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Projects Division

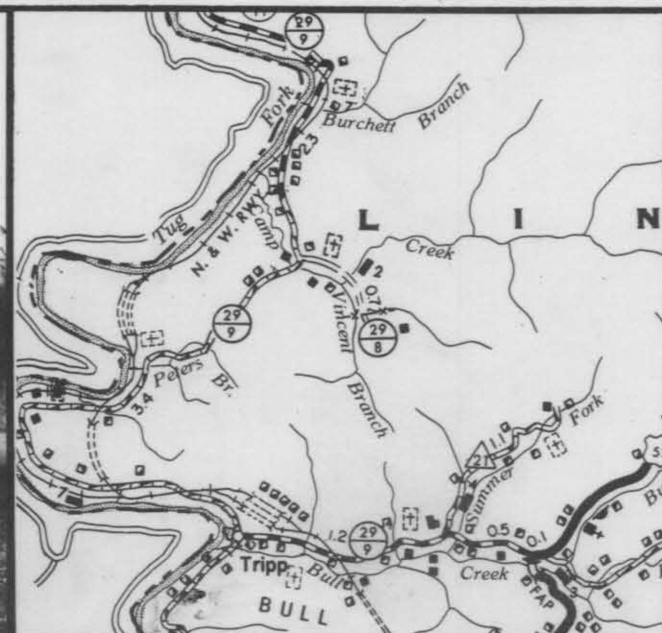
June 1986

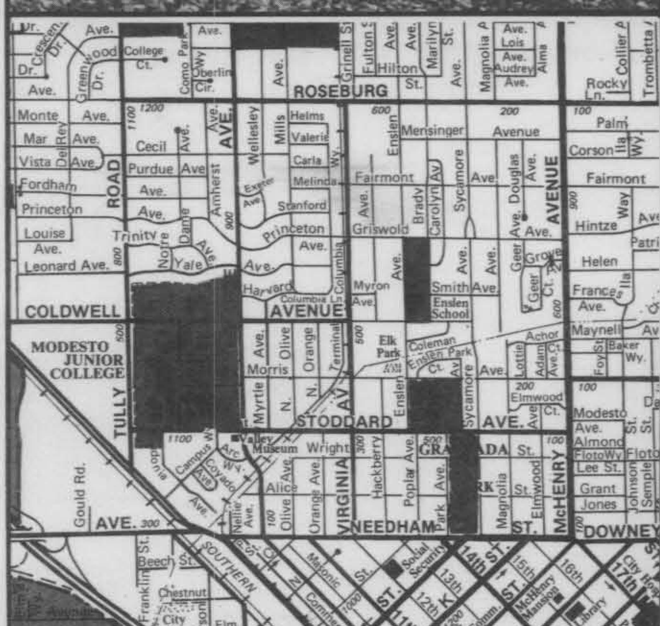
Railroad Crossing Corridor Improvements

A Model Program Based on Field Reviews in Six States

U.S. Department
of Transportation

Federal Highway Administration





NOTICE

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16. Abstract

Since 1973, a special category of Federal-aid highway safety funds (Section 203) has been available for safety improvements at railroad-highway grade crossings. These funds are apportioned to each State highway agency annually and are used to pay 90 percent of the cost of improvements at selected crossings. Over the last 13 years, each State has been able to identify and improve many of its most hazardous crossings, most often by installing train-activated warning devices. There is some concern, however, that too little attention is being paid to the less expensive safety improvements that are needed at a far greater number of crossings.

Demonstration Project No. 70, Railroad Crossing Corridor Improvements, was developed to encourage State highway agencies to expand their current efforts to encompass significantly more crossings each year by including low-cost improvements at the types of crossings that are not presently being addressed.

This report summarizes corridor reviews that were held in six States (Iowa, Florida, Alaska, West Virginia, Louisiana, and California) in late 1985 and early 1986. The final chapter presents a model program which combines the benefits of current individual high-risk crossing programs with those of a corridor approach in which a series of adjacent crossings are reviewed by a diagnostic team.

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Unclassified	Unclassified		

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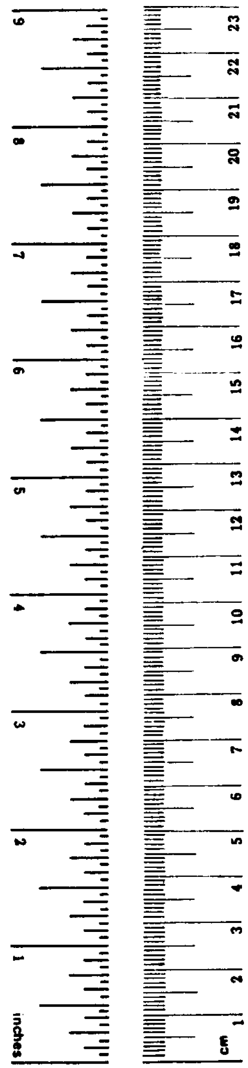
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

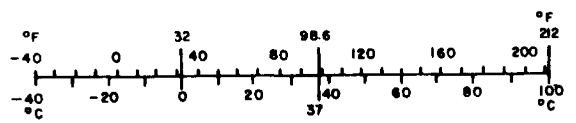
Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



ACKNOWLEDGMENTS

The enthusiastic cooperation of the numerous Federal, State, local, and railroad company personnel who participated in the field reviews conducted under Demonstration Project NO. 70, "Railroad Crossing Corridor Improvements", is very much appreciated.

Special thanks must go to the Demonstration Project No. 70 team members who assisted in the field reviews and provided valuable help in compiling and editing this report. Mr. James M. Overton represented the Federal Highway Administration (FHWA) Office of Engineering-Railroad, Utilities and Programs Branch, Mr. Robert C. Winans represented FHWA's Office of Highway Safety, Policy Development Branch, and Mr. Thomas P. Woll represented the Federal Railroad Administration, Office of Safety.

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I. INTRODUCTION

In 1929, almost 2,500 motorists were killed in the United States as a result of collisions with trains at rail-highway crossings. During the next 50 years, highway mileage increased by one-third, rail freight-tonnage doubled, and the number of registered vehicles increased sixfold. In addition, annual vehicle miles of travel (VMT) increased by a factor of fifteen to 1.5 trillion miles per year. Despite these significant increases in exposure, the number of motorists killed at railroad crossings in 1979 was reduced to 850, about one-third of 1929's death toll. In fact, from a high in 1929, crossing fatalities have been steadily reduced to a record low in 1983 when 512 motorists were killed in collisions involving trains. This reduction in crossing-related deaths has been one of the highway and railroad industries' greatest successes.

There are several reasons for this decrease in fatalities, one of which has been the availability of Federal-aid highway funds for safety improvements at hazardous crossings. These funds have been used by State highway agencies to construct grade separations and to install active warning devices at selected railroad crossings since the Federal-aid highway program began in the early 1900's. Since 1973, a special category of Federal-aid highway safety funds also has been available for crossing safety improvements. These categorical funds, normally called 203 funds after the section of the Federal-aid Highway Act which created the Rail-Highway Crossing Program, are apportioned to each State annually and are used to pay 90 percent of the cost of improvements at crossings selected by the appropriate State agency and approved by the Federal Highway Administration.

Each State is required to establish priorities for its crossing improvements based on:

- the potential reduction in accidents or accident severities,
- the project cost and available resources,
- the relative hazard of each crossing based on a hazard index formula,
- an on-site inspection of each candidate crossing,
- the potential danger to large numbers of people at crossings used on a regular basis by passenger trains or buses, or by trains or motor vehicles carrying hazardous materials, and
- other criteria as deemed appropriate by each State.

As a result of this program, States have been able to identify their higher risk crossings and to improve them systematically over the last 13 years on a crossing-by-crossing basis. Between 1974 and 1985, for example, approximately 900 million dollars in Federal-aid safety funds were used to provide active warning devices at nearly 22,000 crossings. Today, many of the most hazardous crossings have been improved and there is concern that we may be approaching a point of diminishing returns.

Under the current program, low-volume crossings are seldom reviewed by diagnostic teams and any work done at these crossings is usually limited to the installation of crossbucks and advance warning signs. Yet recent statistics show that about half of the annual fatalities are occurring at low-volume crossings where active warning devices may never be practicable. Most of the remaining fatalities occur at crossings where active warning devices are already in place. These deaths are oftentimes attributed to "driver error", and again, the crossings are seldom reviewed by a diagnostic team to determine if cost-effective engineering improvements are feasible and warranted.

Demonstration Project No. 70, "Railroad Crossing Corridor Improvements", was developed to encourage State highway agencies to expand their current programs to encompass significantly more crossings each year and to emphasize low-cost improvements at the types of crossings that are not presently being addressed. It is a two-phase effort consisting of a 1-day seminar which may be followed by an on-site field review of all the crossings along a selected corridor.

The first phase is designed to show that the corridor approach is timely and effective, particularly when used to compliment an existing program based solely on analysis of individual crossings. Special emphasis is given to low-cost improvements.

This report summarizes corridor reviews that were conducted in six States. Two of these States had initiated corridor review programs on their own, one was in the process of developing a statewide program for crossing improvements, and three agreed to undertake a corridor review on a trial basis to ascertain its benefits firsthand.

The final chapter presents a model program which combines the benefits of current individual high-risk crossing programs with those of a systematic corridor review in which several adjacent crossings are evaluated by a diagnostic team. This hypothetical corridor used as an example is composed of actual individual crossings, many of which were reviewed as part of the Demonstration Project No. 70 effort.

II. IOWA

The Iowa Department of Transportation (IDOT), through the initiative of its Rail and Water Division, has developed and implemented the most systematic and comprehensive railroad corridor improvement program in the country. In 1983, this agency made a serious commitment toward low-cost improvements by changing the scope of its Rail-Highway Crossing Improvement Program (Section 203 Program) to include corridor reviews in addition to the traditional individual crossing review and selection procedures.

This approach to crossing safety was formalized in July 1985 with the issuance of IDOT's Policy No. 500.09, "Federal-Aid Section 203 Rail/Highway Safety Program." Under this policy, 60 percent of each year's Section 203 funds are reserved for corridor improvement projects, while the remaining 40 percent are earmarked for improvements at individual crossing locations.

To implement this dual approach, Iowa rail trackage was divided into 164 "line segments", varying in length from approximately 10 to 50 miles. Each individual line segment was then ranked based on the average predicted accident (P.A.) number of all crossings along the corridor and the average exposure index (E.I.). The predicted accident number is computed using the US DOT Accident Prediction Formula (see Appendix A for details); the Exposure Index is derived from a formula developed by the IDOT and includes the factors shown in Table 1. If, for example, a line segment ranked 80th Statewide by its average predicted accident number and 60th by its average exposure index, the "line segment rating" (L.S.R.) for that specific segment would be 140, and it would be considered for funding before any segments with a lower rating.

Under its present policy, the Rail and Water Division notifies railroad and highway authorities by October 1 of each year of the anticipated 203 funding available and provides information on exposure indices, predicted accidents and line segment ratings. Requests for line segment reviews, corridor improvements projects, and individual crossing improvements must be submitted by the appropriate railroad and highway authority by the following June.

Candidate line segments with the highest ratings are selected for review and project development. Individual improvements within a line segment are selected for programming in the following order:

a. low-cost improvements (all crossings)
b. signal improvements if

   (1) E.I. is 1,500 or more and P.A. is .10 or more.
   (2) E.I. is between 500 and 1,500 and P.A. is between .05 and .10 and the cost of signals is less than the cost to clear minimum sight triangles.

EXPOSURE INDEX

AADT x No. Trains x Protection Factor x Angle Factor x Train Speed Factor x No. of Rail Line Factor.

AADT - Average Annual Daily Traffic on Highway.

No. Trains - Number of through train movements plus one-half of switching movements (if value of Number of Trains equals 0, then 0.5 is assigned the Number of Trains.

Protection Factor - Factor for type of protection presently installed

Gates	0.1
Flashing Lights	0.6
Wigwags	0.8
Crossbucks	1.0
Separation	0.00001

Angle Factor - A factor to allow additional credit for crossing angle.

$0\text{-}29^{o} = 2.0$
$30\text{-}59^{o} = 1.2$
$60\text{-}90^{o} = 1.0$

Train Speed Factor - Factor to consider the typical maximum speed over crossing.

60+ mph = 1.0
40-59 mph = 0.9
25-39 mph = 0.8
Less 25 mph = 0.7

No. of Rail Line Factor - Consideration is given to No. of tracks present at crossing.

2 or more mainlines = 1.0
1 mainline + 1 other = 0.85
1 mainline = 0.8
Other Track = 0.75

Note: If exposure index rating appears as 999999.99, then one of the factors is not shown.

TABLE 1: IOWA Exposure Index Formula and Factors

Individual project improvements not within a line segment are selected for programming in the same manner to the extent that funding is available.

All projects selected for funding for a given fiscal year are programmed by September 1.

Adoption of the corridor review process required increased effort by the IDOT. For example, on a typical line segment review, the DOT has assumed responsibility for:

- scheduling the review
- arranging logistics
- providing preprinted inventory forms
- providing print-out of inventory data
- providing copies of accident reports

Changes made by IDOT to handle these increased administrative tasks include:

- increased data processing capabilities
- new file(s) created
- adopted US DOT formula
- created line segment data file
- active role in inventory updating

The Iowa line segment review process began in January 1984. By late 1985, over 1,000 miles of rail line had been reviewed for low-cost improvements. Three full-time and three part-time employees are used by the State for the line segment selections, on-site reviews, and for project development and implementation efforts.

During the week of September 24, 1985, Headquarters office personnel from FHWA and FRA participated in an on-site corridor review conducted by State, railroad and local officials and FHWA Division office personnel. FHWA and FRA personnel from their Regional offices in Kansas City also participated in this activity. The review was coordinated by the Rail and Water Division of IDOT. An excerpt from the State's letter informing participants of the scheduled activities is shown in Figure 1.

The line segment for this review was a 51 mile section of the Chicago and North Western Transportation Company's east-west main line through Ames, Iowa, from Marshalltown to Boone. The segment included 41 public at-grade crossings having an average accident prediction (P.A.) of 0.1122 and an average exposure index (E.I.) of approximately 5,000; it ranked 16th among the State's 164 line segments. Of the 41 crossings, 26 were signalized (flashing lights with or without gates), 3 had wig-wags and the remaining 12

Iowa Department of Transportation
800 Lincoln Way, Ames, Iowa 50010 515-239-1492

August 26, 1985 Ref. No. 403-Statewide

Mr. David Anthoney
Boone County Engineer
Courthouse
Boone, Iowa 50036

Dear Mr. Anthoney:

The Chicago and North Western Transportation Company has requested a line segment review of all at-grade crossings on its east-west main line starting just west of Marshalltown, Iowa westerly to east of Boone, Iowa. A line segment review is a crossing-by-crossing field inspection performed by the Railroad in conjunction with Highway Authorities and the Department. The review is set for the week of September 23, 1985. A map showing the crossings to be reviewed and the schedule are enclosed with this letter. We will start at the most easterly crossing in your jurisdiction as shown on the schedule and progress westerly visiting each crossing completing as many as possible.

We anticipate the following will participate in the review process: The county or city engineer and the county sheriff or city police; railroad signal and engineering forces; and personnel from the Rail and Water Division. The Federal Highway Administration and the Federal Railroad Administration have also indicated they wish to participate. The physical characteristics, accident history, highway and railroad traffic at the crossing will be discussed. Railroad and Highway Authorities will determine what safety improvements should be made at each crossing. Federal Aid "203" Rail/Highway Safety Funds will be made available for safety improvements in accord with the Departmental policy sent to you on July 12, 1985.

This line segment review has been designated as a demonstration project by the Federal Highway Administration. They will document the information they obtain from this review to encourage other states to adopt similar line segment review procedures. I have enclosed a Railroad Crossing Corridor Improvements brochure published by the Federal Highway Administration for additional information.

Please address your questions concerning the line segment review, our new policy, funding of projects or the data sheets supplied with this letter to Mr. Raymond A. Callahan whose telephone number is 515-239-1678.

Sincerely,

Neil Volmer

Neil M. Volmer
Manager, Engineering & Safety
Rail and Water Division

NMV:RAC:dsc
Enclosure

FIGURE 1: Sample letter to participating county

had passive warning devices only. Ten crossings on this corridor (8 with automatic gates and 2 with wig-wags) had already been programmed for improvement as individual projects under the 203 Program. The 8 crossings already having gates were scheduled for new track circuitry (speed predictors) and the 2 wig-wag crossings were scheduled for gates and upgraded track circuits. Twenty-three accidents occurred at crossings along this segment in the preceding 5 years.

Under State policy, the initiative for work on public crossings off the State highway system remains with the appropriate city or county agency or railroad company . The initiating agency must also provide the required 10 percent match for Section 203 funds. Following the review, the railroad company and each highway authority was formally requested to submit any proposed improvement projects resulting from the review to IDOT for possible funding. A copy of the State's follow-up letter to the city of Boone is shown in Figure 2.

Iowa Department of Transportation

800 Lincoln Way, Ames, Iowa 50010 515-239-1678

December 24, 1985

Ref. No. 403-Statewide
Line Segment

Mr. Norman Vegors
Director of Public Works
1410 8th Street
Boone, Iowa 50036

Dear Mr. Vegors:

The Chicago and North Western Transportation Company (CNW) and highway authorities recently completed a Line Segment Review of the at-grade crossings of the CNW east-west mainline. Crossing(s) under your jurisdiction was (were) reviewed to determine what safety improvements should be made. During the review, this office informed you or your representative of the availability of 203 Rail/Highway Safety Funds under the Departmental Policy previously sent.

We requested you submit any proposed safety projects at your crossing(s) for 203 funding consideration. Such proposals were to be sent to Mr. Rick Brown, Railroad Safety Agent, Rail and Water Division, Iowa Department of Transportation, 800 Lincoln Way, Ames, Iowa 50010. Rick's phone number is (515) 239-1511.

This letter is to remind you that Policy requires these projects to be submitted prior to June 1 for consideration in the 1987 safety program. In your review of your crossing(s), please take particular note of the crossing(s) used on a regular basis by school buses, transit buses, pedestrians, bicyclists, or by train and/or motor vehicles carrying hazardous materials. Your early note or letter to Rick about any of your proposals will ensure a proper review and consideration under this safety program.

Please inform me of any questions you have about the Line Segment Review process recently completed or of the Departmental Policy No. 500.09 entitled "Federal-Aid Section 203 Rail/Highway Safety Program" at the above telephone number.

Sincerely,

Raymond A. Callaran
Rail/Highway Crossing Supervisor
Rail and Water Division

RAC:dsc

cc :N. Volmer
J. Latterell
R. Brown
R. Humby

FIGURE 2: Follow-up letter to the city of Boone

III. FLORIDA

In 1972, the Florida legislature assigned the State Highway Department the responsibility for all public rail-highway crossings in the State. This responsibility included determining the need for warning devices at individual crossings, the authority for opening and closing crossings, and the regulation of maximum train speeds.

When the 1973 Highway Safety Act provided separate funding for crossing safety improvements, the Department established an objective of installing active warning devices at approximately 200 crossings each year. This program was implemented in 1974, and by 1981, the total number of train-vehicle collisions had been reduced by 39 percent. Fatal accidents at crossings decreased by 60 percent during this period. However, the cost to reduce these collisions had increased from $19,000 per accident in 1974 to $44,000 per accident in 1980. The State concluded that it had reached a point of diminishing returns and revised its procedures for project selection.

Improvements now fall into one of three categories: hazardous crossings, special cost-effective improvements and corridor improvements.

Hazardous Crossings

Individual crossings having a Florida Safety Index of less than 70 (which approximates one accident in 20 years) are identified each year and become candidates for installation of flashing lights and/or gates. This Safety Index is derived from a mathematical model which considers the following items:

- ADT
- Number of trains
- Train speed
- Vehicle speed
- Sight distance (to the crossing)
- Sight distance (to an approaching train)
- Number of highway lanes
- Number of tracks
- Existing warning devices
- Accident history
- School buses

Appendix B contains the detailed formula from which the Safety Index is derived.

Each grade crossing is ranked according to its Safety Index. Approximately 50 crossings having the highest potential for accidents are then given priority for the installation of active warning devices each year.

Special Projects

This portion of the State's program identifies various improvements that are considered more cost-effective than the installation of lights and gates and projects where these lower cost improvements can be implemented. Examples of such improvements are installation of constant warning-time track circuits, increased visibility of warning lights, and improvements to traffic signals at nearby highway intersections (or use of signs) to prevent vehicles from stopping on the tracks. These types of improvements are, of course, equally applicable to corridor improvement projects.

