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SECOND ANNUAL REPORT
OF
MICHIGAN'S OVERALL HIGHWAY
SAFETY IMPROVEMENT PROGRAM

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AUGUST 31, 1975

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This Report was prepared by the Traffic and Safety, Local Government, and Maintenance Divisions, and the Railroad Contact Section, Bureau of Highways.

The opinions, findings and conclusions expressed in this publication are those of the author and not necessarily those of the Federal Highway Administration.

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INTRODUCTION

This is the second annual report on Michigan's overall Highway Safety Improvement Construction Program. Last year's report was a beginning - especially in relation to the Federal Categorical Safety Program in which efforts really began in late 1973 with the passage of the 1973 Highway Safety Act and the apportionment of funds for safety-related construction projects and other improvements.

With the further passage of time, a full twelve months was available in Fiscal 1974-75 to continue and expand on the efforts begun in late 1973.

Within the last year, it has also become more apparent that the subject involving highway safety is massive and complex. The job does not begin and end with the allocation of funds with which to do the job, but must involve a long-term effort to evolve basic data, trained manpower and the enlightenment of those dedicated to management of a program with the ultimate goal of ensuring highway safety.

Evaluation of the Overall Safety Improvement Program

Much concern has been expressed on the need for an overall evaluation of safety efforts from a standpoint of accident reduction, casualties prevented and cost-benefit applied to show the public the worth of the money expended in a safety program.

Such proofs are highly desirable and worthy of a continued expression of need, but to expect immediate evaluations of projects is incapable of fulfillment. A "before" and "after" evaluation of a total program involves a task that is years in the future. It involves manpower resources, and electronic data processing presently available only in a limited way and the remainder is under development.

However, in this report, an evaluation of the first five years (1965-1970) of the Michigan Safety (Ms) Program is included which shows the accident reductions expected and associated cost/benefits relative to certain types of projects. In this report, the "before" and "after" accident period is one year. In the future, it is planned to continue the evaluation of a subsequent year's program with the "before" and "after" periods being two years. The time period between a program year and the year in which it is studied is approximately 5 years. This allows time for the following:

1. Time for projects let to contract to be constructed.
2. Time for the accumulation of an adequate "after" period of accidents. The recommended period for such studies is two years "before" and "after" the construction of a safety project. A one year "before"

and "after" period is a minimum, and not recommended if a longer period is available.

3. Time in which to conduct the study.

The first effort in a safety program must of necessity be directed toward a beginning, with decisions made wisely and discretely on the basis of past experience and studies, if available. In the absence of in-depth evaluation, decisions must of necessity be made on the basis of common sense, judgment and the application of theory.

MICHIGAN SAFETY PROJECTS
FISCAL YEAR 1974-75 SUMMARY

<u>Funds/Program</u>	<u>Total Costs</u>
FEDERAL CATEGORICAL SAFETY FUNDS-OBLIGATED	
Section 203, rail-highway crossings	1,121,890
Section 205, pavement markings	1,836,770
Section 209, high hazard locations	4,075,220
Section 210, roadside obstacles	5,581,110
Section 230, safer roads demonstration	1,593,450
Section 204, special bridge replacement	3,563,000
OTHER FEDERAL FUNDS	
Interstate Safety (Is)	14,512,880
TOPICS	3,968,730
Urban Programs	7,520,820
Federal Aid Secondary Program	2,317,900
STATE FUNDED PROJECTS	
Mb - bituminous resurfacing	715,620
Mbr - bituminous reconstruction	638,880
M - miscellaneous construction	2,065,580
Mnm - nonmotorized vehicle facility	47,210
Ms - safety program	5,552,800
Msh - shoulder edge treatment	559,320
Mcp - minor construction	954,200
LOCAL FUNDED PROJECTS	1,620,500
SPECIAL PROJECTS	
Guardrail End Treatments	146,660
Total	\$58,392,540

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SECTION 1

FEDERAL-AID CATEGORICAL SAFETY PROGRAM

FISCAL YEAR 1974-75

The 1973 Highway Safety Act in Michigan

INTRODUCTION

The Michigan Department of State Highways and Transportation has administrative responsibility for the five categorical safety project sections of the 1973 Highway Safety Act with the Office of Highway Safety Planning, Michigan Department of State Police, acting in an advisory capacity. The Federal Highway Administration Division office and the Department have each appointed a safety program coordinator. In addition, the Department established a Safety Advisory Committee in January 1974. This committee consisted of working level personnel and was responsible for reviewing the five Categorical Safety Programs at a technical level to determine difficulties in implementing those programs. Upon completion of the review and documentation of their findings, the committee was dissolved.

The Highway Safety Steering Committee was established in May, 1975. The committee members consisted of representatives from the Office of Highway Safety Planning, Federal Highway Administration, Attorney General, Governor's Office and all Division Heads within the Department's Bureau of Highways. The scope of responsibility is much broader as management personnel are involved. Their responsibility is the State's total safety effort and the development of policy and procedures for implementation of all safety programs within the state.

The Department has moved rapidly during this last fiscal year in implementing the five sections with a total obligation of almost \$13 million in Federal Aid Categorical Safety Funds. See summary table of program implementation on page 1-4 and the table showing

the Federal funds appropriated on page 1-5. At the present rate of expenditure, categorical funds appropriated will be spent within the allowable time frame.

Acceptance of the Federal Aid Categorical Safety Programs by local units of government in Michigan has been well accepted during fiscal 1975. Approximately 247 proposed projects were received from local jurisdictions which indicates a significant interest in this finding. The Pavement Marking Program, however, had the greatest participation, mostly because of the ease and simplification of obtaining funds. This shows that greater participation could be obtained if policies, regulations and procedures could be simplified for other categories.

It has become evident that small local agencies may never develop the level of staffing required to understand and implement federal requirements to obtain safety funds. However the local level is where safety emphasis should be placed.

Michigan has accepted and funded many projects less than \$10,000 in value. These many projects create an extensive amount of paper work which makes it difficult for the existing staff to provide orderly and prompt processing of required documentation. To ease this problem, all agencies involved should make every effort to modify procedures to allow a more efficient and expedient processing of projects involved in the Categorical Safety Program.

In addition to the five Categorical Safety Programs, information relative to Section 204 - Bridge Replacement Program is included in this report. This program provides federal funds on a 75 percent

participation basis to replace bridges that are unsafe because of structural deficiencies or deterioration.

This report is intended to be a supplement to the first Annual Report issued August 31, 1974. It will give the general status of the Categorical Program to July 1, 1975 and a brief description of how the program is progressing, some of the problems encountered, and the short cuts in procedures that have been made.

SUMMARY OF 1973 HIGHWAY SAFETY ACT FUND USE
As of 6-30-75

<u>SECTION</u>	<u>OBLIGATED*</u> <u>FY 74</u>	<u>OBLIGATED*</u> <u>FY 75</u>	<u>TOTAL</u> <u>OBLIGATED</u>	<u>3-YEAR</u> <u>APPORTIONMENT</u>	<u>PERCENT</u> <u>OBLIGATED</u>	<u>REMAINING</u> <u>APPORTIONMENT</u>
203	\$ 85,752	\$ 1,009,701	\$ 1,095,453	\$ 6,019,452	18.2	\$ 4,924,039
205	---	1,836,772	1,836,772	5,012,976	36.6	3,176,204
209	651,076	3,667,702	4,318,778	7,699,640	56.1	3,380,862
210	24,750	5,023,003	5,047,753	6,740,661	74.9	1,692,908
230	<u>114,480</u>	<u>1,434,107</u>	<u>1,548,587</u>	<u>9,556,083</u>	<u>16.2</u>	<u>8,007,496</u>
TOTAL	\$876,058	\$12,971,285	\$13,847,343	\$35,028,852	39.5	\$21,181,509

*FHWA PS&E Approval

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Highway Safety Act of 1973

Section	Highway System	Types of Projects	Federal Funds Michigan			
			Finance	1974	1975	1976
<u>203</u> Rail-Highway Crossings	Federal-aid (Except Interstate)	Protective Devices; Signs & Markings; Crossing Illumination & Surface Improvements	90-10	892,680	2,705,647	2,421,165
<u>205</u> Pavement Marking Demonstration Program	All Highways (Except Interstate)	Centerline & Edgeline Markings; Establishing & Painting "No Passing" zones	100	702,979	2,130,679	2,179,318
<u>209</u> Projects for High Hazard Locations	Federal-aid (Except Interstate)	Intersection widening, Channelization, & signalization; Skid-prone location correction	90-10	1,917,958	2,906,608	2,875,074
<u>210</u> Program for Elimination of Roadside Obstacles	Federal-aid (Except Interstate)	Guardrail end treatments; Breakaway signs; Crash cushions; Tree removal; Culvert headwall corrections	90-10	958,979	2,906,608	2,875,074
<u>230</u> Federal-aid Safer Roads Demonstration Program	Non Federal-aid	Pavement Marking; signing; eliminate roadside obstacles; eliminate hazards @ railway crossings & projects for High Hazard Locations	90-10	1,945,998	3,891,997	3,718,088

Section 203 Rail-Highway Crossings

Presently the responsibility for the safety of rail-highway crossings is shared by the Michigan Public Service Commission, the Michigan Department of State Highways and Transportation, the railroads, and local road authorities.

Section 203 is jointly administered by the Department's Local Government Division and the Bureau of Highways. Projects involving the State's highways are handled entirely by the Bureau of Highways.

The Rail-Highway Crossing Improvement Program for fiscal year 1975 involved primarily the continuation of project programming and the obligation of Federal Aid funding. Approximately 98 projects were program approved and 21 projects were obligated by the FHWA involving local jurisdictions. On state highways 24 projects were programmed and 12 were obligated during fiscal 1975. Participation by local jurisdiction is about evenly divided between projects on and off the Federal Aid System. The acceptance of this program by local jurisdictions has been very good and shows the results of "selling" the safety program in fiscal year 1974.

The types of projects submitted by local jurisdictions and accepted for programming include the installation or upgrading of crossing signals, gates and crossing surface improvements, with the exception of three large railroad consolidation projects. These involve the abandoning of near parallel rail lines, through an urban area, and the use of one line for two railroads. Currently there are three urban areas under consideration for this type of project.

Worthy of mention is a project in Bay City, Michigan where the Grand Trunk Western Railroad parallels the Penn Central Railroad through the City, approximately 2 city blocks apart. The proposed work will abandon the GTW RR tracks, restore the street crossings, eliminate approximately 47 rail-street crossings and upgrade the remaining PC RR line to current standards. Federal funding will participate in work within the street right-of-way and in addition provide the necessary safety improvements at the remaining crossings, as needed.

Similar projects are proposed in Iron Mountain and Menominee, Michigan. These projects have been determined by local jurisdictions to be their top priority in rail-highway crossing improvements.

Signing and marking of rail-highway crossings is required by Federal law. Signing and marking is being accomplished by submission of programs under Sections 203, 205 or 230 of the Federal Categorical Safety Programs.

Under current Michigan law, the Department of State Highways and Transportation does not have jurisdiction over local roads, therefore, a railroad sign program must be initiated by the local authority. Michigan does have a current highway needs study which lists conditions at all rail-highway crossings which is of use in developing projects. We expect the Michigan Accident Location Index (MALI) to allow a meaningful inventory to be developed. See page 3-20 for discussions of MALI.

Participation has been good in respect to the upgrading of railroad signs and is expected to continue.

By June 30, 1975, a total of \$1,095,400 in Federal Aid Safety Funds has been obligated, \$1,009,700 in fiscal 1975 representing a total cost of \$1,121,890. This is 18.2% of the initial 3-year apportionment. However, the current backlog of projects (101) indicates that a greater rate of fund usage can be expected in the future.

