FOURTH ANNUAL REPORT

OF

MICHIGAN'S OVERALL HIGHWAY SAFETY IMPROVEMENT PROGRAM

August 31, 1977

MICHIGAN DEPARTMENT
OF
STATE HIGHWAYS AND TRANSPORTATION

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 fourth annual report on Michigan's overall highway safety improvement program. Previous reports discussed in depth the various types of improvements, described surveillance techniques for locating and prioritizing project candidates, and detailed previous annual safety improvement programs. It has become apparent that highway safety is a massive and complex subject. The management of a program with the ultimate goal of ensuring highway safety is a long-term effort involving the evaluation of accident related data by trained manpower and the allocation of funds to implement proposed recommendations.

This year's report is intended to stand by itself in relation to previous year's reports. We have reviewed our entire safety program and provided evaluations of those programs where projects have been completed for at least one year. Our evaluation is not as extensive as we had planned because many projects are either in the construction stages or have been completed for less than the required 1-year-after period. We understand the importance of our evaluations in determining where future federal dollars can be spent cost-effectively.

The first part of the report includes a review of the types of projects and expenditures for our Categorical Safety Program. We have also included an evaluation of projects completed under these programs. It should be noted that the Rail-Highway Crossing Program and the Pavement Marking Demonstration Program do not lend themselves well to an evaluation

based on before-and-after accident totals where a favorable cost-benefit ratio is expected due to accident reductions. Before-and-after accident totals for these programs are so small that evaluations become statistically unreliable. Locations for the Rail-Highway Program were selected based on deficiencies in signals, signing and pavement markings at crossings, which could create a potential hazard for motorists. The intention of the Pavement Marking Demonstration Program was to mark those roads which had never been marked before to better define the roadway at night and during inclement weather. Even though evaluations of before-and-after accident data for these two programs may at this time be of limited value, we have reported accident data where it was available because it may be useful when combined with accident totals from other states.

The second part of the report includes an overview of our Michigan Safety (Ms) Program. This year we have also included an evaluation of eight projects completed under this program at a cost of $2.6 million. The accident data for the 2-year-after period showed a reduction in both fatality and injury accidents even though the after exposure was greater due to increased miles traveled.

During the past year there has been a great deal of activity surrounding many of our other safety-related projects. Within the Interstate Safety Program we have developed a prioritization procedure for ranking and selecting project candidates. This system will provide justification when applying for federal funding to complete interstate safety projects. In our Traffic Engineering Services Program, 85 spot locations were analyzed last year on the local road system. We have included an

evaluation of six projects completed under this program which showed a 43 percent reduction in accidents. The Michigan Accident Location Index (MALI) project is currently operational on the state trunkline system in 81 counties and on the local road system in nine counties. A consultant has been awarded a contract through the Michigan Department of State Highways and Transportation to complete the MALI street index for the local road system during the next two years. The MALI project will continue to be funded with 402 federal dollars through the Michigan Office of Highway Safety Planning.

One of the new sections in this year's report entitled New Developments in Highway Safety discusses the Michigan Dimensional Accident Surveillance Model (MIDAS). This model will analyze abnormal accident patterns, examine feasible corrective treatments including costs and expected accident reductions and select the most cost-effective alternative within the constraints of a fixed budget. When completed, it is likely this model will revolutionize accident surveillance and analysis systems in the United States.

The Michigan Department of State Highways and Transportation has established an overall prioritized safety program. This program establishes both the immediate and long range goals of the department relating to safety. We have included a status of the projects in this program and also a summary of the total safety expenditures in Michigan for fiscal year 1976-77.

The information found in this report relating to the number of projects and expenditures for fiscal 1977 refers to the time period from July 1, 1976 to June 30, 1977.

Michigan's Overall Prioritized Safety Program

1. Interstate Freeway System

   A. Continue present "Yellow Book" program on the interstate system.

      To date, 61 percent of this program has been completed, while 20 percent has been programmed and is in the design stage and 19 percent is either unprogrammed or inactive.

   B. Develop and implement improved interstate safety spot improvement program based upon accident data to provide cost-beneficial expenditures (priority ranking of interchanges).

      The Michigan Department of State Highways and Transportation has developed the Michigan Dimensional Accident Surveillance Model (MIDAS) which will analyze abnormal accident patterns, examine feasible corrective treatments including costs and expected accident reductions and select the most cost-effective alternative within the constraints of a fixed budget. Stage I of this model is complete. Stages II and III will be completed during the next fiscal year so that the total model will be operational.

   C. Develop and implement program sensitive to ran off roadway accidents to allow cost-beneficial expenditures using interstate funding.

When the development of the MIDAS model is completed, implementation of programs of this type will begin.

2. Noninterstate Freeway System

A. Develop and implement improved Michigan Safety (Ms) spot improvement program based upon accident data.

Now that the Michigan Accident Location Index (MALI) is nearing completion on the state trunkline system and Stage I of the MIDAS model is completed, the department is now in a position to improve the effectiveness of the Ms program. For instance, MALI is now providing a high ranking list of locations according to type of accidents to focus on concentration of correctable accident patterns.

B. Develop and implement a program sensitive to ran off roadway accident data using available funding. See response to 1C.

C. Complete "Yellow Book" work with available funds other than Ms.

To date, 174 miles or 33 percent of the total noninterstate freeway mileage has either been completed or obligated.

3. Free Access Trunkline System

A. Develop and implement improved Michigan Safety Spot Improvement Program based upon accident data. See response to objective 2A.

B. Insert greater safety awareness into MCP (minor construction program).

This is a continuous activity and has been implemented as a result of coordinating efforts of a departmentwide highway safety steering committee.

C. "Yellow Book" work (Roadside Safety Improvement Program).

a. Perform Task 1 on the free access trunkline system. Task 1 includes the installation of buffered-end sections to eliminate straight guardrail endings.

Work authorizations have been issued on all noninterstate trunklines to install buffered-end sections. The work is being completed by state forces and local contract agencies and is 20 percent completed.

b. Perform Task 2 on the free access state trunkline system. Task 2 includes upgrading guardrails attached to structures, replacement of inadequate structure railings, or retrofitting guardrails to the existing railing system.

A 10-year program is currently being developed for Task 2 work. This program will be contingent on available funds. It is estimated that the total cost of this program will be $15,000,000. This type of work is currently being included with structure deck resurfacing and repair projects.

c. Perform Task 3 on free access state trunkline system. Task 3 includes complete improvement of the roadside to current "Yellow Book" standards. This work is to be completed with available funds other than Ms.

Due to lack of funds, specific Task 3 programs have not been initiated. However, guardrail modernization work is currently being included with road resurfacing projects on a limited basis.

4. Nontrunkline

A. Support the rapid development of the Michigan Accident Location Index (MALI).

The MALI project is currently operational on the state trunkline system in 81 counties and on the local road system in nine counties. The MALI project on the remainder of the trunkline system will be operational by November, 1977, while the remainder of the local road system will be completed by a consultant who began work on August 10, 1977, and will complete the project in two years.

B. Develop and implement spot accident improvement program utilizing available funds.

The Traffic Engineering Services program provides the capability of identifying, analyzing, and correcting problem accident locations on the local road system. During fiscal 1977, eighty-five spot locations in 20 different local jurisdictions were reviewed and analyzed resulting in remedial recommendations at 45 locations. The completion of the MALI project on the local system will increase the effectiveness of this program.

C. Develop and implement ran-off-roadway accident program utilizing available federal funds.

A program aimed at the ran-off-roadway problem will not begin until the completion of the MALI project on the local road system.

D. Encourage the development of local awareness and expertise in highway safety activities.

Traffic safety seminars have been offered both on the beginning and advanced level by both Wayne State and Michigan State University to local officials responsible for highway safety in their community. In addition, a new course is being developed to serve the needs of graduate engineers starting a career in traffic engineering.

PROGRAM SUMMARY
FISCAL YEAR 1976-77

		Total Costs
FEDERAL CATEGORICAL SAFETY FUNDS-OBLIGATED		
Rail-Highway Crossings		$ 3,411,800
Pavement Marking Demonstration Program		1,287,602
High Hazard Obstacle		2,082,000
Safer Off-System Safety		6,369,466
Special Bridge Replacement		1,276,000
Transitional Quarter Funds		21,420,564
	Total	$ 35,847,432
OTHER FEDERAL FUNDS		
Interstate Safety (Is)		5,432,000
Yellow Book Program		16,271,000
Urban Programs		21,000,000
Federal Aid Primary Program		1,967,000
Federal Aid Secondary Program (includes Off System)		3,262,000
	Total	$ 47,932,000
STATE FUNDED SAFETY PROJECTS		
Ms - safety program		6,440,255
OTHER STATE FUNDED PROJECTS (Safety Items Only)		
Mb - bituminous resurfacing		$ 1,849,000
Mbr - bituminous reconstruction		1,228,000
M - miscellaneous construction		5,890,000
Mnm - nonmotorized vehicle facility		1,344,853
Msh - shoulder edge treatment		1,978,000
Mbd - bridge deck		372,000
	Total	$ 12,661,853
SPECIAL PROJECTS		
Impact Attenuators		$ 1,710,000
STATE-LOCAL MATCHING MONIES		11,033,419
	Total Safety Expenditures	$115,624,959

SECTION 1

THE 1973 AND 1976

HIGHWAY SAFETY ACT IN MICHIGAN

PART 1

CATEGORICAL SAFETY PROGRAM

FISCAL YEAR 1976 - 77

The 1973 and 1976 Highway Safety Acts in Michigan

Introduction

The transition from the 1973 Highway Safety Act (HSA) to the 1976 Act was made in Michigan with some minor problems encountered in obligating federal funds.

The 1976 fiscal year was extended one quarter from July 1 to September 30, 1976, to allow for the change to an October 1 to September 30 fiscal year. This change was made so that the state's fiscal year would correspond with the federal fiscal year. This fifth quarter or transition quarter had a definite effect on the status of the current federally funded fiscal year safety program. Several projects within this program, ready for formal contract letting, were financed with Transition Quarter (T.Q.) funds.

The current fiscal year witnessed the total obligation of 1973 HSA monies in two of five categories within the Categorical Safety Program and the expenditure of 1976 HSA monies in all categories. The 1976 HSA combined Sections 209 and 210 (High Hazard and Roadside Obstacle) into one category called High Hazard Obstacle. Another change was the elimination of the Section 230 Safer Roads Demonstration (SRS) program and its replacement by the Safer Off-System (SOS) program. This later change has severely reduced the small municipality's chance of realizing a safety project except for sign upgrading because this program has been linked to federally recognized urban areas by the 70-30 funding. Funds have been divided amoung governmental jurisdictions, such as cities and

counties. Further division of funds to provide monies for small municipalities, would make each share so small that a single agency could not accomplish much with it.

The administrative responsibility for the categorical safety subprograms in the 1976 Highway Safety Act is assigned to the Michigan Department of State Highways and Transportation's Local Government and Traffic and Safety Divisions. The Local Government Division processes most of the requests that originate for off-trunkline projects while the Traffic and Safety Division processes all trunkline projects and some requests for off-trunkline projects through the division's Community Assistance Program. The Michigan Office of Highway Safety Planning, and the Michigan Department of State Police act in advisory capacities. The department has obligated through the Categorical Safety Programs a total of $45,767,684 since enactment of the 1973 HSA of which the current fiscal year's total is $14,426,868.