Corridor Safety Improvements

Track segments are selected for an on-site safety study if they satisfy at least two of the following conditions:

- o Abnormally high percentage of grade crossings with passive warning only.
- o Freight trains carrying hazardous material.
- o Passenger train routes.
- o Plans for increased rail traffic.

The identified track segments are surveyed by a diagnostic team to determine the improvements necessary to establish a reasonably safe operating environment. An improvement is any work that improves safety or operations at a crossing. Improvements may be made to existing active warning devices such as increasing lens size, adding gates and/or cantilever arms or improving track circuitry. Other improvements can involve better highway geometrics, advance warning signs and/or pavement markings, and sight distance improvements.

When the track segment under investigation passes through a municipality, all crossings are analyzed to determine if any are candidates for closure. All crossings not closed are considered for signalization.

Organizational responsibilities for Florida's Rail-Highway Crossing Improvement Program are divided between several departmental units. The Bureau of System Statistics is responsible for maintaining the crossing data base, the Safety Office has prime responsibility for hazard identification and accident analysis, and the Rail Bureau is responsible for the crossing closure program and overall program evaluation. Once a project is programmed, district office personnel assume responsibility for its implementation.

Florida's corridor reviews began in early 1985 on the Seaboard System Railroad line between Jacksonville and Pensacola. Segment reviews along this line were scheduled and conducted by individual DOT district railroad coordinators.

The State DOT, having agreed to participate in Demonstration Project No. 70, selected that portion of the Seaboard line through Suwannee County for a review in which FHWA, FRA, railroad officials, county/city, and several DOT personnel participated. This segment had previously been reviewed by district personnel and was used primarily as a training exercise for State personnel from other highway districts and to allow FHWA and FRA personnel an opportunity to observe the review procedures followed and to evaluate the original recommendations made for each crossing.

The corridor included 29 public at-grade crossings and consisted of one main track with switching tracks at some of the crossing locations. Train traffic averaged 8 freight trains per day along the corridor. Signal installations were ultimately recommended at 11 crossings, miscellaneous non-signal improvements were suggested at 12 locations, and 6 crossings were recommended for closure.

One outcome of this joint review was a perceived need to develop guidelines for use in future reviews. Uniform guidelines will ensure consistency between State highway districts and will streamline the overall corridor review process. The draft guidelines subsequently developed are included as Appendix C.

IV. ALASKA

The State of Alaska is unique in several respects , one of which is the operation of only one major railroad company - the Alaska Railroad - within its boundaries. The rail line extends northerly from Seward on the Gulf of Alaska, through Anchorage, to Fairbanks in the central region of the State, a distance of approximately 500 miles.

Originally owned and administered by the FRA, the Alaska Railroad was transferred to State ownership in January 1985, at which time a specific need to develop a comprehensive Statewide policy on rail-highway crossing safety was identified. In a letter dated October 9, 1985, Mr. R. J. Knapp, Commissioner for the Department of Transportation & Public Facilities established a task force to "assess existing technology on rail-highway crossings, classify State crossings based on ... their individual characteristics, develop recommended standards for each class, and propose a process to upgrade existing crossings..."

On October 28, 1985, this task force met with FHWA and FRA personnel from their Region 8 (Portland, Oregon) and Headquarters offices to discuss this mandate in conjunction with Demonstration Project No. 70. At this meeting, the Commissioner elaborated on the objectives of his task force , stating that a three-phase rational approach to a crossing safety improvement program was envisioned. Phase I would be the development of a set of standards for each type or class of crossing in the State. Phase II would be a 100 percent inventory of all public crossings and the appropriate classification of each. The final phase would be the development of a priority improvement program based on the work needed at each crossing to bring it to the appropriate standard identified in Phase I.

The meeting was followed by a field review of several crossings in and around Anchorage. The Field Reconnaissance Form (Figure 3) and the Crossing Improvement Summary (Figure 4) used by the State are good examples of the type of documentation that should be used to record the diagnostic team findings and recommendations at each crossing.

In early 1986, the task force completed its work. Appendix D is the draft text of the policy that is expected to be formally adopted and implemented. Some of its key elements are summarized below:

- o The National Rail-Highway Crossing Inventory will be updated annually.

- o The US DOT accident prediction formula will be used as one factor to prioritize crossings for improvements.

ALASKA DOT/PF CENTRAL REGION
RAILROAD CROSSING FIELD RECONNAISSANCE FORM

HAZARD INDEX PRIORITY RANKING ____________ HAZARD INDEX NUMBER ____________ DATE ____________

RAILROAD INFORMATION	HIGHWAY INFORMATION
CROSSING ID # ____________	ROUTE NAME & CDS # ____________
RAILROAD M.P. ____________	HIGHWAY M.P./LOCATION ____________
☐ NUMBER OF TRACKS	☐ ON SYSTEM ☐ OFF SYSTEM
TRAIN SPEED ____________	POSTED SPEED LIMIT ____________
REQUIRED SIGHT DIST. ON TRACKS ____________	REQUIRED SIGHT DISTANCE ON HIGHWAY ____________
RAILROAD CROSSING SURFACE ____________	HIGHWAY SURFACE ____________

APPROACH DATA
GRADIENT

☐ UP ☐ DOWN ☐ LEVEL

CURVATURE

☐ RT ☐ LEFT ☐ STRAIGHT

OF TRAFFIC LANES ____________

OF DRIVEWAYS WITHIN 200' ____________

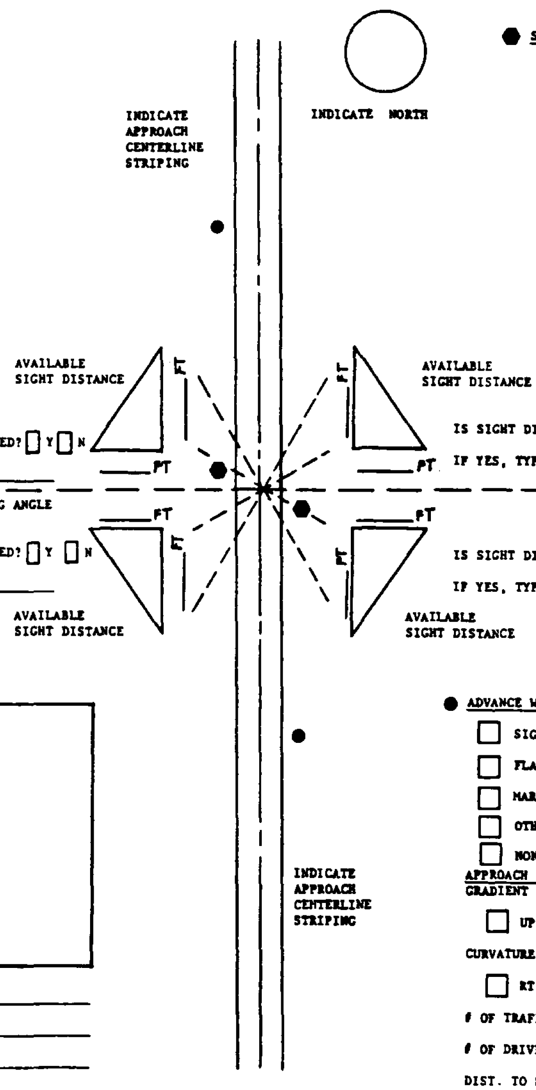
DIST. TO NEXT INTERSECTION ____________

● ADVANCE WARNING — DIST. FROM RR TRACKS

☐ SIGNS ____________
☐ FLASHERS ____________
☐ MARKINGS ____________
☐ OTHER ____________
☐ NONE

● SIGNAL TYPE — MOUNTING

☐ CROSSBUCK ____________
☐ STOP SIGN ____________
☐ FLASHER ____________
☐ BELLS ____________
☐ GATES ____________
☐ ILLUMINATION ____________
☐ STOP BARS ____________
☐ OTHER ____________



IS SIGHT DISTANCE OBSTRUCTED? ☐ Y ☐ N
IF YES, TYPE ____________

IS SIGHT DISTANCE OBSTRUCTED? ☐ Y ☐ N
IF YES, TYPE ____________

INDICATE APPROX. CROSSING ANGLE ON DASHED LINE

IS SIGHT DISTANCE OBSTRUCTED? ☐ Y ☐ N
IF YES, TYPE ____________

IS SIGHT DISTANCE OBSTRUCTED? ☐ Y ☐ N
IF YES, TYPE ____________

SUPPLEMENTAL SKETCH

☐

COMMENTS ____________
____
____

hv:

● ADVANCE WARNING — DIST. FROM RR TRACKS

☐ SIGNS ____________
☐ FLASHERS ____________
☐ MARKINGS ____________
☐ OTHER ____________
☐ NONE

APPROACH DATA
GRADIENT

☐ UP ☐ DOWN ☐ LEVEL

CURVATURE

☐ RT ☐ LEFT ☐ STRAIGH

OF TRAFFIC LANES ____________

OF DRIVEWAYS WITHIN 200' ____________

DIST. TO NEXT INTERSECTION ____________

FIGURE 3: Sample Field Review Form

ALASKA DOT/PF CENTRAL REGION
RAILROAD CROSSING IMPROVEMENT SUMMARY

DATE: ______________

RAILROAD | HIGHWAY

CROSSING ID #: ______________ ROUTE NAME & CDS #: ______________

RR MILEPOINT: ______________ ROUTE M.P./LOCATION: ______________

OF TRACKS: ______________ ☐ ON SYSTEM ☐ OFF SYSTEM

DATE OF LAST CROSSING IMPROVEMENT: ______________

	1976	1977	1978	1979	1980	1981	1982	TOTAL
ACCIDENT HISTORY								

REMARKS: ______________

TRAFFIC CONTROL DEVICE (TCD) TYPES	TYPE OF TCD IN USE	PROPOSED TCD IMPROVEMENT
GATES		
ADVANCE FLASHING		
AT TRACK FLASHING		
ADVANCE SIGNING		
ADVANCE PAVEMENT MARKINGS		
CROSSBUCKS		
CROSSING SURFACE		
ILLUMINATION		
STOP SIGNS		

PREPARED BY: ______________

FIGURE 4: Sample Summary Form for review team recommendations

- Those crossings having an accident prediction of 0.10 or higher (i.e., one or more predicted accidents in a 10-year period) will be considered for the installation or upgrading of active warning devices.

- The final decision on the extent of safety improvements at any specific crossing will be made by a professional diagnostic team after an on-site review.

- The diagnostic team will include appropriate representatives of local jurisdictions.

- Where possible, upgrades and improvements to the roadway and the crossing should be done whenever there is another project affecting the roadway or railway in the area of the crossing. For example, if the railroad is replacing ties and re-ballasting a section of track, all crossing surfaces should be renewed and/or extended as necessary at the same time.

- Twelve-inch roundels will be used for flashing light signals.

- All crossbucks will have reflective sheeting on both sides.

- If a crossing designated as **private** has in fact become **public** through usage, every attempt will be made to reclassify the crossing. This normally will require acceptance of the highway by a public authority for purposes of maintenance.

- Signing at all private crossings will include standard advance warning signs and crossbucks, a private crossing sign, and in some cases, stop signs.

V. WEST VIRGINIA

Since the early 1970's, West Virginia has had an active rail-highway grade crossing diagnostic team comprised of State, FHWA and railroad company officials. One of the primary functions of this group is to identify individual crossings for inclusion in the State's annual Section 203 Program. Using information from the various railroads, the US DOT accident prediction model, FRA accident report summaries and other sources, numerous candidate crossings are selected for field review each year. During this review, a sufficiency rating is calculated for each crossing. Half of this rating (up to a 50 point maximum) is based on the Peabody-Dimmick Hazard Index which considers highway traffic, train traffic, and existing warning devices; the remaining possible 50 points are based on existing sight distances, crossing angles, train speeds and number of main tracks. A subjective "people" factor and a hazardous materials factor are considered in each case. Individual crossings are then selected from the resultant list by the diagnostic team and programmed for Federal funds.

Field reviews of all the crossings on the program are then made by State and FHWA engineers and appropriate representatives of the railroad involved. This diagnostic team determines what devices will be installed at each crossing and their exact locations. Other important factors investigated during this review include the width and condition of the existing surfaces, verification of train speeds and volumes, availability of rights-of-way, necessity for approach highway work, and type of track circuitry required. A field review sheet is then prepared for each crossing, documenting the scope of work and showing the exact locations and sizes for all warning devices. These field reviews are considered essential in reducing problems during the detailed design phase and thus can expedite actual construction.

Since crossing improvements under the Section 203 Program began in West Virginia, signals have been installed or upgraded at over 300 of the 2,400 public grade crossings in the State. West Virginia's annual $2.0 million Section 203 apportionment enables about 30 crossings to be upgraded yearly. It has become more challenging to select appropriate crossings for upgrading each year since many of the more hazardous crossings have already been upgraded .

Consequently, the State expressed an interest in low-cost improvements on selected corridors as advocated under Demonstration Project No. 70, "Railroad Crossing Corridor Improvements". In a letter to the FRA dated July 8, 1985, State Highway Engineer Fred Van Kirk identified six rail corridors for possible review and requested detailed inventory and accident data for each. As shown in Table 2, these corridors varied considerably in length and number of crossings. Table 3 is a summary of the accident prediction values and actual accident histories for the six candidate corridors.

1. __Corridor #1__

Railroad:	Conrail
Locations:	Amherst to Cornelia
Mileage:	52.54
Crossing Numbers:	517-196D to 517-303R
Total Crossings:	54 public-at-grade 106 Total

2. __Corridor #2__

Railroad:	B&O
Locations:	Clarksburg to Ohio River Bridge
Mileage:	89.00
Crossing Numbers:	146-540B to 146-705W
Total Crossings:	85 public-at-grade 154 Total

3. __Corridor #3__

Railroad:	B&O
Locations:	Grafton to Burnsville
Mileage:	203.77
Crossing Numbers:	146-617J to 146-808W 146-814A to 146-848U 146-872V to 146-937L
Total Crossings:	121 public-at-grade 280 Total

4. __Corridor #4__

Railroad:	C&O
Locations:	Sproul to Whitesville
Mileage:	32.89
Crossing Numbers:	226-149 to 226-199U
Total Crossings:	17 public-at-grade 51 Total

5. __Corridor #5__

Railroad:	C&O
Locations:	Barboursville to Man
Mileage:	79.24
Crossing Numbers:	226-492K to 226-632K
Total Crossings:	63 public-at-grade 140 Total

6. __Corridor #6__

Railroad:	N&W
Locations:	Crum to Kenova
Mileage:	33.60
Crossing Numbers:	471-602 to 471-661S
Total Crossings:	16 public-at-grade 56 Total

TABLE 2: Identification and characteristics of candidate corridors

Corridor No. 6, with 16 public crossings, had the highest individual crossing accident prediction (.6125 accidents per year), the highest average accident prediction (.1295), and the highest average number of accidents per crossing (.9375) based on its 5-year accident history. This corridor was then selected for a detailed on-site review.

Most of the crossings had relatively low highway volumes, typically under 100 vehicles per day, and most had two mainline tracks. Active warning devices were in place at four of the crossings (three had flashing light signals with gates and one had flashing light signals only). STOP signs had been erected at a few of the low-volume locations. Inventory data indicated up to 40 trains per day operated on this line at speeds between 40-50 mph.

The review team recommended improvements that ranged from closing some crossings to installing active warning devices at others. Other improvements included new signing, signing modifications, and approach roadway work.

Inventory Date: March 1985

Corridor	Number of Public Crossings	Maximum Accident Prediction	Total Accident Prediction	Number of Accidents Per Year					5-Year Total Accidents	Average Per Crossing	
				80	81	82	83	84		Accident Prediction	5-Year Total Accidents
Corridor #1	54	.1457	1.8711	0	0	0	0	1	1	.03465	.01852
Corridor #2	85	.5700	3.7134	3	7	3	0	2	15	.04369	.17647
Corridor #3	121	.5700	6.1287	4	5	9	6	6	30	.05065	.24793
Corridor #4	17	.0947	.5125	0	0	0	0	1	1	.03015	.05882
Corridor #5	63	.4709	4.7442	4	2	9	5	1	21	.07530	.33333
Corridor #6	16	.6125	2.0723	3	1	2	4	5	15	.12952	.93750

TABLE 3: Summary of accident prediction values for candidate crossings

VI. LOUISIANA

Louisiana has traditionally used a modified New Hampshire Hazard Rating Index to identify candidate crossings for improvement under the State's Section 203 Rail-Highway Crossing Improvement Program. This index is the product of highway traffic, train traffic, and a variable protection factor, divided by 1000.

The protection factors used by Louisiana are:

o gates and cantilevered flashing light signals	0.105
o gates	0.11
o cantilevered flashing lights	0.15
o flashing lights	0.20
o wig-wags and bells	0.34
o pavement markings	0.48
o signs	0.58
o crossbucks	1.00
o no signs	1.50

In general, active warning devices are not recommended at crossings having a Louisiana Priority Index less than 2.00. Under this system, Louisiana has installed active warning devices at essentially all crossings on State and Federal-aid highways where they are warranted and will concentrate primarily on upgrading or replacing obsolete or inadequate active warning devices in the future. Additional active warning device needs on local roads and streets are also being identified and programmed.

Louisiana's 1984 accident data reported 222 motor vehicle accidents at railroad crossings. Of these, 158 (or 71 percent) occurred at locations with passive warning devices only. Of the 23 fatalities that year, 16 (or 74 percent) occurred at passive warning crossings. This may indicate that more attention should be directed towards low-volume crossings and that more emphasis should be placed on low-cost corridor-wide improvements.

Following the Phase I seminar of Demonstration Project No. 70 in Baton Rouge on December 11, 1985, a corridor review was scheduled and held in the city of Kenner on December 13. This particular corridor was suggested by FRA regional office personnel from Fort Worth, Texas, based on available inventory and accident data. There were other candidate corridors suggested, but the Kenner segment appeared to be an excellent starting point and city officials were particularly interested in participation in this effort.

The track segment reviewed is owned by the Illinois Central Gulf Railroad; it parallels a segment of track previously operated by the Kansas City Southern Railroad, whose trains now operate on the ICG tracks. The area around the tracks is zoned residential for the most part, with some special industrial areas. The corridor consists of two mainline tracks carrying approximately 20 trains per day at 20 mph. Only two of the crossings had active warning devices.

The field review revealed that many of the crossings were very close together and most were used quite frequently by school buses. Because of the two main tracks, any active warning devices installed with Federal funds would have to be flashing light signals with gates. Unfortunately, current traffic counts were not available, so the relative degree of hazard of each crossing could not be readily determined, nor could any recommendations for crossing closures be made during the initial review. Kenner city officials were requested to obtain this information (see Figure 5) so that specific recommendations for corridor improvements can be made.

It is noteworthy that at one crossing, vines had completely obscured the crossbuck on one side of the tracks, and that at another, the flashing light signals had been damaged and were apparently inoperative. Within an hour, both deficiencies had been corrected.

May 9, 1986

Railroad Crossing Review
Demonstration Project No. 70

The Honorable Aaron F. Broussard
Mayor, City of Kenner
1801 Williams Boulevard
Kenner, Louisiana 70062

Dear Mayor Broussard:

On December 11, 1985, a seminar entitled, "Project No. 70/Railroad Crossing Corridor Improvement Seminar", was held at the State Police Training Academy in Baton Rouge. Because Kenner is considered a good candidate for a corridor improvement project, a field review of the railroad crossings within your city was made on December 13, 1985. Messrs. Jake Scardino and Keith M. Chiro represented the City of Kenner. Other representatives involved in the review included personnel from the railroad, Federal Railroad Administration (FRA), the Louisiana DOTD Railroad Section, and the Federal Highway Administration (FHWA).

All ICG and KCS railroad grade crossings within the Kenner City limits(between Alliance Street and Filmore Street) were reviewed. Traffic data (ADT) for each crossing is needed to complete the evaluation. It was agreed that the City would provide the traffic information; a time frame of two months was estimated.

As of this date, the traffic information has not been received. Based on conversations with Highway Safety Commission personnel, it is our understanding that Jefferson Parish and the local State Highway District are willing to assist with traffic counters and advice.

Once the traffic information is received it will be forwarded to our Washington office so that the railroad crossing analysis can be completed. After the analysis is completed, improvements to the various crossings will be recommended for implementation.

Your assistance in obtaining and providing the traffic information will be appreciated. We all share a common interest in providing the general traveling public with the safest possible railroad crossings within the City of Kenner.

Sincerely yours,

JAMES N. McDONALD

J. N. McDonald
Division Administrator

SSerna:dc

FIGURE 5: Follow-up request to Kenner city officials

VII. CALIFORNIA

The State of California had established an on-going crossing safety improvement program prior to passage of the 1973 Highway Safety Act which established categorical safety funding at the national level. In 1953, for example, the State legislature established a Crossing Protection Fund to assist cities and counties in paying their share of the cost to install automatic warning devices at rail-highway crossings. Under that program, the railroads and public agencies involved in a specific project ordinarily shared expenses on a 50/50 basis. The Crossing Protection Fund was used to pay up to one-half of the city or county share.