Rail-Highway Crossings
(Section 203)

Project Location	Programmed Projects						No. of Locations						Justification			
	Warning Devices						Construction						Priority ** Points	Potential Accidents	Federal Funds Obligated	Total Costs
	FLS	Gates	CA	AWS	Pvt. Mkg.	X-Bucks	Est. Cost	Appr. Work	X-ing Work	C&G &/or G.R.	Realign Clear Vision	Est. Cost				
Local Jurisdictions	41	16	15	8	55	2	1,973,775	37	51	52		314,289	86	0.9	577,880	642,090
State Highways*	9	0	8				290,993	1	10			188,807	79	0.6	431,820	479,800
															<u>1,009,700</u>	<u>1,121,890</u>

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*These costs are for 12 projects let to contractor obligated during FY 1974-75
There were 24 projects programmed at a total estimated cost of \$1,720,790. (Warning Devices and Construction Costs Combined)

**See 1974 report for a description of the method for determining priority points

- FLS - Flashers
- CA - Cantilever Arm
- AWS - Advance Warning Signs
- C&G - Curb and gutter
- G.R. - Guardrail

Section 205 - Pavement Marking Demonstration Program

This program is administered by the Department of State Highways and Transportation's Local Government Division with the Traffic and Safety Division acting in an advisory capacity. The establishment of No Passing Zones is a high priority portion of the Pavement Marking Program on roads and streets under local jurisdiction.

Acceptance of the Pavement Marking Program has been exceptional in Michigan. The program is aimed at unmarked rural two-lane highways therefore most of the projects are with the 83 counties.

As mentioned in the 1974 report, Michigan programmed two stages, one for establishment of all No Passing Zones not in conformance with the current Manual of Traffic Control Devices and another for markings including the No Passing Zones.

Seventy percent of Michigan's 83 counties have participated in the survey of No Passing Zones and the same percentage is expected to participate in the markings. As of July 1, 1975, 60 counties have participated in projects under contract to survey No Passing Zones, and 20 counties have projects contracted for pavement marking. We are pleased with the participation and the results are indicative of the effort involved in selling the program. Also procedures have been greatly simplified making it appealing to local jurisdictions and a record remains on file with each local jurisdiction showing the limits of No Passing Zones for future pavement marking reference.

Unit costs for projects for the survey of No Passing Zones were bid at about \$35 per mile surveyed at the beginning of the program. However, with the addition of more bidding contractors, the price has dropped to about \$25 per mile surveyed.

The program to date can be best evaluated by the excellent acceptance by local jurisdictions. Insufficient field work has been accomplished to make an evaluation by the use of accident records.

Projects are chosen by local authorities for work both on and off the Federal-Aid System and they also determine the priorities for pavement marking within their jurisdiction.

Genesee County, which is one of Michigan's most populous counties, submitted a program of painting 1,100 miles of edgemarking, 60 miles of No Passing Zones, 78 thermoplastic railroad crossing markings, 2,900 lineal feet of crosswalk markings, 50 school legends, and 275 lineal feet of stop bars. There were 550 miles involved in the survey of No Passing Zones. The cost of the pavement painting contract was \$122,000 and the No Passing Zone survey contract was \$18,000. Narrow bridge pavement marking treatments are also included in this program.

The Department made and received FHWA concurrence in a public interest finding for the use of thermoplastic material for certain markings. This procedure greatly reduced paper work for justification in the use of this material.

By June 30, 1975, a total of \$1,836,770 in Federal-Aid Safety Funds had been obligated, all in fiscal year 1974-75. This represents

36.6% of the initial three-year apportionment. The current backlog of 40 counties which have not submitted pavement marking projects but are under contract to survey No Passing Zones indicates that the funds apportioned will be used.

STAGE I - NO PASSING ZONE SURVEY
PAVEMENT MARKING PROGRAM

RCS HTO 20-01
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

No Passing Zone Survey During FY <u>75</u>	Miles & Cost by System											
	Federal-Aid System				Off The Federal-Aid System				Total Miles and Cost During FY <u>75</u>		Total Miles and Cost To Date	
					State Jurisdiction		Local Jurisdiction					
	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost
	12,002	291,000					4,111	99,000	16,113	390,000	16,113	390,000
Total	12,002	291,000					4,111	99,000	16,113	390,000	16,113	390,000

Total Miles Remaining to be Surveyed

	Miles by System					
	Federal-Aid System		Off The Federal-Aid System		Total	
			State	Local		
	1,040			570	1,610	
Total	1,040			570	1,610	

STAGE II
PAVEMENT MARKING PROGRAM

RCS HTO 20-01
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

Placement of Markings During FY <u>75</u>	Miles & Cost by System											
	Federal-Aid System				Off The Federal-Aid System				Total Miles and Cost During FY 75		Total Miles and Cost To Date	
					State Jurisdiction		Local Jurisdiction					
	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost
Both centerlines and edge lines Miles of Road	828	255,000					127	39,000	955	294,000	955	294,000
Only centerlines Miles of Road	1,674	213,000					674	86,000	2,348	299,000	2,348	299,000
Only edge lines Miles of Road	452	82,000					245	44,000	697	126,000	697	126,000
Total	2,954	550,000					1,046	169,000	4,000	719,000	4,000	719,000

Total Miles Remaining to be Marked

Placement of Markings	Miles by System				
	Federal-Aid System		Off The Federal-Aid System		Total
			State	Local	
Both centerlines and edge lines Miles of Road	2,700			500	3,200
Only centerlines Miles of Road	5,500			2,600	8,100
Only edge lines Miles of Road	1,500			1,000	2,500
Total	9,700			4,100	13,800

Section 209 - High Hazard Locations

The administrative responsibilities for this program are divided between the Department's Local Government Division and the Traffic and Safety Division. The Traffic and Safety Division administers the Department's portion and acts in a review and advisory capacity to the Local Government Division which has responsibility for the administration of projects on roads under local jurisdiction. Some projects currently being implemented came from those TOPICS projects with accident experience that were not funded due to depletion of TOPICS funds; high hazard locations identified by TOPICS studies and 402 studies; and locations individually identified by high-accident experience with correctable patterns, including skidproofing projects (see pages 3-8 through 3-11) and signal modernizations. Projects on state highways are drawn from the Department's ongoing Michigan Safety (Ms) Program and were individually justified.

This portion of the Categorical Safety Program has been well accepted by local jurisdictions, with the number of projects somewhat limited because of the large size of projects and the dollar cost of each. However, a good representation of various job types has been received, many of which are under contract.

Wayne County, the state's most populous county, submitted a group of four intersections for widening, costing \$400,000. A Genesee County project for pavement grooving and guardrail on a hazardous section of road will cost \$65,000.

Evaluations cannot be made until a later date when construction and studies can be completed.

By June 30, 1975, a total of \$4,318,778 in Federal Aid Safety Section 209 Funds had been obligated: \$3,667,700 of this was obligated during fiscal 1974-75 representing a total cost of \$4,075,220. This figure represents 56.1% of the initial 3-year apportionment. No difficulty is foreseen in expending the total funds apportioned.

SECTION 209 - High Hazard Locations

		NUMBER AND TYPES OF WORK								
		Total Projects		Programmed						
Fiscal Year	Fed. Funds 90%	Program	PS&E App.	Intersec.	Signals	Skid Proofing	Other			
1974-75	1,695,600	13	8	9	2		2			Local Jurisdiction
	1,972,100	19	14	13	2	4				State Highways
Total	3,667,700	32	22	22	4	4	2			

1-17

Section 210 - Elimination of Roadside Obstacles

The administrative responsibility for this program is also divided between the Department's Local Government Division and the Traffic and Safety Division. The Traffic and Safety Division administers the Department's state highway portion and acts in a review and advisory capacity to the Local Government Division which has responsibility for projects on highways under local jurisdiction. Under this program, the Department has primarily concentrated on "Yellow Book" type projects on the non-Interstate Freeway System, with participation for sign upgrading by the State's Safety (Ms) Program to augment the federal funds.

The statewide sampling survey of roadside obstacles required by Section 210 has been completed for the rural areas and is about 40 percent complete for urban areas on highways under local jurisdiction and the sampling on state highways has been completed. The results of the sampling survey thus far are shown on page 1-20 which has been expanded to show the estimated total obstacles statewide. The sampling survey is expected to be complete in October 1975.

Among local jurisdictions, this section of the Categorical Safety Program has been primarily oriented toward tree removal projects, narrow bridge treatments, small culvert replacement and extensions, removal of roadside obstacles and removal and installation of guardrail. Projects are initiated by local jurisdictions and priorities chosen by them.

One project submitted by Macomb County is of the "Yellow Book" type, both on and off the Federal Aid System. The cost of the project will be approximately \$750,000 and will treat all obstacles for several four-mile sections of country roads. Work includes: tree removal, narrow bridge treatments, guardrail placement, flattening slopes, and removal of various obstacles. Construction should start about September 1975.

By June 30, 1975, a total of \$5,048,000 in Federal Aid Safety Section 210 Funds had been obligated, with \$5,023,000 obligated during fiscal 1974-75 representing a total cost of \$5,581,110. This figure represents 74.9% of the initial three-year apportionment. Present backlog indicates depletion of this fund in the near future.

SECTION 210 - OBSTACLES

		NUMBER AND TYPES OF WORK								
Fiscal Year	PS&E Federal Funds	Total Projects			Programmed					
		Program	PS&E App.	Removals	Yellow Book	Atten.	Culverts	Narrow Bridges	Guard Rail	Other
1974-75										
Local jurisdiction	1,267,360	13	7	7	1	0	1	2	2	0
State Hwys.	3,755,640	8	7	0	6	2	*	*	*	
Total	5,023,000	21	14	7	7	1	1	2	2	0

*included in "Yellow Book"

1-20

SECTION 210

RURAL ROADSIDE OBSTACLE SURVEY

Obstacle Type	Federal Aid Routes*		Non-Federal Aid Routes	
	Obstacles/ Mile	Estimated Total Obstacles Statewide	Obstacles/ Mile	Estimated Total Obstacles Statewide
Guardrail Not Attach.	.35	8,552	.10	6,294
Without Proper Guard- rail Treatment	.84	20,525	.56	34,814
Guardrail Not Flared, Buried or Cushioned	.49	11,973	.07	4,448
Inadequate Guardrail Treatment	.86	21,014	.30	18,564
Sign Supports	2.86	69,884	1.87	116,823
Utility Poles	10.38	253,635	9.09	567,325
Trees or Stumps Alone	24.98	610,386	33.05	2,061,370
Trees or Stumps in Clumps or Strips (Acres)	.76	18,570	1.62	101,347
Buildings	.42	10,262	.65	40,634
Ditches (Miles)	.11	2,687	.11	6,675
Others	7.69	187,905	9.84	613,766

*These figures exclude Interstate.

Comments on Fixed Object Accidents

A cursory cost evaluation of the data shown in the preceding Fixed-Object Summary Chart indicates that the subject involving roadside obstacles represents several hundred million dollars in Michigan alone. On a like basis, a nationwide cost would involve several tens of billions of dollars.

What is not apparent is the environmental consideration that must be made regarding removal or protection from fixed objects, especially in regard to trees. Environmental laws in Michigan, nationally and in many states basically dictate that natural resources must be protected and it must be shown that there are no feasible or prudent alternatives to their removal. With these restrictions, any program affecting the roadside environment is very complex and comes under the scrutiny of the law, many agencies and organizations.

Last year's report gave the results of a preliminary study in which it was determined that a large proportion of car-tree accidents occurred at, or very near the same spot or milepost. In a comparison of three years of tree accidents it was found that 30 percent of the tree accidents occurred within a summary distance of 61 miles (0.66 percent) on the State Highway System, which is a significant disproportionate relationship.

In this study, it also became apparent that the tree accident concentrations were no respecter of class of highways and that many locations, having one tree accident, had several accidents in which other objects were involved.

A partial analysis was then performed to see if all fixed-object accidents also would occur in concentrations beyond normal chance expectancy. A comparison of three years of fixed-object accidents in one district and part of another indicated that there was a concentration.

On the basis of this sampling, a 3-year printout (1972, 1973, 1974) of fixed-object accidents involving 5 or more accidents within 0.2 mile gave the following results:

Total Locations	Total Mileage of Locations	Total Fixed Object Acc. at Locations
3,248	650 miles (7%)	26,156 (50%)

Total State Hwy. Miles	Total Fixed Object Acc. on State Hwys in 1972, 1973, and 1974
9,325	52,012

The fixed-object accident data reflected the statewide trend in the yearly decreasing numbers of accidents, influenced by limited energy resources, the need for conservation and the economic situation. Nevertheless, the data showed that fixed object accidents do occur on a significantly disproportionate share of the highway mileage.

On this basis, a program, based upon engineering investigations to correct the causes or elimination of the objects struck, should yield meaningful results and a good benefit in the reduction of accidents and/or casualties. A preliminary analysis of several concentrations indicates that some degree of corrective action other than removal of the objects should be required, such as: erection of barriers

at the road edge; improved delineation or warning; possible curve correction or reconstruction; possible skidproofing, etc.