Following is a more detailed discussion of each categorical program with an evaluation of completed projects.

Rail-Highway Crossings

This section of the categorical safety program is jointly administered by the department's Local Government Division and the Bureau of Highways' railroad contact engineer. Projects on the state trunkline system are administered entirely by the railroad contact engineer. The safety of all rail-highway crossings is the shared responsibility of the department's Railroad Safety Unit, the railroads, and the local highway authorities.

The Rail-Highway Crossing Improvement Program for fiscal year 1977 completed the programming and obligation of 1973 Highway Safety Act monies and programmed and obligated $1,373,018 of 1976 HSA monies. A total of 41 new projects (23 trunkline, 18 local) have been programmed at an estimated cost of $3,411,800 of which $3,070,620 are federal funds. Since enactment of the 1973 HSA, the department has obligated a total of $7.3 million for 88 projects.

The type and size of projects have varied considerably. The smallest project cost less than $2,000 for signing an individual crossing to $320,000 for upgrading a crossing which consisted of crossing and approach work, flashing signals with cantilevers, 1/2 gates, pavement markings, and advance warning signs.

The department let to contract on June 15, 1977, three projects for thermoplastic pavement markings for bituminous surfaced at-grade railroad crossings on the state trunkline system. Collectively the three contracts called for painting the RR symbols, transverse bars, and stop bars (over

1,000 individual lane markings) at 379 rail-highway at-grade crossings. The number of crossings marked represents 65.8 percent of the active at-grade crossings (576) on the state trunkline system.

Evaluation data for Section 203 projects completed during the 1974 calendar year is shown on page 1-23. The data is based on a 24-month before-and-after period. For purposes of simplicity, we used 1972-73 as the before period and 1975-76 as the after period and discarded all accidents that occurred during the construction year. As is the case in most instances, we have very few accidents in either period and only one car-train accident. An evaluation based solely on accident data will not show the projects as being cost effective as the selection of projects is keyed to signing, signals, and other factors as indicated by the railroad priority determination on page 1-26.

Railroad crossings which did not have warning signs or had substandard signs were given top priority. In this regard the national inventory shows if the signing is in place or not; but does not reference substandard signing. This inventory has not been completely accurate as it indicates crossings without signing when the signing was in place. A check made by the department found that all the crossings noted in the inventory as not having signs were in fact, signed.

The criteria used in the railroad priority determination sheet on page 1-26 does not consider accidents that may have occurred. However accident potential is considered in the charts, found on pages 1-27 through 1-29, for the various types of crossing protection. These charts provide an exposure factor for the crossing based on vehicular traffic versus the

type of protection present with the resultant answer being expressed as probable vehicle-train accidents annually. We anticipate computerization of both the data contained in the accident potential charts and the priority determination sheet plus actual accident data. Through the analysis capabilities of the computer program a more meaningful priority assignment can be determined.

Pavement Marking Demonstration Program

The administrative responsibility for this program belongs to this department's Local Government Division with the Traffic and Safety Division acting in an advisory capacity.

A 4-item pavement marking program has received wide acceptance in Michigan. The first item, identification of no passing zones based on criteria in the Michigan Manual of Uniform Traffic Control Devices, has had participation by 79 of Michigan's 83 counties, which is 95 percent. Item 2, the initial placement of pavement markings, has had participation by 70 counties or 84 percent. Item 3, placement of pavement markings for at-grade railroad crossings, was completed using PMS funds as part of Item 2 for local streets and roads for simplicity of bookkeeping. Section 203 Rail-Highway Crossing funds were used for thermoplastic pavement marking of at-grade railroad crossings on the state's trunkline system as mentioned on pages 1-3 and 1-4. Item 4, renewal of previously painted roadways, has received considerable participation. As of June 30, 1977, a total of 41 counties had requested renewal paintings. This represents 59 percent of those counties previously expending funds under Item 2.

When this program started in 1974, under the 1973 HSA, high priority was given to marking all unmarked 2-lane rural highways and all no passing zones on roads and streets under local (county) authority. Pavement marking standards in the Michigan Manual of Uniform Traffic Control Devices 1973 edition (MMUTCD) were followed in addition to standards

developed by the U.S. Department of Transportation which are emphasized in Volume 6, Chapter 8, Section 3, Subsection 5, of the Federal Aid Highway Program Manual.

According to federal standards, centerline markings were to be applied on all paved roadways 16 feet wide or wider that carried an average of 250 or more vehicles per day. The MMUTCD adds to the pavement width requirement that a prevailing speed of greater than 35 mph must also exist. The federal standards for edgeline marking, which required a paved surface 20 feet or wider with an ADT of 250 or more vehicles, were followed. All routes marked were chosen by the local authorities based on the above-mentioned criteria. They also determined the priorities for pavement marking within their jurisdictions.

By June 30, 1977, a total of $5,846,461 in Federal Aid Section 205 Safety Funds had been obligated, $1,287,602 during fiscal year 1977. The total amount expended represents $5,012,976 (100%) of the 1973 HSA apportionment plus $833,485 of 1976 HSA monies.

It is evident that this program's acceptance by local authorities speaks for further continuation and/or expansion to include small urban areas not presently allowed pavement marking projects. To further substantiate this, an evaluation of two initial pavement marking projects completed in 1975 is found on page 1-23. It should be noted that this evaluation is based solely on the number and severity of accidents in the before-and-after periods and an exposure factor based on an ADT x time accumulative. We have not completed an evaluation of this program based on accident types. It is our goal that such an in-depth evaluation will be completed within the next year.

Form Approved
OMB 04-R3665

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

PAVEMENT MARKING PROGRAM

Placement of Markings During FY _____	Miles & Cost by System								Total Miles and Cost During FY 77		Total Miles and Cost To Date	
	Federal-Aid System				Off The Federal-Aid System							
	Primary		Secondary		State Jurisdiction		Local Jurisdiction					
	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost (000)
Both centerlines and edge lines			7918	704702			3083	274387	11001	979089	12544	1438.4
Only centerlines			4532	139132			1828	56120	6360	195252	10615	678.2
Only edge lines			1006	76707			388	29585	1394	106292	2351	276.3
Total			13456	920541			5299	360092	18755	*1280633	25510	*3623000

Total Miles Remaining to be Marked

*Does not include special pavement marking or surveys

Placement of Markings	Miles by System				
	Federal-Aid System		Off The Federal-Aid System		
	Primary	Secondary	State	Local	Total
Both centerlines and edge lines		785		1975	2760
Only centerlines		351		1383	1734
Only edge lines		98		256	354
Total		1234		3614	4848

Form FHWA 1451
(1-74)

High Hazard Obstacle/Roadside Obstacle

Administrative responsibilities for this program have been divided between the department's Local Government and Traffic and Safety Divisions. The Local Government Division has responsibility for locations that are off the state's trunkline system with the Traffic and Safety Division acting in an advisory capacity. Administrative and engineering responsibility for locations on the state's trunkline system belongs to the Traffic and Safety Division.

Several factors should be considered when evaluating the required accident justification necessary to gain project approval for federal funds. Michigan has 531 cities and villages which have jurisdiction over more than 18,500 miles of roads and streets. Additionally, there are 83 county road commissions with over 88,000 miles of primary and local roads under their jurisdictions. Each local jurisdiction has what they consider to be high accident locations that should be eligible for federal safety funds. We have reviewed project requests submitted by local agencies at locations which average three to five accidents annually. Projects at these locations are rarely approved because the recommended improvements are not justified based on a cost-benefit analysis. Several requests have been received for signal upgradings that fall in this category. Since they are on the federal aid system and have to be accident justified and cost beneficial, we cannot approve them. This requirement will have to be reviewed and possibly altered if all traffic control devices are to be in compliance with the MMUTCD by 1981.

In order to obtain viable projects which qualify for federal funding on city and county levels, our Community Assistance Subunit, which is funded by 402 funds, has developed a letter and a handout sheet. The letter (page 3-14) has been sent to local agencies to explain the available traffic engineering services and to request their participation. The hand-out sheet (page 3-15) was designed to assist local agencies when submitting candidate locations for federal safety high hazard funding by showing them the data required for FHWA project approval. Local jurisdictions have not yet seen this handout sheet but we anticipate providing this information to them through the Community Assistance Subunit in the near future. A MDSHT Local Government engineer in each district office has been appointed to specifically assist local agencies in implementing federally funded safety projects.

Enactment of the 1973 Highway Safety Act provided the states with an impetus to direct their efforts toward reducing accidents at hazardous locations. Michigan, in 1974, programmed 28 projects within the HHS/ROS programs, 20 of which were state trunkline locations. The estimated cost of these projects was $3 million. During 1975 we obligated $8.7 million, for 36 projects and a 2-year total obligation of $9.3 million. By June 30, 1976, we had obligated over $13.2 million. This represented 91.3 percent of the allocated ($14,440,301) 1973 HSA monies. A total of 72 projects had been identified as high accident locations, 40 of which were on the state trunkline system. With this year's obligation of $2,082,000, our total obligation since 1974 is $15.3 million of the total allocation of $19.2 million for the combined 1973 and 1976 HSA.

Local jurisdiction have not been submitting projects for roadside obstacle removal. This, we believe, is due to the legal action taken in the Grand Rapids Federal Court. This legal action has required the state to hire an outside firm to develop an environmental impact statement that will satisfy the public action groups and allow obstacles identified as being hazardous in well defined areas to be removed. We have not yet received such an E.I.S. As of June 30, 1977, the only roadside obstacle removal project obligated on a local road system was for guardrail removal and culvert extensions in Kent County. The cost of that project was $150,000.

The enactment of the 1976 HSA combined Sections 209 and 210 of the 1973 HSA into one fund or category with a 1977 fiscal year appropriation of $4,790,000. As of June 30, 1977, we had obligated $699,000 of the $1,169,038 remaining from the 1973 HSA HHS/ROS funds plus $1,383,000 of the 1976 HSA appropriation. We do, however retain a small percentage of monies in each of the two categories to cover possible overruns. Our total obligated amount for the period from July 1, 1976, to June 30, 1977, is $2,082,000. This total could have exceeded the fiscal appropriation by a considerable margin as another $21 million of qualified projects were let to contract using Transitional Quarter (TQ) funds.

Project selection for HHS/ROS trunkline locations and Michigan's Safety (Ms) improvements is both the most important and most difficult phase of the program. Emphasis is, of course, placed on attempting to ensure the highest possible return for the money expended. There is, however, a recognition that a problem's magnitude is related to the geographical area in which it occurs. The cost of completing similar improvements varies widely depending on the need to acquire new right-of-way or on

problems related to drainage and soil considerations and maintaining traffic flow during construction. Certain locations, which are recognized as being deficient with regard to capacity and safety, sometimes defy attempts to develop practical and economical plans for improvement.

Factors taken into account in the screening process for spot improvements, not necessarily in order of importance, are as follows:

A. Number and severity of accidents.

B. Presence of "correctable patterns" and reoccurring patterns.

C. Practicality - potential for improvement, size of project, consideration of potential right-of-way and/or drainage problems, and necessity of securing participation from municipalities.