In 1957, the State legislature established a fund to assist cities and counties in financing crossing elimination projects on city streets and county roads. Although this fund was administered by the State Highway Commission, priorities for use of this money were set by the Public Utilities Commission (PUC).

When Federal railroad crossing improvement funds (Section 203) became available after 1973, the PUC was charged with setting priorities for the use of these funds. Specific requests from cities and counties for the installation of active warning devices were reviewed by the PUC and each approved project was included in the Statewide Rail-Highway Crossing Improvement Program. All projects appearing on the Statewide listing are considered eligible for funding and are advanced to construction on a first-come, first-served basis. The review team uses the New Hampshire Formula to establish relative priorities, but makes improvement recommendations based on a detailed on-site review. However, projects appearing on the official priority list can be advanced to construction in any order.

As is presently the case in most States, California's program focuses on individual crossings and virtually all recommendations for improvements include automatic warning devices. In fact, 37 percent of California's public at-grade crossings have train activated gates, compared to 10 percent nationally.

As a result of a Demonstration Project No. 70 Seminar held in Sacramento in November 1985, State officials agreed to participate in a corridor review and identified seven candidate corridors for a detailed analysis. Available information on each corridor was summarized and analyzed in a manner similar to the West Virginia procedure outlined in Chapter V. After reviewing the results of this analysis, the State decided to review a Union Pacific (formally Tidewater Southern) line in the City of Modesto.

At a meeting in late April 1986, Modesto city officials met with personnel from Caltrans, the California PUC, Federal Highway and Federal Railroad Administration Engineers and railroad officials prior to conducting the on-site corridor review. The Union Pacific tracks enter Modesto at the north city limits and run due south through several residential areas. As the tracks approach the downtown area, they swing southwesterly before entering 9th Street. Here they turn south and run down the center of 9th street for approximately 14 blocks before they cross the Tuolumne River and the south city limits. Through train traffic is only four trains per day, but there are several switching movements along the 9th Street segment of the line. The city has attempted for many years to relocate the 9th Street tracks one-half block west to use the existing Southern Pacific Transportation Company right-of-way. This action would eliminate 14 crossings along 9th Street and result in the Union Pacific trains utilizing existing SP crossings already having active warning devices. Figure 6 shows the final recommendations made by a consulting firm hired by the city.

Although this relocation/consolidation is outside the scope of work normally suggested as part of a corridor review, it is eligible for Section 203 funding to the extent agreed upon by State, local and railroad officials and by Federal Highway Administration field personnel.

As an interim measure, all streets intersecting 9th Street should have crossbucks and advance warning signs to indicate the presence of a track in the center of the street. Since this is a relatively rare occurrence, special warning signs might be appropriate. It is also important that the locations where the trains enter 9th Street be clearly identified since these are the locations where most accidents have occurred in the past.

In addition to the downtown area, the review team looked at all the crossings north of 9th Street. Of these 14 crossings, 12 were equipped with automatic gates and two had crossbucks only. The city had recently applied to the California PUC for a new crossing to improve traffic circulation through two recently completed neighborhoods.

Both of the two passive warning crossings had restricted sight distances in at least one quadrant. At least one appeared to be an excellent candidate for closure. The feasibility of closing or adding gates to the second passive crossing should also be investigated. If either option is implemented, all public crossings from College Avenue to the north city limits would have train-activated gates.

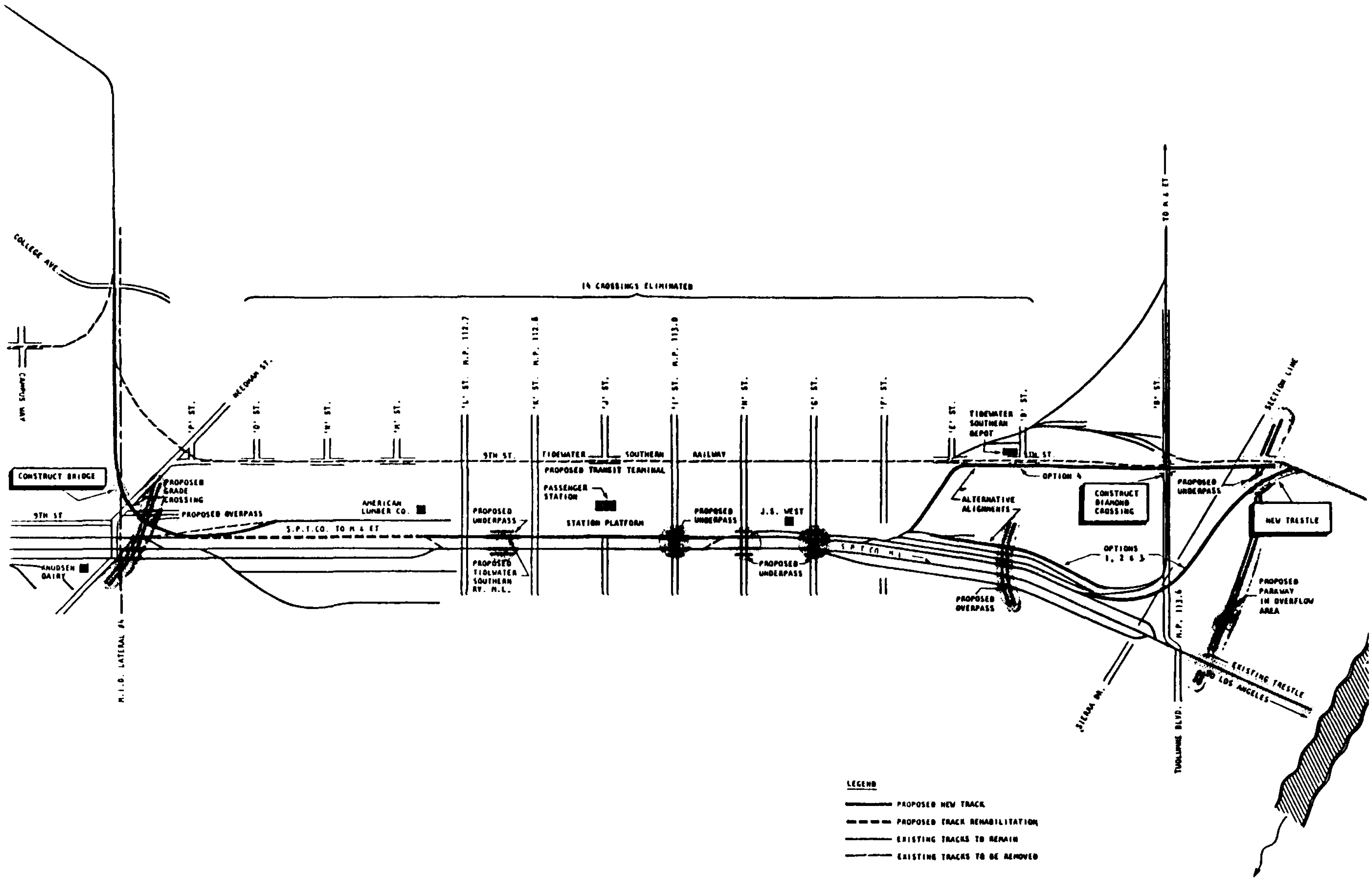


FIGURE 6: Proposed track relocation plan

Several of the gated crossings had trees near the tracks which could obscure a motorist's view of both the flashing light signals and the the gates in their upright position. This may not be unduly hazardous when traffic speeds are low, but can decrease a motorists' reaction time when highway approach speeds are higher. Typically, gates are installed when sight distance down the tracks is limited so it is important that the gates themselves can be readily seen as a motorist approaches a crossing. Likewise, several of the advance warning signs were partially hidden by trees and/or were located too close to the crossing to serve their intended purpose.

In general, the crossings in Modesto were in very good condition. The crossing surfaces were exceptionally wide and smooth compared to other corridors that had been reviewed. While the signs and markings were not always optimally placed, they were present at virtually every crossing north of College Avenue.

VIII. A MODEL PROGRAM

An effective Rail-Highway Safety Improvement Program which includes corridor reviews must consist of three elements: corridor selection, on-site crossing reviews, and a systematic method for completing all recommended improvements. Each of these elements are discussed in this chapter.

PART 1: SELECTING A CORRIDOR

The primary goal of the Section 203 Rail-Highway Crossing Improvement Program is to reduce the number and severity of accidents between trains and motor vehicles. The continual decline of such accidents attests in part to the success of this effort. However, programs which were very effective in the 1970's may be less so today, simply because many of the most dangerous locations have been improved. It remains in the best interests of all concerned that available funds be spent wisely. Each agency which administers the 203 Program is encouraged to review its current procedures to ensure cost-effective use of Federal funds as well as other monies available for crossing improvements. This review should encompass three areas: **Problem definition, objectives**, and **methodology.**

Problem definition

In virtually all States, both the total number of motor vehicle-train accidents and the resulting fatalities are relatively small. For example, in 1985, the average number of accidents per State was 120 and the average number of fatalities was only about 10. Each State agency should analyze these accidents annually to determine if 203 funds are being spent at those crossings or classes of crossings where correctable accidents are most likely to occur and for the types of improvements most likely to reduce or eliminate these accidents. The results of such an analysis should indicate if a State's current program represents the best use of 203 and other funds.

Objectives

The primary objective of categorical safety funding for railroad crossing improvements is to reduce the total number of crossing accidents and to reduce the severity of those that do occur. To meet these objectives, it is essential that the nature and extent of each State's problem be clearly defined as indicated above.

Methodology

Once a State's rail-highway crossing problem is clearly defined, the selection of an appropriate program can be made. Essentially, four options exist:

- o Individual Crossings only
- o Corridors only
- o Individual Crossings and Corridors (parallel programs)
- o Individual Crossings with Corridors (expanded program)

Each of these options are discussed below:

Individual crossings

This is essentially the historical approach in use by most highway agencies today. It has resulted in individual crossings being selected from priority lists and generally improved by installing or upgrading active warning devices. Since these improvements generally range in cost from $40,000 to over $100,000, relatively few crossings are done each year. If a State's accident analysis reveals that many of its accidents and of most of its fatalities are still occurring at crossings which rank high on their statewide priority lists, then this approach may be the most effective and should probably be continued.

Corridors

Alaska is the only State whose program is essentially based on a review of all crossings along a corridor. This is practical only because the State has a single major railroad and only one corridor. This corridor has a relatively low number of public at-grade crossings (approximately 200). For most States, a program based only on corridor projects would not be feasible and, in fact, could be detrimental from a legal standpoint if an accident occurred at a relatively high-risk individual crossing that was not included in the State's program. However, for those States which have both a limited number of total crossings and relatively few accidents and fatalities each year , a corridor approach might be the best way to generate low-cost improvements at a large number of crossings per year and may, in fact, prove to be an exceptionally cost-effective means of reducing accidents and liability to their lowest levels.

Individual Crossings and Corridors

This is the approach currently used by Iowa and Florida. It consists in effect of two separate programs operating simultaneously. High-priority **individual crossings** are identified and improved but high-priority **corridors** are also singled out for field reviews.

The existence of parallel programs may not significantly increase the workloads of the agencies involved, particularly if an effective data processing system is available to identify individual crossings and corridors for review. However, any project which involves work by two or more agencies must be carefully coordinated. This requires the capability of the lead agency to follow up on the field reviews to ensure timely project development and implementation.

Railroad and local highway agency personnel are usually very interested in safety improvements at their crossings when they become aware of hazard index and/or accident prediction ratings at specific locations. Given the opportunity to upgrade several adjacent crossings under a single project, railroad companies may be more willing to provide some or all of the 10-percent match that is required when Federal 203 funds are used.

Individual Crossings with Corridors

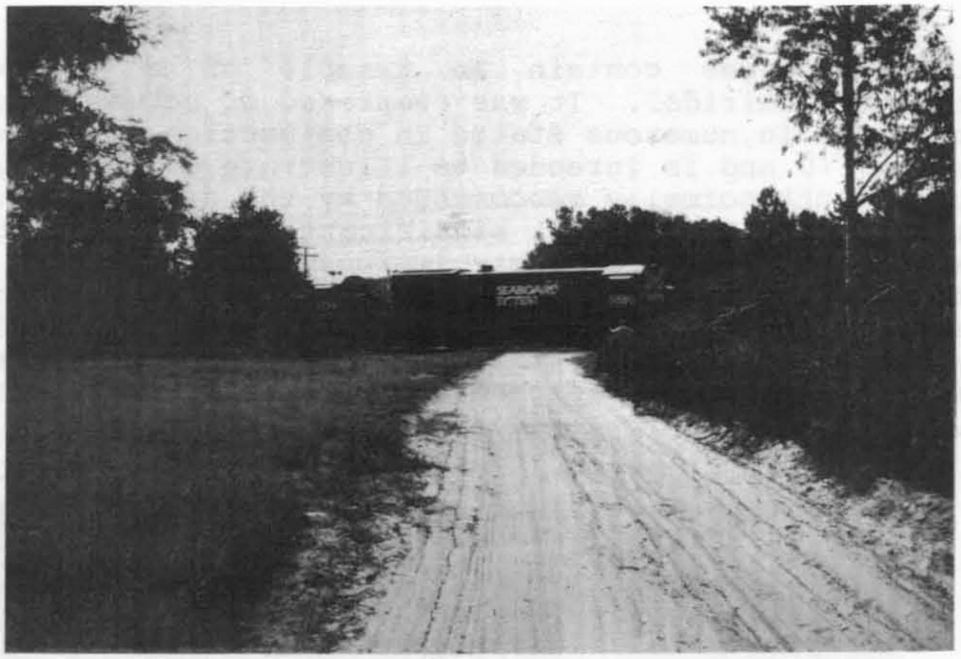
This approach may best be described as an expanded individual crossing program. Using this method, individual high-priority crossings form the nucleus of each project, but adjacent crossings are also reviewed by the diagnostic team. Appropriate improvements are then recommended for each location and included in a single project for funding. Based on the locations of the high-priority crossings, all crossings within a city or within a county could be reviewed and included in the project. Thus each project could be packaged quite readily and would involve the State highway agency, the appropriate railroad company and one local agency. This approach could increase by a factor of ten or more the number of crossings that are reviewed by a professional diagnostic team each year in each State, thereby significantly improving the safety characteristics of rail-highway crossings nationwide.

PART 2: REVIEWING THE CROSSINGS

The following pages contain an example of a review along a hypothetical corridor. It was comprised of actual crossings that were reviewed in numerous States in conjunction with Demonstration Project No. 70 and is intended to illustrate graphically the types of improvements normally recommended by the diagnostic teams. Two factors in particular will significantly expedite both the field review and the resultant safety improvements. These are the prior development and use of guidelines that clearly identify the standards to be applied to each crossing, and the use of a field review form upon which the recommended improvements at each crossing and the agency responsible for their implementation are noted.

The crossing shown above is a good example of the inappropriate use of a Stop sign. Intended here strictly as a speed control measure, these signs were completely ignored by motorists using this crossing because the sight distance was virtually unlimited. There was no perceived need to reduce speed, much less come to a complete stop. Immediate removal of these signs was recommended.

If a speed reduction is considered desirable by a diagnostic review team, an advisory speed plate may be used with the advance warning sign. In some cases, a reduction in the posted speed limit may be warranted.



This low volume rural crossing has extremely restricted sight distance and no advance warning sign on this approach. The train is difficult to see during the day, and would be much less visible if it occupied the crossing at night. Depending on actual conditions at this or similar crossings, it might be a candidate for illumination. Conditions such as nighttime train operations, low train speeds, frequent blockages of the crossing after dark, or a history of accidents involving motorists unable to see a train on the crossing at night may suggest a need for lighting. Street lighting can usually be installed for less than $5,000 if commercial power is readily available. It was not feasible to close this crossing in spite of a low traffic count.

Recommendations included brush clearing, installation of an Advance Warning sign, a Stop Ahead sign, and a Stop sign at the crossing. Stop signs should normally be used only where highway traffic is below 400 ADT in rural areas (1500 ADT in urban locations), train traffic is approximately ten movements per day or more, and the sight distance requires motorists to reduce their speed to 10 miles per hour or less to cross safely. When used at a crossing, the Stop sign **must** be preceded by a W3-1a (Stop Ahead) sign. It is permissible to mount the Stop sign below the crossbuck if all MUTCD placement requirements can be met.

Although the train activated wig-wag was a reasonably effective warning device when highway speeds were in the 30 mph range, it is a non-standard device today. If the crossing still warrants active devices, these signals should be replaced. Diagnostic team members must be familiar with their State's criteria for the use of active warning devices. Some agencies have established threshold values for a hazard rating or safety index at which point flashing light signals or flashing light signals and gates are considered. In one State, this value corresponded to one accident in a 10-year period, although another State will consider train-activated signals for crossings with one accident expected every 20 years.

In addition to considering upgraded signals, the diagnostic team recommended removal of the large trees (behind the parked cars in the photo above) which restrict an approaching motorist's view of the crossing.

In several instances, it was noted that a roadway in the vicinity of a railroad crossing had significantly poorer geometrics than adjacent sections of the road. The portion of road from the tracks to the main highway at this crossing is less than two lanes wide, has poor turning radii, and in general requires a motorist to divert attention from looking for an approaching train to negotiating the crossing smoothly. The crossing surface should be extended to full approach roadway width plus shoulders and the road itself should be rebuilt from the tracks to the intersection. Work would include lengthening the culvert parallel to the main road and moving the Stop sign further from the crossing. In its present location, a large vehicle such as a school bus would overhang the tracks if stopped at the sign.

There is no reason why a 10-foot usable shoulder elsewhere along the highway should not be continued over the crossing. Every crossing surface should be at least as wide as the approach roadway plus shoulders. One of the most common deficiencies observed throughout the corridor review was crossing surfaces that were too narrow, leaving exposed tracks that could cause a low-speed vehicle to become stuck on the tracks or a high-speed vehicle to go out of control. Ideally, the entire width of the crossing between its traffic control devices should be traversable, even if the outside limits are filled with asphalt rather than timber or other crossing surface materials. When crossing surfaces are renewed, reusable sections of timber could be used to extend the crossing width beyond the travelled way at little additional cost.

Since most active warning devices are not considered breakaway, several State highway agencies require that they be shielded in certain instances. If such a policy is in effect, it is imperative that the guardrail or crash-cushion be an acceptable design that will perform as intended. The use of any non-standard barrier strictly to "protect" the warning device should not be allowed. However, in low-speed situations, a ring-type metal guardrail does serve to keep turning vehicles, especially trucks, away from mast-mounted lights and gates and may be installed. The photographs above depict the use of W-beam guardrail to shield a cantilevered flashing light signal along a high-speed rural highway, and the use of a commercially available crash cushion at a similar location.

The intersecting side road adjacent to the tracks complicates the driving task at this crossing. As a minimum, side lights are needed on the signal masts and an appropriate advance warning sign may be needed on the side road. Note the crossbuck is turned to face side road traffic, but the flashing lights are aimed down the main road. At locations like this, the intersecting roadway can sometimes be realigned to place it further away from the crossing. This will separate possible highway traffic conflicts from train conflicts at the crossing and allow a motorist entering the main road to concentrate on each maneuver independently rather than simultaneously.

Several State agencies routinely upgrade existing flashing light signals from the 8 3/8-inch diameter roundels to 12-inch lenses. The larger roundels may provide somewhat better visibility.

Another critical item that can only be reviewed on-site is the alignment of the signal heads. Because the roundels are designed to focus low-wattage light into a narrow, intense beam, misalignment of one or more units can significantly reduce their visibility to a driver. The high traffic volume on this road combined with a high percentage of truck traffic and partially restricted sight distances make this crossing a good candidate for the installation of gates. If that were done, these flashing light signals could possibly be used at another crossing on the same corridor where passive signing is no longer considered adequate.

Although this crossing does have flashing lights, their proximity to a signalized intersection makes them difficult to see. The railroad signals were not interconnected with the traffic signals. An accident occured here when a motorist made a right turn and drove into the path of an oncoming train. Similar crossings should be analyzed carefully to ensure proper signal pre-emption exists and that right turns on red are prohibited during the pre-emption phase.

To determine if automatic gates are warranted, the following factors are usually considered:

- o multiple mainline tracks.
- o multiple tracks where a train on or near the crossing can obscure the view of a second train approaching the crossing.
- o high speed train operation and limited sight distance.
- o high speed trains and moderately high railroad and highway traffic.
- o frequent use of the crossing by passenger trains, school and transit buses, or by hazardous materials carriers (railroad or highway).
- o accident history with flashing light signal only.