This approach would be in general conformance with most Action Plans and also provide the justification necessary to prove the necessity of a project in the interest of the safety of the traveling public.

Section 230 - Federal Aid Safer Roads Demonstration Program

This section of the Federal Safety Act provides funds for safety work on roads and streets off the Federal Aid System. It is administered by the Department's Local Government Division with the Traffic and Safety Division providing traffic engineering consultation on an as-needed basis. The program for Michigan is composed of sign upgrading projects, rail-highway crossing improvements, "Yellow Book" type projects, tree removals, obstacle removals, narrow bridge treatments, and intersection improvements.

The largest participation is in the rail-highway crossing improvement area, with sign upgrading second. It is anticipated that more projects for intersection improvements will be received in fiscal 1976. Eleven were obligated in fiscal 1975. An excellent reception of the sign upgrading program has taken place by local jurisdictions with 68 projects programmed and another 50 proposed.

An inventory of all signs on local streets and roads is a necessary first step to a proposed sign upgrading project. The inventory is compiled by the local authority with guidance from the State's Traffic and Safety Division. This, in effect, will standardize all local jurisdictions in the state and provide them with a record to assist them in establishing a future sign maintenance schedule.

The Department has received Federal Highway Administration concurrence in the use of hi-intensity, encapsulated lens reflectorized material for certain signs. This public interest finding will

ease justification requirements for the use of such material in future projects.

By June 30, 1975, a total of \$1,549,000 in Federal Aid Safety funds had been obligated, with \$1,434,107 obligated in fiscal 1975, representing a total cost of \$1,593,450. The total expenditure to date represents 16.2% of the initial three-year apportionment. Due to the rapidly accelerated rate of expenditure this fiscal year, it is anticipated that all funds will be expended.

Rail-Highway Crossings
Section 230

Fiscal Year	Project						Description					Justification		Cost in Federal Funds	
	Warning Devices						Construction					Priority Points	Potential Accidents	PSE Cost	
FLS	Gates	CA	AWS	Pvt. Mkg.	X-Bucks	Total Cost	Appr. Work	X-ing Work	C&G &/or G.R.	Realign	Total Cost				
Fiscal 1974 Summary	15	6	0	6	15	0	508,000	10	9	7	1	117,500	86	1.4	-0-
Fiscal 1975 Summary	28	15	4	38	36	1	1,001,000	31	33	31	2	1,850,150	89	0.8	537,810
Total to date	43	21	4	44	51	1	1,509,000	41	42	38	3	1,967,650			537,810

FLS = Flasher
 CA = Cantilever Arms
 AWS = Advance Warning Signs
 C&G = Curb & Gutter
 G.R. = Guardrail

SECTION 230 Safer Roads Demonstration

NUMBER AND TYPES OF WORK										
Fiscal Year	Federal Funds 90%	Total Projects			Programmed					
		Program	PS&E App.	Removals	Yellow Book	Atten.	Culverts	Narrow Bridges	Guard Rail	Obstacl & Signs
1974	0	5	0	0	0	1	0	0	0	4
1975	896,300	46	9	9	2	0	3	1	1	30
Sub- Total 74-75	896,300	51	9	9	2	1	3	1	1	34
+ Railroad	537,810									
TOTAL	1,434,110									

Section 204 Special Bridge Replacement Program

Section 144 of Title 23 of the United States Code provides funds on a 75 percent participation basis to replace bridges over waterways or other topographical barriers that are significantly important and unsafe because of structural deficiencies or physical deterioration. The program in Michigan is administered by the Department's Local Government Division.

Bridges under local jurisdiction have been surveyed for structural adequacy and are ranked for priority of replacement in accordance with critical need on the basis of an operating and inventory rating.

To date 15 bridges representing \$11,983,517 in Federal Aid Funds have been obligated, with 9 bridges and \$2,672,250 obligated during fiscal 1974-75 representing a total cost of \$3,563,000.

SECTION 2

REPORT

of the

MICHIGAN SAFETY (Ms) PROGRAM

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SECTION 2

PART I

THE 1974-1975

MICHIGAN SAFETY (Ms) PROGRAM

INTRODUCTION

The Michigan Department of State Highways and Transportation annually seeks out, identifies, and recommends improvements at locations experiencing severe accident or operational problems on state highways. The Michigan Safety (Ms) Program was initiated in 1965. It was expanded in 1965 in response to an increased emphasis on highway safety and is now funded with \$6,000,000 in State funds. The Safety Programs Unit operating within the Traffic and Safety Division administers this Safety Program.

Projects typical of the Safety (Ms) Program include intersectional widenings to provide for additional through capacity and for protected turning lanes, improved roadside control, increased curb radii, protective guardrail and barrier median, and skidproofing of roadways experiencing a disproportionate number of wet surface accidents and low coefficients of wet sliding friction. The Safety (Ms) Program has also financed limited state highway improvements in the vicinity of new traffic generators such as shopping centers, factories, sports facilities, and educational institutions.

This report includes a review of past projects, a summary of projects completed in our most recent fiscal program (1974 - 1975) and a discussion relative to future program emphasis and project selection procedures.

The method of project selection used to develop the 1974-75 Safety (Ms) Program is similar to that outlined in our annual report dated August 31, 1974. Our goal continues to be selection of projects with the greatest potential for accident reduction and highest benefit/cost ratio.

The screening process is a very important element in the development of the annual Safety (Ms) Program and bears repeating. The factors considered in the screening process are outlined below:

- (1) Number, rate and severity of accidents.
- (2) Presence of reoccurring correctable patterns.
- (3) Practicality - potential for improvement, size of project, consideration of potential right-of-way and/or drainage problems and necessity of securing local cost participation.
- (4) Operational considerations such as increased capacity and roadside control.
- (5) Area factor - potential growth, traffic generators, and uniformity of treatment within a route.
- (6) Possible alternate treatments - signals, signs, pavement markings and other operational controls.

Candidate locations for consideration as safety projects are generated from three basic sources:

- (1) Computer listings of high accident locations. Our 1974 report discusses applicable computer programs in more detail.

- (2) District Traffic and Safety Engineer recommendations and public input.
- (3) Surveillance team field observations.

The review process of candidate projects continues to be basically as outlined in our previous report.

- (1) A review of other Department programs is initiated to insure that other projects to correct the problem are not simultaneously being developed.
- (2) Traffic and accident data is collected.
- (3) The location is reviewed, preliminarily, with our District Traffic and Safety Engineer.
- (4) Locations deemed potentially correctable are reviewed on site by a multidisciplinary review team.
- (5) A proposed corrective treatment is outlined.
- (6) Functional schemes and cost estimates are prepared for various alternatives where feasible.
- (7) Benefit/cost analyses are prepared, priorities established and a project programmed, if deemed justified.

The majority of projects are placed under contract about one year after programming, however those involving right-of-way or presenting engineering difficulties may take longer.

1974-75 Expenditures

The fiscal 1975 Safety (Ms) Program was budgeted at \$6,000,000 less a deficit of \$547,448 from the previous year. Expenditures by project type are given below:

<u>Description</u>	<u>Number of Projects</u>	<u>Amount</u>
Spot locations	60	\$3,457,475
Skidproofing	3	166,200
Sign upgrading to MUTCD Standards (force account)	Statewide	663,770
*Sign upgrading (contracts)	3	333,890
TOPICS	6	349,995
Thermoplastic pavement markings	Statewide	93,870
Wrong-way ramp signing and modifications		26,675
Work orders	123	371,175
Preliminary engineering		89,750
		<hr/>
		\$5,552,800
		+ R.O.W.**

Project costs in the spot location category ranged from a low of \$1,600 for a lane transition taper to \$536,000 for construction of directional crossovers, with the average cost per project being \$60,000. It should be noted that an additional 1.3 million dollars of projects of this type originally programmed as Ms projects were funded under Section 209 (HHS) of the Federal Highway Safety Act of 1973.

While the fiscal 1975 Ms Skidproofing Program amounted to \$166,200, another \$186,200 in projects originally programmed as (Ms) projects were funded under Section 209 of the Federal Highway Safety Act of 1973, and another \$320,660 funded by TOPICS.

*Not eligible for Federal Aid

**Right-of-way charges, unavailable at this time, must be added for the yearly total charges.

Sign upgrading is accomplished through work authorizations and is performed in response to the requirements of the 1973 Michigan Manual of Uniform Traffic Control Devices. It is anticipated that this activity will be completed by January 1, 1977.

Sign upgrading (contracts) refers to sign work performed in conjunction with Section 210 (Elimination of Roadside Obstacles) Federal Highway Safety Act of 1973 projects.

The State contribution to the TOPICS Program was paid from the Safety (Ms) Fund.

Approximately \$100,000 is budgeted annually for thermoplastic lane lines.

Work orders refer to authorizations written by District Traffic and Safety Engineers for minor construction projects performed by State forces or local agencies. \$500,000 was allocated to our districts for use at their discretion subject to approval by the (Ms) Program administrator.

Preliminary engineering charges listed are those costs not chargeable to a specific contract project or those engineering costs for programmed projects subsequently deleted from the letting schedule.

SECTION 2

PART II

EVALUATION OF THE
MICHIGAN SAFETY (Ms) PROGRAM

THE FIRST FIVE YEARS

1965-1970

Evaluation of the Michigan Safety (Ms) Program

Between July 1, 1965 and June 30, 1970, a total of \$21,000,000 was allocated through the Safety (Ms) Program. Most of the funds were devoted to spot improvement type projects which amounted to \$15,000,000 (71 percent of the total). Skidproofing accounted for \$2,550,000 or 12 percent of total expenditures. Other expenditures included \$580,000 (3 percent) for tree removal, \$650,000 (3 percent) for median guardrail, \$830,000 (4 percent) for painting edgelines, and \$1,360,000 (7 percent) for various improvements on a force account basis--pier reflectorization, sign illumination, and thermo-plastic pavement marking.

In addition to the types of improvements already discussed, the Safety (Ms) Program has funded trial installations of promising new products or techniques. Thermoplastic pavement markings, cold rolled plastic lane line inserts, longitudinal pavement grooving to reduce hydroplaning and transverse grooving to improve skid resistance are examples. A portion of the budget has also been earmarked for installation of impact attenuating devices and upgrading of signs to conform with the 1973 MUTCD.

Our review of the 1965-1970 program includes an analysis of accidents at 250 locations. Accident records showed that casualties (fatalities and injuries) were reduced by 750, although property damage accidents increased by 737 in the first year following completion of the improvements. The casualty reduction resulted in a net dollar savings of \$1,835,000 in the first year after construction of the projects. Assuming that this yearly benefit continued, the cost of the projects would be returned in 6.6 years. See Table 1, page 2-11 for a summary of cost-benefit data for the various project types.

Between 1965 and 1970, there were nine basic types of improvements included in the Spot Improvement Program:

- (1) correction of horizontal and vertical alignment
- (2) construction of right-turn lanes
- (3) construction of median left-turn lanes
- (4) widening from 4 to 5 lanes (intersections)
- (5) widening from 4 to 5 lanes (extended sections)
- (6) widening from 2 to 3 lanes
- (7) construction of directional crossovers
- (8) roadside control
- (9) miscellaneous widening
- (10) skidproofing

The geometric changes were provided through formal contract letting procedures. Individual project costs vary from less than \$1,000 to nearly \$2,000,000. (See Charts 1, 2 and 3 on pages 2-12 to 2-14 for summary by cost, type, and number of projects.)

There were a total of 309 spot improvements funded through the Safety (Ms) Program between 1965 and 1970. Of these, 250 (80 percent) are included in the study of before-and-after accidents. These projects accounted for 12.3 million of the \$15 million total, (82 percent). The remainder of the locations were not considered in the study because: (1) accident data was unavailable for some projects*, and/or (2) the projects were developed to forestall accidents anticipated in the vicinity of new roadside developments such as shopping centers in previously undeveloped areas where no accident problem existed.

*Until late 1968, local agencies were not legally required to transmit copies of accident reports to the Michigan State Police. The reports from the City of Detroit are unavailable.

The Significance of the Accident Severity Reduction

The graph below appeared in an article entitled "Two Simple Techniques for Determining the Significance of Accident Reducing Measures" by Richard H. Michaels in the September, 1966 issue of "Traffic Engineering" magazine.