D. Operational considerations such as increased capacity, providing for left and right turns, roadside control, and removal of obvious "bottlenecks."

E. Area factors - potential growth, traffic generators, and uniformity of treatment within a route.

F. Consideration is given to expanding an intersection to its "ultimate cross section" in selecting appropriate treatment and project limits.

G. Operational changes rather than reconstruction, such as signs, signals, or pavement markings.

State trunkline locations for consideration as safety projects come from basically three sources, which are:

1. Listing of high accident locations by 0.2 mile increments from accident data printout.
2. District traffic and safety engineer suggestions/public complaints reflecting everyday field observations.
3. Surveillance team field observations.

Upon receipt of suggestions regarding the need for improvements at a location, a preliminary office review is initiated. This starts with a comparison of suggested locations against other department improvement programs to determine if any of the locations will be improved by major trunkline projects within the near future. Those locations contained within the limits of such a project are further checked to determine if the proposed improvements have potential to reduce accidents. If information received indicates that a spot location will be satisfactorily improved within a reasonable length of time, then the location is dropped from further project consideration. Our accident analysis system will, however, continue to monitor the location to determine if further difficulties appear.

Location files for those locations not eliminated due to inclusion in other programs, are reviewed for recent and pertinent data on volumes, turning movements, previous improvements, and accident diagrams. If such data is missing, then studies are ordered or steps are taken to renew the data.

Locations within a district having adequate background data are accumulated and preliminary review is held with the district traffic and safety engineer to determine which locations have potential for accident reduction and to discuss other problems associated with the location, such as:

parking removal, traffic control, right-of-way, and the character of immediate and adjacent areas (business development, downtown areas, adjacent signal operation, and progression, etc.).

Those locations determined to have a potential for corrective action are scheduled for an on-site multidisciplinary review by traffic and safety engineers specializing in signing, signals, geometrics, and surveillance in company with the district traffic and safety engineer. Each location is reviewed independently and a consensus developed as to the corrective measures needed. Cost benefit analysis then determines the most cost-effective corrective treatment.

At those locations in need of geometric revision, a functional scheme and cost estimate is prepared. Priorities are then established from which design and letting schedules are set. The majority of projects are placed under contract in about one year after programming; however, those involving right-of-way or presenting engineering difficulties may take longer.

There are some problems within both the high hazard and roadside obstacle removal areas. The priority ranking system requirement of these programs has been difficult to achieve without local road accident location system. This problem will remain until the Michigan Accident Location Index (MALI) is totally operational on a statewide basis. Our current schedule indicates that 1980 will be the first year all statewide accident data becomes available. This will increase our flexibility in determining high accident locations on the local systems as accident patterns will become more evident. We anticipate that local agenices will also participate

more in the federal safety programs when this data becomes available to them. We can only speculate as to why more projects are not being submitted by local agencies. It could be fiscal constraints or the lack of manpower to hand search sufficient data for justification or even a genuine desire not to get involved in the red tape required in obtaining federal funding.

Roadside obstacle removal projects on the state's freeway system has not been a problem. This system was given top priority for correction because of large volumes of traffic. We anticipate that the completion of MALI used in conjunction with our MIDAS program will provide those tools needed to develop a schedule for the elimination of roadside obstacles.

Safer Off-Systems Program

This section of the categorical safety program replaces Section 230 of the 1973 H.S.A. but continues the provision of monies for safety improvements for roads and streets off the federal aid system. The administrative duties are with the department's Local Government Division. The Traffic and Safety Division provides traffic engineering consultation on an as-needed basis. Project types include, but are not limited too, sign and signal upgradings, rail-highway crossing improvements, geometric improvements, treatment at narrow bridges, and obstacle removal.

A total of 3,525,000 or 53.4 percent of the appropriated $6,601,197 for fiscal 1977 was disbursed among Michigan's 83 counties based on their area, road mileage, and population densities outside of federally recognized urban areas. These allocations ranged from a low of $14,628 for Keweenaw County to a high of $75,433 for Oakland County. Cities and villages not included in either federally recognized urban or rural areas have $435,000 or 6.6 percent earmarked for their use. This amount is based on population and mileage. However, projects will be selected on a statewide basis with special emphasis placed on sign upgrading.

Local agencies in the urban areas with populations between 5,000 and 50,000 have $264,597 available to them with special emphasis again placed on sign upgrading projects. Other urbanized areas have been assigned $2,376,600 based on a formula similar to the one under which Federal Aid Urban funds are distributed. The total allocated to urban areas is therefore $2,646,197 or 40 percent. However the $699,597 or

10.6 percent allocated to small urban areas with emphasis placed on sign upgrading projects does not allow enough monies for other types of justifiable projects that are eligible for funding under this program.

During the old fiscal 1977 $4,637,466 of the $4,912,155 remaining monies from the 1973 H.S.A. were obligated. Additionally, $1,732,000 (21 projects) of the 1976 H.S.A. Safer Off-System funds were obligated. Therefore the total off-system federal aid safety dollars obligated during fiscal 1977 was $6,369,466. Michigan did not receive the 1976 HSA Safer Off-System allocation of $6,601,197 until June, 1977, and this accounts for the low obligated amount.

We support the continuance of this program as this provides the monetary emphasis for improvements on local road systems. Considering that the state's trunkline system with the interstate system carries two-thirds of the traffic and has less than 28 percent of the accidents, there are numerous high accident locations on the local system to identify. When the MALI system does become totally operational in Michigan, identification of those locations will be greatly simplified. We anticipate considerable involvement in this program by local agencies at that time.

Special Bridge Replacement Program

Section 144 of Title 23 of the United States Code provides financial assistance to replace bridges over waterways or other topographical barriers that are considered significantly important and are unsafe because of structural deficiencies, physical deterioration or functional obsolescence. 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 based on the local agency's financial resources, importance of the bridge to the area, and the structural condition of the existing bridge. From 1972 through June 30, 1977, bridges representing $13,900,000 in Federal Aid funds have been obligated. Seven were obligated during fiscal 1977 at a cost of $1,267,000 which depletes the fiscal appropriation.

We currently have a backlog of approximately 350 structures to be improved. A typical improvement costs between $150,000 and $200,000 and occasionally exceeds $1,000,000. Additional funds required to improve all currently listed deficient structures, if available, would be approximately $60,000,000.

Transitional Quarter Funds

During the 1976 calendar year, Michigan extended the 1975-76 fiscal year from June 30, 1976, to September 30, 1976. This change made the state's fiscal year coincide with the federal fiscal year October 1, 1976, to September 30, 1977. The addition of a fifth quarter may benefit those who work on fiscal budgets but it further complicates this state's preparation of the required annual reports. Since this report is due at FHWA Division offices on or before August 31 of each calendar year, records have to be kept on two fiscal periods, July 1 to June 30 for the annual report and October 1 to September 30 for budgetary considerations. We strongly recommend that the due date for this report be changed to correspond with the new fiscal year, thereby eliminating the need for dual reporting systems.

This fifth or Transition Quarter (TQ) provided increased flexibility with respect to our safety efforts. Ten of the 19 projects financed with TQ funds were ready for formal contract letting within this program. One of these projects was a trunkline HHS project for $1,657,260 of federal funds. A total of 17 projects, all on trunkline, were of the Roadside Obstacle or Yellow Book type for $19,012,972. The other location was a trunkline Michigan Safety (Ms) project at a cost of $557,592. The total federal cost of all projects eligible for safety funding in the Transitional Quarter was $21,420,564.

Although introduction of the transition quarter may have created some administrative difficulties, the benefits far outweigh any difficulties encountered. The projects that were let to contract ranged

from a cost of $50,000 to over $8 million. The availability of TQ funds made it possible to expend a greater amount of funds for High Hazard Obstacle projects in a shorter period of time. This should maximize safety benefits to the traveling public.

SECTION 1

PART 2

EVALUATION DATA SUBMITTED FOR THE

CATEGORICAL SAFETY PROGRAM

Evaluation Data

The evaluation data on the following page is being submitted as a requirement of FHPM 6-8-2-1 on a format developed by the FHWA. Following is a brief discussion of those categorical safety programs that had projects completed during 1974 or 1975.

Rail-Highway - Except for the project on line 3 the before-and-after periods are 24 months long. The accident data indicated includes an area 400 feet on each side of the at-grade crossing. This program does not require accident justification. However, by using National Safety Council accident cost data and subtracting after-period accident costs ($92,000) from the before-period costs ($145,000) and dividing by 2, an annual benefit of $26,500 is indicated which would recover construction costs in less than 16 years.

Pavement Marking - The before-and-after periods are 12 months long. The accident data for this program should be analyzed in depth to determine possible changes in accident types rather than accident numbers. However, by going through the same process as mentioned above, an annual benefit of $355,000 is realized which would recover construction costs in less than five years. This constitutes a cost-effective program because it is less than the 10-year recovery rate suggested by the FHWA.

High Hazard - Four of the seven projects for which before-and-after data was collected are on the state's trunkline system. Since these projects are directed at a correctable reoccurring accident pattern, an in depth analysis will be completed. This will make everyone more aware of

possible accident pattern trade-offs that do occur with certain types of improvements. We know for instance that the installation of a traffic signal at an intersection will reduce right-angle type accidents but increase rear-end type accidents.

The evaluation data submitted indicates that by again following the above-mentioned procedures an annual benefit of $245,570 is realized which would recover construction costs in less than five years. This recovery factor also makes this program cost-effective.

TABLE 1

State Michigan | M | I | FIPS CODE (Alpha)

HIGHWAY SAFETY IMPROVEMENT PROGRAM
ANNUAL REPORT 1977
EVALUATION DATA FOR COMPLETED IMPROVEMENTS
COST, ACCIDENT AND EXPOSURE DATA

Line		Safety Improvement Program (1)	Safety Classification Code (2)	Total Cost of Evaluated Improvements ($1000) (3)	Quantity of Improvements (4)	Units (5)	Number of Accidents										Exposure		Units (18)	Evaluation Status (19)
							Before					After								
							Mos. (6)	Fat. (7)	Inj. (8)	PDO (9)	Tot. (10)	Mos. (11)	Fat. (12)	Inj. (13)	PDO (14)	Tot. (15)	Before (16)	After (17)		
01		RR	54-58	137	4	C	24	-	1	8	13	24	-	2	12	14	7344	7848.	V	F
02		RR	54	77	3	C	24	-	2	8	10	24	-	-	12	12	20088	20488	V	F
03		RR	56	85	1	C	24	-	22	61	83	12	-	10	25	35	23616	24984	V	F
04		RR	58	101	3	C	24	-	1	6	7	24	-	3	15	18	38232	36072	V	F
05		PM	99	180	2		12	16	345	954	1315	12	12	364	963	1339	59785	59994	M	F
06		HH	10	416	4	X	12	1	38	76	115	12		18	44	62	17748	18540	V	F
07		HH	12	310	2	X	12		7	55	62	12		9	28	37	14220	14940	V	F
08		HH	29	347	1	N	12		20	40	60	12		14	38	52	11196	6480	V	F
09																				
10			TOTAL	1653	20			17	436	1218	1665		12	420	1137	1569				
11																				
12																				
13																				
14																				
15																				

*Instructions and code explanations for this Table can be found in Appendix II.