Apparently, the gate arm on the right had been hit in the past and was not properly repaired. It is notably shorter than required, making it easy for a motorist to drive around it after a train has passed. In a double track situation like this, that could be a costly mistake. It is important to review all crossings along a corridor, including those that are fully signalized, to identify deficiencies such as this that may normally go undetected.

Railroad pavement markings are required in advance of all crossings which have active warning devices and at crossings where the prevailing highway speed is 40 mph or higher (provided, of course, that the roadway is surfaced and that the surface is in good enough condition for effective placement and retention of the markings). These markings are optional at other locations. "No passing" striping should be added at the location above. A recent change to the Manual on Uniform Traffic Control Devices (MUTCD) requires that these markings should be placed opposite the Advance Warning signs with an additional set nearer the crossing if deemed necessary.

This motorist has driven around a lowered gate, after seeing only a slow-moving train in the distance. When gates are down unnecessarily or too long before a train reaches a crossing, this is a relatively common occurrence. Increased law enforcement may solve the problem temporarily, but in the long term, more credible warning devices should be considered. In many cases, track circuitry improvements such as constant warning time devices or motion sensing equipment can eliminate this problem by reducing or minimizing unwarranted delays. If train speeds are relatively constant but significantly different from those originally used to design the track circuit, modifications to the existing circuit may be a necessary improvement.

This particular crossing has several intersecting side roads and many tracks, two factors that may account for its relatively high number of accidents in recent years. The number of decisions a motorist has to make at this crossing could be reduced by eliminating or rerouting one or more of the side roads that enter the main highway immediately adjacent to the crossing.

The "UNEVEN TRACKS" sign is misleading, since there was only one track at the crest of the hill and the crossing was relatively smooth. A far more significant problem is that the crossing has virtually no sight distance and is on a high ADT rural route. These facts, plus its recent accident history, should make this crossing a high priority for the installation of gates. However, this State's hazard index does not directly address accidents at specific crossings, and no improvements had been contemplated prior to the corridor review.

An on-site review can oftentimes reveal significant changes at a specific crossing that may make safety improvements there a much higher priority than previously thought. Usually, the factors that have the most influence on a crossing's relative ranking are highway traffic volumes, the number of trains per day, and recent accident experience. The first two items in particular were found to be incorrect quite frequently in the inventory data available to the review teams. State agencies and railroad companies should make every effort to keep the National Grade Crossing Inventory Data current so it can be used effectively.

Where a highway is parallel to a rail line and the distance between the two is less than 100 feet, there is not enough space to display the standard Advance Warning sign (W10-1) effectively. For traffic turning from the main road, one of three other Advance Warning signs (W10-2, W10-3, W10-4) should be used when their need has been determined by an engineering study or if a diagnostic team recommends them. The correct use of the W10-2 sign is shown in the photograph above.

It is critical that the advance warning signs for a railroad crossing be located far enough from the crossing to give a motorist enough time to stop safely if a train is at or near the crossing. In practice, many public agencies use the W10-1 Advance Warning sign at locations where there is less than 100 feet between the main road and the crossing, believing this to be at least partially effective for the low turning speeds normally involved. However, these signs should be considered supplementary to signs located in accordance with MUTCD recommendations.

The use of Advance Warning signs on both sides of the intersecting road might also be considered. This would ensure that at least one would be in the line of sight of a driver turning onto the side road from either direction.

In unusual circumstances, signing over and above recommended minimums should be installed. The above photograph shows an Advance Warning sign 1/2 mile from the actual crossing. The sign is on a high-speed, high volume rural arterial where an at-grade crossing is unexpected. It is followed by a train-activated Advance Warning sign located the normal distance from the crossing as shown below.

By definition, a private crossing is one which is not open to the general public and/or is not on a road maintained by a public agency.

One problem that several States have experienced occurs when a crossing that is legally private becomes public through usage. Since Federal (and usually State) funds cannot be spent on private roads, one of two actions must take place. One is to retain the crossing as private and to identify it as such with appropriate signing. The second possible action is to re-categorize the crossing as public and to install standard warning devices. The former action requires agreement between the property owner(s) and the railroad company, while the latter requires that a public highway authority assume maintenance responsibility for the road.

Some States and railroad companies have established minimum signing requirements for private crossings. Typically, these may include crossbucks, Stop signs, and/or a warning against trespassing. A sign similar to that shown above is used by some States at all private crossings.

The Manual on Uniform Traffic Control Devices (MUTCD) requires one reflectorized crossbuck on each approach to every public crossing. It is important that the crossbuck be properly oriented toward approach traffic, particularly if the approach roadway is sharply curving. Where there are intersecting roads in the immediate vicinity of the crossing, additional crossbucks may be needed to meet the MUTCD requirements. A few States now specify that the crossbucks be reflectorized both front and back. This adds little to the cost of each crossbuck and can be particularly effective at night at unlighted crossings. Two reflectorized crossbucks delineate the crossing width at night and may be helpful in detecting the presence of a train on the crossing. When a train is using the crossing at night, a "flickering" effect is seen as the train cars pass between the motorist and the far side (left) reflectorized crossbuck. If a passive crossing has multiple tracks as shown above, the Number of Tracks sign (R15-1) is required beneath the crossbuck.

It is important that the DOT-AAR crossing numbers be displayed at each crossing. Oftentimes, the State agency will pay for permanent identification tags and the railroad company will install them. When a crossing is upgraded from crossbucks to active warning devices, the DOT-AAR number should be transferred to the new signals.

This crossing forces a motorist to focus attention on the crossing itself rather than look for an approaching train since the steep approach grade continues right to the tracks. If a level platform were built on the roadway at this crossing, a driver would have a clear view of the tracks and could cross safely. The work at this type of location is relatively minor and should be done without detailed plan and profile sheets for maximum cost-effectiveness. Although the approaches could be flattened for a considerable distance, costs can be minimized on low volume roads by building a relatively short platform on each side of the tracks. A level surface at the crossing gives the motorist an unobstructed view of the crossing surface width and minimizes the likelihood of a vehicle becoming stalled or stuck on the tracks if the crossing width is substandard.

This type of improvement simplifies the driving task by separating potential hazards and allowing a motorist to concentrate on one at a time.

As shown here, a highway improvement project may stop just short of a crossing. The motorist may then be left with conflicting information, such as the yellow center line which encourages him to continue straight ahead and the Chevron Alignment signs which suggest he turn left. The actual railroad crossing is on the left of the picture, where the diagnostic review team members can be seen. Whenever a crossing lies just beyond the project limits, it may be advantageous to extend the project to include the crossing so a dangerous situation is not created. If a roadway project includes a crossing, that crossing should be brought up to current standards.

When a major roadway parallel to a rail line is reconstructed, it may also be an opportune time to reconstruct the side road approaches to the tracks if the crossings are immediately adjacent to the main road and in need of repair.

A few State agencies are using this sign at crossings having moderately restricted sight distances. Although not specifically included in the MUTCD, it is an acceptable warning sign and can be an excellent compromise between an Advance Warning sign only and an Advance Warning sign with a Stop sign at the crossing. Certainly less restrictive than a Stop sign, it gives a driver notice that he should be specifically alert for a possible train. If used, the LOOK FOR TRAINS sign should be located between the Advance Warning sign and the crossing. An advisory speed plate under this sign may be appropriate in some situations.

The sign pictured above is mounted too high and may be too close to the crossing, but its message is clear.

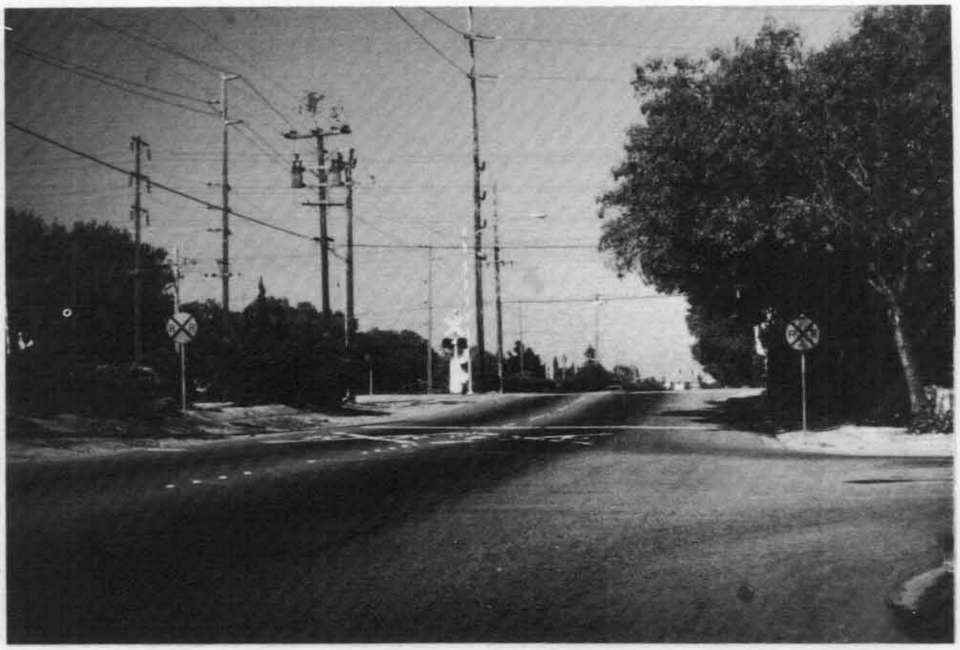
A significant percentage of Rail-Highway Crossing Safety funds are spent to replace rough crossings each year. Although difficult to evaluate from an accident reduction standpoint, there is no doubt that this type of improvement is readily noticed and appreciated by the motoring public. Regardless of the type of surface used, it is critical that it be applied over a thoroughly compacted, well-drained base. The "pumping" that is evident at the crossing above can only be corrected by proper subsurface drainage.

The Pennsylvania Department of Transportation has documented its experience with several different high-type surfaces and has written a model specification for their installation. Copies of this report, entitled "High-Type Railroad Crossing Surface Monitoring and Evaluation", are available through the National Technical Information Service in Springfield, Virginia.

At least one State has reconstructed several crossings with full depth timber planking over an asphalt concrete base and has reported good performance. Most State agencies permit the use of one or more high-type proprietary crossing surfaces at relatively high volume crossings.

Although sight distance along the tracks is less critical when active warning devices are in place, it remains important to preserve and maintain as much visibility along the tracks as possible. Approximately half of the fatalities at grade crossings in recent years have occurred at crossings with flashing light signals or flashing lights with gates. Most motorists will at least look for a train if gates are down or if a signal is flashing at a crossing. Sight distance restrictions such as the equipment housing shown here can block a driver's view and can contribute to accidents at a crossing with train-activated warning devices. Every attempt must be made to locate this housing where it will be least obtrusive.

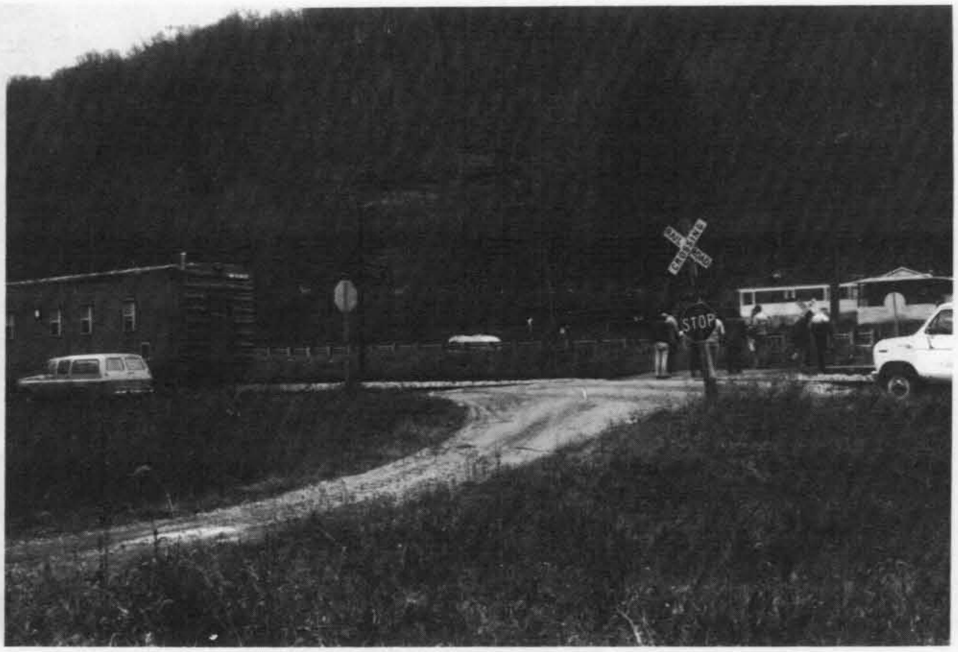
Likewise, any other sight distance obstructions at crossings should be minimized, including brush and trees within the railroad and highway rights-of-way.



Until recently, the MUTCD provided only general guidelines on the placement of advance warning signs, suggesting 100 feet in urban areas and 750 feet in rural locations. However, MUTCD Revision No. 2, dated December 1983, expanded Section 2C-3, Placement of Warning Signs, and provides more specific guidance. Placement is now dependent on both the type of decision a driver must make and on the 85th percentile or posted highway speed, whichever is higher.

As a general comment, advance warning signs were usually in place at each crossing the diagnostic team reviewed, but their locations were not always optimal for site conditions. Several signs were mounted too high or too low and many were obscured by foliage.

This photo shows a pair of advance warning signs located too close to the crossing for the prevailing highway speeds on the main road. At this site, the W10-1 signs may provide some warning for motorists entering from the side road. However, when the distance from the side road intersection to the crossing is less than 100 feet, a W10-2, W10-3, or W10-4 Advance Warning sign may be needed.



In addition to permanent sight distance obstructions, parked rail cars can sometimes be a problem as seen above. This particular crossing is one of three that serve a very small community. The diagnostic team recommended that the lesser used crossings on either side be closed, and that gates be added at this crossing in conjunction with roadway improvements.

Another type of non-permanent sight distance obstruction in agricultural areas may be crops. A crossing that has adequate sight distance during the winter months may have that sight distance severely restricted or obscured by corn or wheat later in the year. In some instances, minimum sight distance triangles may be preserved if the potential problem is brought to the landowners attention before planting. In other cases, non-permanent signing may be used to warn motorists of significant but temporary sight distance restrictions.

PART 3: IMPLEMENTING THE IMPROVEMENTS

Once the corridor review is completed, the recommended improvements should be categorized by responsible agency, time required for implementation, and cost. Generally, three categories of work will evolve:

- o Immediate implementation - little or no project costs
- o Short term implementation - moderate project costs
- o Long-term implementation - moderate or high project costs

Examples of each category are as follows:

Immediate Implementation

Work in this category will normally consist of that which must be done to bring the crossing to minimum current standards. It will usually include such items as installation of advance warning signs where none are present and application of appropriate pavement markings. Occasionally, it will require removal of non-standard signing or relocation of existing signs that are not properly placed. Clearing minor vegetation (brush, shrubs, etc.) within highway and railroad rights-of-way would also be included.

Since most of this work can be defined as maintenance, Federal funding normally would not be used. However, if most or all of the crossings in a particular corridor lack signing, the use of Federal funds may be appropriate.

Short-term Implementation

Work in this category can usually be completed in 1 to 6 months and would normally be done by the highway agency which maintains the roadway. An example would be complete resigning in cases where standard MUTCD signing never existed. It would also include any new signs that are needed to warn motorists of unusual geometrics or unexpected site conditions. Approach roadway work at one or more crossings, including grade changes and/or roadway realignment, would also fall in this category, as would any earthwork or tree removal needed to improve sight distances. The latter types of improvements would oftentimes be done by highway agency personnel (force account), but contract work may be considered if numerous crossings are involved or the work is beyond the capabilities of the maintaining road authority. Virtually all of these types of improvements are eligible for Federal funds.

Long Term Implementation

This type of work usually requires scheduling of railroad crews and may require 6 to 24 months lead-time. Examples include installation or upgrading of active warning devices, changes in track circuitry, and track removal, relocation or adjustment, including crossing surface improvements. Occasionally, roadway work that is awarded to a private contractor through competitive bidding will also be in this category. Costs associated with any of these improvements are generally moderate to high, but most are eligible for Federal funding.

Using the hypothetical series of crossings shown earlier in this chapter, the recommended improvements might be summarized and scheduled for implementation as follows:

	ITEM (Number of Crossings)	Responsible Agency	Estimated Cost Federal Funds
1.	crossing closure (2)	State/RR	5K
2.	minor sight distance improvements (7)	county/RR	0
3.	tree removal (1)	county	2K
4.	install FLS&G (2)	RR	180K
5.	adjust signals (2)	RR	0
6.	adjust existing signs (4)	county/city	0
7.	install new signs (2)	county/city	0
8.	upgrade existing signals(2)	RR	150K
9.	roadway improvements (6)	county	25K
10.	crossing surface (3)	RR	2-40K
11.	traffic signal interconnection (1)	city/RR	2-5K
12.	track circuitry (1)	RR	30K

The first category essentially includes those improvements which are relatively minor or often considered maintenance (items 2,5,6,7). They are done by the maintaining agency and would not usually involve Federal funds. For these items, a follow-up letter to each jurisdiction summarizing the review team's recommendations at specific locations and suggesting a target date for completion of the work is advisable.

The second category of work is more extensive than simple maintenance but can usually be done by State, county or city forces (items 3,9,11). Typically, these improvements would be eligible for Federal participation. The Federal share of costs could range from 75 to 100 percent depending on the types of funds used. Section 203 Safety Funds have a 90 percent Federal share. The 10 percent non-Federal share would have to be funded by others such as the State, county, city, or railroad.

In some cases, if public authorities do not have funds available or budgeted for the non-Federal share of project expenses, consideration should be given to using public forces to accomplish the work. Federal funds can be used to reimburse public authorities for the Federal share of properly documented costs. Under this approach, the non-Federal share is then represented by that portion of agency costs (usually salaries) not reimbursed with Federal funds. Thus, a cash outlay is avoided.

If the proposed work is beyond a local agencies' capability, a regular Federal-aid project can be developed, advertised and awarded to a private contractor. This normally requires more lead time than force account work and is generally more expensive if the total amount of work is small. However, if approach work is required at several crossings on a corridor, all can (and should) be included in a single project.

It should be noted that if a State or local agency elects to use its own forces in lieu of competitive bids, the local FHWA division office must concur that the proposed method is cost-effective.

The third category of work is that which is traditionally done by the railroad companies, primarily installation or upgrading of active warning devices and track circuitry and the installation of new crossing surfaces (items 1,4,8,10,12 above). Since all work along the corridor would normally be done by a single railroad, it is both possible and desirable to program a single project which covers the work at all locations. If a master agreement exists between the State and railroad company, the paperwork can be further simplified.

In addition, when the work to be done is well defined and the cost estimate is highly accurate, use of a lump sum payment arrangement should be considered. Such a payment arrangement can minimize recordkeeping efforts for a project. This may be true for signal installations by railroad crews as well as for minor roadway or signing improvements done by State, city, or county personnel. In both cases, plans need be only detailed enough to indicate clearly the extent of the improvement(s). In many cases, a simple sketch of the proposed work and a summary of quantities may suffice.

PART 4: SUMMARY

There can be no doubt that the various safety improvement programs and other efforts undertaken by both public and private agencies have been tremendously successful in reducing motor vehicle accidents and fatalities at rail-highway crossings in the United States. While State programs have traditionally focused on high-risk crossings where train activated warning devices are warranted, many accidents today occur at low-volume crossings where the installation of flashing light signals and gates cannot usually be justified. Under most current programs, these crossings are seldom reviewed by a professional diagnostic team. By incorporating some form of corridor reviews into their on-going activities, State agencies could potentially increase the overall effectiveness of their efforts.

Specific aspects of a corridor approach to crossing safety that should be emphasized include the following:

- Far more crossings are reviewed on-site and analyzed by a diagnostic team each year than are reviewed on a crossing-by-crossing basis.

- Most of the additional work that is recommended is low-cost and should not significantly decrease a State's ability to improve individual high-priority crossings.

- Individual crossings within a corridor that warrant the installation or upgrading of active warning devices would also be identified and improved under most State's current programs. The corridor approach can be used to compliment existing efforts rather than compete with them for limited funds.

- Safety improvements are concentrated in one area, enabling some crossings to be closed when adjacent crossings are upgraded. Work at many crossings can be included in one or two projects, thereby consolidating and minimizing the paperwork associated with individual projects.

- The corridor review approach enables a State agency to remain "on top of the situation" by identifying potentially hazardous crossing locations and recommending appropriate improvements before they become problem crossings as a result of serious accidents.