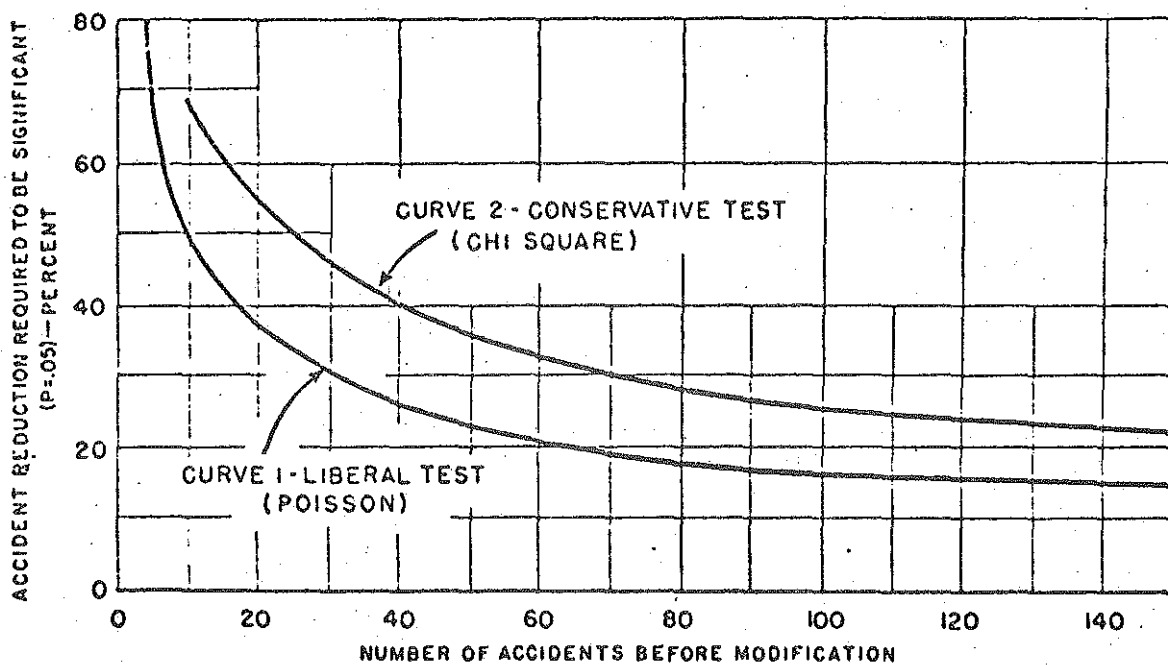


FIGURE A-1

Curve #1 is the liberal curve and may be used where more than minimum accident records are available, such as two years before and two years after as in this case. Curve #2 should be used where data may only be available one year before and one year after.

Computed Benefits Derived Through Accident Reduction
Cost Analysis

The method of evaluating accident costs, used below, is given on page 67 of Roy Jorgensen's report of Highway Safety Improvement Criteria, 1966 edition.

In the following analysis the costs provided by the National Safety Council for year 1968 are:

Death - \$38,700

Non-fatal - \$2,300

Property Damage Accident - \$360

$$B = \frac{ADT_a}{ADT_b} \times (Q R_1 + 360 R_2)$$

where

B = benefit in dollars

ADT_a = average traffic volume after the improvement

ADT_b = average traffic volume before the improvement

R₁ = reduction in fatalities and injuries combined = 750

R₂ = reduction in property damage accidents = -737

and $Q = \frac{\$38,700 + (I/F \times 2,300)}{1 + I/F}$

where

I/F = ratio of injuries to fatalities that occurred statewide.

$$= \frac{160,400}{2,392} = 67.06$$

*In the above noted reference, R₁ is listed as A_{fi} x P_{fi}.

It is evident upon inspection that P_{fi} = $\frac{R_1}{A_{fi}}$ (see definition above) so that A_{fi} x P_{fi} = A_{fi} x $\frac{R_1}{A_{fi}}$ = R₁. Similarly R₂

replaces A_{pd} x P_{pd}.

** ADT_a and ADT_b have been computed as average figures covering the entire project for the study period.

Therefore,

$$Q = \frac{38,700 + (67.06 \times 2,300)}{68.06} = 2,800$$

The computed benefits to the motoring public accrued during the "after" period is then:

$$\begin{aligned} B &= \frac{ADT_a}{ADT_b} * (2,800 R_1) + (360 R_2) \\ &= 1.105 (2,800(750) - 360(737)) \\ &= 1,835,000 \end{aligned}$$

* Assumes a 10.5% increase in ADT over a two-year period. During the 5-year period this report encompasses, the miles traveled in Michigan increased from 43.9 billion miles in 1965 to 53.1 billion miles in 1970. This represents a 20.95% increase for an annual average increase of 4.19%. The process of simplification dictated we should use accident cost figures for 1968, the middle year of the five-year period. We are therefore using 1968 traffic data which represents a 10.5% (2½ years) increase in traffic since 1965.

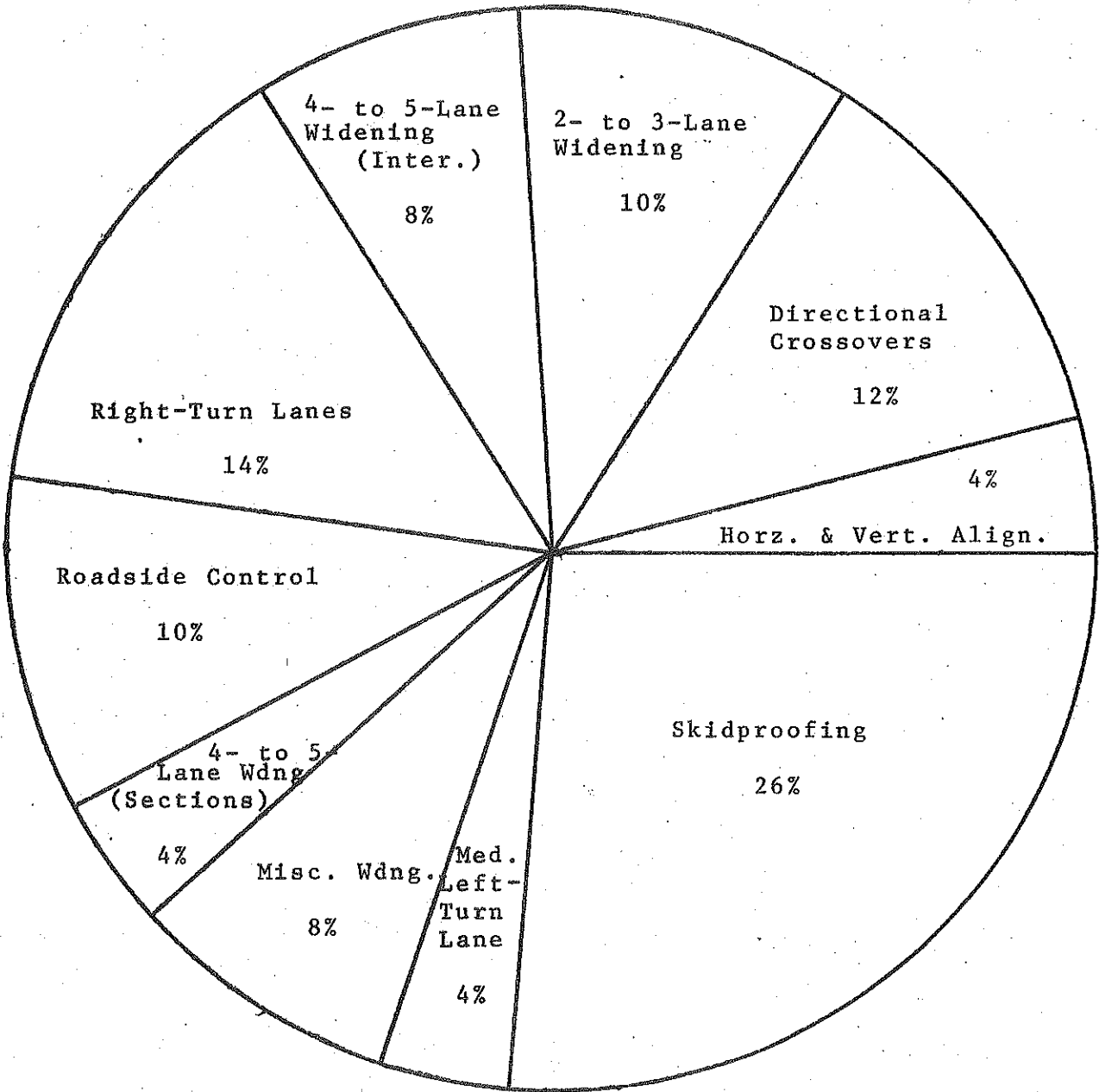
1965 - 1970 MICHIGAN SAFETY PROGRAM (SPOT LOCATIONS)

TABLE I

TYPE OF IMPROVEMENT	NO. OF PROJECTS	NUMBER OF ACCIDENTS												PERCENT REDUCTION				COST OF PROJECTS (\$ 1000)	AVG. YEARLY BENEFIT (\$1000)		
		BEFORE (1 YEAR)						AFTER (1 YEAR)						TOTAL	FATAL DEATHS	INJURY INJURIES	PD				
		TOTAL	FATAL DEATHS	INJURY INJURIES	PD	TOTAL	FATAL DEATHS	INJURY INJURIES	PD												
HORIZONTAL AND VERTICAL ALIGNMENT	7	103	...	...	33	68	70	120	...	...	52	80	68	-17	...	...	-58	-18	3	372	0
DIRECTIONAL CROSSOVERS	20	1352	2	2	474	772	876	1249	2	2	379	610	868	8	...	...	20	21	1	2,007	500
2 TO 3 LANE WIDENING	17	140	6	6	46	88	88	89	4	5	34	67	51	36	33	17	26	24	42	468	80
4 TO 5 LANE WIDENING (INTERSECTION)	13	405	2	3	170	303	233	255	1	2	86	148	168	37	50	33	49	51	28	1,268	500
RIGHT TURN LANE	24	788	1	1	288	496	499	826	4	6	262	447	560	-5	-300	-500	9	10	-12	923	110
ROADSIDE CONTROL	17	170	1	2	60	94	109	171	...	...	48	80	123	0.5	100	100	20	15	-13	376	40
4 TO 5 LANE WIDENING (SECTION)	7	431	1	1	133	225	297	424	2	2	114	210	308	2	-100	-100	14	7	-4	1,234	75
MISC. WIDENING	13	299	1	1	117	190	181	264	...	...	82	138	182	12	100	100	30	27	-0.5	2,936	160
MEDIAN LEFT TURN LANE	8	234	3	5	74	144	157	287	1	1	98	182	188	-23	67	80	-32	-26	-20	231	0
SKIDPROOFING	44	4193	15	15	1584	2685	1594	3689	19	20	1345	2351	2325	12	-26	-27	15	12	-46	2,550	396
TOTAL	*170	8205	32	36	2979	5065	4104	7374	33	38	2500	4313	4841	10.1	-3	-5	16.1	15	-18	12,365	1,835