State Michigan

FIPS CODE (Alpha)

HIGHWAY SAFETY IMPROVEMENT PROGRAM
ANNUAL REPORT 1977
PROCEDURAL INFORMATION

Line	Highway System (1)	HIGHWAY LOCATION REFERENCE SYSTEM: Miles Covered (Percent) (2)	Accidents Covered (Percent) (3)	Expected Completion (Year) (4)	TRAFFIC RECORDS SYSTEM: Reports Entered (Percent) ** (5)	Volume Data (Percent) (6)	Highway Data Correlation (Y,N,U) (7)	HAZARDOUS LOCATIONS: Location Criteria (8)	Priority Selection (9)	Update Frequency (10)
101	Interstate	87	3	1977	100	100	Y-U	A-E-R-S-Z	C-E-I-R-R	A
102	State - F.A.	94	27	1977	100	100	Y-U	A-E-R-S-Z	C-E-I-P-R	A
103	State - Non-F.A.	100	-	-	100	100	Y-U	A-E-R-S-Z	C-E-I-P-R	A
104	Local - F.A.	24	5	1979	10	-	-	-	-	-
105	Local - Non-F.A.	24	12	1979	10	-	-	-	-	-

Line	Highway System (1)	ROADSIDE OBSTACLES: Priority Selection *(11)	Skid Improvement Selection *(12)	Narrow Bridges (13)	RAILROAD-GRADE CROSSINGS: Survey Update *(14)	Priority Selection *(15)	Non complying Crossings (Percent) (16)	Compliance Target Date (Year) (17)
201	Interstate	AEHV	A-G-H-I-P-S-V-W-Y	HRS				
202	State - F.A.	AEHV	"	HRS	None	C-I-P-T-V-W	NA	None
203	State - Non-F.A.	AEHV	"	HRS	None	C-I-P-T-V-W-Z	NA	None
204	Local - F.A.	-	-	-	None	A-C-E-H-I-P-T-V-W	NA	None
205	Local - Non-F.A.	-	-	-	None	A-C-E-H-I P-T-V-W	NA	None

*If more than one code is appropriate, show all codes.
Describe "Y" Codes on separate sheet and attach to this form.
F.A.=Federal-Aid

**Accidents resulting in less than $200.00 in damages are not reported.

*Instructions and code explanations for this Table can be found in Appendix I.

Column 12 - Skid Improvement Selection

Of significant importance in analysis of locations for skid prevention projects are:

1. Percentage of wet to total accident experience as compared to average experience in area.

2. Rainfall data and wet exposure time.

3. Type of accident, especially wet surface, loss of control and rear end.

4. Intersection control--stop-and-go or stop control.

5. Signal progression, split, and length of amber.

6. Mainline section or approach speed and whether or not hydroplaning may be a factor.

7. Depth of water on surface, drainage problems, clogged drainage structures.

Procedural Information contd.

Column 15 - Priority Selection

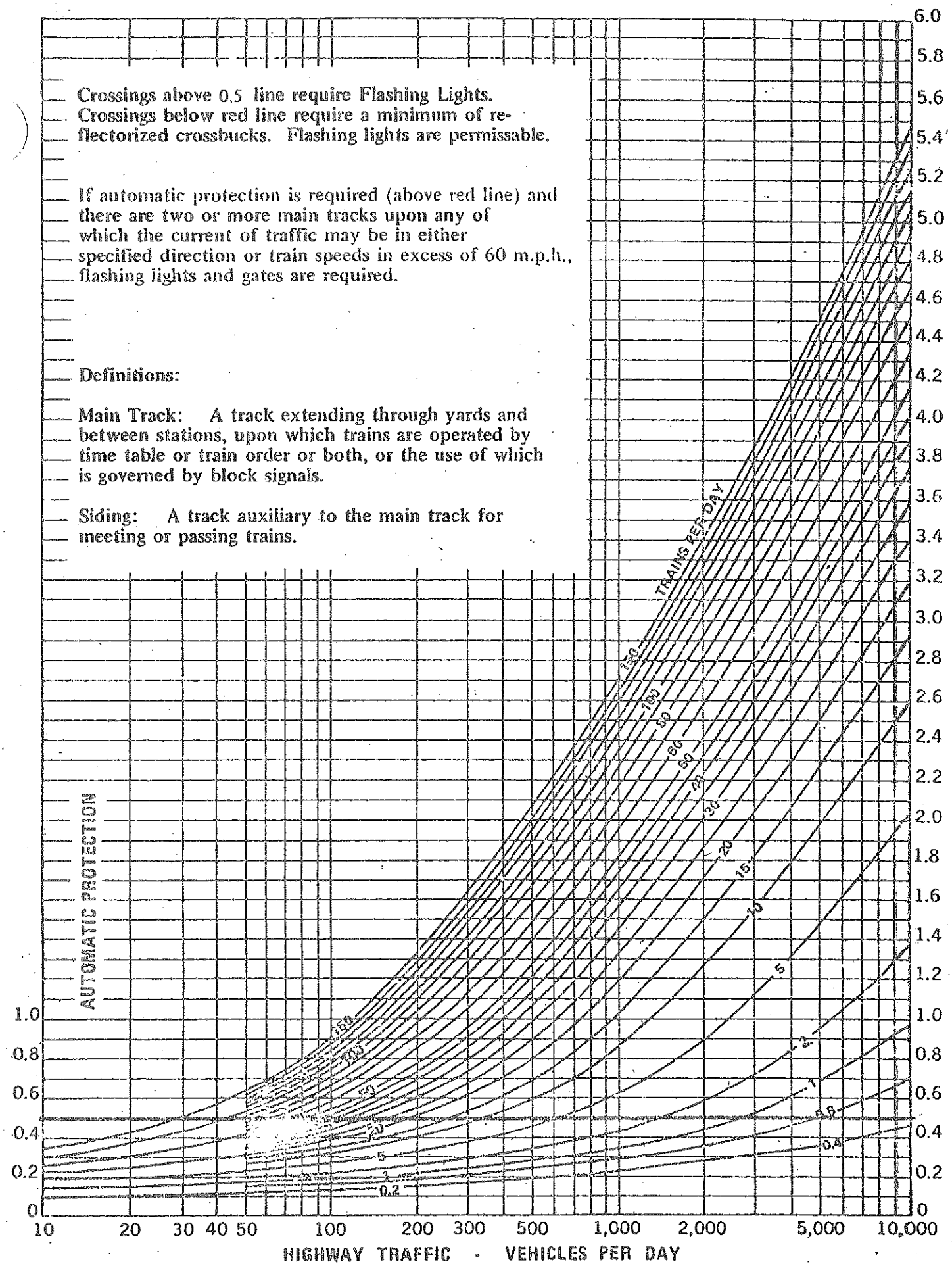
HHS
SECTIONS 203, 230
RAILROAD PRIORITY
DETERMINATION

DATE: _____

CROSSING - _____

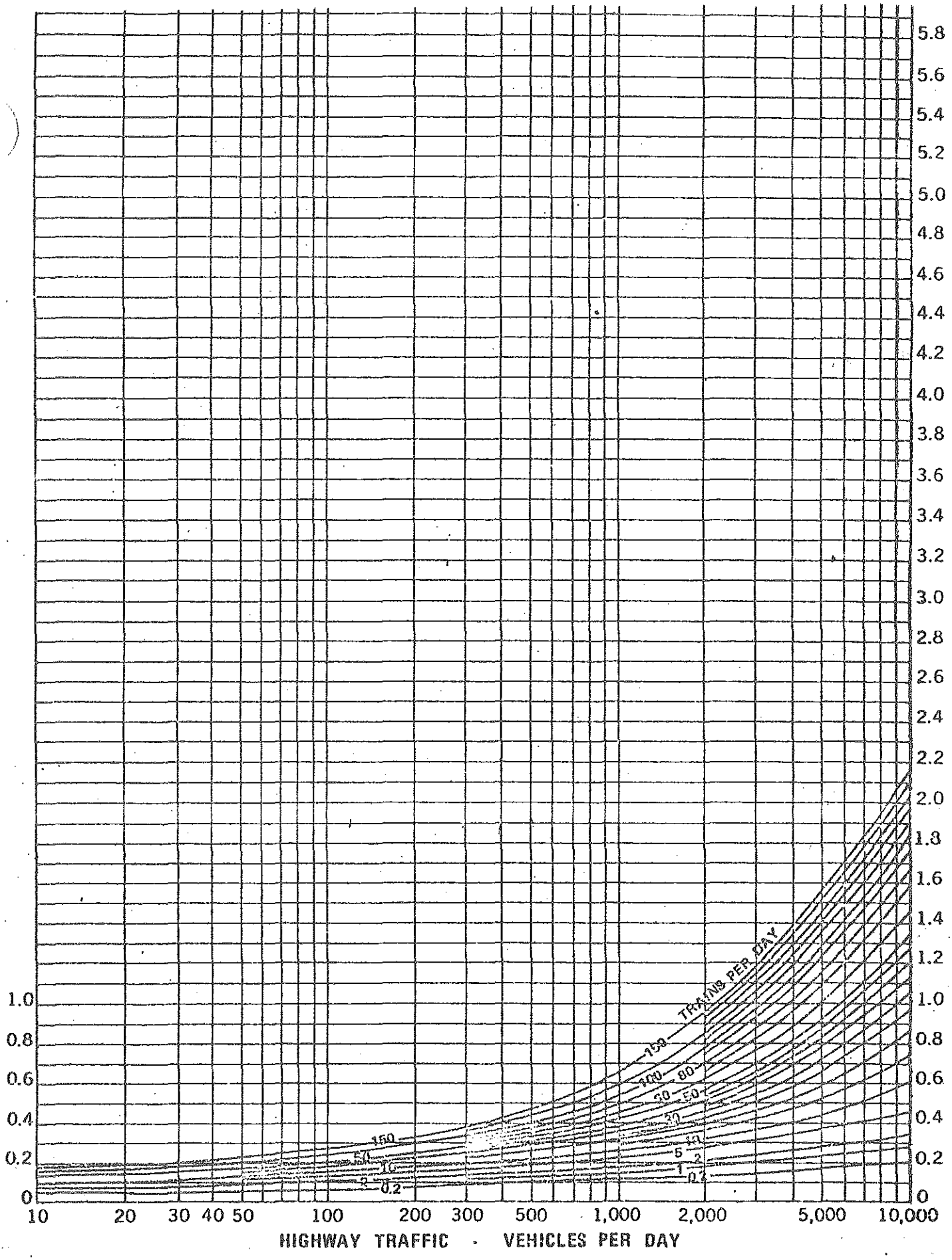
Determination of Points

CRITERIA	MAX. POINTS	RELATIVE INFORMATION	ACTUAL POINTS	REVISED POINTS
MPSC - (Priority & Order)	40			
Speed	10			
Chart - ADT, No. Trains	20			
Alignment & Sight -	10			
No. Tracks - (Max. For 2)	5			
Condition of Approaches	5			
School Busses -	5			
No. Trains -	5		_____	_____
TOTAL POINTS				
Other Criteria - Circumstances which affect priority, not included above. 10 Points.				
TOTAL POINTS			_____	_____