APPENDIX A
U.S. DOT ACCIDENT PREDICTION FORMULA

The U.S. Department of Transportation accident prediction formula computes the expected number of accidents per year at a crossing based on information available from the National Grade Crossing Inventory and Accident/Incident data files. The formula was developed by the U.S. Department of Transportation, Research and Special Programs Administration, Transportation Systems Center, Cambridge, Massachusetts, as an aid in determining the allocation of funds for rail-highway crossing improvements. Complete details are contained in Report No. FHWA-IP-83-7 ,"RAIL-HIGHWAY CROSSING RESOURCE ALLOCATION PROCEDURE USER'S GUIDE". A revised edition of this report, which includes methods to predict accident severities, is expected to be available in FY 1987.

Although the basic formulas (see Table 3-6) used to compute the expected number of accidents at any given crossing can be difficult to use in the field, they have been reduced in Tables 3-7, 3-8, and 3-9 to values which can be selected directly from the appropriate Table and multiplied together to obtain the basic accident prediction number. This basic number is then adjusted for a crossing's past accident history, using Tables 3-1, 3-2, 3-3, 3-4, or 3-5, depending upon how many years of data are available. Thus, the current accident prediction number for any particular crossing can be calculated on-site in a few minutes if all the input factors are known.

TABLE 3-6. EQUATIONS FOR CROSSING CHARACTERISTIC FACTORS

GENERAL FORM OF BASIC ACCIDENT PREDICTION FORMULA: a = K x EI x MT x DT x HP x MS x HT x HL

CROSSING CATEGORY	FORMULA CONSTANT K	EXPOSURE INDEX FACTOR EI	MAIN TRACKS FACTOR MT	DAY THRU TRAINS FACTOR DT	HIGHWAY PAVED FACTOR HP	MAXIMUM SPEED FACTOR MS	HIGHWAY TYPE FACTOR HT	HIGHWAY LANES FACTOR HL
		CROSSING CHARACTERISTIC FACTORS						
PASSIVE	0.002268	$((c \times t + 0.2)/0.2)^{0.3334}$	$e^{0.2094mt}$	$((d + 0.2)/0.2)^{0.1336}$	$e^{-0.6160(hp-1)}$	$e^{0.0077ms}$	$e^{-0.1000(ht-1)}$	1.0
FLASHING LIGHTS	0.003646	$((c \times t + 0.2)/0.2)^{0.2953}$	$e^{0.1088mt}$	$((d + 0.2)/0.2)^{0.0470}$	1.0	1.0	1.0	$e^{0.1380(hl-1)}$
GATES	0.001088	$((c \times t + 0.2)/0.2)^{0.3116}$	$e^{0.2912mt}$	1.0	1.0	1.0	1.0	$e^{0.1036(hl-1)}$

c = annual average number of highway vehicles per day (total both directions)

t = average total train movements per day

mt = number of main tracks

d = average number of thru trains per day during daylight

hp = highway paved, yes = 1.0, no = 2.0

ms = maximum timetable speed, mph

ht = highway type factor value

hl = number of highway lanes

HIGHWAY TYPE	INVENTORY CODE	ht VALUE
RURAL		
Interstate	01	1
Other principal arterial	02	2
Minor arterial	06	3
Major collector	07	4
Minor collector	08	5
Local	09	6
URBAN		
Interstate	11	1
Other freeway and expressway	12	2
Other principal arterial	14	3
Minor arterial	16	4
Collector	17	5
Local	19	6

TABLE 3-7. FACTOR VALUES FOR CROSSINGS WITH PASSIVE WARNING DEVICES

GENERAL FORM OF BASIC ACCIDENT PREDICTION FORMULA: a = K x EI x MT x DT x HP x MS x HT x HL

K	"c" x "t"	EI	Main Tracks	MT	Day Thru Trains	DT	Highway Paved	HP	Maximum Timetable Speed	MS	Highway Type Code**	HT	Highway Lanes	HL
0.002268	0*	1.00	0	1.00	0	1.00	1 (yes)	1.00	0	1.00	01&11	1.00	1	1.00
	1 5	2.22	1	1.23	1	1.27			5	1.04			2	1.00
	6- 10	3.30	2	1.52	2	1.38	2 (no)	0.54	10	1.08	02&12	0.90	3	1.00
	11- 20	4.24	3	1.87	3	1.45			15	1.12			4	1.00
	21- 30	5.01	4	2.31	4	1.50			20	1.17	06&14	0.82	5	1.00
	31- 50	5.86	5	2.85	5	1.55			25	1.21			6	1.00
	51- 80	6.89	6	3.51	6	1.58			30	1.26	07&16	0.74	7	1.00
	81- 120	7.95			7	1.61			35	1.31			8	1.00
	121- 200	9.29			8	1.64			40	1.36	08&17	0.67	9	1.00
	201- 300	10.78			9	1.67			45	1.41				
	301- 400	12.06			10	1.69			50	1.47	09&19	0.61		
	401- 500	13.11			11-20	1.78			55	1.53				
	501- 600	14.02			21-30	1.91			60	1.59				
	601- 700	14.82			31-40	2.00			65	1.65				
	701- 1000	16.21			41-60	2.09			70	1.71				
	1001- 1300	17.93							75	1.78				
	1301- 1600	19.37							80	1.85				
	1601- 2000	20.81							85	1.92				
	2001- 2500	22.42							90	2.00				
	2501- 3000	23.97												
	3001- 4000	25.98												
	4001- 6000	29.26												
	6001- 8000	32.73												
	8001- 10000	35.59												
	10001- 15000	39.71												
	15001- 20000	44.43												
	20001- 25000	48.31												
	25001- 30000	51.65												
	30001- 40000	55.98												
	40001- 50000	60.87												
	50001- 60000	65.08												
	60001- 70000	68.81												
	70001- 90000	73.74												
	90001- 110000	79.44												
	110001- 130000	84.42												
	130001- 180000	91.94												
	180001- 230000	100.92												
	230001- 300000	109.94												
	300001- 370000	118.87												

K = formula constant
"c" x "t" = number of highway vehicles per day, "c", multiplied by total train movements per day, "t"
EI = exposure index factor
MT = main tracks factor
DT = day thru trains factor
HP = highway paved factor
MS = maximum timetable speed factor
HT = highway type factor
HL = highway lanes factor

* Less than one train per day.
** For definition of highway type codes, see Table 3-6.

TABLE 3-8. FACTOR VALUES FOR CROSSINGS WITH FLASHING LIGHT WARNING DEVICES

GENERAL FORM OF BASIC ACCIDENT PREDICTION FORMULA: a = K x EI x MT x DT x HP x MS x HT x HL

K	"c" x "t"	EI	Main Tracks	MT	Day Thru Trains	DT	Highway Paved	HP	Maximum Timetable Speed	MS	Highway Type Code**	HT	Highway Lanes	HL
0.003646	0*	1.00	0	1.00	0	1.00	1 (yes)	1.00	0	1.00	01&11	1.00	1	1.00
	1- 5	2.27	1	1.11	1	1.09			5	1.00			2	1.15
	6- 10	2.99	2	1.24	2	1.12	2 (no)	1.00	10	1.00	02&12	1.00	3	1.32
	11- 20	3.59	3	1.39	3	1.14			15	1.00			4	1.51
	21- 30	4.17	4	1.55	4	1.15			20	1.00	06&14	1.00	5	1.74
	31- 50	4.79	5	1.72	5	1.17			25	1.00			6	1.99
	51- 80	5.52	6	1.92	6	1.18			30	1.00	07&16	1.00	7	2.29
	81- 120	6.27			7	1.18			35	1.00			8	2.63
	121- 200	7.20			8	1.19			40	1.00	08&17	1.00	9	3.02
	201- 300	8.22			9	1.20			45	1.00				
	301- 400	9.07			10	1.20			50	1.00	09&19	1.00		
	401- 500	9.77			11-20	1.23			55	1.00				
	501- 600	10.37			21-30	1.26			60	1.00				
	601- 700	10.89			31-40	1.28			65	1.00				
	701- 1000	11.79			41-60	1.30			70	1.00				
	1001- 1300	12.89							75	1.00				
	1301- 1600	13.80							80	1.00				
	1601- 2000	14.71							85	1.00				
	2001- 2500	15.72							90	1.00				
	2501- 3000	16.67												
	3001- 4000	17.91												
	4001- 6000	19.89												
	6001- 8000	21.97												
	8001- 10000	23.66												
	10001- 15000	26.08												
	15001- 20000	28.80												
	20001- 25000	31.02												
	25001- 30000	32.91												
	30001- 40000	35.34												
	40001- 50000	38.06												
	50001- 60000	40.39												
	60001- 70000	42.43												
	70001- 90000	45.11												
	90001- 110000	48.18												
	110001- 130000	50.85												
	130001- 180000	54.84												
	180001- 230000	59.56												
	230001- 300000	64.25												
	300001- 370000	68.86												

K = formula constant
"c" x "t" = number of highway vehicles per day, "c", multiplied by total train movements per day, "t"
EI = exposure index factor
MT = main tracks factor
DT = day thru trains factor
HP = highway paved factor
MS = maximum timetable speed factor
HT = highway type factor
HL = highway lanes factor

* Less than one train per day.
** For definition of highway type codes, see Table 3-6.

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TABLE 3-9. FACTOR VALUES FOR CROSSINGS WITH GATE WARNING DEVICES

GENERAL FORM OF BASIC ACCIDENT PREDICTION FORMULA: a = K x EI x MT x DT x HP x MS x HT x HL

K	"c" x "t"	EI	Main Tracks	MT	Day Thru Trains	DT	Highway Paved	HP	Maximum Timetable Speed	MS	Highway Type Code**	HT	Highway Lanes	HL
0.001088	0*	1.00	0	1.00	0	1.00	1 (yes)	1.00	0	1.00	01&11	1.00	1	1.00
	1- 5	2.37	1	1.34	1	1.00			5	1.00			2	1.11
	6- 10	3.18	2	1.79	2	1.00	2 (no)	1.00	10	1.00	02&12	1.00	3	1.23
	11- 20	3.86	3	2.40	3	1.00			15	1.00			4	1.36
	21- 30	4.51	4	3.21	4	1.00			20	1.00	06&14	1.00	5	1.51
	31- 50	5.22	5	4.29	5	1.00			25	1.00			6	1.68
	51- 80	6.07	6	5.74	6	1.00			30	1.00	07&16	1.00	7	1.86
	81- 120	6.94			7	1.00			35	1.00			8	2.07
	121- 200	8.03			8	1.00			40	1.00	08&17	1.00	9	2.29
	201- 300	9.23			9	1.00			45	1.00				
	301- 400	10.25			10	1.00			50	1.00	09&19	1.00		
	401- 500	11.08			11-20	1.00			55	1.00				
	501- 600	11.80			21-30	1.00			60	1.00				
	601- 700	12.43			31-40	1.00			65	1.00				
	701- 1000	13.51			41-60	1.00			70	1.00				
	1001- 1300	14.84							75	1.00				
	1301- 1600	15.96							80	1.00				
	1601- 2000	17.07							85	1.00				
	2001- 2500	18.30							90	1.00				
	2501- 3000	19.48												
	3001- 4000	21.00												
	4001- 6000	23.46												
	6001- 8000	26.06												
	8001- 10000	28.18												
	10001- 15000	31.22												
	15001- 20000	34.67												
	20001- 25000	37.49												
	25001- 30000	39.91												
	30001- 40000	43.03												
	40001- 50000	46.53												
	50001- 60000	49.53												
	60001- 70000	52.18												
	70001- 90000	55.67												
	90001- 110000	59.68												
	110001- 130000	63.16												
	130001- 180000	68.41												
	180001- 230000	74.63												
	230001- 300000	80.85												
	300001- 370000	86.98												

K = formula constant
"c" x "t" = number of highway vehicles per day, "c", multiplied by total train movements per day, "t"
EI = exposure index factor
MT = main tracks factor
DT = day thru trains factor
HP = highway paved factor
MS = maximum timetable speed factor
HT = highway type factor
HL = highway lanes factor

* Less than one train per day.
** For definition of highway type codes, see Table 3-6.

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TABLE 3-1. FINAL ACCIDENT PREDICTION FROM INITIAL PREDICTION AND ACCIDENT HISTORY [1 YEAR OF ACCIDENT DATA (T=1)]

INITIAL PREDICTION FROM BASIC MODEL, a	NUMBER OF ACCIDENTS, N, IN T YEARS					
	0	1	2	3	4	5
0.00	0.000	0.048	0.095	0.143	0.190	0.238
0.01	0.009	0.066	0.123	0.179	0.236	0.292
0.02	0.019	0.084	0.150	0.215	0.280	0.346
0.03	0.028	0.102	0.176	0.250	0.324	0.398
0.04	0.037	0.119	0.202	0.284	0.367	0.450
0.05	0.045	0.136	0.227	0.318	0.409	0.500
0.06	0.054	0.153	0.252	0.351	0.450	0.550
0.07	0.063	0.170	0.277	0.384	0.491	0.598
0.08	0.071	0.186	0.301	0.416	0.531	0.646
0.09	0.079	0.202	0.325	0.447	0.570	0.693
0.10	0.087	0.217	0.348	0.478	0.609	0.739
0.20	0.160	0.360	0.560	0.760	0.960	1.160
0.30	0.222	0.481	0.741	1.000	1.259	1.519
0.40	0.276	0.586	0.897	1.207	1.517	1.828
0.50	0.323	0.677	1.032	1.387	1.742	2.097
0.60	0.364	0.758	1.152	1.545	1.939	2.333
0.70	0.400	0.829	1.257	1.686	2.114	2.543
0.80	0.432	0.892	1.351	1.811	2.270	2.730
0.90	0.462	0.949	1.436	1.923	2.410	2.897
1.00	0.488	1.000	1.512	2.024	2.537	3.049
1.10	0.512	1.047	1.581	2.116	2.651	3.186
1.20	0.533	1.089	1.644	2.200	2.756	3.311
1.30	0.553	1.128	1.702	2.277	2.851	3.426
1.40	0.571	1.163	1.755	2.347	2.939	3.531
1.50	0.588	1.196	1.804	2.412	3.020	3.627
1.60	0.604	1.226	1.849	2.472	3.094	3.717
1.70	0.618	1.255	1.891	2.527	3.164	3.800
1.80	0.632	1.281	1.930	2.579	3.228	3.877
1.90	0.644	1.305	1.966	2.627	3.288	3.949
2.00	0.656	1.328	2.000	2.672	3.344	4.016
2.10	0.667	1.349	2.032	2.714	3.397	4.079
2.20	0.677	1.369	2.062	2.754	3.446	4.138
2.30	0.687	1.388	2.090	2.791	3.493	4.194
2.40	0.696	1.406	2.116	2.826	3.536	4.246
2.50	0.704	1.423	2.141	2.859	3.577	4.296

TABLE 3-2. FINAL ACCIDENT PREDICTION FROM INITIAL PREDICTION AND ACCIDENT HISTORY [2 YEARS OF ACCIDENT DATA (T=2)]

INITIAL PREDICTION FROM BASIC MODEL, a	NUMBER OF ACCIDENTS, N, IN T YEARS								
	0	1	2	3	4	5	6	7	8
0.00	0.000	0.045	0.091	0.136	0.182	0.227	0.273	0.318	0.364
0.01	0.009	0.063	0.116	0.170	0.223	0.277	0.330	0.384	0.438
0.02	0.018	0.079	0.140	0.202	0.263	0.325	0.386	0.447	0.509
0.03	0.026	0.095	0.164	0.233	0.302	0.371	0.440	0.509	0.578
0.04	0.034	0.110	0.186	0.263	0.339	0.415	0.492	0.568	0.644
0.05	0.042	0.125	0.208	0.292	0.375	0.458	0.542	0.625	0.708
0.06	0.049	0.139	0.230	0.320	0.410	0.500	0.590	0.680	0.770
0.07	0.056	0.153	0.250	0.347	0.444	0.540	0.637	0.734	0.831
0.08	0.063	0.167	0.270	0.373	0.476	0.579	0.683	0.786	0.889
0.09	0.070	0.180	0.289	0.398	0.508	0.617	0.727	0.836	0.945
0.10	0.077	0.192	0.308	0.423	0.538	0.654	0.769	0.885	1.000
0.20	0.133	0.300	0.467	0.633	0.800	0.967	1.133	1.300	1.467
0.30	0.176	0.382	0.588	0.794	1.000	1.206	1.412	1.618	1.824
0.40	0.211	0.447	0.684	0.921	1.158	1.395	1.632	1.868	2.105
0.50	0.238	0.500	0.762	1.024	1.286	1.548	1.810	2.071	2.333
0.60	0.261	0.543	0.826	1.109	1.391	1.674	1.957	2.239	2.522
0.70	0.280	0.580	0.880	1.180	1.480	1.780	2.080	2.380	2.680
0.80	0.296	0.611	0.926	1.241	1.556	1.870	2.185	2.500	2.815
0.90	0.310	0.638	0.966	1.293	1.621	1.948	2.276	2.603	2.931
1.00	0.323	0.661	1.000	1.339	1.677	2.016	2.355	2.694	3.032
1.10	0.333	0.682	1.030	1.379	1.727	2.076	2.424	2.773	3.121
1.20	0.343	0.700	1.057	1.414	1.771	2.129	2.486	2.843	3.200
1.30	0.351	0.716	1.081	1.446	1.811	2.176	2.541	2.905	3.270
1.40	0.359	0.731	1.103	1.474	1.846	2.218	2.590	2.962	3.333
1.50	0.366	0.744	1.122	1.500	1.878	2.256	2.634	3.012	3.390
1.60	0.372	0.756	1.140	1.523	1.907	2.291	2.674	3.058	3.442
1.70	0.378	0.767	1.156	1.544	1.933	2.322	2.711	3.100	3.489
1.80	0.383	0.777	1.170	1.564	1.957	2.351	2.745	3.138	3.532
1.90	0.388	0.786	1.184	1.582	1.980	2.378	2.776	3.173	3.571
2.00	0.392	0.794	1.196	1.598	2.000	2.402	2.804	3.206	3.608
2.10	0.396	0.802	1.208	1.613	2.019	2.425	2.830	3.236	3.642
2.20	0.400	0.809	1.218	1.627	2.036	2.445	2.855	3.264	3.673
2.30	0.404	0.816	1.228	1.640	2.053	2.465	2.877	3.289	3.702
2.40	0.407	0.822	1.237	1.653	2.068	2.483	2.898	3.314	3.729
2.50	0.410	0.828	1.246	1.664	2.082	2.500	2.918	3.336	3.754

TABLE 3-3. FINAL ACCIDENT PREDICTION FROM INITIAL PREDICTION AND ACCIDENT HISTORY [3 YEARS OF ACCIDENT DATA (T=3)]