* 250 LOCATIONS

15% ANNUAL RECOVERY

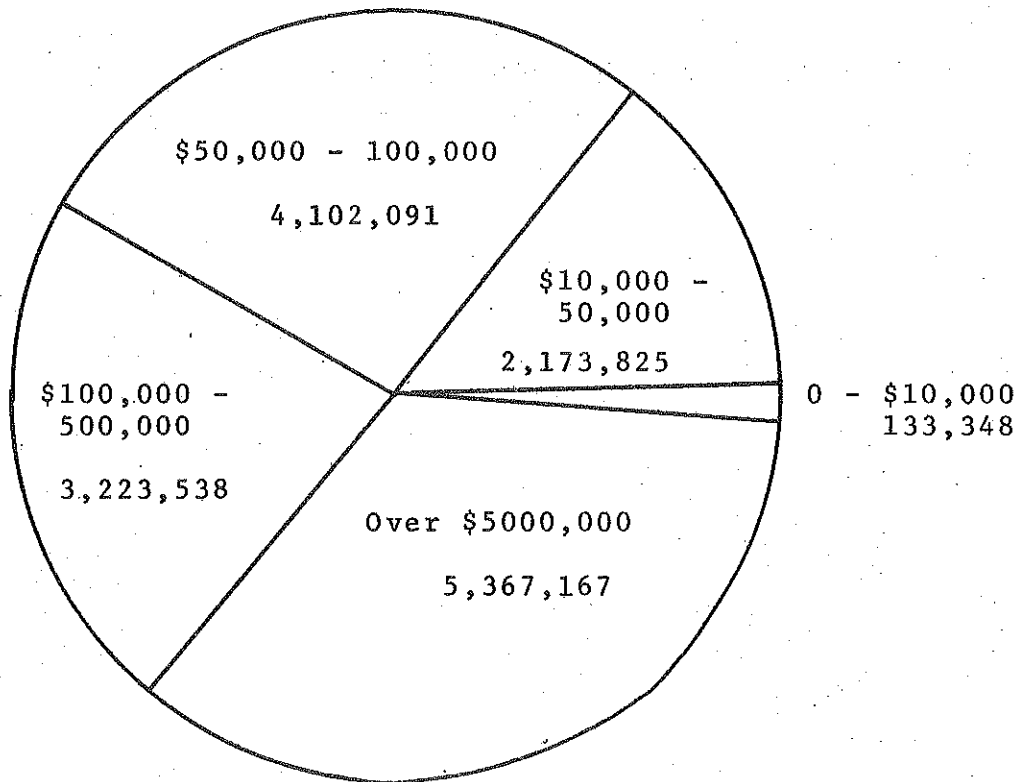


DISTRIBUTION OF SAFETY PROJECTS

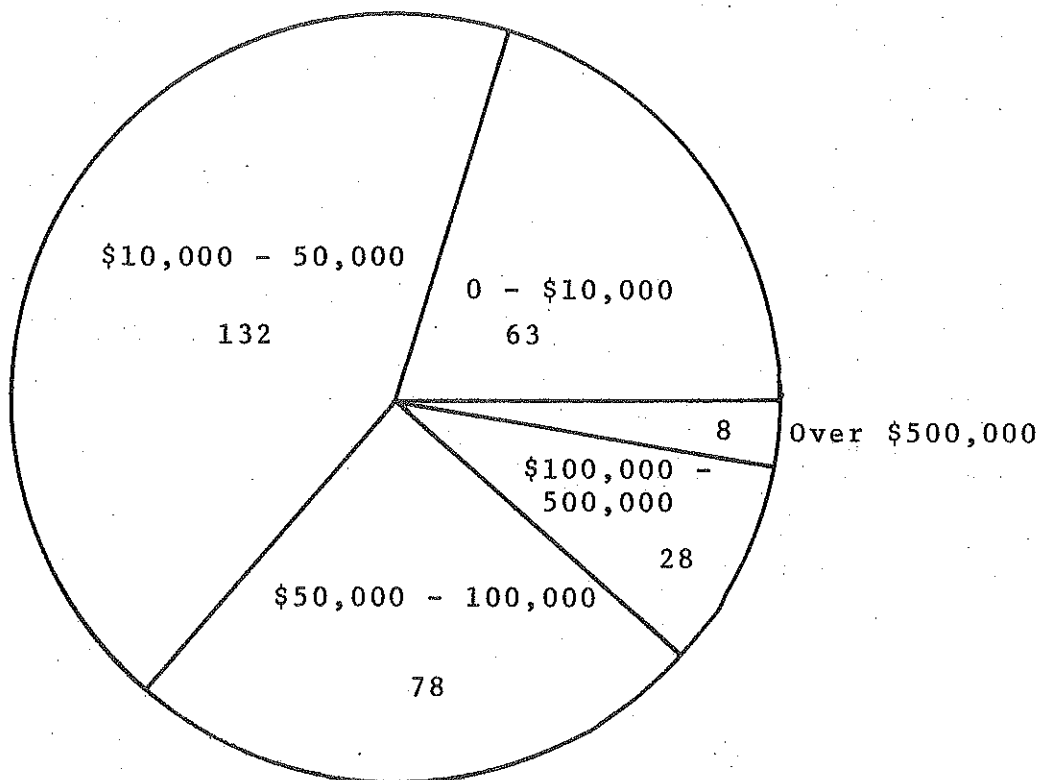
by Type of Improvement

(based on 309 locations)

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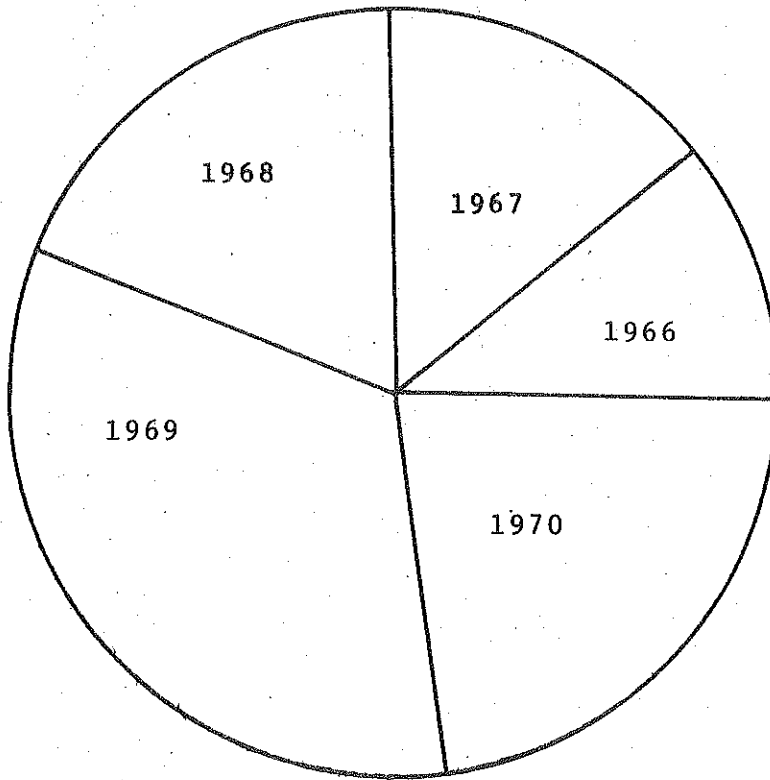


Distribution of Projects by Cost
(based on 309 locations)

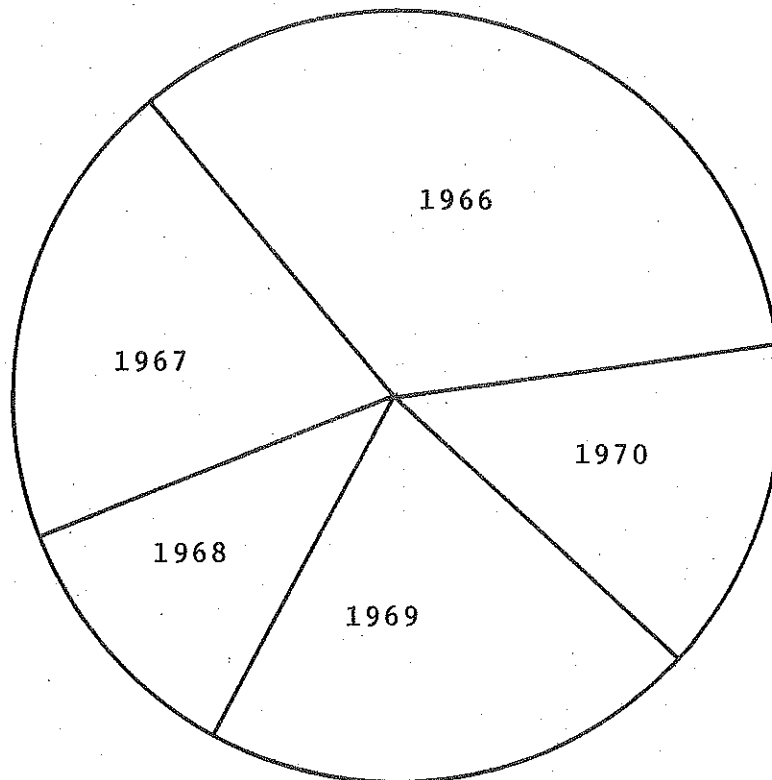


Distribution of Projects by Number and Cost Range
(based on 309 locations)

CHART 2



Distribution of Projects by Fiscal Year Costs



Distribution of Locations Improved by Number Per Fiscal Year

II

TYPES OF IMPROVEMENTS

Safety improvements reflect current "state-of-the-art" techniques. "Average" improvements during the years studied ranged between \$50,000 and \$100,000 and frequently focused on intersection widening in order to provide additional through traffic lanes and exclusive turn lanes. However, as it developed, the Spot Improvement Program expanded its horizons and has performed a wide variety of improvements varying from a cost of \$50 to a maximum of slightly under \$2,000,000 with an average cost of approximately \$50,000. In addition to the relatively major improvements completed under formal contract procedures, numerous minor improvements have been completed under "Work Authorizations" by either city or county contract agencies, or by State forces.

Following is a brief description and summary of the nine basic project types developed between 1965 and 1970.

Horizontal and Vertical Alignment

The seven projects in this category can be classified into two types: improvement of sight distance through vertical grade alteration and improvement of surface rideability (driver comfort).

There were two grade-lift projects, one six inches and the other thirty-six inches. The six-inch lift occurred in advance of a structure because of subbase settlement. The larger lift was to reduce a sight restriction and improve drainage.

Another project corrected a short section of trunkline which was originally constructed over muck and which had, for several years, experienced horizontal and vertical separation of adjacent pavement slabs. The area was resurfaced with a variable depth bituminous overlay to provide a smoother riding surface.

Projects of this type were often aimed at correcting an undesirable pavement situation and were not necessarily directed at locations with an unfavorable accident history. The total cost of these projects was \$372,000. No accident benefits were calculated since they were assumed not to be significant.

Directional Crossovers

Directional crossovers in Michigan have proven useful in reducing accidents and improving capacity at major at-grade intersections of divided highways when constructed in conjunction with prohibition of left turns at the major intersection proper. Wide median widths, sixty feet or more, are generally desirable where directional crossovers are constructed, as this width allows for a median left-turn storage-deceleration lane in advance of the crossover and adequate turn radii for larger vehicles exiting from the crossover.

Directional crossovers and prohibition of left turns at the major intersection have reduced congestion and accidents. Vehicles wishing to turn left off of the main arterial are required to travel beyond the intersection, negotiate a U-turn through the crossover, return to the intersection and complete a right turn. Cross street vehicles proceed right to the U-turn crossover, exit, then continue straight along the arterial. This type of

project has been very successful in improving the operation and reducing accidents at high volume divided intersections. The proper placement of directional crossovers is important as commercial development expands. We attempt to develop master plans which indicate the most favorable locations for crossover construction based on anticipated development. This allows projects to be completed on individual or extended section basis as conditions warrant. Where exceptionally large left-turn demands exist, signalization of the crossover may be required to alleviate potential accident problems and congestion. "Symbol" signing is also desirable to guide unfamiliar drivers through the crossovers. Symbol signs are particularly useful where left turns from the intersecting cross street are prohibited.

The twenty locations evaluated cost a total of \$2,007,000. The annual calculated benefits through reduced accidents is \$500,000; therefore, it is anticipated that total costs will be recovered in approximately four years.

Widening from Two to Three Lanes

Several projects providing for a third lane (left turns only) at low ADT intersections and along short trunkline sections which have experienced limited commercial or industrial expansion have been programmed. This treatment eliminates delays to through traffic caused by left-turning traffic in addition to reducing accidents associated with left-turn movements.

Seventeen third lane projects were constructed at a cost of \$468,000. They are returning annual calculated benefits of \$80,000 after project completion. The average recovery period is 5.9 years.

Widening from Four to Five Lanes

Projects in this category fall into two groups: 1) intersectional widening, and 2) extended section widening. Project locations in both groups carry relatively high average daily traffic volumes and have experienced continuing left-turn head-on and left-turn rear-end accident patterns.

Intersectional widening projects are relatively short in length and costs are minimal, particularly when additional right-of-way is not required. Accident patterns are usually concentrated and well defined. "Heading" up the opposing left turns at an intersection provides each driver an unobstructed view of opposing traffic for choosing an acceptable gap to complete the turn and essentially eliminates rear-end conflicts with through traffic.

