Chapter Forty-two
SCHOOL CROSSING STUDIES

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Chapter Forty-two
SCHOOL CROSSING STUDIES

Traffic engineering professionals have recognized for some time that it is imperative that a firm and uniform practice on school crossings should be followed. Through comprehensive practices and studies followed in Montana and elsewhere across the United States, a basis of standard methods is set forth in this chapter. Informative traffic investigations promote sound engineering judgments. School crossing tools such as signs, markings, signals and adult supervisor programs can be effective. Pertinent and uniform actions enhance driver expectancy and the safety of school children. This will also increase respect by the driving public for school crossing activity.

Chapter Forty-two documents the Department's procedures for conducting school crossing studies and emphasizes the warrants and design criteria for these investigations. Chapter Forty-two does not, however, address the details of technical studies or analytical procedures; this is documented elsewhere in the traffic engineering literature.

42.1 GENERAL

42.1.1 References

For additional information on school crossings, refer to the following publications:

1. Manual on Uniform Traffic Control Devices, FHWA, ATSSA, AASHTO and ITE;
2. School Trip Safety Program Guidelines, ITE;
3. Traffic Engineering Handbook, ITE;
4. Manual of Transportation Engineering Studies, ITE;
5. Signs and Signing Materials Catalog, MDT;
6. School Crossing Protection Manual, Montana Office of Public Instruction;
7. Pedestrian Traffic and Montana State Law, Montana Office of Public Instruction;
8. Bicycle Traffic and Montana State Law, Montana Office of Public Instruction; and
9. Montana Code Annotated.

42.1.2 Applicable Legal Statutes

There are several applicable legal statutes documented in the Montana Code Annotated that should be considered during the investigation. Title 61, Chapter Eight, Parts 3, 5

and 6 are the laws on vehicular traffic, pedestrian traffic and bicycle traffic, respectively. The law for school safety patrols is documented in Section 20-1-408.

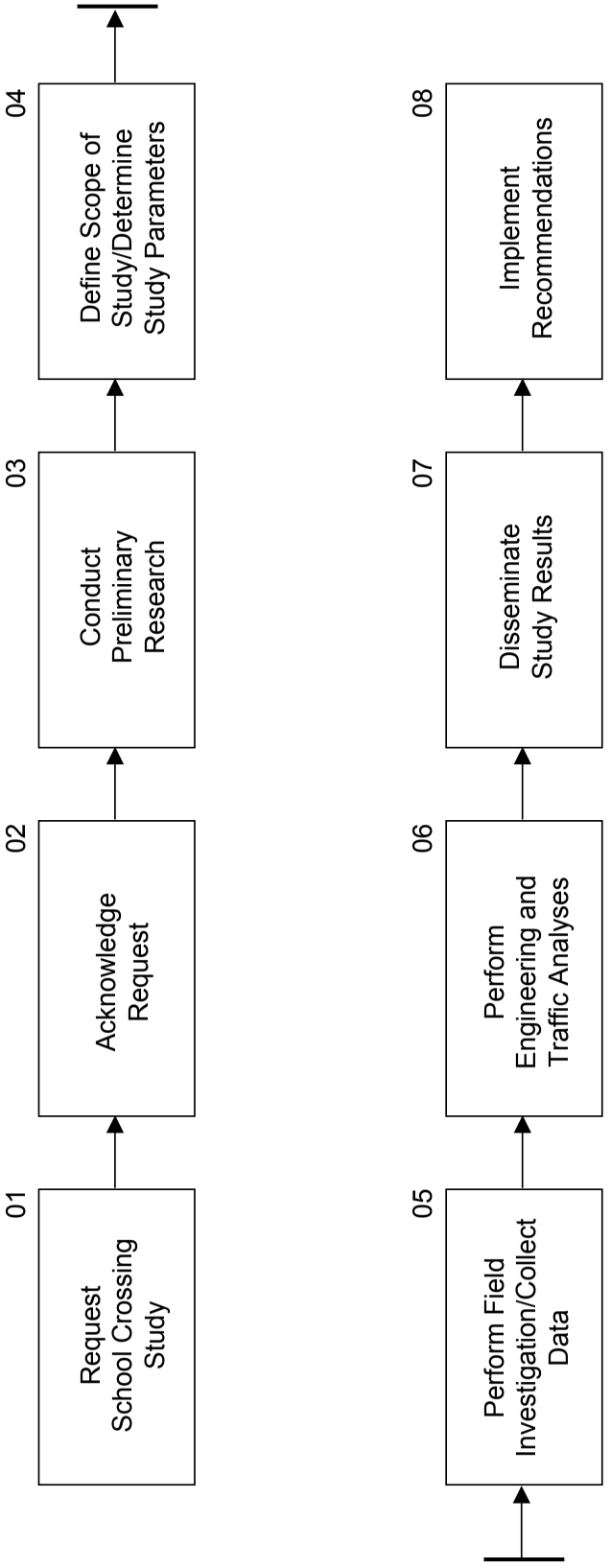
Montana State Statute, Section 61-1-209, defines a crosswalk as:

> *(1) that part of a roadway at an intersection included within the connections of the lateral lines of the sidewalk on opposite sides of the highway measured from the curbs or in the absence of curves, from the edges of the traversable roadway:*
>
> *(2) any portion of a roadway at an intersection or elsewhere distinctly indicated for pedestrians crossing by lines or other markings on the surface.*

Marked school crosswalks are used to identify locations of demonstrated and documented above normal school crossing activity or a designated school route.

42.2 SCHOOL CROSSING STUDY PROCEDURES

To facilitate consistency, Figure 42.2A presents a flowchart illustrating the proper steps that should be followed during a school crossing study. Following Figure 42.2A are brief descriptions of each activity within the flowchart. Adhering to these procedures will reduce confusion and provide for a consistent study approach.



SCHOOL CROSSING STUDY PROCEDURES

Figure 42.2A

SCHOOL CROSSING STUDY ACTIVITY

Activity Title:	Request School Crossing Study
Activity No.:	01
Responsible Unit:	General Public, Local Officials or MDT

Activity Description:

A request for a school crossing study can be initiated by any number of sources including:

1. parents;
2. concerned citizens;
3. special interest or civic groups;
4. school traffic safety committees;
5. school officials;
6. local government officials; and
7. by the Department itself (e.g., MDT District Offices, MDT Central Office).

Such requests will usually be via a telephone call or letter to either a District Office or the Central Office. Intradepartmental requests typically arise from roadway construction, spot improvements or other highway-related projects that are considering traffic control in the vicinity of a school.

SCHOOL CROSSING STUDY ACTIVITY

Activity Title: Acknowledge Request

Activity No.: 02

Responsible Unit: MDT Traffic Investigations Unit

Activity Description:

The Traffic Investigations Unit, through the Traffic Engineer, will typically acknowledge the request by letter and send a copy of the request and the acknowledgment to the District. At a minimum, the letter should:

1. acknowledge the receipt of the request,
2. acknowledge the scope of the investigation, and
3. estimate both the start date and the duration of the investigation, if practical.

The letter may also indicate that a meeting is required before further action is taken. On a case-by-case basis, the Traffic Engineer may request such a meeting to identify specific issues and concerns of the requesting party.

Local government approval is not required for a school crossing study. However, if a speed limit investigation is anticipated, then the procedures in Chapter Forty will apply. The Traffic Investigations Unit will be responsible for coordinating the procedures of multiple studies.

Section 2.2 provides the criteria for preparing general correspondence. If the investigation requires an initial meeting, a letter similar to Figure 40.5A may be considered.

SCHOOL CROSSING STUDY ACTIVITY

Activity Title: Conduct Preliminary Research

Activity No.: 03

Responsible Unit: MDT Traffic Investigations Unit

Activity Description:

Upon receiving the request, the Traffic Investigations Unit will initiate the preliminary research for the school crossing study. This is primarily a research activity that involves the collection of relevant data from within the Department and may include:

1. searching the Montana Road Log;
2. reviewing current roadway plans;
3. viewing the Department's photo log;
4. compiling data on existing and proposed traffic control devices;
5. reviewing previously conducted engineering and traffic investigations;
6. compiling and reviewing information from speed study files;
7. compiling and reviewing existing traffic data;
8. retrieving statistics from the Safety Management System;
9. reviewing aerial photography, if available; and
10. contacting local officials to obtain information on official school-age pedestrian routes.