INITIAL PREDICTION FROM BASIC MODEL, a	NUMBER OF ACCIDENTS, N, IN T YEARS												
	0	1	2	3	4	5	6	7	8	9	10	11	12
0.00	0.000	0.043	0.087	0.130	0.174	0.217	0.261	0.304	0.348	0.391	0.435	0.478	0.522
0.01	0.008	0.059	0.110	0.161	0.212	0.263	0.314	0.364	0.415	0.466	0.517	0.568	0.619
0.02	0.017	0.074	0.132	0.190	0.248	0.306	0.364	0.421	0.479	0.537	0.595	0.653	0.711
0.03	0.024	0.089	0.153	0.218	0.282	0.347	0.411	0.476	0.540	0.605	0.669	0.734	0.798
0.04	0.031	0.102	0.173	0.244	0.315	0.386	0.457	0.528	0.598	0.669	0.740	0.811	0.882
0.05	0.038	0.115	0.192	0.269	0.346	0.423	0.500	0.577	0.654	0.731	0.808	0.885	0.962
0.06	0.045	0.128	0.211	0.293	0.376	0.459	0.541	0.624	0.707	0.789	0.872	0.955	1.038
0.07	0.051	0.140	0.228	0.316	0.404	0.493	0.581	0.669	0.757	0.846	0.934	1.022	1.110
0.08	0.058	0.151	0.245	0.338	0.432	0.525	0.619	0.712	0.806	0.899	0.993	1.086	1.180
0.09	0.063	0.162	0.261	0.359	0.458	0.556	0.655	0.754	0.852	0.951	1.049	1.148	1.246
0.10	0.069	0.172	0.276	0.379	0.483	0.586	0.690	0.793	0.897	1.000	1.103	1.207	1.310
0.20	0.114	0.257	0.400	0.543	0.686	0.829	0.971	1.114	1.257	1.400	1.543	1.686	1.829
0.30	0.146	0.317	0.488	0.659	0.829	1.000	1.171	1.341	1.512	1.683	1.854	2.024	2.195
0.40	0.170	0.362	0.553	0.745	0.936	1.128	1.319	1.511	1.702	1.894	2.085	2.277	2.468
0.50	0.189	0.396	0.604	0.811	1.019	1.226	1.434	1.642	1.849	2.057	2.264	2.472	2.679
0.60	0.203	0.424	0.644	0.864	1.085	1.305	1.525	1.746	1.966	2.186	2.407	2.627	2.847
0.70	0.215	0.446	0.677	0.908	1.138	1.369	1.600	1.831	2.062	2.292	2.523	2.754	2.985
0.80	0.225	0.465	0.704	0.944	1.183	1.423	1.662	1.901	2.141	2.380	2.620	2.859	3.099
0.90	0.234	0.481	0.727	0.974	1.221	1.468	1.714	1.961	2.208	2.455	2.701	2.948	3.195
1.00	0.241	0.494	0.747	1.000	1.253	1.506	1.759	2.012	2.265	2.518	2.771	3.024	3.277
1.10	0.247	0.506	0.764	1.022	1.281	1.539	1.798	2.056	2.315	2.573	2.831	3.090	3.348
1.20	0.253	0.516	0.779	1.042	1.305	1.568	1.832	2.095	2.358	2.621	2.884	3.147	3.411
1.30	0.257	0.525	0.792	1.059	1.327	1.594	1.861	2.129	2.396	2.663	2.931	3.198	3.465
1.40	0.262	0.533	0.804	1.075	1.346	1.617	1.888	2.159	2.430	2.701	2.972	3.243	3.514
1.50	0.265	0.540	0.814	1.088	1.363	1.637	1.912	2.186	2.460	2.735	3.009	3.283	3.558
1.60	0.269	0.546	0.824	1.101	1.378	1.655	1.933	2.210	2.487	2.765	3.042	3.319	3.597
1.70	0.272	0.552	0.832	1.112	1.392	1.672	1.952	2.232	2.512	2.792	3.072	3.352	3.632
1.80	0.275	0.557	0.840	1.122	1.405	1.687	1.969	2.252	2.534	2.817	3.099	3.382	3.664
1.90	0.277	0.562	0.847	1.131	1.416	1.701	1.985	2.270	2.555	2.839	3.124	3.409	3.693
2.00	0.280	0.566	0.853	1.140	1.427	1.713	2.000	2.287	2.573	2.860	3.147	3.434	3.720
2.10	0.282	0.570	0.859	1.148	1.436	1.725	2.013	2.302	2.591	2.879	3.168	3.456	3.745
2.20	0.284	0.574	0.865	1.155	1.445	1.735	2.026	2.316	2.606	2.897	3.187	3.477	3.768
2.30	0.286	0.578	0.870	1.161	1.453	1.745	2.037	2.329	2.621	2.913	3.205	3.497	3.789
2.40	0.287	0.581	0.874	1.168	1.461	1.754	2.048	2.341	2.635	2.928	3.222	3.515	3.808
2.50	0.289	0.584	0.879	1.173	1.468	1.763	2.058	2.353	2.647	2.942	3.237	3.532	3.827

TABLE 3-4. FINAL ACCIDENT PREDICTION FROM INITIAL PREDICTION AND ACCIDENT HISTORY [4 YEARS OF ACCIDENT DATA (T=4)]

INITIAL PREDICTION FROM BASIC MODEL, a	NUMBER OF ACCIDENTS, N, IN T YEARS														
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
0.00	0.000	0.042	0.083	0.125	0.167	0.208	0.250	0.292	0.333	0.375	0.417	0.458	0.500	0.542	0.583
0.01	0.008	0.056	0.105	0.153	0.202	0.250	0.298	0.347	0.395	0.444	0.492	0.540	0.589	0.637	0.685
0.02	0.016	0.070	0.125	0.180	0.234	0.289	0.344	0.398	0.453	0.508	0.563	0.617	0.672	0.727	0.781
0.03	0.023	0.083	0.144	0.205	0.265	0.326	0.386	0.447	0.508	0.568	0.629	0.689	0.750	0.811	0.871
0.04	0.029	0.096	0.162	0.228	0.294	0.360	0.426	0.493	0.559	0.625	0.691	0.757	0.824	0.890	0.956
0.05	0.036	0.107	0.179	0.250	0.321	0.393	0.464	0.536	0.607	0.679	0.750	0.821	0.893	0.964	1.036
0.06	0.042	0.118	0.194	0.271	0.347	0.424	0.500	0.576	0.653	0.729	0.806	0.882	0.958	1.035	1.111
0.07	0.047	0.128	0.209	0.291	0.372	0.453	0.534	0.615	0.696	0.777	0.858	0.939	1.020	1.101	1.182
0.08	0.053	0.138	0.224	0.309	0.395	0.480	0.566	0.651	0.737	0.822	0.908	0.993	1.079	1.164	1.250
0.09	0.058	0.147	0.237	0.327	0.417	0.506	0.596	0.686	0.776	0.865	0.955	1.045	1.135	1.224	1.314
0.10	0.062	0.156	0.250	0.344	0.438	0.531	0.625	0.719	0.812	0.906	1.000	1.094	1.188	1.281	1.375
0.20	0.100	0.225	0.350	0.475	0.600	0.725	0.850	0.975	1.100	1.225	1.350	1.475	1.600	1.725	1.850
0.30	0.125	0.271	0.417	0.563	0.708	0.854	1.000	1.146	1.292	1.437	1.583	1.729	1.875	2.021	2.167
0.40	0.143	0.304	0.464	0.625	0.786	0.946	1.107	1.268	1.429	1.589	1.750	1.911	2.071	2.232	2.393
0.50	0.156	0.328	0.500	0.672	0.844	1.016	1.188	1.359	1.531	1.703	1.875	2.047	2.219	2.391	2.563
0.60	0.167	0.347	0.528	0.708	0.889	1.069	1.250	1.431	1.611	1.792	1.972	2.153	2.333	2.514	2.694
0.70	0.175	0.363	0.550	0.738	0.925	1.113	1.300	1.488	1.675	1.863	2.050	2.238	2.425	2.613	2.800
0.80	0.182	0.375	0.568	0.761	0.955	1.148	1.341	1.534	1.727	1.920	2.114	2.307	2.500	2.693	2.886
0.90	0.188	0.385	0.583	0.781	0.979	1.177	1.375	1.573	1.771	1.969	2.167	2.365	2.563	2.760	2.958
1.00	0.192	0.394	0.596	0.798	1.000	1.202	1.404	1.606	1.808	2.010	2.212	2.413	2.615	2.817	3.019
1.10	0.196	0.402	0.607	0.813	1.018	1.223	1.429	1.634	1.839	2.045	2.250	2.455	2.661	2.866	3.071
1.20	0.200	0.408	0.617	0.825	1.033	1.242	1.450	1.658	1.867	2.075	2.283	2.492	2.700	2.908	3.117
1.30	0.203	0.414	0.625	0.836	1.047	1.258	1.469	1.680	1.891	2.102	2.313	2.523	2.734	2.945	3.156
1.40	0.206	0.419	0.632	0.846	1.059	1.272	1.485	1.699	1.912	2.125	2.338	2.551	2.765	2.978	3.191
1.50	0.208	0.424	0.639	0.854	1.069	1.285	1.500	1.715	1.931	2.146	2.361	2.576	2.792	3.007	3.222
1.60	0.211	0.428	0.645	0.862	1.079	1.296	1.513	1.730	1.947	2.164	2.382	2.599	2.816	3.033	3.250
1.70	0.213	0.431	0.650	0.869	1.088	1.306	1.525	1.744	1.962	2.181	2.400	2.619	2.837	3.056	3.275
1.80	0.214	0.435	0.655	0.875	1.095	1.315	1.536	1.756	1.976	2.196	2.417	2.637	2.857	3.077	3.298
1.90	0.216	0.437	0.659	0.881	1.102	1.324	1.545	1.767	1.989	2.210	2.432	2.653	2.875	3.097	3.318
2.00	0.217	0.440	0.663	0.886	1.109	1.332	1.554	1.777	2.000	2.223	2.446	2.668	2.891	3.114	3.337
2.10	0.219	0.443	0.667	0.891	1.115	1.339	1.562	1.786	2.010	2.234	2.458	2.682	2.906	3.130	3.354
2.20	0.220	0.445	0.670	0.895	1.120	1.345	1.570	1.795	2.020	2.245	2.470	2.695	2.920	3.145	3.370
2.30	0.221	0.447	0.673	0.899	1.125	1.351	1.577	1.803	2.029	2.255	2.481	2.707	2.933	3.159	3.385
2.40	0.222	0.449	0.676	0.903	1.130	1.356	1.583	1.810	2.037	2.264	2.491	2.718	2.944	3.171	3.398
2.50	0.223	0.451	0.679	0.906	1.134	1.362	1.589	1.817	2.045	2.272	2.500	2.728	2.955	3.183	3.411

TABLE 3-5. FINAL ACCIDENT PREDICTION FROM INITIAL PREDICTION AND ACCIDENT HISTORY [5 YEARS OF ACCIDENT DATA (T=5)]

INITIAL PREDICTION FROM BASIC MODEL, a	NUMBER OF ACCIDENTS, N, IN T YEARS														
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
0.00	0.000	0.040	0.080	0.120	0.160	0.200	0.240	0.280	0.320	0.360	0.400	0.440	0.480	0.520	0.560
0.01	0.008	0.054	0.100	0.146	0.192	0.238	0.285	0.331	0.377	0.423	0.469	0.515	0.562	0.608	0.654
0.02	0.015	0.067	0.119	0.170	0.222	0.274	0.326	0.378	0.430	0.481	0.533	0.585	0.637	0.689	0.741
0.03	0.021	0.079	0.136	0.193	0.250	0.307	0.364	0.421	0.479	0.536	0.593	0.650	0.707	0.764	0.821
0.04	0.028	0.090	0.152	0.214	0.276	0.338	0.400	0.462	0.524	0.586	0.648	0.710	0.772	0.834	0.897
0.05	0.033	0.100	0.167	0.233	0.300	0.367	0.433	0.500	0.567	0.633	0.700	0.767	0.833	0.900	0.967
0.06	0.039	0.110	0.181	0.252	0.323	0.394	0.465	0.535	0.606	0.677	0.748	0.819	0.890	0.961	1.032
0.07	0.044	0.119	0.194	0.269	0.344	0.419	0.494	0.569	0.644	0.719	0.794	0.869	0.944	1.019	1.094
0.08	0.048	0.127	0.206	0.285	0.364	0.442	0.521	0.600	0.679	0.758	0.836	0.915	0.994	1.073	1.152
0.09	0.053	0.135	0.218	0.300	0.382	0.465	0.547	0.629	0.712	0.794	0.876	0.959	1.041	1.124	1.206
0.10	0.057	0.143	0.229	0.314	0.400	0.486	0.571	0.657	0.743	0.829	0.914	1.000	1.086	1.171	1.257
0.20	0.089	0.200	0.311	0.422	0.533	0.644	0.756	0.867	0.978	1.089	1.200	1.311	1.422	1.533	1.644
0.30	0.109	0.236	0.364	0.491	0.618	0.745	0.873	1.000	1.127	1.255	1.382	1.509	1.636	1.764	1.891
0.40	0.123	0.262	0.400	0.538	0.677	0.815	0.954	1.092	1.231	1.369	1.508	1.646	1.785	1.923	2.062
0.50	0.133	0.280	0.427	0.573	0.720	0.867	1.013	1.160	1.307	1.453	1.600	1.747	1.893	2.040	2.187
0.60	0.141	0.294	0.447	0.600	0.753	0.906	1.059	1.212	1.365	1.518	1.671	1.824	1.976	2.129	2.282
0.70	0.147	0.305	0.463	0.621	0.779	0.937	1.095	1.253	1.411	1.568	1.726	1.884	2.042	2.200	2.358
0.80	0.152	0.314	0.476	0.638	0.800	0.962	1.124	1.286	1.448	1.610	1.771	1.933	2.095	2.257	2.419
0.90	0.157	0.322	0.487	0.652	0.817	0.983	1.148	1.313	1.478	1.643	1.809	1.974	2.139	2.304	2.470
1.00	0.160	0.328	0.496	0.664	0.832	1.000	1.168	1.336	1.504	1.672	1.840	2.008	2.176	2.344	2.512
1.10	0.163	0.333	0.504	0.674	0.844	1.015	1.185	1.356	1.526	1.696	1.867	2.037	2.207	2.378	2.548
1.20	0.166	0.338	0.510	0.683	0.855	1.028	1.200	1.372	1.545	1.717	1.890	2.062	2.234	2.407	2.579
1.30	0.168	0.342	0.516	0.690	0.865	1.039	1.213	1.387	1.561	1.735	1.910	2.084	2.258	2.432	2.606
1.40	0.170	0.345	0.521	0.697	0.873	1.048	1.224	1.400	1.576	1.752	1.927	2.103	2.279	2.455	2.630
1.50	0.171	0.349	0.526	0.703	0.880	1.057	1.234	1.411	1.589	1.766	1.943	2.120	2.297	2.474	2.651
1.60	0.173	0.351	0.530	0.708	0.886	1.065	1.243	1.422	1.600	1.778	1.957	2.135	2.314	2.492	2.670
1.70	0.174	0.354	0.533	0.713	0.892	1.072	1.251	1.431	1.610	1.790	1.969	2.149	2.328	2.508	2.687
1.80	0.176	0.356	0.537	0.717	0.898	1.078	1.259	1.439	1.620	1.800	1.980	2.161	2.341	2.522	2.702
1.90	0.177	0.358	0.540	0.721	0.902	1.084	1.265	1.447	1.628	1.809	1.991	2.172	2.353	2.535	2.716
2.00	0.178	0.360	0.542	0.724	0.907	1.089	1.271	1.453	1.636	1.818	2.000	2.182	2.364	2.547	2.729
2.10	0.179	0.362	0.545	0.728	0.911	1.094	1.277	1.460	1.643	1.826	2.009	2.191	2.374	2.557	2.740
2.20	0.180	0.363	0.547	0.731	0.914	1.098	1.282	1.465	1.649	1.833	2.016	2.200	2.384	2.567	2.751
2.30	0.180	0.365	0.549	0.733	0.918	1.102	1.286	1.471	1.655	1.839	2.024	2.208	2.392	2.576	2.761
2.40	0.181	0.366	0.551	0.736	0.921	1.106	1.291	1.475	1.660	1.845	2.030	2.215	2.400	2.585	2.770
2.50	0.182	0.367	0.553	0.738	0.924	1.109	1.295	1.480	1.665	1.851	2.036	2.222	2.407	2.593	2.778

APPENDIX B
FLORIDA DOT SAFETY INDEX

FLORIDA SAFETY INDEX

An accident prediction mathematical model was developed by Florida State University under contract to the Florida DOT Office of Safety. Statistical consultants at Florida State University utilized stepwise regression analysis, and the following three statistical techniques not previously employed, to develop the accident prediction model: (1) transformation of data; (2) use of dummy variables;and (3) transformation of the accident prediction model to its original scale. The resulting model is shown on the next page.

The predicted number of accidents per year (Y) is adjusted for accident history. Although this introduces a mathematical bias, it is needed to ensure that all possible hazardous situations are investigated. The accident prediction model explains less than half of the accident environment, whereas human failure is almost always involved. Therefore, locations experiencing non-predicted accidents should receive special investigation. Unfortunately, the phenomenon of regression toward the mean now may apply because a crossing that has 2-3 accidents one year may not have any more until it reaches it actual predicted accident rate. The accident history adjustment equation that is chosen always increases (never decreases) the accident predictor. The following adjustment for accident history is only calculated when the accident is greater than the accident prediction.

$$Y = y\sqrt{H \div (y \cdot P)}$$

Where:

- y = accident prediction based on the regression model
- Y = accident prediction adjusted for accident history
- H = number of accidents for six-year history or since year of last improvement
- P = number of years of the accident history period

FLORIDA ACCIDENT PREDICTION EQUATIONS

1. $t_p = -8.075 + .318 \ln S_t + .484 \ln T + .437 \ln A + .387 \ln V_v +$
$(.28 - .28\,(\frac{MASD}{RSSD}))^{**} + (.33 - 1.23\,(\frac{MCSD}{RSSD}))^{*} + .15$ (if no crossbucks)

1a. $y = \exp(.968 t_p + 1.109) \div 4$

2. $t_a = -8.075 + .318 \ln S_t + .166 \ln T + .293 \ln A + .387 \ln V_v +$
$(.28 - .28\,(\frac{MASD}{RSSD})) + .225\,(L-2)^{***} - .233$ (if gates)

2a. $y = \exp(.968 t_a + 1.109) \div 4$

Where:

A = vehicles per day or annual average daily traffic

L = number of lanes

MASD = actual minimum stopping sight distance along roadway

MCSD = clear sight distance (ability to see approaching train along the roadway, recorded for the four quadrants established by the intersection of the railroad tracks and road)

RSSD = required stopping sight distance on wet pavement

S_t = maximum speed of train

T = yearly average of the number of trains per day

t_a = ln of predicted number of accidents in four year period at crossings with activ protection

t_p = ln of predicted number of accidents in four year period at crossings with passive protection

V_v = posted vehicle speed limit unless geometrics dictate a lower speed

y = predicted number of accidents per year at crossing

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* This variable omitted if crossing is protected by flagman or the calculation is less than zero.

** This variable omitted if sight restriction is due to parallel road.

*** This variable omitted when gates are present.

A simple method of rating each grade crossing from zero to 90 was derived based mathematically on the accident prediction. This method, entitled Safety (Hazard) Index, is used to rank each grade crossing. A Safety Index of 70 is considered safe (no further improvement necessary). A grade crossing with an accident prediction of 0.05 or one accident every 20 years would have a Safety Index of 70. It is not considered economical to provide active warning devices at grade crossings with a lower accident prediction. A Safety Index of 60, or one accident every nine years, would be considered marginal. The Safety Index is calculated as follows:

$$R = X(1 - \sqrt{Y})$$

Where:

R = Safety Index

Y = Adjusted accident prediction value

X = 90 when less than ten school buses per day traverse the crossing.

= 85 when ten or more school buses per day and active warning devices exist without gates.

= 80 when ten or more school buses per day and passive warning devices exist.

The Safety Index is used to indicate the relative hazard of all public grade crossings in Florida. The crossings that exhibit the lowest Safety Index values are given highest priority for installation of warning devices such as flashing lights and gates, or even grade separation structures for extremely hazardous crossings that have frequent train arrivals and high vehicular traffic. Each grade crossing is assigned a statewide priority number based on the Safety Index. The grade crossing with the lowest Safety Index would be assigned priority number one, etc.

APPENDIX C
FLORIDA DOT GUIDELINES FOR ON-SITE REVIEWS

Florida
Guidelines For Review of Railroad
Grade Crossings

I. General

A. Participation of road maintaining agency (i.e., local, other state, federal, etc.) in review is very important in (1) attaining commitments to perform some work with that agency's forces, and (2) making reasonable recommendations for crossing closures.

B. Prior to field review, obtain and/or review the following.

1. Update inventory data of each crossing to be inspected.
2. Aerials or current county maps to check road patterns (i.e.,through streets vs. dead ends).
3 Accident reports at the crossings (hard copies).
4. FDOT manual on rail crossing profiles (take a lock level in field to measure profile at non-state road crossings).
5. Survey of state road rail crossings to see which will allow passage of the state law truck.
6. Functional classification (roads) maps.

C. During Field Inspections.

1. Check future developments that appear likely to occur on the road (which would increase future ADT).
2. Try to utilize removed equipment at closed crossings at other crossings.

II. Protective Devices

A. Cross-Bucks

1. Check reflectivity (both sides) and general condition.
2. Check proper positioning and offsets.
3. Check need for active protection.

B. Active Protection

1. General

a. Check offsets.

b. Check positioning and focusing

c. Check lens size and number of lenses.

d. Check need for cantilevers.

e. Check for preemption at adjacent (within 200 feet) intersections.

2. Flashing Lights

a. Check need for gates.

3. Flashing Lights and Gates

a. Check proper gate length

C. Track Circuitry

1. Check need for motion detectors.

2. Check need for constant warning time device.

III. Crossing Surface

A. Check condition (need total replacement?)

*B. Check width.

C. Check drop-off adjacent to crossing.

D. Check if crossing profile will allow passage of state law truck.

(*If widening is needed, determine if it should be equally on both sides or all on one side)

IV. Approach Roadways

A. Check width adjacent to crossing.

B. Check condition.

*C. Check geometrics (curvature, alignment).

D. Check profile across crossing (NOTE: if paved roads needs additional material to eliminate a crossing "hump", pave with full depth asphalt. If a graded road, raise grade with embankment or limerock, and pave to 4-5"with asphalt for distance needed to reduce "hump" to allow passage of state law vehicle).