Extended section widenings require more careful analysis of accident data. As commercial development expands, a definite increase in traffic and left-turn demand is evident. Along four-lane pavements, the increased turning demand effectively restricts through traffic to the outside lane, while left turners store in the inside lane awaiting gaps to complete their turn. This breeds through traffic entrapment behind the left-turning traffic leading to rear-end collisions and same-direction sideswipe accidents caused by abrupt lane changes in addition to head-on left-turn collisions.

Construction of a fifth lane (left turns only) at intersections or along continuous sections of highway provides a refuge area for left-turning traffic freeing the remaining lanes for through traffic. This nearly doubles the roadway capacity in both instances

in addition to reducing accidents. An early concern relative to possible opposite direction head-on accidents occurring where continuous center lanes for left turns were constructed has not materialized.

Evaluation of intersectional and extended section widening, where extensive development exists is relatively simple because traffic demands are relatively stable in the before-and-after period. However, a meaningful evaluation is impossible when the widening is coordinated with the construction of a large development. Preventive projects of this type are located on trunkline sections with moderate ADT's and minor accident problems in the "before" period. Upon completion of the development, the ADT increases considerably with a corresponding increase of accidents. Group evaluations which include projects of this nature, as this report does, indicate greatly reduced computed benefits in the "after" period. Table 1 shows this to be true as the annual benefit computed for construction of fifth lanes at intersections was \$500,000 while the benefit for section widenings, which cost more, were only \$75,000.

However, a report published in 1972 evaluated the widening of four-lane roadways to five lanes (Michigan Department of State Highways and Transportation Report TSD-G-207-72). This report evaluated four sections of highway incorporating a total of 6.58 miles of continuous center left-turn lanes in basically fully developed areas. The study showed a decrease in total accidents of 33 percent. Left-turn accidents were reduced 45 percent and rear-end type collisions by 62 percent. Annual benefits were \$455,000

in one year compared to project costs of \$3,246,000. In these areas, project costs are estimated as realized in 7.1 years.

Right-Turn Lanes

Right-turn lanes were constructed at 24 locations between July, 1965 and June, 1970. All project locations experienced either a heavy right-turn demand at four- and five-lane urban intersections or a moderate demand in high speed two-lane rural areas. Inadequate turning radii existed in all situations.

The urban intersections where right-turn lanes were constructed had heavy turn demand which caused delays for through traffic and rear-end accidents associated with the turn. Construction of the right-turn lanes generated additional capacity and provided a deceleration lane for the right turn.

The total cost of these projects was \$923,000. The annual benefit returned to the motoring public was calculated to be \$110,000 based on accident data for a one-year period before and after construction.

Roadside Intersection Betterment and Control

Projects of this type are usually programmed as additions to one of the Department's other construction programs. However, a small number of the projects were large enough to be programmed through individual contract lettings.

The process of adding minimal-type improvements to other projects allows us to group several differently funded projects together under one contract. This procedure lowers the costs in areas where a separate small project would not be warranted because of excessive costs.

Projects of this nature may involve minor intersection revisions such as concrete curb and gutter to better define an intersection or the construction of insulating islands to facilitate the orderly movement of vehicles into and out of commercial establishments.

The 17 projects completed and evaluated in this report cost a total of \$376,000 with an annual benefit of \$40,000 realized with minimal accident justification. It is estimated that 9.3 years are required to recover the initial project costs.

Miscellaneous Widening

Improvement projects within this category encompass a total of 23 locations. Due to lack of accident data, only 13 have been evaluated and included in this report.

Six basic improvement types were programmed at the 13 locations.

They are:

- | | |
|---|------------|
| (1) two-to five-lane widening | 2 projects |
| (2) five-to seven-lane widening | 1 project |
| (3) intersectional flaring to standard lane width | 4 projects |
| (4) truck-climbing lane | 1 project |
| (5) left-turn lane - one-way street | 2 projects |
| (6) intersection channelization | 3 projects |

These improvements represent the greatest money expenditure (\$2.9 million) of the nine categories evaluated. (See Table 1). The reason for large money expenditures is that some locations passed through highly developed commercial areas.

Widening projects in such an area usually require the purchase of additional right-of-way and solution of drainage problems. Other

locations require upgrading a rural facility to an urban design with curb and gutter and enclosed drainage. Time required to recover these project costs is 18.3 years, at a computed annual recovery rate of \$160,000.

Median Left-Turn Lanes

Projects of this type fall within two groups. Group 1 includes locations where a directional crossover existed and where a turn lane or taper was not initially required. Group 2 includes locations where short median left-turn lanes existed which were extended through the intersection.

Projects within Group 1 experienced moderate traffic demands on both intersecting streets at the time that directional crossovers were initially constructed. Since this initial construction, traffic demands increased to a point where through traffic and left turns destined for the crossover were competing for the median lane. Consequently, median left-turn lanes were constructed beyond the intersecting street.

Group 2 projects initially included median left-turn lanes between the intersecting cross street and the directional crossover. However, due to a greatly increased crossover traffic demand, these turn lanes were extended back through the intersection. In several instances, right-turn lanes were also constructed as part of these projects. On divided highways where directional crossovers exist, extended median left-turn lanes are not constructed unless the median width is a minimum of 60 feet. The eight projects in these categories cost \$231,000. No accident reduction benefits were realized after construction of these projects.

Skidproofing Program - The First Five Years

The Michigan Department of State Highways and Transportation has long recognized wet surface accident problems. The early 1960's saw the initiation of a program designed to improve slippery-when-wet conditions on a district-by-district basis throughout the state. This program was accelerated during the 1965-66 fiscal year following passage of the 1965 Safety Act. A total of seventy-three locations were let during that year's program under seven statewide contracts. The 1966-67 fiscal year included twenty-two locations corrected under thirteen statewide contracts. During the 1967-68 fiscal year, an additional nine locations were improved under seven statewide contracts.

Each fiscal program was evaluated on the basis of a one year before-and-after accident comparison. Before-and-after wet sliding friction (W.S.F.) values were determined for most locations as equipment schedules permitted.

The three evaluations revealed a 15.7% reduction in total accidents and a 14% reduction in casualties (injuries and fatalities). The most significant reduction (47.2%) was noted in wet surface accidents.

The Department uses the results of these studies to aid in forecasting accident trends and benefits of later fiscal year programs. The results of these evaluations are summarized on the following page. The entire five-year skidproofing program has been evaluated. The benefit is shown in Table 1, page 2-11.

SUMMARY OF SKIDPROOFING PROGRAM

ACCIDENTS

YEAR	NO. LOC.	BEFORE (1-YEAR)						AFTER (1-YEAR)						COST
		TOTAL	F(K)	I(I)	PD	WET	WET%	TOTAL	F(K)	I(I)	PD	WET	WET%	
65-66*	73	2191	10(10)	880(1547)	1301	935	43	1817	13(13)	720(1314)	1084	423	23	1,006,353
66-67*	24	807	2(2)	334(537)	471	289	36	726	4(5)	282(494)	440	217	30	806,484
67-68*+	10	306	1(1)	100(170)	205	136	44	250	1(1)	79(133)	170	76	30	321,138
68-69	12	493	1(1)	181(291)	311	117	24	482	1(1)	175(288)	306	112	23	253,303
69-70	5	396	1(1)	89(140)	306	117	30	414	0(0)	89(122)	325	82	20	162,984
TOTAL	124	4193	15(15)	1584(2685)	2594	1594	38	3689	19(20)	1345(2351)	2325	910	25	2,550,262

Benefits 1965-66 Program 645,000* for 1 year after period
 1966-67 Program 106,700* for 1 year after period
 1967-68 Program 144,500* for 1 year after period
 1968-69 Program Data Not Significant for 1 year after period
 1969-70 Program Data Not Significant for 1 year after period.

2-24

The average annual benefit derived for the 5-year period is \$396,000 or 15.5%.

Initial construction costs will be recovered in 6.5 years.

* From Evaluation Reports TSD-SS-126-70; 129-70; 146-70

+ Includes one additional location not contained in report

EVALUATION OF SAFETY ACTIVITIES

During the course of the Safety (Ms) Program, in depth evaluations have been initiated on individual projects or groups of similar type projects to determine their effect on accident experience. These studies have not been limited to construction projects funded by the Safety (Ms) Program. Factors affecting the choice of locations for study included:

1. Number of improvements made or new developments. A number of changes or unusual growth at an improved location can introduce variables that negate the ability to define reasons for changes in accident experience. Many locations that are the subject of improvements experience so many changes in variables such as signal installation, traffic growth due to new industry, shopping centers or attraction to the new facility that a study to determine the effect of an improvement will not yield meaningful results.

Total before-and-after accidents must be of sufficient number so that an increase or reduction can be ascribed to the improvement. Many locations experience random year-to-year fluctuations of accidents which can render the results of a study not significant.

Evaluations performed by the Michigan Department of State Highways and Transportation give results of safety activities, either operational measures or reconstruction. These reports form the basis for judging the merits of varying corrective measures that could be undertaken at locations currently being considered for project programming. The following is a list of evaluation reports that have been completed.

PUBLISHED REPORTS

1. M-43, US-27, and US-131. Evaluation of four safety projects in Ingham and Kent Counties - 1972.
Subject: Widening 6.6 miles of 4-lane roadway to 5 lanes.
Report TSD-G-207-72
2. M-11 (28th Street) - 1969.
Subject: Adding a left-turn phase to traffic signals.
Report TSD-SS-125-69
3. M-153 (Ford Road) in Garden City, Wayne County - 1968.
Subject: Removal of curb parking and changing 4-lane roadway to 5-lane operation.
Refer to by location.
4. BL-96 (Cedar) @ Jolly Road, Ingham County - 1968.
Subject: Widening of BL-96 from four to five lanes to provide a center lane for left turns. Refer to by location.
5. All Red Traffic Lights - 1972.
Subject: Addition of an all red clearance interval to the traffic signal timing sequence.
Report TSD-G-208-72.
6. Score - 1972.
Subject: Systematic Correction of Roadside Environment.
(Michigan Yellow Book)
Report TSD-SS-142-70.
7. I-94 at M-239 (La Porte Road) Berrien County - 1968.
Subject: Several traffic devices were changed at the westbound I-94 where the freeway ends. Refer to by location.

8. An Evaluation of the Installation of Oversized Lenses and Low Level Type Signals - 1973.
Subject: Adding Oversized and Low Level Signals to Fourteen Locations.
Report TSD-229-73.
9. I-75 Median G.R., Monroe County - 1969.
Subject: Evaluation of Three Installations of "Blocked-out" Median Guardrail with Glare Screen.
Report TSD-SS-123-69.
10. 1965-1966 and 1966-1967 Tree Removal Program - 1971.
Subject: Tree Removals.
Report TSD-SS-149-70.
11. 1965-1966 Skidproofing - 1970.
Subject: Skidproofing Overlays.
Report TSD-SS-126-70.
12. 1966-1967 Skidproofing - 1970.
Subject: Skidproofing Overlays.
Report TSD-SS-129-70.
13. 1967-1968 Skidproofing - 1970.
Subject: Skidproofing Overlays.
Report TSD-SS-146-70.
14. M-17 (Ecorse Road) at Pelham Road, City of Allen Park, Wayne County - 1969.
Subject: Widening on M-17 from four to five lanes to provide a center lane for left turns. Refer to by location.
15. US-12 in the City of Wayne, Wayne County - 1969.
Subject: Evaluation of overhead traffic lane-use-control signs. Report TSD-SS-112-69.

16. US-23 at Beaver Road and Kawkawlin Road, Bay City - 1968.
Subject: Widening US-23 (rural highway) to provide left-turn lanes. Refer to by location.
17. M-53 (Freeway Ending) @ Van Dyke (Earle Memorial Highway) - 1970.
Subject: Evaluation of Electrical and Reflective Devices for Signal Control and Advance Warning.
Report TSD-SS-139-70.
18. US-10 at Opdyke Road, Oakland County - 1969.
Subject: Replacement of a median bidirectional crossover with a pair of directional crossovers.
Report TSD-SS-116-69.
19. M-46 @ M-37 - 1970.
Subject: Evaluation of changing the assignment of vehicle right-of-way at a rural trunkline intersection.
Report TSD-SS-128-70.
20. M-85 (Fort Street) @ Oak and Phelps - 1971.
Subject: Reconstruction of median crossovers and removal of median parking.
Report TSD-SS-152-71.
21. Interchange of I-75 and M-85 (Fort Street) - 1971.
Subject: Installation of dual roadside "symbol" signs and illumination of existing overhead signs.
Report TSD-SS-113-69.
22. US-127 at Holmes Road, Ingham County - 1967.
Subject: Skidproofing Overlay.
Refer to by location.
23. Supplement to Tree Removal - 1974.
Subject: Tree Removals.
Supplement to Report TSD-SS-149-70.

