N. Clyde
Engineer of Traffic and Safety

Subject: Attached Questionnaire
Pavement Markings on 3-Lane, 2-Way Highways

Please answer the attached questionnaire and mail it back by Monday, January 21. Fold it in half so that the return address shows.

This questionnaire will help us determine how effective the different marking schemes are at informing drivers of the proper use of three-lane highways. For each sketch you are asked to decide if each of six different moves (3 for each direction) can be properly made in the center lane. For each of the 33 questions, please check either "Yes" or "No".

Keep these points in mind:

1. Answer each question quickly; we want your first interpretation of the markings. If you came upon one of these sections while driving, you would have to decide quickly how it is to operate.

2. Evaluate each sketch separately. The different markings do not necessarily mean the same things, and there is no meaning to the order in which the sketches are placed.

3. This questionnaire tests our ability to convey the proper messages to drivers; it isn't a test of your driving ability. Please do not consult others or the Vehicle Code before answering the questions.

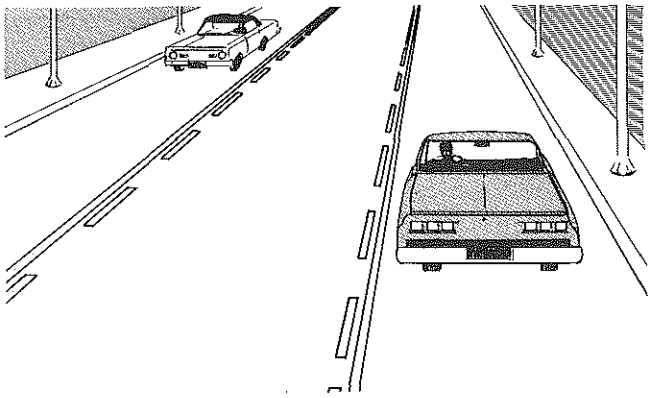
Max N. Clyde
Engineer of Traffic and Safety

T&SD - DJM:mec
Attachment

3-LANE PAVEMENT MARKINGS QUESTIONAIRE

INSTRUCTIONS: 1) Please check "Yes" or "No" for each question – 6 questions per sketch.
2) Evaluate each sketch by itself. The different types of markings may have different meanings.
3) Give your first impressions of the markings, spend no more than 2 minutes on each sketch.

ONE



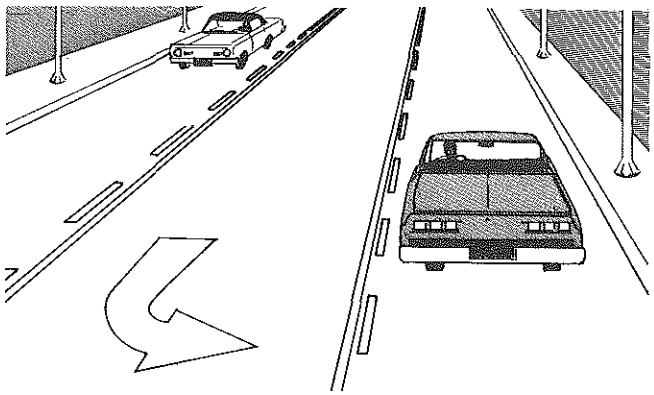
A. Based on the pavement markings in Sketch 1, would it be proper for you, the driver, to use the middle lane to:

	YES	NO
1) Drive straight thru?	☐	☐
2) Pass another car?	☐	☐
3) Make a left turn?	☐	☐

B. And would it be proper for an oncoming driver to use the middle lane to:

	YES	NO
1) Drive straight thru?	☐	☐
2) Pass another car?	☐	☐
3) Make a left turn?	☐	☐

TWO



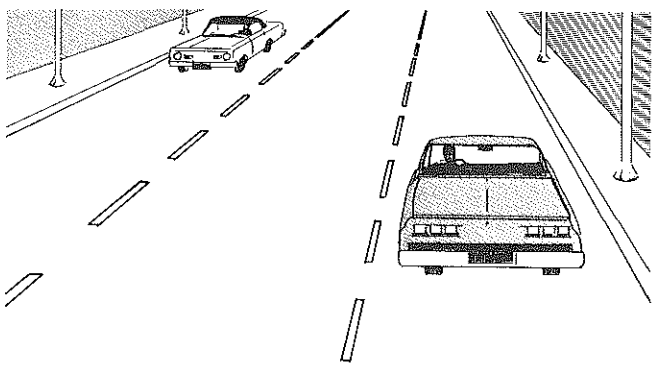
A. Based on the pavement markings in Sketch 2, would it be proper for you, the driver, to use the middle lane to:

	YES	NO
1) Drive straight thru?	☐	☐
2) Pass another car?	☐	☐
3) Make a left turn?	☐	☐

B. And would it be proper for an oncoming driver to use the middle lane to:

	YES	NO
1) Drive straight thru?	☐	☐
2) Pass another car?	☐	☐
3) Make a left turn?	☐	☐

THREE



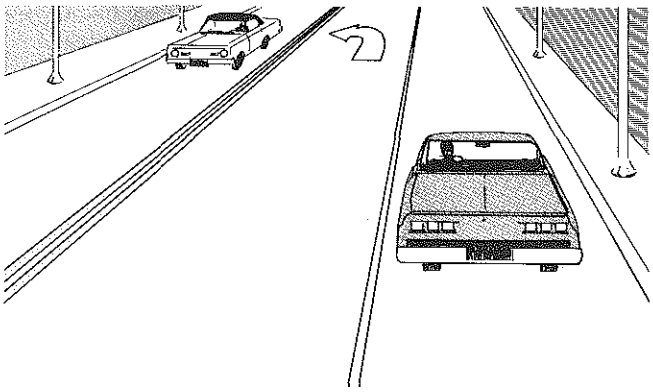
A. Based on the pavement markings in Sketch 3, would it be proper for you, the driver, to use the middle lane to:

	YES	NO
1) Drive straight thru?	☐	☐
2) Pass another car?	☐	☐
3) Make a left turn?	☐	☐

B. And would it be proper for an oncoming driver to use the middle lane to:

	YES	NO
1) Drive straight thru?	☐	☐
2) Pass another car?	☐	☐
3) Make a left turn?	☐	☐

FOUR



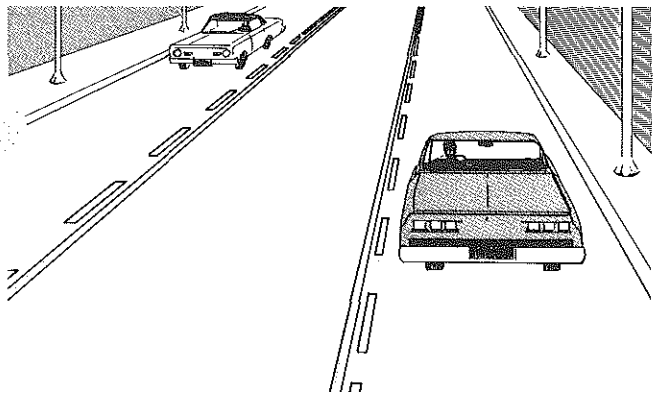
A. Based on the pavement markings in Sketch 4, would it be proper for you, the driver, to use the middle lane to:

	YES	NO
1) Drive straight thru?	☐	☐
2) Pass another car?	☐	☐
3) Make a left turn?	☐	☐

B. And would it be proper for an oncoming driver to use the middle lane to:

	YES	NO
1) Drive straight thru?	☐	☐
2) Pass another car?	☐	☐
3) Make a left turn?	☐	☐

FIVE



A. Based on the pavement markings in Sketch 5, would it be proper for you, the driver, to use the middle lane to:

	YES	NO
1) Drive straight thru?	☐	☐
2) Pass another car?	☐	☐
3) Make a left turn?	☐	☐

B. And would it be proper for an oncoming driver to use the middle lane to:

	YES	NO
1) Drive straight thru?	☐	☐
2) Pass another car?	☐	☐
3) Make a left turn?	☐	☐

SIX

The Michigan Vehicle Code (Section 642) specifies how the center lane of a three-lane, two-way highway is to be used if there are no markings or signs that specify a different use. Does that law permit the use of the center lane to:

	YES	NO
1) Drive straight thru?	☐	☐
2) Pass another car?	☐	☐
3) Make a left turn?	☐	☐

Thank You! ***Now please fold both sheets in half, so that the return address shows, staple, and mail the questionnaire back.***

STATE OF MICHIGAN
DEPARTMENT OF STATE HIGHWAYS
AND TRANSPORTATION

Form 2140
Rev. 1/59

DATE: _____

TO: Peter H. DeCamp, Engineer
Research and Development Section

- ☐ Prepare reply for _____ signature
- ☐ Prepare reply for my signature
- ☐ Advise me, please
- ☐ Reply direct, copy to this office
- ☐ Per your request
- ☐ For your approval &/or signature
- ☐ For your review
- ☐ For your information
- ☐ Note and return
- ☐ Per our conversation
- ☐ For your files

REMARKS: Questionnaire
3 Lane 2 Way Pavement Markings

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