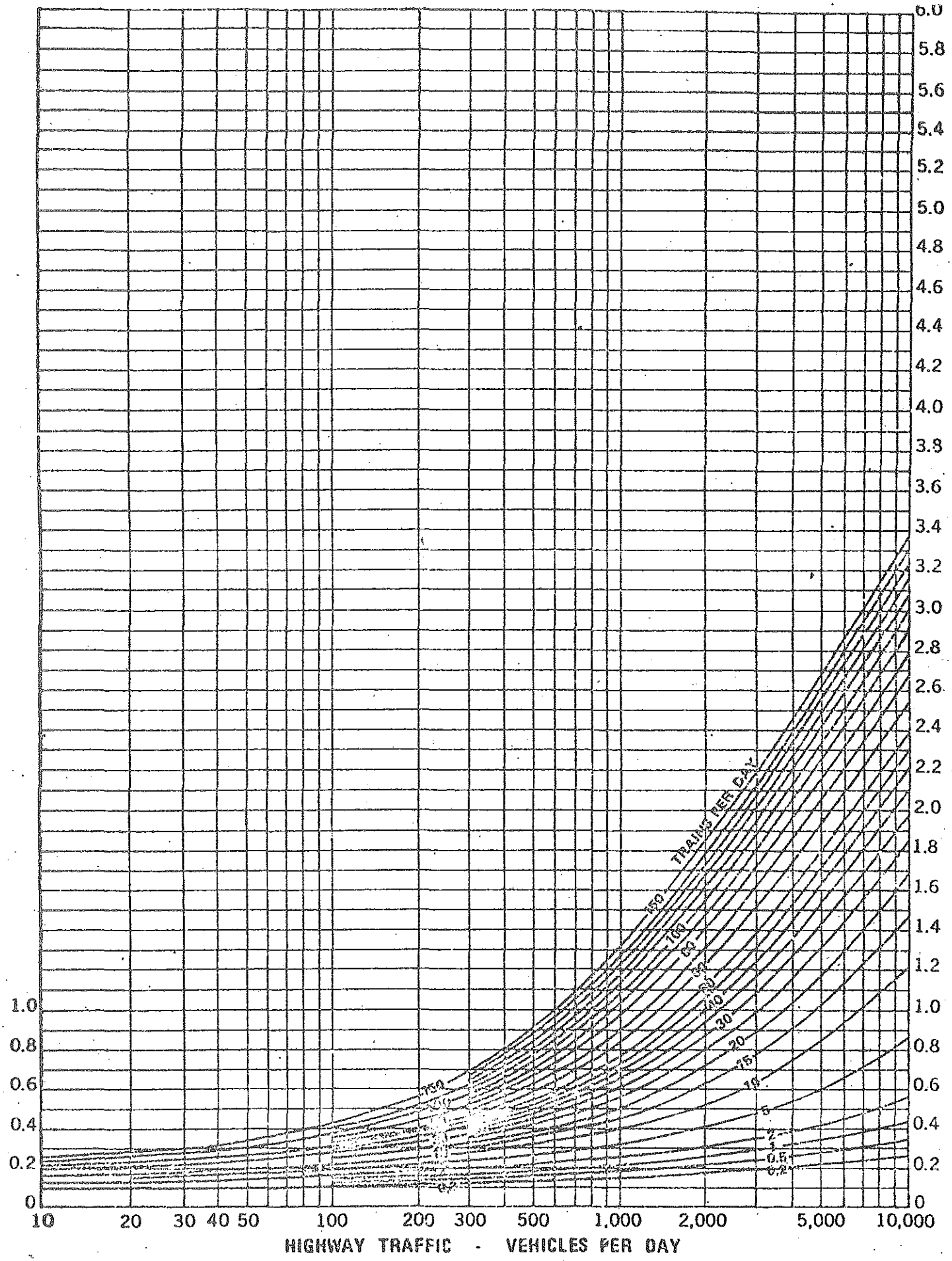
PROBABLE ANNUAL NUMBER OF VEHICLE - TRAIN ACCIDENTS

AT GRADE CROSSINGS PROTECTED BY SIGNS ONLY



PROBABLE ANNUAL NUMBER OF VEHICLE - TRAIN ACCIDENTS

GRADE CROSSINGS PROTECTED BY AUTOMATIC GATES



PROBABLE ANNUAL NUMBER OF VEHICLE - TRAIN ACCIDENTS

AT GRADE CROSSINGS PROTECTED BY FLASHING LIGHTS

SECTION 2

THE 1976-77

MICHIGAN SAFETY (Ms) PROGRAM

Michigan Safety (Ms) Program

The Michigan Safety (Ms) Program was established more than a decade ago and has been principally aimed at the isolation and improvement of high accident locations on the state trunkline system. Of major importance in any program for injury avoidance is an accurate efficient accident location system, which leads to a ranking of locations in order of the highest number, rate, or severity. Using accident data provided by the Michigan Accident Location Index, we have also developed a ranking list according to type of accidents to focus on concentration of correctable accident patterns--types of accidents for which we have developed proven engineering solutions. We know, for instance, that we may correct many angle accident patterns at signalized intersections, solve head-on left-turn collision concentrations, and significantly reduce the incidents of abnormal concentrations of accidents occurring on wet pavement. Utilizing the computer programs to establish these criticality lists saves countless working hours. Our computerized accident location system (MALI) is now being expanded to include all roads rather than state trunklines only.

Analysis of accident locations is the next step in our Ms Program. Many agencies work from accident data tabulations but we prefer collision diagrams and, in our case, they are computer generated (developed by 402 funds). Recommendations are formulated and the anticipated probable reduction in accidents after implementation at each location is estimated. Normally at least two years of accident experience must be available to make an accurate projection. Rather than utilizing published tables to forecast accident reduction, our Safety Unit uses data from previous

before-and-after accident studies. For instance, injury reductions of 50 percent are expected when widening a signalized intersection from four to five lanes and, in strip commercial areas, a reduction in rear-end accidents of 62 percent is used when considering a 4- to 5-lane widening project.

Once reductions have been forecast, the estimated yearly benefit is computed using National Safety Council values for property damage accidents, injuries, and fatalities. The estimated cost of each improvement is computed and compared to the anticipated accident reduction. For several years we have used a modified time-of-return approach because it is simple. The time of return is computed by merely dividing the estimated initial cost by the anticipated yearly benefit, neglecting interest, maintenance, and salvage factors. Having worked with computing equivalent annual costs and benefits or base expenditures on present worth of anticipated benefits over the life of the project, we recognize the simplifying assumptions of our system. Uncertainties of future construction costs, hospitalization costs, travel, and other variables of interest suggest our system provides a reasonable comparative index since most of our projects have a similar design life. At present, we are programming most projects expecting a return in safety benefits exceeding our investment in about five years.

Projects typical of the 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 dis-

proportionate number of wet surface accidents and low coefficients of wet sliding friction. The 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.

To improve the effectiveness of the Ms Program we are developing an improved computer-oriented accident surveillance system (MIDAS). The system includes three principal stages: a sophisticated statistical analysis of abnormal accident patterns; an examination of all feasible corrective treatments, including cost and expected accident reductions; and an optimization process whereby the most cost-effective alternatives are selected which maximize the expected casualty reduction within the constraints of a fixed budget. There is a complete discussion of this new system on page 4-3.

1976-1977 Expenditures (June 30, 1977)

During the past fiscal year $6,440,255 has been spent through the Michigan Safety (Ms) Program. Expenditures by project type are given below:

Description	No. of Projects	Amount
Spot locations	34	$5,913,953
Skidproofing	8	222,900
District Work Orders (as of June 30)	65	209,402
Preliminary Engineering for Safety Studies	9	94,000
	Totals	$6,440,255

Spot location project cost varied from $1,104 for a roadside control island to $337,000 for widening from four to five lanes, including resurfacing. Average project cost was approximately $170,000.

The evaluation data on the following page is based on projects completed during 1973. The format is not one that we would use for our own evaluation purposes as it is based on before-and-after accident numbers and severity. It does not reflect the changes in an identifiable, correctable accident pattern which justified the project initially. However, by applying 1973 accident costs $90,000/fatal, $3700/injury, and $500/PDO we have a before period accident cost of $3,833,700 and an after period cost of $2,736,600 or a 28.6 percent reduction. The total project costs of $2,676,000 would be recovered in 4.9 years.

TABLE 1

Page___of___

State Michigan | M | I | (FIPS CODE (Alpha))

HIGHWAY SAFETY IMPROVEMENT PROGRAM
ANNUAL REPORT 1977
EVALUATION DATA FOR COMPLETED IMPROVEMENTS
COST, ACCIDENT AND EXPOSURE DATA

Line		Safety Improvement Program (1)	Safety Classification Code (2)	Total Cost of Evaluated Improvements ($1000) (3)	Quantity of Improvements (4)	Units (5)	Number of Accidents										Exposure		Units (18)	Evaluation Status (19)
							Before					After					100,000 Before (16)	100,000 After (17)		
							Mos. (6)	Fat. (7)	Inj. (8)	PDO (9)	Tot. (10)	Mos. (11)	Fat. (12)	Inj. (13)	PDO (14)	Tot. (15)				
01		SL	26	161	6	X	24	0	143	611	754	24	0	121	543	664	394.	419.3	M	F
02		SL	42	16	1	N	24	0	3	14	17	24	0	3	8	11	.381	.320	M	F
03		SL	10	217	4	X	24	1	104	208	312	24	2	109	221	330	113.4	122.5	V	F
04		SL	19	592	9	X	24	2	129	242	373	24	0	97	227	314	114.7	130.1	V	
05		SL	29	417	4	N	24	1	76	126	202	24	0	54	134	188	76.28	82.6	M	F
06		SL	21	750	9	N	24	1	30	115	146	24	0	33	61	94	78.91	84.53	V	F
07		SL	22	210	2	L	24	6	42	131	179	24	0	38	52	90	63.87	64.06	M	F
08		SL	23	313	6	L	24	0	34	89	123	24	0	53	108	161	34,56	38.66	V	F
09																				
10							TOTALS 11		561	1536	2106		2	508	1354	1852				
11																				
12																				
13																				
14																				
15																				

*Instructions and code explanations for this Table can be found in Appendix II.

SECTION 3

OTHER SAFETY-RELATED PROJECTS

FISCAL YEAR 1976-77

Introduction

Michigan programs several other types of projects that are safety-related. Projects falling within this category include federal aid urban, federal aid primary, federal aid secondary (includes off-system projects), and 100 percent state and local funded projects.

Typical safety-related work items accomplished through these projects are: intersectional geometric improvements, signal modernizations, rail-highway crossing and signal improvements, roadside control, guard-rail modernization, obstacle removal, resurfacing for skidproofing, median barrier construction, side slope improvement, and shoulder improvements.

Federal Aid Urban Program

A total of 42 projects were let to contract during fiscal 1977. Safety-related improvements were included in 21 of the projects. Several long projects included intersections which would have qualified for safety funding based on accident experience. Other projects involved the modification of crossovers, the improvement of sight distance through extensive grading, and the installation of guardrail when obstacle relocation or removal was not feasible.