* (Possible improvements would be to realign the road and relocate the crossing or use curve or chevron signs where they could be effective).

V. Sight Clearance.

   A. Check sight distance approaching crossing.

   B. Check sight distance at the crossing.
      (NOTE: Proper sight distance down the tracks is critical for passive protection and desirable for active protection).

   C. Check roadway approach view of protective devices.
      (For A, B & C above, check and note necessary clearing that may be required and whether it is on road or railroad ROW or private property).

VI. Crossing Closing

   A. Consider for low volume crossings where another crossing is within a reasonable distance (say 0.2-0.3 mile) over a road passable in all weather conditions - the roadway connecting to the nearest open crossing and/or the roadway which the open crossing is on can be improved with 203 funds.

   B. Consider improving the open crossing adjacent to the one being recommended for closure, possibly by installing active warning devices where they don't presently exist.

VII. Signing

   A. Check railroad advance warning sign (WIO-1).
      1. Need for sign.
      2. Placement of sign.

   B. Check need for railroad warning sign(s) (WIO-2,3,4) on parallel roads.

   C. Check need for flashing beacon on advance warning sign.

   D Check need for stop signs.
      1. On nearby parallel roads.
      2. At the crossing.
      3. At nearby intersections.

   E. Check need for approach road curve or chevron signs.

VIII. Pavement Markings

A. Check need for RR advance markings.

B. Check need for stop bars at:

1. Nearby intersections.
2. The crossing.

(NOTE: 203 funds can be used for upgrading markings from paint to thermoplastic if the painted marking is in need of refurbishment).

IX. Illumination - Check Warrants.

X. Other - Any work that would improve the safety at a grade crossing can be funded with 203 funds, including such work as improving the radii of nearby intersecting road intersections and resultant extension of culverts, etc.

APPENDIX D
ALASKA GRADE CROSSING POLICY (DRAFT)

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2.0 EXECUTIVE SUMMARY

2.1 Introduction:

The goal of any transportation agency is to provide for the safe, efficient and economical movement of people, goods and services. It is a continuing challenge to seek the proper balance between safety, efficiency and economy to bring the greatest good to the most people within the constraints of available resources.

With the acquisition of the Alaska Railroad by the State, continued population growth, and decreasing financial resources, the need for a more uniform statewide program to provide safe railroad/highway grade crossings became apparent.

Responding to this need, the Commissioner of the Department of Transportation and Public Facilities (DOT&PF), Richard Knapp, and the President and Chief Executive Officer of the Alaska Railroad Corporation (ARRC), Frank Turpin, established a Task Force on Rail/Highway Crossings composed of representatives of their agencies and the Federal Highway Administration (FHWA).

At the Task Force's first meeting on October 29, 1985, the Commissioner outlined his concept of the three subtasks required to carry out his charge to the Task Force:

1. After referring to available technology and standards, determine the reasonable type of protection for each "class" of crossings.

2. Inventory all crossings in the State to determine the appropriate protection "classes".

3. Develop a reasonable structured priority system to implement improvements through a rational and systematic allocation of available resources.

Within these subtasks, the Task Force set out to accomplish this change and make the Alaska highway system and Alaska Railroad safer for the traveling public.

2.2 Discussion:

Most crossings of the Alaska Railroad Corporation are under permit to the agency (State of local) which has the road authority. The terms of the permit make the road agency responsible for construction and maintenance costs associated with the permitted road crossing, and for claims resulting from the construction, maintenance and use of the road crossing.

The Task Force, with the assistance of the FHWA and the Federal Railroad Administration (FRA), reviewed the latest safety resource

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allocation techniques, including an accident prediction model developed through FHWA research. FHWA's research was aimed at establishing a national standard for planning crossing improvements.

The computed "DOT Accident Prediction Value" (APV) of a crossing is the product of a series of factors representing the various characteristics of the crossing, and is equivalent to the expected number of accidents per year at that crossing.

The State inventory was completed and the APV's of all crossings were computed. A graph was made of the number of crossings exceeding the various values of APV, and this was compared to a similar graph developed by the FHWA/FRA for all crossings in the nation. On a percentage basis, the two graphs were very similar. The Task Force found that the crossings with the highest APV's are generally those that are already known to be in need of improvement, many of which are already programmed or in progress.

The FHWA resource allocation model develops threshold values of the APV to determine the optimum cost-effective safety improvement decisions at each crossing.

With the exception of grade separations, the biggest decision is whether or not to install active devices (train activated flashing lights or flashing lights and gates). The allocation model arrives at an APV of 0.1 as the cost-effective threshold value for considering going form passive devices (signs, markings) to active protection. Rapidly decreasing safety benefits along with rapidly rising costs are associated with an APV less than a value near 0.1, both for the national inventory and the State distribution.

When this criterion is applied to the State's crossings, the Task Force found that it resulted in a program that can be accomplished in a reasonable time within the available State and federal resources.

In addition, this technique meets the federal requirement of a rational prioritization scheme for using federal crossings safety improvement funds.

The Task Force noted that this prioritization system is only an indicator of the probable treatment required at a given crossing in order to concentrate efforts where they are most urgently needed. In other words, the final decision as to what major treatment is required at a crossing would be based on an on-site evaluation by a professional diagnostic team, and the APV criterion would not normally be blindly followed, especially for borderline cases. There will be instances in which an evaluation reveals that relatively low-cost improvements such as increased sight-distance in conjunction with better signing might change the accident potential to a level that would not require active devices which are expensive to install and maintain, thereby freeing funds to be applied where they would do more good.

It is also imperative that local jurisdictions be brought into the diagnostic process when they are affected by the engineering decision. Likewise, local jurisdictions, developers, and other State agencies that have the potential to create a rail/highway safety conflict must take this into account in their planning functions, and should be responsible for their fair share of any costs created by their actions, especially in an era of declining State resources.

Provision should be made to maintain the program through regular updating of the inventory and priority list, and periodic evaluation of the effectiveness of the improvements made.

2.2.1 Definitions and Recommendations

The following subsections summarizes the results of the Task Force investigations and deliberations.

2.2.2 The DOT/ARR Railroad - Highway Crossing Inventory Procedures Manual ("Procedures Manual") defines public and private crossings as follows:

"Public Crossing: A public crossing is a location where the tracks cross a road which is under the jurisdiction of and maintained by a public authority and which is open to public travel."

"Private Crossing: A private crossing is a location where a physical crossing is present but the road does not meet the conditions indicated above for a public crossing. Private crossings usually restrict public use by an agreement which the railroad has with the property owner, or by gates or similar barriers."

2.2.3 When the Task Force looked at the inventory of crossings on the Alaska Railroad, it became apparent that there are numerous crossing that are open to public travel but not "under the jurisdiction of and maintained by a public authority." The Procedures Manual also states "In some instances changes in land use have resulted in an expansion of crossing use to the extent that is has become a public crossing in fact, whether or not any public agency has accepted responsibility for maintenance or control of the use of the traveled way over the crossing. The railroad company and highway agency should make every effort to mutually resolve and agree on the appropriate classification (either public or private) of questionable crossings."

2.2.4 The Task Force recognized the problem of crossings that are open to public travel but are not under the jurisdiction of and maintained by a public authority. To be able to move forward and identify the magnitude of the problem, the Task Force developed and assigned the designation of PUB-4 to this type of crossing.

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2.2.5 The Task Force's definition is: "PUB-4. A crossing that is open to the public but the road is not maintained by a public authority." Open to the public means that (1) there is no restriction placed upon the use of the crossing; (2) if there is a gate but the gate is not being closed to restrict the use of the crossing; (3) if there is more than one user regularly using the crossing; or (4) if the roadway serves more than one piece of property on the opposite side of the tracks. One or more of these condition may exist today on a truly "private" crossing. With the exception of serving more than one piece of property, most existing private crossings could be made to fit this definition.

2.2.5.1 While the problems are the most acute in the Fairbanks North Star Borough, other boroughs, cities and municipalities have PUB-4 crossings. These include the Matanuska-Susitna Borough, Kenai Peninsula Borough, Municipality of Anchorage, City of Houston, City on Nenana, City of North Pole, and City of Seward. To be eligible for federal funding, the road authority must be responsible for the maintenance and meet the standards for public crossings as defined by the DOT/ARR Rail-Highway Crossing Inventory.

2.2.6 The roadway crossing at a PUB-4 crossing may have a designated street name, may be recognized as a public roadway and may be platted as such in either side of the railroad right-of-way.

2.2.7 The only PUB-4 crossings outside of the boundaries of local government are the crossings at Cantwell ARRC MP 319.6, at Ferry ARRC MP 371.1, and North Nenana ARRC MP 415.5. The first two crossings are at the end of State maintained roads.

2.2.8 For the area outside of the organized boroughs (Broad Pass to Dunbar), the Task Force recognized the problem of no planning agency. To be able to properly plan the development in this area, all state and federal agencies having land in this area must work together.

2.3 General Recommendations:

2.3.1 All crossings should be brought up to basic safety standards in the Alaska Traffic Manual.

2.3.2 New construction will adhere to the standards in the Alaska Traffic Manual, American Association of Railroads (ARR) Rail/Highway Crossing Handbook, and other State standards for the installation of passive and active warning devices.

2.3.2.1 Sight distances, track profile, drainage and train operation will all be factors considered in the design and improvements of crossings. The Railroad Highway Grade Crossing Handbook, Federal Highway Administration Public TS-78-214 (or revision) and current State of Alaska design standards thereof will be consulted in the design of crossings.

2.3.3 12-inch roundels for flashing lights and RR crossbucks with high intensity reflective sheeting on both sides should be adoped as a standard in the State of Alaska.

2.3.4 DOT&PF and the ARRC will update the FRA National Rail/Highway Crossing Inventory annually or more frequently if significant changes are discovered, and use of this data base to compute the crossing Accident Prediction Values.

2.3.5 "Operation Lifesaver" should be actively supported and participate in by the ARRC, DOT&PF, local governments and law enforcement agencies.

2.3.6 The ARRC and DOT&PF should arrange meetings with all local governmental planning and road agencies in the railbelt. These meetings would be used to discuss the results of the Task Force and set up procedures for implementing these recommendations.

2.4 Planning Recommendations

2.4.1 Local jurisdiction, state and federal agencies, and private enterprise should incorporate planning processes (a) aimed at minimizing the need for at-grade crossings and traffic at existing at-grade crossings; and (b) which will evaluate the effect on a crossing by changes in zoning, approval of new subdivisions and other elements of the planning process. Estimated future accident prediction values based on the proposed activity and future highway and railroad traffic densities will be used in the evaluation of the crossings. New at-grade crossings are discouraged and no new crossings will be permitted without concurrence of the appropriate diagnostic team.

2.4.2 Agencies, authorities, jurisdictions, and/or private enterprise whose actions have an impact on the crossings, should be required to participate in the funding of the construction and maintenance costs precipitated by those actions. For construction, this could include the matching funds (10%) if federal funding is available.

2.4.3 The ARRC and DOT&PF should arrange a meeting with BLM, DNR, NPS, Community and Reginal Affairs Department, and State Parks to review the planning processes for the area in the unorganized borough.

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2.5 Diagnostic Team Recommendations

2.5.1 A professional diagnostic team should team should perform an on-site evaluation before any major improvement is planned for an existing crossing or new crossing is approved.

2.5.2 Diagnostic teams should include as a minimum representatives of the ARRC and the DOT&PF Region. Where appropriate, representatives of the following should be informed and invited to participate in any on-site evaluation leading to an improvement decision:

a. The FHWA;
b. The Agency maintaining the road, if not DOT&PF;
c. The borough;
d. Municipality or other local agency; and
e. The law enforcement agency(ies).

2.5.3 The recommendation of the diagnostic team will be forwarded to the appropriate parties involved for action. The action at the crossing shall be in accordance with the permit and construction agreement with the ARRC.

2.5.4 The diagnostic teams should always consider the feasibility of eliminating crossings if this can be accomplished with safety benefits which outweigh the increased operational costs and inconvenience to users, and if it would not shift the safety problem to another area, or increase the area-wide hazard potential.

2.6 Existing Crossing Recommendations

2.6.2 The DOT Accident Prediction Value (APV) should be used as one factor in classifying and prioritizing crossings for improvements.

2.6.3 Diagnostic teams should consider an APV of 0.1 (one accident every 10 years) as an indicator of probable need to go from passive to active warning devices.

2.6.4 Diagnostic teams should evaluate crossings which have an APV greater than the 0.1 but which may already have active warning devices to determing the feasibility of providing grade separations (overpass/underpass) or increasing the level of protection of the active warning devices.

2.6.5. Where possible, upgrades and improvements should be accomplished when there is another project affecting the roadway in the area of the crossing.

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2.7 New Crossing Recommendations

2.7.1 New crossings must be part of a comprehensive community plan. For the area between Broad Pass and Dunbar (unorganized borough) DOT&PF or Community and Regional Affairs Department (or the appropriate State agency) will be required to develop the plan. The comprehensive community plan must address factors such as future growth in the area, existing local governmental agencies, land ownership, geographical restrictions, availability and/or restrictions of natural grade separation locations.

2.7.2 New at-grade crossings should not be allowed if there is another crossing within two mile of the proposed new location, nor if there is a reasonable alternative to a crossing such as a feeder road. Exception may possibly be made after the diagnostic team review. Factors to be considered would include when terrain conditions make alternative access impossible or economically unfeasible.

2.7.3 It will be the responsibility of the government authority having road jurisdiction in the area of the proposed crossing to hold the necessary public hearings to insure that the road will be located so as to efficiently connect into future road networks. It will also be that governmental authority's responsibility to handle all protests concerning crossing location.

2.7.4 A professional diagnostic team will perform an on-site evaluation before any new crossing is approved. Factors to be considered by the diagnostic team:

2.7.4.1 Any new crossing will become a permanent crossing and possibly become a major roadway.

2.7.4.2 The proximity of the proposed new crossing to existing crossing and/or other planned crossings.

2.7.4.3 The effect the construction of the new crossing will have on the elimination of one or more existing crossings, making transportation network safer and better able to serve the road needs of the area.

2.7.4.4 The grade of approaches to all crossings should be level with top of rail (±1") for at least 100' to prevent long low trailers from hitting the crossing.

2.7.4.5 Roadway approaches to the crossing should be at or nearly 90°. Short radius curves or skew angle approaches below 75° will not be permitted.

2.7.4.6 For public crossings, the road must have a dedicated right-of-way on both sides of the Alaska Railroad main line. The dedicated road right-of-way must include dedicated sight triangles for maximum design highway and train speeds.

2.7.4.7 For private crossings, the owner must own or secure road right-of-way and sight triangles for maximum design speeds. The private owner will be restricted from developing within the sight triangles.

2.7.5 The DOT accident prediction formulas will be used as one factor in designing protection at new crossings. The new crossing will also be compared to existing crossings of similar geometric characteristics and rail and highway traffic densities. The comparison will also look at accident history and the effect of accidents on the DOT accident prediction value.

2.7.6 The crossing permit issued by the ARRC for private crossings will be recorded as an addendum to the deed of the property owner/permittee including the restriction on sight triangles, with the obligations of the permittee to remain appurtenant to the real property.

2.7.7 For public crossings, the ARRC will only issue the permit to the DOT&PF or government authority having road construction and maintenance jurisdiction at the location of the crossing.

2.8 Private Crossings Recommendations

2.8.1 Existing truly "private" crossing and new private crossings will be deemed public when any of following occur:

1. The crossing serves two or more parcels of property, unless all parcels are owned by the same owner;

2. The use of the crossing cannot be or is not controlled by the owner of the crossing;

3. The roadway is designated a road by the governmental authority responsible for planning and/or zoning; or

4. If school buses or mass transit vehicles use the crossing.

2.8.2 Some existing private crossing current serve more than one parcel of property. The crossing may remain as a private crossing as long as there is not further subdivision of the property and property is owned by the same owner.

2.8.3 If the owner no longer complies with the conditions of the "Private Crossing Permit" and the crossing has not become a public crossing, the ARRC will notify the owner of the

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deficiencies. If the owner fails to correct the deficiencies, the crossing will be removed at the owner's expense.

2.8.4 If the crossing's use has become public, the ARRC will work with appropriate public authority to permit the crossing as a public crossing. A diagnostic team shall review the crossing prior to the issuance of the public crossing permit. Based on the diagnostic team's review, any physical improvements required to the geometric characteristics and protective devices will be made in accordance with current design standards.

2.8.5 If the public authority refuses to accept the responsibility for the public crossing, the crossing owner shall take appropriate action (if possible) to make the crossing "private". If the owner fails to correct the deficiencies, the ARRC will remove the crossing at the owner's expense.

2.9 PUB-4 Crossings Recommendations

2.9.1 ARRC and DOT&PF should involve the local governments and use diagnostic teams to address the problems of these crossings. The local public authority with road powers must make decisions on the continuing need for the crossing balanced with the cost and liability of maintaining the crossings.

2.9.1.1 Diagnostic teams should be formed as soon as possible with each governmental agency which has PUB-4 crossings within its boundaries.

2.9.2 The use of ARRC right-of-way to eliminate a crossing will be reviewed on a case by case basis. When development has occurred and natural physical obstructions such as lakes and rivers prevent alternate accesses, the ARRC may permit to the public authority a road on ARRC right-of-way to facilitate the removal of one or more crossings. The use of ARRC right-of-way should only be permitted after a diagnostic team review and coordination with the local planning and zoning agency.

2.9.3 Roadway signing at the PUB-4 crossing should be in accordance with the Alaska Traffic Manual and include as a minimum:

1. Stop sign on both sides of the track unless a diagnostic team determines that stop signs are not required;

2. Crossbuck on both sides of the track;

3. Railroad advance warning signs (W10 Series) as per Alaska Traffic Manual; and

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4. An "ARRC property proceed at your own risk" sign at the right-of-way on both sides of the track.

2.10 Conclusion

2.10.1 The Task Force believes that if these recommendations are accepted and given the weight of official State policy, the resulting program will meet the Task Force objectives with regard to the immediate and ongoing concern for safety at rail/highway grade crossings.

APPENDIX E
SAMPLE COMPUTER PRINTOUT FORMATS

Several computer programs have been developed to provide States, railroad companies and other interested agencies information contained in the National Grade Crossing Inventory and Accident/ Incident files maintained by the Federal Railroad Administration (FRA). A complete listing of available formats can be obtained by contacting the FRA Office of Safety at 400 7th Street, SW., Washington, D.C. 20590. This appendix contains examples of printouts that can be used specifically to develop and facilitate corridor improvement projects.

Page E-2 is the standard U.S. DOT - AAR Crossing Inventory Form that has been completed for all crossings in the U.S.

Page E-3 is an example of the computer printout of the information contained in the original (or subsequent updates) of the Inventory Form. If this printout is available during field reviews, incorrect data that might significantly change the accident prediction value for a crossing can be identified and corrected.

Page E-4 is an example of a series of crossings ranked by decreasing accident prediction value. This information is available for all crossings in a State, county or city, all crossings along a selected corridor, all crossings owned by a specific railroad company or by almost any other categorization. In the example shown, crossing number 624313P ranks second with a predicted accident rate of 1.0210 accidents per year (or 10.21 accidents in a 10-year period). It has had accidents in 1980, 1981, 1983, and 1984, currently has flashing light signals (Warning Device Class 7), and is on a highway functionally classified as an urban minor arterial (Func. Class 16). Only the factors shown on this form are used to compute a crossing's accident prediction value.

Page E-5 is a listing of crossings by sequence, i.e., all crossings along a section of track in numerical order. This listing is also available for all crossings Statewide, and can be useful in selecting a corridor that has relatively high accident prediction values for a detailed review

Page E-6 is a sample of an Accident/Incident Report which summarizes the accident history for a specific crossing. A separate printout is made for each accident at a crossing. Although the information on this form gives a generalized summary of each accident, it is not a substitute for a police report, a copy of which should be used whenever possible by the on-site review team to analyze each crossing.