24. US-27 and US-127 Curves, Jackson County - 1973.

Subject: Curve Superelevation and Drainage Correction to
Prevent Hydroplaning.

Report TSD-224-73.

Copies of the individual studies can be acquired by submitting
a written request to the Michigan Department of State Highways
and Transportation's Traffic and Safety Division.

SECTION 2

PART III

FUTURE MICHIGAN SAFETY (Ms) PROGRAMS

The Michigan Safety (Ms) Program now operates within the Safety Programs Unit of the Department's Traffic and Safety Division. As a result of a recent Division reorganization, the (Ms) Safety Program and all Federally funded safety programs are now being administered under the direct supervision of one engineer supervisor. It is anticipated that the closer coordination of all of the safety programs will increase the efficiency of the various programs, eliminate duplication of effort and encourage integration of surveillance procedures, problem identification and project selection.

In future programs, we intend to revise and expand our surveillance of high accident locations. We are now initiating modifications to the Department's accident program which will allow the identification of accident pattern concentrations in addition to existing programs which generate lists of locations experiencing numbers of accidents exceeding predefined threshold levels. We have requested revisions to existing computer programs which will allow the generation of lists of locations experiencing concentrations of the following accident types:

- (1) angles
- (2) rear-ends
- (3) left-turn (spot)
- (4) left-turn (area)
- (5) sideswipe
- (6) night
- (7) wet

We have also requested that the search segment length be varied. (The present high accident locating program utilizes a floating 0.2 mile segment length.) We believe that various patterns are associated with varying segment lengths. For example "angle" accidents usually reflect a "spot" problem. As a result we have requested that this pattern be searched on a 0.1 mile segment basis. Since sideswipe accidents may reflect an area "weave" problem, we have requested that this parameter be searched in 0.5 mile increments.

A listing of locations experiencing large numbers of "wet" accidents is utilized now in the preparation of our skidproofing program. We are requesting that this program be modified to "screen" out those segments which fall below a minimum wet/total ratio. A similar list has been requested in our analysis of night collisions.

In addition we are attempting to develop a severity index to identify locations experiencing lower numbers of accidents, but with high proportions of casualties.

We anticipate that our future generation of "high accident" lists and candidate projects will be based on an assimilation of all of the above data rather than the present system of number/rate only.

Another problem with the existing identification of high accident locations is definition of the minimum threshold accident levels. The minimum threshold is now based loosely on the urbanization of the area. We are now seeking to develop the

capability to statistically analyze total accidents and specific accident types in more discrete areas. Ultimately, our definition of a "high accident" segment would be based on some relevant average. A priority system for review and attention could then be predicated on any particular segment's deviation from this average.

The matter of project priorities is also being considered. We hope to review the benefits of past projects in depth to determine, as accurately as possible, the anticipated benefits of future projects of any particular type. Using benefit/cost analyses, we will then be better able to evaluate which types of projects are most cost effective and which specific projects of one particular type are competitive when compared to historical averages.

It is our goal to further emphasize only those projects with the greatest potential for accident reduction and the highest benefit/cost ratio. We believe that past programs have been developed with this philosophy and that, in conjunction with the proposed modifications, future programs will be more so.

SECTION 3

OTHER SAFETY-RELATED CONSTRUCTION PROJECTS

FISCAL YEAR 1974-75

TRANSPORTATION LIBRARY
MICHIGAN DEPT. STATE HIGHWAYS &
TRANSPORTATION LANSING, MICH.

Section 3

OTHER SAFETY-RELATED PROJECTS - FISCAL YEAR 1974-75

INTRODUCTION

There are a number of safety-related projects in the State's various Construction and Maintenance Programs which are not categorized under a specific safety program, in addition to the State's Safety (Ms) Program, the Interstate Safety (Is) Program, the TOPICS Program, Federal Aid Urban and Secondary funds, and several state funded programs (M, Mb, Mbr, Msh) which involve improvements at known accident locations and a few others with a high accident potential. Projects which fall into this category are:

1. Interstate (Is) Safety
2. TOPICS
3. Urban funds
4. Secondary funds
5. State or local funds only

Examples of the types of safety-related projects include railroad-highway signal and crossing improvements; median barrier construction; relocation or providing breakaway supports for lighting; intersection and short section widening for turn lanes; roadside control; resurfacing for skidproofing (Ms, Mb and Mbr projects); guardrail lengthening; removal, upgrading, and end cushions; culvert extensions; tree removal; grading and flattening slopes; placement of a three-foot bituminous edge strip along narrow roads; minor construction - conducted by State and contract work forces; and skid testing.

Interstate Safety (Is)

Projects accomplished under the Interstate Safety (Is) Program may be large or small in scope and the construction is contracted through the competitive bid process. Some safety projects are authorized after approval of a justification based upon the reduction of accidents and recommended corrective measures. The "Yellow Book" (improvement of the roadside environment, removal of fixed objects, etc.) portion included within Interstate Safety (Is) projects differs in that these projects are aimed at lessening the hazards of the roadside environment, sign upgrading, and impact attenuators. Further details regarding the "Yellow Book" program are on pages 3-12 and 3-13.

In fiscal year 1974-75, Michigan awarded 23 Interstate Safety (Is) projects at a total cost of \$14,512,880. Of the 23 projects, 5 involved the construction of a concrete median barrier, 5 projects involved lighting--4 of which relocated lighting from the roadside to the top of a median concrete barrier, and one project was for longitudinal grooving to lessen the incidence of suspected hydroplaning accidents on curves.

A. TOPICS PROGRAM

The Federal Aid TOPICS Program included eight projects designed to increase safety. These projects involve the last ones funded by this program. Though the original funding ended in fiscal 1973, the projects were authorized and lettings were extended into fiscal 1975. Four of these projects involved skidproofing overlays to improve skid coefficients, one involved the reconstruction of an intersection to eliminate a dog-leg, one added left-turn lanes on the approaches to an intersection, one involved the installation of computer-controlled traffic control signal system in the

City of Grand Rapids, and the largest (\$2,780,990 total) participated in the upgrading of the Lodge Freeway (US-10) in Detroit, with a concrete median barrier replacing a raised island with guardrail, providing impact attenuators and installation of units of a freeway surveillance system. In fiscal year 1974 the Lansing Metropolitan Area Computer Traffic Signal Control System was let to contract on April 24, 1974, under TOPICS funding. The project is progressing towards a final system acceptance by December 1, 1975. The central control facility has been completed with computer map display, and all peripheral equipment now in place. The force account field installation portion of the contract consisting of 165 inductive loop detectors and controller interface units is approximately 70% complete.

During the month of September 1975, the various project subsystems consisting of 197 signalized intersections will be brought "on-line" to the computer. Initially, existing signal timing will be implemented to thoroughly exercise and "debug" the contractor's computer software. When this task is complete, implementation of new optimized signal-timing plans will provide the operational framework for six weeks of rigorous system testing and fine tuning prior to project acceptance.

The cost of the TOPICS projects let to contract in fiscal year 1975 totaled \$3,968.730.

Federal Aid Urban Programs

There were a total of 13 safety-related projects let to contract in fiscal 1975 funded with Federal Aid Urban Funds. These were TOPICS type or former TOPICS projects funded with Urban Funds.

Two of the projects involved reconstruction on the Lodge Freeway (US-10) in Detroit in which a concrete median barrier will replace the existing raised island with guardrail, lighting relocated from the roadside to the barrier, impact attenuators at several locations, general "Yellow Book" work and installation of units of a freeway surveillance system, one of these projects had participation by TOPICS funds.

During the year there were 11 projects let to contract on roads under local jurisdiction for \$2,869,740 and 2 on State highways for \$4,651,080. The total funds expended in this program in fiscal 1975 was \$7,520,820.

Federal Aid Secondary Program

There were 13 safety-related projects let to contract funded with Federal Aid Secondary Funds. Eight involved narrow bridges at a cost of \$2,132,120 and five involved highway-railroad crossings at a cost of \$185,780. All involved highways under local jurisdiction.

The total funds expended on 13 projects in this program during fiscal 1975 was \$2,317,900.

Local Funded Projects

These projects involved former TOPICS projects or ones of a similar type, funded entirely under local jurisdictions. There were 79 individual projects, 55 of which involved traffic signal work and 24 involved minor construction work.

The cost of the locally funded safety-related projects let to contract or performed by work forces during fiscal 1975 totaled \$1,620,500. The 55 signal-related projects totaled \$268,500 and the 24 minor construction projects totaled \$1,352,000.

Michigan Funded Projects

In addition to the Safety (Ms) Program, which is reported in Section 2 of this report, there are several other programs within which safety-related work is performed on State highways. These include:

Mb Bituminous Resurfacing - This program is primarily aimed at the maintenance of highways; however, during fiscal 1975, there were 10 projects involving the resurfacing of highways that exhibited low coefficients of wet friction, a high percentage of wet accidents, or both. The cost of these projects totaled \$715,620.

Mbr Bituminous Reconstruction - This program is also primarily aimed at the maintenance of highways and their general upgrading; however, during fiscal 1975 there was one project that continued the four- to five-lane widening of an adjacent Safety (Ms) project at a cost of \$638,880, due to the limitations of the Ms funds.

M Miscellaneous Construction - During fiscal 1975 there were six safety-related projects costing \$2,065,580. Four were for highway-railroad crossing signals or improvement at a cost of \$26,660. One project was for sign upgrading on an Interstate route at \$201,880 and one project, formerly TOPICS, widened an existing two lanes to five lanes at a cost of \$1,837,040.

Mnm Nonmotorized Vehicle Facility - This program involves construction, usually adjacent to highways, for pedestrians and bicycles. However, during fiscal 1975, one project involved providing a paved shoulder in the vicinity of the National Music Camp at Interlochen, which has been the subject of concern for several years about a conflict between vehicles and pedestrians on the highway. The project cost was \$47,210.

Msh Shoulder Edge Treatment - This program provides a three-foot bituminous edge strip along the right-hand edge of State highways. It is aimed at preventing the formation of an edge drop between the pavement and adjacent shoulder material. An edge line is provided along the edge of the regular pavement to prevent regular usage of the added width. During fiscal 1975 there were eight projects involving 67.2 miles at a cost of \$449,320.

Mcp Minor Construction - This program involves the implementation of projects by maintenance forces. This is "Yellow Book" work performed on State highways, mostly nonfreeways. The type of safety-related work includes: grading for elimination of guardrail; providing clear vision or eliminating a snow-drift problem; upgrading obsolete type guardrail, extending to current standards and placing end cushions; culverts - extending, placing flared ends and removing headwalls; miscellaneous - tree removals.

During fiscal 1975 there was a total of \$954,200 expended in this program.

Skidproofing Projects

The projects contained within this category are reported within several other programs in this report, as follows:

	<u>No. of Projects or Locations</u>	<u>Cost</u>
Interstate Safety (Is)	2	78,550
Ms Funds	3	166,200
Mb Funds	10	715,620
TOPICS Funds	5	320,660
Section 209 Funds	<u>4</u>	<u>186,220</u>
	24 Total	1,467,250

In Michigan the Skidproofing Program is administered by the Traffic and Safety Division of the Department of State Highways and Transportation in conjunction with the Testing and Research Division.

The Traffic and Safety Division has evolved a rigorous screening process for location identification. Computer printouts of state highway segments experiencing high numbers of accidents are reviewed and, in addition, referrals from other Department personnel and the public receive follow-up action.

Where a high percentage of wet accidents could be caused by low coefficients of friction, skid testing is ordered. This test is conducted by the Testing and Research Division.

When low coefficients are confirmed by such tests, an evaluation is made and a skidproofing treatment is determined, and the location is programmed for implementation by the Safety (Ms) Program, or by other Department programs.

In fiscal 1975, several projects originally programmed for correction by the Safety (Ms) Program were subsequently let to contract under the TOPICS and Federal Aid Section 209 High Hazard Programs. Several other locations were noted to be scheduled in the Mb Resurfacing Program, so that programming in the Safety (Ms) Program was not attempted to eliminate duplication of effort due to fund limitations of the Ms Program.