During fiscal 1977, a total of $31,993,000 was expended of which $21,000,000 was safety related. These funds include three projects involving nonmotorized vehicle facilities for exclusive pedestrian and bicycle usage.

Federal Aid Primary Program

Projects within this program are on state trunkline routes and roads on the county primary system. Project types vary and include bridge railing and bridge deck replacement, traffic signing, and interchange ramp upgrading. During fiscal 1977, 21 projects were let to contract at a total cost of $12,560,000. A review of the projects indicated that approximately $1,967,000 is safety related.

Federal Aid Secondary Program

Projects within this program are usually less than $100,000 although occasionally a project will exceed $1,000,000 as one did during the 1976 fiscal year. The typical project types include bituminous resurfacing shoulder repair, culvert replacement, sign erection, bridge deck replacement, and minor widening projects. A total of $6,649,000 was expended by this program under 47 separate contracts. It was determined that $2,212,000 of the total amount involved highway safety.

Michigan Funded Projects

In addition to the Safety (Ms) Program, there are several other state funded programs within which safety-related work is performed.

The determination of which project types are safety related is relatively simple, but time consuming. For instance, resurfacing projects are checked against skidtest data within the project limits. Those areas where the skid number was low are considered as safety expenditures. The same criteria was used in determining which bridge deck would be credited as a safety item.

Projects which replaced bridge railings, improved traffic signals, eliminated guardrail through grading, extended culverts, upgraded guardrail type, installed flared guardrail endings, etc., were evaluated similar to projects submitted for federal aid funding. If the project would have qualified for federal funds, 100 percent of the cost was considered safety. The percentage of safety items on other projects varied considerably.

Pedestrian and bicycle construction projects were considered 100 percent safety related if total segregation from the automobile conflict was established. Shoulder improvements were also considered 100 percent safety related because of the large percentage of right side, ran-off-roadway accidents and published research confirming the value of stabilized shoulders.

Mb Bituminous Resurfacing - This program is primarily aimed at the driving surface of highways. During fiscal 1977, there were 36 such projects let to contract. Resurfacing of highways that exhibit low coefficients of wet sliding friction, a high percentage of wet surface accidents, or have uneven surfaces are of primary concern. Correction of superelevation has also been accomplished through this program. The cost of these projects totaled $9,944,000, $1,849,000 for safety.

Mbr Bituminous Reconstruction - This program focuses on the surface and base of highways. Projects may include minor widening and roadside control with curb and gutter and enclosed drainage. During fiscal 1977, 17 projects were let to contract at a cost of $5,169,000 of which 1,228,000 was identified as safety related.

M Miscellaneous Construction - During fiscal 1977, there were nine safety-related projects costing $5,890,000. One project was for bridge deck and railing replacement at $694,000 and three projects were for widening and resurfacing at a cost of $2,613,000. Two at-grade railroad crossings were improved at a cost of $178,000 and one railroad structure at a high accident location in the city of Niles was removed at a cost of $202,000. One bridge railing replacement project was done for $174,000, and one for culvert replacement project costing $44,000 was also done. Another high accident location in the city of Grand Rapids was reconstructed to provide a median at a cost of $1,985,000.

Mbd - Bridge Deck - Projects in this program correct bridge decks that have exhibited spalling to the point where rebars are exposed, the bridge deck leaks or the bridge deck is slippery when wet. In most cases the deck is waterproofed after completing any required minor deck repair and a latex modified mortar, concrete, or bituminous surface is applied. During fiscal 1977, 15 projects were let to contract at a cost of $956,000 of which $372,000 is safety related.

Mnm Nonmotorized Vehicle Facility - This program funds facilities for exclusive pedestrian and bicycle usage. The conflict between vehicles, bicycles, and pedestrians has been the subject of concern for several years. The five projects programmed cost a total of $1,344,853 and were all on the interstate system. The projects provided paved shoulders or separate pathways for nonmotorized vehicles.

Msh Shoulder Edge Treatment - This program provides a minimum 3-foot bituminous edge strip along the right-hand side 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 to delineate the driving lanes and prevent regular usage of the added width. During fiscal 1977, there were 20 projects involving 167.2 miles at a cost of $1,978,000.

Skidtesting

During fiscal 1977, 11,469 skidtests were conducted statewide as part of Testing and Research's normal testing procedures with 686 of these on the local road system. Six trunkline projects from the high accident list were programmed at a cost of $281,045 to correct pavements with low coefficients of friction and concentrations of wet accidents. Since 1965, the cost-benefit ratio of completed skidproofing projects on the state trunkline system has been five years or less. Locations on the local road system which have low coefficients of friction are submitted to the local agency. To date only one skidproofing project within the categorical safety program has been realized from the skidtesting of local roads.

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 1976-77, 15 interstate safety (Is) projects (234 miles) were let to contract for roadside obstacle corrections.

Five projects on the state's freeway system were let to contract during fiscal 1977 at a federal cost of $16,003,792 in transition quarter funds.

Due to the hazard that exposed guardrail endings pose to impacting vehicles and the possibility of penetration into passenger compartments, the Department began a program to eliminate guardrail end shoes by replacing them with buffered endings along all state highways not on the interstate system. This program required a field survey of unprotected guardrail endings and was started in the winter of 1974-75. The field survey was completed during the 1976-77 fiscal year.

The buffered ending work is being performed by state and local contract forces. The estimated cost of this work is $1,455,000 and is being financed with Transition Quarter Funds as a Roadside Obstacle Safety (ROS) project with the FHWA participating in 90 percent of the total cost. During fiscal 1976-77, $1,466,800 have been expended of which $1,320,120 is federal funds, and the project is estimated to be 17 percent completed.

Interstate Freeways - Yellow Book Status

The removal, relocation, or protection of roadside obstacles on the 1,080 miles of interstate routes open to traffic continues with 935 miles of upgrading approved by the FHWA. The remaining 145 miles are in accordance with present day standards with the exception of a limited number of buried end section guardrails which should ultimately be replaced with cable type anchorages.

Of the 935 miles:

1. Sixty-one percent (570 miles) has been completed or are presently under contract.
2. Twenty percent (186 miles) are programmed and in design.
3. Nineteen percent (179 miles) are either unprogrammed or inactive to date.

In 1976-77 Michigan awarded Yellow Book projects that total $16,271,000 and encompassed 456.9 miles of freeways.

Interstate Safety (Is)

The Federal-Aid Interstate Safety Program provides funding for both major and minor corrective safety work on the interstate system and is contracted through the competitive bid process. Major corrective work includes bridge widenings, bridge railing replacements with concrete safety barriers, extensive regrading, additional through and/or auxiliary lanes, redesign of basic geometry or the complete reconstruction of

an interchange, replacement of existing median guardrails with concrete safety barriers and providing or upgrading freeway lighting. Most safety projects are authorized after approval of a justification based upon the reduction of accidents and recommended corrective measures.

Minor corrective work, of a Yellow Book nature utilizes federal aid interstate funding to provide a safer roadside for errant motorists on the state's highway system. It includes modernization or replacement of guardrails, minor grading, culvert extensions and safer endings, and putting sign posts on frangible bases or relocating signs to bridge overpass structures. Further details regarding the Yellow Book program are on page 3-7.

In fiscal year 1976-77, Michigan awarded 23 Interstate Safety (Is) projects totaling $5,432,000.

Impact Attenuators

Presently the Michigan Department of State Highways and Transportation has 116 existing impact attenuators installed on the state highway system. Seventy-seven are Hi-Dro Cell attenuators, five are "Great" guardrail energy absorption terminal attenuators, 26 are "Sand Barrel" attenuators, two "Steel Barrel" attenuators, and the remaining six are "Cell Cluster" attenuators.

We also have an additional 76 attenuators, either proposed or presently under contract. According to type they are: Hi-Dro Cell - 45, "Great" - 21, Sand Barrels - 5, Cell Clusters - 4, and Hi-Dri Cell - 1. The total estimated installation cost for these attenuators is $1,710,000.

Personnel from the Traffic and Safety Division recently conducted a field inspection of all of the existing attenuators on our trunkline system. An inventory has been formulated as a result of these inspections that has been forwarded to the Maintenance Division for their review.

Traffic Engineering Services

The Michigan Department of State Highways and Transportation provides traffic engineering services to local governmental agencies through the Community Assistance Program and the Operational Inventories Unit. The Community Assistance Program provides the capability of identifying, analyzing, and correcting problem accident locations. The recommendations outline operational and geometric improvements which, when implemented, will reduce the number of accidents and their severity. The Operational Inventories Unit provides assistance to local governmental agencies for the inventory of the traffic control devices on the local road system. As part of the inventory process, recommendations are made for the erection, replacement, relocation, and removal of traffic control devices to meet the requirements of the 1973 Michigan Manual of Uniform Traffic Control Devices. Department personnel conduct inventories for the smaller agencies and train local personnel to conduct their own inventories in larger agencies.

Participation in both services is initiated through a request by the local agency to the department's Local Government or Traffic and Safety Divisions. Both programs are federally funded through a grant from the Office of Highway Safety Planning using Section 402 funds and the services are free to the local agencies.

During fiscal 1976-77, the Community Assistance Program has reviewed and analyzed 85 spot locations in 20 different local jurisdictions. Recommendations resulting from these analyses involve traffic signal installations, traffic signal modernizations, and intersection reconstructions. The anticipated cost to implement these recommendations was approximately $902,500. Federal funding will be used to assist the local agencies in funding these projects through the categorical safety programs and other federal aid programs.

Statewide, traffic control device inventories have been completed on 16,126.41 miles of county primary roads in 51 counties, 9,345 miles of county local roads in 11 counties, and 5,769 miles of major and local streets in 126 cities and villages. This accounts for approximately 29 percent of the total statewide nontrunkline mileage of 106,727 miles. The accomplishments by fiscal year from 1969 to present are:

MANUAL INVENTORIES

Fiscal Year	County Primary/FAS No.	County Primary/FAS Miles	County Local No.	County Local Miles	Cities or Villages No.	Cities or Villages Miles	Cumulative No.	Cumulative Miles
69-70	1	277.26	-	-	-	-	1	277.26
70-71	7	2,670.96	-	-	-	-	7	2,670.96
71-72	24	6,198.30	-	-	-	-	24	6,198.30
72-73	6	2,345.97	-	-	-	-	6	2,345.97
73-74	3	1,140.53	-	-	2	35.60	5	1.176.13
74-75	1	357.00	1	746.61	10	148.93	12	1.252.54
75-76	2	765.22	4	3,241.11	18	452.78	24	4,459.11
Trans. Quarter	5	1,370.20	2	1,616.59	13	197.37	20	3,184.16
10-1-76 to 6-4-77	1	254.33	3	2,099.60	40	408.21	44	2,762.14
Sub Total	50	15,379.77	10	7,703.91	83	1,242.89	143	24,326.57

In addition to Michigan Department of State Highways and Transportation inventory activities, one county and 43 local agencies have been inventoried by consultants using the photolog procedure resulting in computerized printout inventories involving 6,914 miles of nontrunkline roadways.