OMB 2130-0017

U.S. DOT — AAR CROSSING INVENTORY FORM

A. INITIATING AGENCY
☐ RAILROAD ☐ STATE

B. CROSSING NUMBER ____________

C. REASON FOR UPDATE:
☐ CHANGES IN EXISTING CROSSING DATA
☐ NEW CROSSING
☐ CLOSED CROSSING

D. EFFECTIVE DATE
M D Y

Part I Location and Classification of All Crossings (Must Be Completed)

1. Railroad Operating Company
2. Railroad Division or Region
3. Railroad Subdivision or District
4. State
5. County
6. County Map. Ref. No.
7. City
8. Nearest City
9. Highway Type and No.
10. Street or Road Name
11. RR I. D. No.
12. Nearest RR Timetable Station
13. Branch or Line Name
14. Railroad Mile Post

DO NOT WRITE IN THIS SPACE
State County
City Nearest City
RR Code Timetable Station

15. Pedestrian Crossing
☐ 1. at grade
☐ 2. RR under
☐ 3. RR over

16. Private Vehicle Crossing
A. ☐ 1. Farm ☐ 2. Residential ☐ 3. Recreational ☐ 4. Industrial
B. ☐ 5. at grade C. ☐ 8. signs-specify
☐ 6. RR under ☐ 9. signals-specify
☐ 7. RR over ☐ 0. none

17. Public Vehicle Crossing
☐ 1. at grade
☐ 2. RR under
☐ 3. RR over

COMPLETE REMAINDER OF FORM ONLY FOR PUBLIC VEHICLE CROSSINGS AT GRADE

Part II Detailed Information for Public Vehicular at Grade Crossing

1A. Typical Number of Daily Train Movements

Daylight (6 AM to 6 PM)		Night (6 PM to 6 AM)	
thru trains	switching	thru trains	switching
1	2	3	4

1B. Check if Less Than One Movement Per Day ☐ 5

2. Speed of Train at Crossing
A. Maximum time table speed 1
B. Typical Speed Range Over Crossing from ___ 2 to ___ 3 mph

3. Type and Number of Tracks
main ___ 1 other ___ 2 If other specify ___ 3

4. Does Another RR Operate a Separate Track at Crossing?
☐ Yes 1☐ No Specify: RR ___ 2

5. Does Another RR Operate Over Your Track at Crossing?
☐ Yes 1☐ No Specify: RR ___ 2

6. Type of Warning Device at Crossing
A. Signs

Crossbucks reflectorized	Crossbucks non-reflectorized	Standard Highway Stop Sign	Other Stop Signs	Other Signs: Specify
01 Number	02 Number	03 Number	04 Number	05 Number ___ 06; 07 Number ___ 08

B. Train Activated Devices

Gates: red & white reflectorized	Gates: other colored	Cantilevered Flashing Lights: over traffic lane	Cantilevered Flashing Lights: not over traffic lane	Mast Mounted Flashing Lights	Other Flashing Lights Specify	Highway Traffic Signals	Wigwags	Bells
09 Number	10 Number	11 Number	12 Number	13 Number	14 Number ___ 15	16 Number	17 Number	18 Number

C. Specify Special Warning Device not Train Activated ___ 19
D. No Signs or Signals ☐ 20

7. Is Commercial Power Available? ☐ Yes ☐ No
8. Does Crossing Signal Provide Speed Selection for Trains? ☐ Yes ☐ No ☐ N/A
9. Method of Signalling for Train Operation: Is Track Equipped with Signals? ☐ Yes ☐ No

Part III Physical Data

1. Type of Development ☐ 1. Open Sp. ☐ 2. Res ☐ 3. Comm. ☐ 4. Ind. ☐ 5. Inst.
2. Smallest Crossing Angle ☐ 0°-29° ☐ 30°-59° ☐ 60°-90°
3. Number of Traffic Lanes Crossing Railroad ___ Number
4. Are Truck Pullout Lanes Present? ☐ Yes ☐ No
5. Is Highway Paved ☐ Yes ☐ No
6. Pavement Markings ☐ Stoplines ☐ RR Xing Sym. ☐ None
7. Are RR Advance Warning Signs Present? ☐ Yes ☐ No
8. Crossing Surface ☐ 1 Sec. Timber ☐ 2 Full Wd Plank ☐ 3. Asphalt ☐ 4. Concrete Slab ☐ 5 Concrete Pave. ☐ 6. Rubber ☐ 7. Metal Sections ☐ 8. Other Metal ☐ 9 Unconsolidated ☐ 0 Other Specify
9. Does Track Run Down A Street? ☐ Yes ☐ No
10. Nearby Intersecting Highway? ☐ Yes ☐ No

Part IV Highway Department Information

1. Highway System ___
2. Is Crossing on State Highway System? ☐ Yes ☐ No.
3. Functional Classification of Road over Crossing ___
4. Estimate AADT ___
5. Estimate Percent Trucks ___

I. D. Number

Form FRA F 6180.71 (8-84)

CROSSING NUMBER: 190715T   EFFECTIVE BEGIN-DATE OF RECORD: 02/13/85

PART I LOCATION AND CLASSIFICATION OF ALL CROSSINGS

RAILROAD: CHICAGO AND NORTHWESTERN TRANSPORTATION DIVISION: IOWA   SUBDIVISION: EAST IOWA
STATE: IOWA   COUNTY: BOONE   COUNTY MAP REF. NO.: 0000008259
NEAREST CITY: AMES   HWY TYPE AND NO.:
STREET OR ROAD NAME: COUNTY ROAD   RAILROAD I.D. NO.: 4030 04113   FRA RR NETWORK LIC: CH234
NEAREST RR TIMETABLE STN.: ONTARIO   BRANCH OR LINE NAME: CLINTON-BOONE   RAILROAD MILEPOST: 0193.85
CROSSING TYPE AND PROTECTION: PUBLIC   AT GRADE

PART II DETAILED INFORMATION FOR PUBLIC VEHICULAR AT GRADE CROSSINGS

TYPICAL NUMBER OF DAILY TRAIN MOVEMENTS: 12 DAY THRU 0 DAY SWITCHING 12 NIGHT THRU 0 NIGHT SWITCHING
SPEED OF TRAIN AT CROSSING: MAXIMUM TIMETABLE SPEED 60 TYPICAL SPEED RANGE OVER CROSSING FROM 10 TO 60 MPH
TYPE AND NUMBER OF TRACKS: 2 MAIN 0 OTHER
DOES ANOTHER RR OPERATE A SEPARATE TRACK AT CROSSING? NO
DOES ANOTHER RR OPERATE OVER YOUR TRACK AT CROSSING? NO
TYPE OF WARNING DEVICE(S) AT CROSSING
SIGNS: 2 REFLECTORIZED CROSSBUCK(S)   0 NON-REFLECTORIZED CROSSBUCK(S)
0 STANDARD HIGHWAY STOP SIGN(S)   0 OTHER STOP SIGN(S)
0 OTHER SIGN(S):   0 OTHER SIGNS:
TRAIN ACTIVATED DEVICES: NONE
SPECIAL WARNING DEVICES NOT TRAIN ACTIVATED: NONE
IS COMMERCIAL POWER AVAILABLE? NO
DOES CROSSING SIGNAL PROVIDE SPEED SELECTION FOR TRAINS? N/A
METHOD OF SIGNALLING FOR TRAIN OPERATION: IS TRACK EQUIPPED WITH SIGNALS? NO

PART III PHYSICAL DATA

TYPE OF DEVELOPMENT:	OPEN SPACE
SMALLEST CROSSING ANGLE:	60 TO 90 DEGREES
NUMBER OF TRAFFIC LANES CROSSING RAILROAD:	1
ARE TRUCK PULLOUT LANES PRESENT?	NO
IS HIGHWAY PAVED?	NO
PAVEMENT MARKINGS:	NO PAVEMENT MARKINGS
ARE RR ADVANCE WARNING SIGNS PRESENT?	YES
CROSSING SURFACE:	UNCONSOLIDATED
DOES TRACK RUN DOWN A STREET?	NO
NEARBY INTERSECTING HIGHWAY?	NO

PART IV HIGHWAY DEPARTMENT INFORMATION

HIGHWAY SYSTEM:	NON-FEDERAL-AID
IS CROSSING ON STATE HIGHWAY SYSTEM?	NO
FUNCTIONAL CLASSIFICATION OF ROAD OVER CROSSING:	RURAL:LOCAL
ESTIMATED AADT:	000039
ESTIMATED PERCENT TRUCKS:	11

PUBLIC RAIL-HIGHWAY CROSSINGS
RANKED BY PREDICTED ACCIDENTS PER YEAR
INVENTORY DATE: SEPT 1985

RANK	PREDICTED ACCIDENTS	CROSSING ID	STATE	RAIL ROAD	# OF ACCIDENTS 80	81	82	83	84	DATE OF CHANGE	WARNING DEVICE CLASS	TRAINS PER DAY	DAY THRU TRAINS	# OF MAIN TRACKS	TIME TABLE SPEED	IS HWY. PAVED	# OF TRAFFIC LANES	FUNC. CLASS	AADT
1	1.1870	628334W	FL	SBD	4	3	1	0	0		7	14	6	1	79	YES	2	16	19130
2	1.0210	624313P	FL	SBD	1	1	0	3	2		7	19	6	1	79	YES	2	16	9765
3	0.9692	628502A	FL	SBD	1	4	0	0	0		7	6	0	1	25	YES	8	14	85090
4	0.9432	272736P	FL	FEC	2	1	2	0	2		8	26	4	2	25	YES	4	16	17035
5	0.8304	625404Y	FL	SBD	2	4	0	0	0		7	24	8	1	30	YES	2	19	3725
6	0.8117	624319F	FL	SBD	1	0	1	4	0		7	19	6	1	79	YES	2	14	5170
7	0.8049	272567E	FL	FEC	2	0	1	1	1		8	20	3	2	35	YES	6	14	43340
8	0.7939	625419N	FL	SBD	1	1	2	3	2		8	24	8	1	79	YES	4	02	1550
9	0.7822	622322G	FL	SBD	1	0	1	3	2		7	6	0	0	15	YES	2	02	6610
10	0.7694	624241N	FL	SBD	2	2	1	1	0		7	18	0	1	40	YES	2	08	4395
11	0.7649	628186E	FL	SBD	1	2	0	0	4		8	14	6	1	79	YES	2	09	34000
12	0.7568	628507J	FL	SBD	2	1	0	1	1		7	6	0	1	25	YES	4	19	20290
13	0.7394	631055E	FL	SBD	0	0	2	2	1		7	4	0	1	30	YES	4	19	23990
14	0.6631	624325J	FL	SBD	0	0	0	2	2		4	19	6	1	79	YES	2	19	1422
15	0.6620	272544X	FL	FEC	1	2	0	0	1		8	14	3	2	60	YES	7	16	40300
16	0.6613	628103N	FL	SBD	1	1	0	0	2		7	28	6	1	79	YES	2	16	11160
17	0.6421	272592M	FL	FEC	0	1	2	1	0		8	16	3	2	30	YES	4	19	21900
18	0.6421	272604E	FL	FEC	2	1	0	1	0		8	16	4	2	50	YES	6	14	35900
19	0.6150	339696K	FL	SBD	0	4	0	1	0		8	10	5	1	35	YES	2	06	31470
20	0.5952	624370D	FL	SBD	1	0	0	0	3		8	31	6	2	25	YES	4	19	17490
21	0.5852	624345V	FL	SBD	1	0	0	2	1		7	19	6	1	79	YES	2	08	4740
22	0.5839	628139W	FL	SBD	0	1	2	0	0		7	16	6	1	40	YES	4	06	27000
23	0.5721	272390P	FL	FEC	1	2	0	0	1		8	18	4	2	60	YES	5	14	15160
24	0.5432	628322C	FL	SBD	4	0	0	0	0		7	14	6	1	79	YES	2	19	3260
25	0.5347	622080N	FL	SBD	1	2	1	0	0		8	15	4	1	50	YES	4	02	36400
26	0.5226	626815H	FL	SBD	2	1	0	0	0		7	12	4	1	15	YES	4	17	10170
27	0.5121	272748J	FL	FEC	0	1	0	1	1		7	26	4	2	20	YES	2	19	6665
28	0.4989	713556M	FL	SOU	0	1	2	0	1		7	50	0	2	10	YES	0	19	1340
29	0.4955	626670Y	FL	SBD	0	0	0	3	0		7	12	4	1	55	YES	2	09	14925
30	0.4925	272738D	FL	FEC	2	0	0	1	0		8	26	4	2	20	YES	4	19	30565
31	0.4897	272596P	FL	FEC	1	1	1	0	0		8	52	41	2	50	YES	4	17	14495
32	0.4731	627592X	FL	SBD	2	1	0	0	0		7	17	6	1	75	YES	2	07	6325
33	0.4666	272598D	FL	FEC	0	0	1	1	1		8	16	4	2	50	YES	6	14	15640
34	0.4615	624214S	FL	SBD	2	0	2	1	0		4	10	0	0	20	YES	2	09	3330
35	0.4596	624175D	FL	SBD	1	1	0	0	1		7	8	2	1	25	YES	2	16	12100
36	0.4578	624427C	FL	SBD	1	1	0	0	1		7	11	1	1	60	YES	4	16	16490
37	0.4370	628146G	FL	SBD	0	0	0	0	2		7	16	6	1	35	YES	5	19	18140
38	0.4367	628045V	FL	SBD	1	0	0	0	2		7	12	6	1	79	YES	2	06	4335
39	0.4341	625678A	FL	SBD	0	2	0	0	0		7	18	4	2	45	YES	2	19	8940
40	0.4331	339973S	FL	SBD	1	0	1	0	1		7	8	4	1	30	YES	2	17	6440
41	0.4288	626913Y	FL	SBD	2	0	1	0	0		7	16	4	1	20	YES	2	14	2955
42	0.4247	620839B	FL	SBD	0	0	0	0	3		7	14	1	1	79	YES	2	19	3790
43	0.4243	627695X	FL	SBD	2	0	0	1	0		7	2	1	1	30	YES	4	02	10335
44	0.4202	272805V	FL	FEC	1	2	0	0	0		7	2	0	1	25	YES	4	16	12660
45	0.4153	339709J	FL	SBD	0	1	1	0	1		8	16	6	2	20	YES	4	09	5100
46	0.4141	627218E	FL	SBD	0	0	0	3	0		7	2	2	1	20	YES	4	16	7640
47	0.4106	621054V	FL	SBD	1	0	0	0	1		7	12	5	1	15	YES	4	16	18360
48	0.4103	628191B	FL	SBD	1	2	0	0	0		8	14	6	1	79	YES	6	16	63800
49	0.4087	272097Y	FL	FEC	0	1	0	1	1		8	18	6	1	60	YES	4	14	22885
50	0.4075	628116P	FL	SBD	0	1	0	2	0		8	38	6	1	40	YES	5	17	7595
51	0.4073	624317S	FL	SBD	0	0	0	2	0		4	19	6	1	79	YES	2	19	1985

GXID	ACCPRED	STATE	STATEW	COUNTY	CNTY	CITY	CITYW	RAILROAD
335426X	0.0169359	22	LA	071	ORLEANS	1690	NEW ORLEANS	LA
335427E	0.0036648	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335429T	0.1324603	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335433H	0.5143968	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335437K	0.0590805	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335438S	0.3205087	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335439Y	0.0905460	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335440T	0.0576826	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335441A	1.0538197	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335442G	0.0664330	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335443N	0.1004865	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335445C	0.1675181	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335446J	0.0576826	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335447R	0.2299747	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335448X	0.0364304	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335449E	0.0885212	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335450Y	0.0364304	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335451F	0.0364304	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335454B	0.0485045	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335458D	0.2778471	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335459K	0.1747189	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335460E	1.1440639	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335461L	0.0578355	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335462T	0.0542592	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335463A	0.1393137	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335465N	0.2374995	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335469R	0.0370874	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335472Y	0.2928586	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335474M	0.1055746	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335478P	0.0174305	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335479W	0.1140997	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335480R	0.0120160	22	LA	033	EAST BATON ROUGE	0150	BATON ROUGE	LA
335485A	0.1571077	22	LA	005	ASCENSION	1953	PRAIRIEVILLE	LA
335488V	0.1235785	22	LA	005	ASCENSION	1953	PRAIRIEVILLE	LA
335489C	0.0226728	22	LA	005	ASCENSION	1953	PRAIRIEVILLE	LA
335490W	0.0798995	22	LA	005	ASCENSION	1953	PRAIRIEVILLE	LA
335492K	0.0846433	22	LA	005	ASCENSION	1953	PRAIRIEVILLE	LA
335494Y	0.0554385	22	LA	005	ASCENSION	0648	DUPLESSIS	LA
335495F	0.0703466	22	LA	005	ASCENSION	0648	DUPLESSIS	LA
335496M	0.0251139	22	LA	005	ASCENSION	0648	DUPLESSIS	LA
335497U	0.1649469	22	LA	005	ASCENSION	0648	DUPLESSIS	LA
335498B	0.2486550	22	LA	005	ASCENSION	0870	GONZALES	LA
335499H	0.0593135	22	LA	005	ASCENSION	0870	GONZALES	LA
335500A	0.0758706	22	LA	005	ASCENSION	0870	GONZALES	LA
335501G	0.1935264	22	LA	005	ASCENSION	0870	GONZALES	LA
335502N	0.0458169	22	LA	005	ASCENSION	0870	GONZALES	LA
335503V	0.0742162	22	LA	005	ASCENSION	0870	GONZALES	LA
335504C	0.0695803	22	LA	005	ASCENSION	0870	GONZALES	LA
335506R	0.0652933	22	LA	005	ASCENSION	0870	GONZALES	LA
335509L	0.1627540	22	LA	005	ASCENSION	2189	SORRENTO	LA
335510F	0.1822982	22	LA	005	ASCENSION	2189	SORRENTO	LA
335511M	0.0373712	22	LA	005	ASCENSION	2189	SORRENTO	LA
335515P	0.1873524	22	LA	093	ST JAMES	0890	GRAMERCY	LA

RAIL-HIGHWAY GRADE CROSSING
ACCIDENT/INCIDENT REPORT

GRADE CROSSING ID: 865215N   DATE OF INCIDENT:04/27/83   TIME: 1025 PM

RAILROADS INVOLVED	INCIDENT NUMBER	ALPHABETIC CODE	
REPORTING RAILROAD:	241183	WP	WESTERN PACIFIC RAILROAD COMPANY
OTHER RAILROAD INVOLVED:	---	---	
RAILROAD RESPONSIBLE FOR TRACK MAINTENANCE:	241183	WP	

PART 1: LOCATION

NEAREST RAILROAD STATION: MODESTO
CITY: MODESTO
COUNTY:STANISLAUS
STATE:CALIFORNIA
HIGHWAY: P ST

PART 2: INCIDENT SITUATION

HIGHWAY USER INVOLVED: AUTO
SPEED: 045 MPH
POSITION OF CAR UNIT IN TRAIN: 001
POSITION: MOVING OVER CROSSING
WAS HIGHWAY USER AND/OR RAIL EQUIPMENT INVOLVED IN THE IMPACT TRANSPORTING HAZARDOUS MATERIALS? NEITHER
EQUIPMENT INVOLVED: LIGHTLOCO(S)(STANDING)
VEHICLE DIRECTION: WEST
CIRCUMSTANCE: TRAIN STRUCK BY HIGHWAY USER

PART 3: ENVIRONMENT

TEMPERATURE: 055 F
VISIBILITY: DARK
WEATHER: RAIN

PART 4: TRAIN AND TRACK

TYPE OF TRAIN: LIGHT LOC
TRACK NUMBER OR NAME: SINGLE MAIN
NUMBER OF CARS: 000
TRAIN SPEED: 000 MPH (ESTIMATED)
TYPE OF TRACK: MAIN
FRA TRACK CLASSIFICATION: 1
NUMBER OF LOCOMOTIVE UNITS: 01
TIME TABLE DIRECTION: EAST

PART 5: CROSSING WARNING

TYPE:					
GATES	NO	HWY. TRAFFIC SIGNALS	YES	WATCHMAN	NO
CANTILEVER FLS	NO	AUDIBLE	NO	FLAGGED BY CREW	NO
STANDARD FLS	NO	CROSSBUCKS	NO	OTHER	NO
WIG WAGS	NO	STOP SIGNS	NO	NONE	NO

WAS THE SIGNALED CROSSING WARNING WORKING? YES
WAS CROSSING WARNING INTERCONNECTED WITH HIGHWAY SIGNALS? YES
LOCATION OF WARNING: BOTH SIDES
WAS CROSSING ILLUMINATED BY STREET LIGHTS OR SPECIAL LIGHTS: YES

PART 6: MOTORIST ACTION

MOTORIST PASSED STANDING HIGHWAY VEHICLE: NO
MOTORIST DID NOT STOP
VIEW OF TRACK OBSCURED BY NOTHING
MOTORIST DROVE BEHIND OR IN FRONT OF TRAIN AND STRUCK OR WAS STRUCK BY SECOND TRAIN: NO

PART 7: HIGHWAY VEHICLE PROPERTY DAMAGE/CASUALTIES

HIGHWAY VEHICLE PROPERTY DAMAGE: $2000.00
TOTAL NUMBER OF OCCUPANTS KILLED: 0000
TOTAL NUMBER OF OCCUPANTS INJURED: 0002
DRIVER WAS INJURED
WAS DRIVER IN THE VEHICLE ? YES
TOTAL NUMBER OF OCCUPANTS INCLUDING DRIVER: 0003

ITEMNO. 00002305