An evaluation of skidproofing projects undertaken in previous years indicates a very favorable cost benefit for this type of safety project. A study of 73 locations indicated the following:

Annual benefit from accident reduction \$645,000 per year.

Cost of Projects \$1,006,350.

<u>Skid Number</u>	<u>Percent Wet Accident Reduction Expected</u>
.20 & below	70%
.20 to .25	65%
.25 to .30	55%
.30 to .35	25%

Skid Testing

The equipment and record keeping necessitated by skid testing is administered by the Testing and Research Division of the Department of State Highways and Transportation.

The skid resistance measurements of pavements in several categories are tested annually. This list is arranged in order of priority.

1. High accident areas
2. Special requests
3. Experimental surfaces
4. New surfaces
5. Surfaces after five year's service
6. Surfaces after ten year's service
7. Special requests by local jurisdictions

Annual reports, summarizing skid test results have been published since 1961. Tests of high accident areas and special requests are reported immediately as results are processed. In addition, when a roadway appears slippery to the testing crew in their travels, tests are made, and low values, if measured, are immediately reported.

This year, in an effort to serve local jurisdictions with their lack of equipment and trained personnel, the Department has begun the testing of local roads and streets by request. In fiscal 1975, tests were conducted at 31 locations (29 intersections were included), serving 6 cities and 5 counties.

As this service gains experience, some indication will be apparent of the magnitude of the needs off the Highway System. Future decisions involving supplemental equipment or consultant services

depends on the number of requests and the ability of the Department to handle the testing.

The beginning requests, thus far have been within the ability of the existing organization.

"Yellow Book" Program

The Michigan Department of State Highways and Transportation is currently engaged in a program of implementing safety improvements to reduce hazards in the roadside environment. Some work is being done and has been done by Maintenance forces; but an increasing number of "Yellow Book" projects are being contracted through the State's regular construction bid letting process. During fiscal year 1974-75, 5 Interstate Safety (Is) projects specifically were for roadside obstacle corrections. This type of work was also included as part of 5 other projects.

On the non-Interstate Freeway System, there were 4 projects let to contract utilizing Section 210 Federal Safety Funding. These projects included 97.6 miles of freeway.

The number of projects let and their cost are included in the Interstate Safety (Is) and Section 210 of the Federal Aid Categorical Safety Programs.

Due to a concern over the hazard that exposed guardrail endings pose to impacting vehicles and the possibility of penetration into passenger compartments, the Department has begun a program to offset and blunt all guardrail endings on all state highways not on the Interstate System.

A survey of unprotected guardrail endings was begun in the winter of 1974-75 and is continuing. Of the State's 83 counties, 33 have been surveyed to date.

It is planned to perform the required work by State and local contract forces. During fiscal year 1975 work authorizations

totaling \$146,655 were issued. Funds totaling \$1,850,000 have been allocated for fiscal year 1976.

Interstate Freeways - "Yellow Book" Status

The following is the overall status of items of work concerning the safety of roadside obstacles on the 1,062 miles of Interstate routes open to traffic. Twelve percent (143 miles) of the system is built to sufficiently high standards such that "Yellow Book" work is not considered necessary.

Of the remaining mileage (919 miles):

1. Twenty percent (181 miles) has been recently reconstructed or is presently under contract and will be considered up to standards when completed.
2. Thirteen percent (120 miles) has had "Yellow Book" work partially completed or underway with further contract lettings necessary to be considered up to standards. The majority of this work is being done by State or contract forces. The remaining work is either under design (70 miles) or awaiting recommendations to begin design (50 miles).
3. Forty-seven percent (430 miles) is programmed and is presently being designed.
4. Twenty percent (188 miles) is awaiting recommendations so that projects may be programmed and designed. Fifty miles of this total has work partially completed (item 2 above).

Impact Attenuators

During fiscal 1975 the Michigan Department of State Highways and Transportation's Traffic and Safety Division recommended the addition of 39 impact attenuators to Interstate Safety (Is) or Michigan freeway projects that were either let to formal contract or completed by force account. Hi-Dro Cell attenuators were installed at 32 locations with the remaining 7 locations receiving Fitch Barrel attenuators.

Additionally, 11 Hi-Dro Cells and 1 Fitch Barrel attenuators were installed as part of the Federally funded Section 210 Roadside Obstacles Elimination Program.

The average cost per Hi-Dro Cell installation is \$28,000 while the average cost per Fitch Barrel installation is \$5,000. Therefore, a total of \$1,264,000 (\$1,204,000 for Hi-Dro Cell installations and \$60,000 for Fitch Barrel installations) was authorized during fiscal 1975.

During the period of 1970 through 1973 impact attenuators were installed at 28 locations with 17 being Hi-Dro Cells and the remaining 11 being Fitch Barrels.

To determine locations where impact attenuators are recommended, an initial request was made to all District Traffic and Safety Engineers to submit a list of locations where it appeared that impact attenuators could be utilized. Priorities were then assigned based on accident histories and accident potential. Since the initial survey, there is a standing request that further locations be submitted as observed to pick up omissions and new locations to keep the list current.

Priorities are then assigned with the highest assigned on the basis of accident history followed by consideration of fixed objects located in target position and in areas containing points of decision.

Design standards of impact attenuator installations closely follow those of the manufacturer to determine the numbers of cells, the dimensions and details required to meet a deceleration rate which does not exceed 6 to 8 times the force of gravity based on a specified design speed according to the class of highway. The standards also provide for the elimination of barrier-type curbs in the path of a flat approach angle.

Traffic Engineering Services for Cities and Counties (402 funds)

The Traffic Engineering Services Program involves a traffic accident analysis of high accident locations on city or county streets and an inventory and analysis of traffic control devices on local agencies roads. This program is funded by Federal funds by a grant from the Office of Highway Safety Planning, Department of State Police. The objectives of this program are:

1. To improve highway safety on all Michigan streets and roads by accurately determining high accident locations on county and city streets and roads and making subsequent recommendations to improve conditions at these locations.
2. To determine to what degree traffic control devices on city and county roads meet the national standards for uniformity and adequacy, and to assist cities and counties in estimating what must be done to upgrade these traffic control devices in order to meet the national standards, and to help locals prepare their inventories so that they are eligible to receive 230 funds for purchasing signs.
3. To provide a program of traffic engineering expertise for all political subdivisions. This would be accomplished by providing the political entities with consulting services.
4. To stimulate interest and awareness on the part of local governmental agencies to the extent they will upgrade their traffic control devices.

This project has been ongoing since July 1, 1972. During this period, extensive work has been done in determining high accident

locations in cities and counties, analyzing the problems and providing traffic engineering recommendations designed to alleviate these problems. Concurrently, work has been ongoing to inventory the road network of cities and counties to determine if the traffic control devices on the local road system meet the standards as set forth in the Manual of Uniform Traffic Control Devices.

Previous work activities have resulted in the completion of traffic control devices inventories for 43 counties and 11 cities or villages. In terms of mileage this means that 13,243 miles of the 25,552 miles of county primary roads throughout the state have been inventoried. We have also completed traffic engineering analysis of high accident locations for 12 cities and 19 counties. More than 526 locations were thoroughly field checked and the accident experience analyzed during the process of completing reports for these cities and counties.

To achieve uniformity in the upgrading of traffic control devices, Department personnel are conducting a program to train personnel in local jurisdictions to conduct field inventories on their respective highway system. Initially the instruction will be on an individual basis, that is, county-by-county, or city-by-city. These training sessions are two days in length and will take place at the local's home office. The first stage of the training is a one day course in familiarizing agency personnel with the Michigan Manual of Uniform Traffic Control Devices and a briefing on the proper materials and procedures to be used in inventorying traffic control devices.

The second stage of the training involves an actual inventorying of 10 to 20 miles of local roads by agency personnel under the supervision of Department of State Highways and Transportation personnel.

As requests for assistance increase the Department plans to use instructional seminars as the primary method of training local personnel in the technicalities of conducting inventories of traffic control devices. In these instructional seminars it is planned to utilize photolog film projectors as a teaching aid. In addition, Department personnel act as consultants in providing technical assistance to the local governmental agencies and review completed inventories by spot checks.

The local governmental personnel receiving the aforementioned training are also apprised of the types of funding available for implementing necessary re-signing revealed by their inventories.

The Department plans to continue the identification of high accident locations. In addition, program personnel plan to identify and analyze hazardous locations by entire routes within a county or city. We believe that this system approach to accident analysis will enable a better identification of areas of accident potential which has not always been done. It will enable us to identify roadside hazards and road alignment problems, and more importantly, it will enable us to better mesh our program with the available Federal programs, especially the five categorical sections of the Highway Safety Act of 1973.

The Office of Highway Safety Planning administers the 402 Program in Michigan. This office places emphasis on program areas having the greatest potential for impacting the traffic crash program. The Federal funds are divided into two areas - standards administered by the National Highway Traffic Safety Association (NHTSA) and those administered by FHWA. The Federal funds available for obligation in most recent years are:

	FHWA (3+ Standards)	NHTSA (14+ Standards)
1974-75	\$687,000	\$3,345,000
1975-76	\$979,000	\$3,314,000

In the traffic engineering standard area, programs receiving the most emphasis include the Michigan Accident Location Index (MALI).

Currently this system is operational in one county and plans are that it will be operational in all 83 counties within the next five years. This automated system will permit the identification of problem locations and analysis of factors contributing to crash occurrence at these sites.

Other areas of emphasis within the 3+ standards are traffic control device inventories, both manual and computerized; traffic engineering seminars and studies of high accident locations which can be corrected with funds available through the Highway Safety Act of 1973.

Michigan Accident Location Index (MALI)

The Michigan Departments of State Police and State Highways and Transportation have jointly completed a proposal for implementation of a computerized accident location reference system for all highways in the state. This system, commonly referred to as MALI (Michigan Accident Location Index), is currently scheduled for implementation on all public roads within the state over a six-year period at an estimated cost of \$3,530,600. Both departments are currently funded to implement this project through separate Federal safety grants administered by the Office of Highway Safety Planning. The estimated cost to operate the statewide system on a continuing basis, following the six-year implementation period, is \$460,000 per year.

The current goal is to have MALI operational on all state highways by January 1, 1976 and on all roads and streets in six additional counties by July 1, 1976.

The purpose of this system is to identify hazardous locations on all highways and streets, forming the basis for finding and establishing priorities for safety improvement projects, selective enforcement areas, and other operational practices that will impact on the state's accident experience.

Photologging

Photologging is a project of the Michigan Department of State Highways and Transportation funded jointly with the Office of Highway Safety, Planning. It provides engineers with a collection of visual information of the roadway for the entire state highway system and is planned to be updated continuously on a two-year cycle. The program is unique in that the information is presented pictorially to the engineer as he would observe it from a driver's vantage point during a field investigation.

The photolog consists of reels of individual 35mm color photographs projected to rear or forward screens taken every one-hundredth of a mile (52.8 feet) in each direction of travel for the 9,250-mile trunkline system. Each photograph has a digital legend identifying the route or section of highway (control section number), the direction of travel (+ or -) and the mileage location to one-hundredth of a mile, which corresponds with the present Department data file of other vital roadway information. A calibrated grid may be placed over each photograph to obtain measurements of location and distance from the road centerline.

The completed project resulted in 354 reels of film averaging approximately 39 reels of film in each of the districts. There will be approximately 26 miles of roadway on each reel of film to be filed by county and route number for easy retrieval. Each district office is being supplied with a filmed record of trunklines for their respective district and each has appropriate projection equipment. The Highways Building in Lansing is supplied with a complete record of

all state highways for use by various divisions within the Department. Photographing was completed in June, 1975. The work to refilm the highway system has begun in our Saginaw District (1,338 trunkline miles).

The photolog system gives a visual inventory of all roadway features and appurtenances allowing for the investigation of specific locations or sections of roadway to be done in the office; thereby obviating the need for making field inspections in many instances. It thus provides an easy and inexpensive method of obtaining technical and detailed information as well as serving as a permanent record of the roadway at a given date. Some examples of photolog use are an up-to-date inventory of traffic control devices, geometric design features, driveway details and pavement conditions.

The photolog system has been used extensively by Department personnel for the study of high accident locations, operational problem locations, traffic control devices, guardrail adequacy, roadside obstacles and environmental conditions.