Departmental personnel are providing technical assistance to the local governmental agencies by assisting them in preparing the necessary documents required to obtain federal funds for project implementation. Fifty-four agencies, including nine counties, obtained approval for federal funding of sign upgrading projects under the Safer Roads Demonstration Program of the 1973 Highway Safety Act. Approximately $3.9 million in federal funds were utilized to fund sign upgrading projects. In addition, seven rural community sign upgrading projects are being funded under the Section 219 (off-system) program of the 1974 Highway Safety Act amendments. Six of the seven communities will be receiving federal funds for the signing recommendations on those city or village streets that are designated federal aid secondary routes but are under local jurisdiction.

Currently, 90 local agencies, including five counties, have completed traffic control devices inventories of their road system and will be programming a project under the Safer-off-System Program of the Highway Safety Act of 1976, Federal and Secondary Program, and Urban System Program to fund their respective sign upgrading projects.

Fifty-one sign upgrading projects are being implemented at this time. Two agencies, Wolverine Lake and Webberville, have been completed.

Evaluation

Traffic Engineering Services

Location	1 Year Accidents Before	After	% Reduction	Accident Savings $ Per Year	*Cost of Project	Ratio of Annual Benefits to Initial Investment
Napier Ave. at Colfax Ave.	30	12	60	17,730	108,617	.16
Columbia Ave. at Main St.	37	19	49	50,190	158,238	.31
Flansburg Rd. at South St.	10	9	10	4,200	7,211	.58
Vermont St. at Milham Rd.	4	6	0	-4,770	25,000	
Napier Ave. at Langley	12	11	8	570	500	1.14
Douglas Ave. at Mosel Ave.	22	8	63	28,760	45,591	.63
Total	115	65	.43	96,680	345,157	.28

*estimated cost

TABLE 1

State Michigan — FIPS CODE (Alpha): M I

HIGHWAY SAFETY IMPROVEMENT PROGRAM
ANNUAL REPORT 1977
EVALUATION DATA FOR COMPLETED IMPROVEMENTS
COST, ACCIDENT AND EXPOSURE DATA

Line		Safety Improvement Program (1)	Safety Classification Code (2)	Total Cost of Evaluated Improvements ($1000) (3)	Quantity of Improvements (4)	Units (5)	Number of Accidents										Exposure		Units (18)	Evaluation Status (19)
							Before					After								
							Mos. (6)	Fat. (7)	Inj. (8)	PDO (9)	Tot. (10)	Mos. (11)	Fat. (12)	Inj. (13)	PDO (14)	Tot. (15)	Before (16)	After (17)		
01		SL	12	47	1	X	12		7	12	22	12		1	7	8	3780	3789	V	F
02		SL	60	0.5	1	N	12		1	11	12	12		1	10	11	3565	3565	V	F
03		SL	90	32.2	2	N	12		3	11	14	12		3	12	15	7092	7092	V	F
04																				
05																				
06																				
07																				
08																				
09																				
10																				
11																				
12																				
13																				
14			*Instructions and Code explanations for this table can be found in Appendis II.																	
15																				

These 4 locations were improved using 100% local funds. They were part of 402 funded reports to local agencies completed by our Community Assistance Sub-Unit in which recommendations for corrective action are made regarding high hazard locations.

Dear Mr.

The Highway Safety Act of 1966 was enacted by the Congress of the United States in order to promote highway safety. Through this act a traffic engineering service, under the direction of the Michigan Department of State Highways and Transportation, has been made available in Michigan. It is the intent of this program to provide limited traffic engineering services to cities and counties, which do not have a traffic engineering staff or the services of a traffic engineering consultant, by analyzing high accident nontrunkline locations and developing recommendations for safety improvements.

A federal grant, through the Office of Highway Safety Planning, was awarded to the Department of State Highways and Transportation to finance the cost of this service so that there will be no direct charge to participating cities and counties.

The Highway Safety Act of 1976 now provides funds to all levels of government to use for improving highway safety. Under this act limited funds are available to your community on a 90 percent (federal) and 10 percent (local) cost basis for improving high accident locations, modernizing signal systems, and correcting sections of roadway that exhibit slippery when wet characteristics. A review of your more critical problem locations, by your police agency or other persons having traffic engineering responsibilities, may reveal that this service can be of benefit to your community.

Any city or county interested in the above services should write to Mr. Richard L. Blost, Supervising Engineer, Safety Programs Unit, Michigan Department of State Highways and Transportation, P.O. Box 30050, Lansing, Michigan 48909.

Very truly yours,

DONALD E. ORNE
ENGINEER OF TRAFFIC AND SAFETY

By: Richard L. Blost
Supervising Engineer
Safety Programs Unit

DATA REQUIRED FOR FHWA PROJECT APPROVAL

I. Accident Data

1. Narrative or tabulations explaining accident patterns and severity.

2. Collision diagrams are preferable.

II. Existing Conditions - Major and Minor Streets

1. Existing number of lanes and width - curb and gutter present (enclosed drainage system) or ditches (open drainage).

2. Type of area - land use pattern - residential - commercial - industrial - mixed.

3. Traffic volumes (hourly - 24-hour - T.M.) pedestrian movements - school.

III. Proposed Corrective Treatment

1. Geometric or operational changes to be made.

2. Additional right-of-way required.

IV. Estimate of Project Costs - Right-of-Way - Construction

V. Effects of Proposed Project

1. Cost effectiveness analysis.

2. Accident reduced by the project.

3. Cost benefit analysis.

a. Length of time to recover total project costs.

b. A 7-year evaluation of safety (Ms) projects on the trunkline system shows an average recovery of 7.99 years. FHWA would like all federal aid projects to have recovery rates of 10 years or less.

Michigan Accident Location Index (MALI)

The Michigan Department of State Highways and Transportation and the Michigan Department of State Police, in cooperation with the Michigan Office of Highway Safety Planning, have developed a computerized accident location reference and analysis system referred to as the Michigan Accident Location Index (MALI). The MALI system is designed to generate a computerized description of traffic accident locations directly from the information reported by the police officer. The computer system generates and maintains the accident location information on the MALI street index for later retrieval and analysis. The MALI street index is a map of the street network stored in the computer. The street index is composed of distances between intersections, alternate street names, and accurate city and township boundaries.

The primary functions of the MALI system are to expand the state's accident locating capability to all roads and streets, eliminate the manual locating of accidents, and provide accident analysis information to state and local users. The MALI system will enable the user to identify hazardous locations on all roads and streets, forming the basis for establishing priorities for safety improvement projects, selective enforcement areas, and other activities that have an impact on the state's accident experience.

The MALI project is currently operational on the state trunkline system in 81 counties and on the local road system in nine counties. We anticipate completing the MALI street index for the state trunkline

system by October of 1977. The MALI street index for the local road system will be completed in five additional counties by January of 1978 leaving 70 counties to complete. The Traffic and Safety Division of the Michigan Department of State Highways and Transportation has recommended that a contract be awarded to a consultant to complete the MALI street index for the remainder of the local road system. The consultant began work on August 10, 1973, and will take two years to complete the project.

The MALI system is presently locating 47 percent of the total accidents in the state of Michigan. The remaining accidents are being located to pseudo locations by road type and political subdivision rather than specific locations. The percent of accidents located will increase as the remaining trunkline routes and local routes are added to the master index.

SECTION 4

NEW DEVELOPMENTS IN

HIGHWAY SAFETY

NEW DEVELOPMENTS IN HIGHWAY SAFETY

The past year has seen some rather innovative developments take place relative to Michigan's highway safety program. Of special interest are three closely related items that will be used in the safety project selection procedure. One concerns the development of a systematic procedure for establishing project priorities on a statewide basis. Another involves the formulation of an interchange priority methodology. The last deals with the development of a computer-oriented accident surveillance system known as the Michigan Dimensional Accident Surveillance Model (MIDAS).

Prioritization Procedure

A prioritization procedure for ranking and selecting project candidates was initiated by the department in order to conform with the intent of the federal guidelines as specified in FHPM 6-8-2-1. Eventually, project eligibility will be based on a location's ranking on a priority listing.

The general methodology now being used for ranking and selecting safety improvements on our state trunkline system includes the following procedures:

1. A computer-oriented surveillance system that will identify road sections or locations experiencing statistically disproportionate numbers of injury/fatal accidents and analyze locations exhibiting similar geometric/environment/traffic characteristics.

2. A selection process identifying groups of projects with the highest priority rankings.

3. An evaluation of likely alternate solutions with estimated costs.

4. A cost-effective analysis incorporating expected reduction in accidents based on historical data.

As of this writing, the MIDAS model was operable for nonfreeway state highways only and applicable to only Step 1 of our prioritization procedure. In the very near future, freeway surveillance should also be possible, and the MIDAS model will be used for all steps in our prioritization procedure.

Interchange Priority Study

In conjunction with the safety improvement prioritization procedure that is now being formulated, an interchange priority study has been initiated. The study will evaluate accidents at all state trunkline interchanges, interstate as well as noninterstate. Ultimately, relative rankings, developed by cost analysis prioritization techniques, will be established for interchanges within a topmost grouping on a statewide basis.

Phase I of the study employs a methodology that establishes a criticality ranking of those statewide interchanges exhibiting an abnormally high number of injury accidents. The procedure for identifying these interchanges incorporates statistical analysis of injury accident data as well as the application of injury accident rates. The criticality ranking list established by Phase I is to be used as a tool in the decision-making process of selecting major interchange safety improvement projects.

Phase II of the study will address alternate solutions, estimated costs, and cost effectiveness. As of this writing, this phase of the study has yet to be completed.

Michigan Dimensional Accident Surveillance (MIDAS)

The department is currently developing an improved, computer-oriented, accident surveillance system known as MIDAS. The model includes three principal stages: a sophisticated statistical analysis of abnormal accident patterns; an examination of all feasible corrective treatments, including costs and expected accident reductions; and an optimization process whereby the most cost-effective alternatives are selected which maximize the expected casualty reduction within the constraints of a fixed budget.

The backbone of the model's first stage is a computerized data bank containing information such as laneage, alignment, lane and shoulder widths, auxiliary lanes, traffic controls, and land usage. It is possible to classify the information into as many as one-half-million discreet units, with each unit containing accident data for sites with identical characteristics. The numerous variables are explained by the four basic dimensions; geometry, environment, cross section, and accident characteristics. We are also investigating traffic volume (more specifically congestion) at the time of the accident which will be more definitive than the presently used accident rates based on average daily traffic. It will be possible to explore the relationship of variables to one another and search for variables and combination of variables which explain the accident phenomena. Based on encouraging preliminary outputs, Stage I has been implemented within the department.

Stage II of the computer model will calculate the cost effectiveness of each potential accident countermeasure. For every site identified as having a significant accident concentration, every feasible corrective treatment (left-turn lanes, traffic signals, all-red phases, etc.) will be cost estimated using historical cost data input into the computer. The expected reduction in accidents will be estimated by a complex statistical analysis relying on the Stage I data base. The projected cost divided by the anticipated reduction in accidents relatively describes the cost effectiveness of each proposal. Stage II is now being developed and tested with completion expected in the near future.

Stage III will involve objective optimization using one of a number of available mathematical optimizing processes. The computer will select the abnormal accident site and identify countermeasures which maximize the expected reduction in accidents and personal injuries within the constraints of available safety funds. Development of this stage has not yet started. However, it is not expected to be difficult since mathematical optimization procedures are in common use.

It is likely that this model will revolutionize accident surveillance and analysis systems in the United States, thus confirming Michigan's role as a leader in this field.

As the MIDAS model becomes more fully developed, its working components will be interfaced with the prioritization procedures of the various categorical, interstate, federal aid, and Michigan safety programs in order to best optimize the variety of funds that are available for

safety improvement projects. By continually improving these safety project prioritization techniques, it is felt that a safer highway network will result. It is likely that these new developments will help the department to carry on a continuing and comprehensive highway safety program that will address the needs of the total state trunkline system.

SECTION 5

SPECIAL STUDIES

Special Studies

The Safety Programs Unit has undertaken two rather noteworthy studies pertaining to the field of highway safety during the past year. Both of these studies has contributed some valuable information to the state-of-the-art of the particular area researched.

One of the areas investigated examined the effects that snow accumulation in concrete median barrier areas has on the safety of vehicles striking the concrete wall. The other study established the relationship and correlation that exists between rutted pavement conditions and wet surface accidents.

Concrete Median Barrier Study During Periods of Snow Accumulation

This study examined the effects of snow accumulation along concrete median barriers relating to the safety of vehicles impacting the barrier. The study makes use of both a statewide accident analysis and a Delphi Survey conducted among district traffic and maintenance personnel.

The recommendations contained in the report addressed two areas relating to the safety and effectiveness of concrete median barrier. The first area concerns snow plowing procedures along barrier walls. The second area involves effective barrier height and the use of concrete glare screen. The report recommendations are briefly summarized as follows:

1. A snowplowing process known as "verticalizing" should be considered for possible use on a statewide basis in concrete median barrier shoulder areas.

2. "Engineering judgment" should dictate the feasibility of when and where snow removal procedures are to be applied along barrier shoulders.

3. Consideration should be given to the installation of concrete glare screen atop concrete median barrier in urbanized areas.

4. Where new concrete median barrier is to be installed, consideration should be given to increasing the effective height of the wall. (The presence of snow tends to effectively reduce the height of a barrier.).

As a result of the report, there will be a concerted effort to implement Recommendation No. 3 (installation of concrete glare screen in urbanized areas) through the use of safety funds.

Rutted Pavement: Its Effect on Wet Surface Accidents

This report makes use of linear regression and correlation statistical techniques to establish the relationship and correlation (or lack of it) between depth of rutted pavements and incidence of wet surface accidents on freeway sections. The report concludes "that little correlation exists between rutted pavements and wet surface accidents" and that "corrective measures should not be initiated to eliminate rutted pavement surfaces unless the rut equals or exceeds 1/2 inch in depth." In addition, the report states that "resurfacing rutted pavement surfaces appears unwarranted unless the number of wet surface accidents is significantly greater than the expected frequency for similar roadway sections which are not rutted."

APPENDIX I

HIGHWAY SAFETY IMPROVEMENT PROGRAM
ANNUAL REPORT 1977
PROCEDURAL INFORMATION CODES

Highway Location Reference System

Column (2) - Percent of miles covered by location reference system

" (3) - Percent of accidents covered by location reference system

" (4) - If column (2) is less than 100%, show date it is expected 100% of highway mileage will be covered by reference method (Year)

Traffic Records Systems

Column (5) - Percent of all reported accidents entered into (or coordinated with) the State traffic records system

" (6) - Percent of entered accidents for which accident data is correlated with volume data

" (7) - Is it currently possible to correlate accident data with highway inventory data through automated data processing? (Y-Yes, N-No, U-Under development)

Hazardous Locations

Column (8) - Criteria used to identify high hazard locations for further study

CODES (more than one may apply)

A	Number of accidents
E	Economic loss/accident cost
L	A specific number of locations (e.g. top 100)
R	Accident rate, including rate-quality control
S	Accident severity
Y	Other (describe on separate sheet)
Z	Under development

Column (9) - Factors taken into account in establishing hazardous location project priorities.

CODES (more than one may apply)

C Criteria indicated in column (8)

E Cost-benefit analysis

I On-site investigation

P Project cost

R Accident and/or severity reduction expected from improvement

Y Other (describe on separate sheet)

Z Under development

Column (10) - Frequency of updating project priority list.

CODES

Q Quarterly

S Semi-annually

A Annually

O Other (describe on separate sheet)

Elimination of Roadside Obstacles

Column (11) - Factors analyzed in establishing project priorities for correction of roadside obstacle hazards.

CODES (more than one may apply)

A Accident data

E Cost-benefit analysis

H Highway system or type

I Type of obstacle/type of improvement

O Obstacle survey data

S Traffic speed or speed limit

V ADT

Y Other (describe on separate sheet)

Z Under development

Skid Improvement Projects

Column (12) - Factors analyzed in determining priorities for correcting hazardous skid prone location.

CODES (more than one may apply)

A	Total accidents
G	Roadway geometrics
H	Included in hazardous locations
I	On-site investigation besides skid testing
P	Pavement texture or other pavement characteristics besides skid number
S	Skid number
V	ADT
W	Wet pavement accidents
Y	Other (describe on separate sheet)
Z	Under development

Narrow Bridges

Column (13) - Procedures to identify and correct functional hazardous conditions associated with narrow bridges

CODES

H	Included in hazardous locations
R	Included in roadside obstacle program
S	A separate program for narrow bridges
X	None
Y	Other (describe on separate sheet)
Z	Under development

Rail-Highway Grade Crossings

Column (14) - Method of updating crossing inventory

CODES

N	According to National Railroad-Highway Crossing Inventory Update Manual
S	State inventory
Y	Other (describe on separate sheet)

Column (15) - Factors taken into account in establishing project priorities

CODES (more than one may apply)

A	Accident history
C	Physical characteristics of the crossing
E	Cost-benefit analysis
H	Hazard rating index (show formula on separate sheet and define all terms)
I	On-site investigation
P	People factor (buses, passenger trains, etc.)
T	Characteristics of train traffic
V	Characteristics of highway traffic
W	Existing warning devices
Y	Other (describe on separate sheet)
Z	Under development

Column (16) - Percentage of public crossings that do not comply with MUTCD

" (17) - Target date for full compliance with MUTCD - Year

APPENDIX II

Instructions

Table 1

HIGHWAY SAFETY IMPROVEMENT PROGRAM
ANNUAL REPORT 1977
EVALUATION DATA FOR COMPLETED IMPROVEMENTS
COST, ACCIDENT AND EXPOSURE DATA

General

- Only include information for improvements with at least 1 year "before" and 1 year "after" accident data.

- Improvements (projects) may be grouped as long as the source of funds (column 1) and classification (column 2) are the same.

Column (1) - Indicate source of funds for the safety improvement.

Code:

HH - High Hazard Location Projects

RO - Elimination of Roadside Obstacles

SR - Safer Roads Demonstration

RR - Rail-Highway Crossings

SO - Safer Off-System Roads Program

IS - Interstate Safety Improvements

FA - Other Safety Improvements Made with Federal-aid Funds

SL - Safety Improvements Funded with State and Local Funds Only

Column (2) - Indicate the type of safety improvement as classified by the Safety Classification Codes in FHPM 6-8-2-1.

Column (3) - Enter the total cost(s) for the improvement(s) included on the line in thousands of dollars.

Column (4) - Based on classification code used in column (2), enter the total quantity of improvements included on each line according to the codes below:

For Safety Codes	Quantity of Improvements	Units Code
10-19	Number of intersections	X
20, 23, 25, 26	Number of miles	M
30-39	Number of structures	S
50-59	Number of crossings	C
68	Number of locations	L
Other codes	Not necessary	N

Column (5) - Indicate the appropriate unit code for quantity shown in column (4).

Number of Accidents

Columns (6) and (11) - Indicate the number of months included in the "before" and "after" time periods, respectively.

Columns (7) and (12) - Enter the number of fatal accidents that occurred in the "before" and "after" time periods, respectively.

Columns (8) and (13) - Nonfatal injury accidents.

Columns (9) and (14) - Property damage only accidents.

Columns (10) and (15) - Total accidents.

Exposure

Columns (16) and (17) - For each line entry, based on the classification codes used in column (2), enter the appropriate exposure data in the "before" and "after" periods: (vehicles = $\sum$ADT X 30 X number of months) (vehicle-miles = $\sum$ADT X 30 X number of months X project length)

For Safety Codes	Exposure	Units Code
10-19, 30-39, 50-59, 68	Vehicles	V
20, 23, 25, 26	Vehicle-miles	M
All others	Either of the above as appropriate	V or M

Column (18) - Indicate the appropriate unit code for the exposure data shown in columns (16) and (17).

Column (19)

For each line of data in the table:

Enter "P" if this is preliminary data and the final evaluation data will be submitted on the improvement(s) at a later date.

Enter "F" if this is the final evaluation data that will be submitted on the improvement(s).

SAFETY CLASSIFICATION CODES

The following Classification Codes shall be used when reporting highway safety improvements:

1. Intersection Projects

10 - Channelization, including left turn bays
11 - Traffic signals, installed or improved
12 - Combination of 10 and 11
13 - Sight distances improved
19 - Other intersection work (except structures, Codes 30-39)

2. Cross Section Projects

20 - Pavement widening, no lanes added
21 - Lanes added, without new median
22 - Highway divided, new median added
23 - Shoulder widening or improvement
24 - Combination of 20, 21, 22 and 23
25 - Skid Treatment/Grooving
26 - Skid Treatment/Overlay
27 - Flattening and/or clearing of side slopes
29 - Other cross section work or combinations of above categories

3. Structures

30 - Widening existing bridge or other major structure
31 - Replacement of bridge or other major structure
32 - Construction of new bridge or major structure (except to eliminate a railroad grade crossing or one for pedestrians only)
33 - Construction or improvement of minor structure
34 - Construction of pedestrian over- or under-crossing
39 - Other structure work

4. Alignment Projects

40 - Horizontal alignment changes (except to eliminate highway grade crossing, Code 52)
41 - Vertical alignment changes
42 - Combination of 40 and 41
49 - Other alignment work

5. Railroad Grade Crossing Projects

50 - Flashing lights replacing signs only
51 - Elimination by new or reconstructed grade separation

52 - Elimination by relocation of highway or railroad
53 - Illumination
54 - Flashing lights replacing active devices
55 - Automatic gates replacing signs only
56 - Automatic gates replacing active devices
57 - Signing and/or marking
58 - Crossing surface improvement
59 - Other railroad grade crossing improvement

6. Roadside Appurtenances

60 - Installation or upgrading of traffic signs
61 - Breakaway sign or lighting supports
62 - Installation or improvement of road edge guardrail
63 - Installation or improvement of median barrier
64 - Installation of striping and/or delineators
65 - Roadway lighting installation
66 - Improvement of drainage structures
67 - Installation of fencing
68 - Impact attenuators
69 - Other roadside appurtenances

7. Other Safety Improvements

90 - Safety provisions for roadside features and appurtenances
99 - All projects not otherwise classifiable