The relevancy of the information obtained during this activity will provide a good basis to scope the investigation and to determine the extent to which additional data is needed.

SCHOOL CROSSING STUDY ACTIVITY

Activity Title: Define Scope of Study/Determine Study Parameters

Activity No.: 04

Responsible Unit: MDT Traffic Investigations Unit

Activity Description:

Based on the information obtained through the requesting party and the preliminary research activity, the Traffic Investigations Unit will define the scope of the investigation and determine its study parameters. The Traffic Investigations Unit will design the investigation and define:

1. the traffic studies that are needed (e.g., gap, pedestrian, volume, speed);
2. the type and amount of data required from the field;
3. the data collection locations (i.e., marked on plats, maps or plans);
4. the day, time period and interval to collect the data;
5. the collection method and equipment to use (i.e., manual, automated); and
6. any other conditions or factors that should be considered.

The field investigation and data collection activity will be conducted by either the Traffic Investigations Unit or the District Office. If conducted by the District, convey the study parameters to the District through a memorandum. The Traffic Investigations Unit is responsible for preparing this memorandum for the Traffic Engineer's signature. Section 2.2 provides additional information on what should be included in this memorandum.

SCHOOL CROSSING STUDY ACTIVITY

Activity Title: Perform Field Investigation/Collect Data

Activity No.: 05

Responsible Unit: MDT Traffic Investigations Unit/MDT District Office

Activity Description:

The field investigation and data collection activity will be conducted by either the Traffic Investigations Unit or the District Office. If the District is responsible for this activity, then, upon its completion, the District should forward the following information to the Traffic Investigations Unit through the Traffic Engineer:

1. the data collection dates and times;
2. the weather conditions at the time of collection;
3. the tally forms, video tapes, photos and related files;
4. the inventory data (e.g., pedestrian facilities, traffic control devices);
5. the data tapes and summaries (e.g., vehicle counts);
6. the District's opinion of the stated problem as compared to field observations; and
7. any other information obtained through field observations.

SCHOOL CROSSING STUDY ACTIVITY

Activity Title: Perform Engineering and Traffic Analyses

Activity No.: 06

Responsible Unit: MDT Traffic Investigations Unit

Activity Description:

Upon receiving the information from the field investigation and data collection activity, the Traffic Investigations Unit will:

1. review and evaluate the field observations;
2. process and refine the data into a form suitable for analysis;
3. compare the results to legal statutes, policies, warrants and design criteria;
4. analyze the data to define what, if any, deficiency exists;
5. develop alternative countermeasures to mitigate the deficiency;
6. meet with the appropriate Department personnel to review the alternatives;
7. select the countermeasure best suited for the deficiency; and
8. finalize and document the Department's recommendations.

The Traffic Investigations Unit will be responsible for preparing a memorandum from the Traffic Engineer to the District summarizing the results of the study and the Department's recommendations. Section 42.7 discusses the information that should be included.

SCHOOL CROSSING STUDY ACTIVITY

Activity Title: Disseminate Study Results

Activity No.: 07

Responsible Unit: MDT Traffic Investigations Unit

Activity Description:

A report will be submitted to the District outlining the conclusions and recommendations of the study. The report will include all the supportive information used to arrive at the conclusions. Under cover letter, a copy will also be sent to the requesting party. At the local officials' request, an oral presentation will be given.

SCHOOL CROSSING STUDY ACTIVITY

Activity Title: Implement Recommendations

Activity No.: 08

Responsible Unit: MDT District Office

Activity Description:

It is the responsibility of the District to ensure that the improvements are implemented. The majority of school crossing improvements should be implemented when school is not in session.

The District Traffic Engineer will inspect the installed improvements and certify to the Traffic Engineer that the improvements have been completed, inspected and conform to the Department's criteria. The Traffic Investigations Unit will place the acknowledgment of the implementation in the Project File.

42.3 PRELIMINARY RESEARCH

Upon receiving the study request, the preliminary research activity will be initiated for the school crossing study. Its major focus is to gain a better understanding of both existing and proposed conditions at the site and to reduce the possibility of collecting duplicate data by researching, beforehand, the relevancy and usefulness of existing data. The following sections present the sources of information and the data that should be considered during this activity.

42.3.1 Road Log Information

Information pertaining to State highways may be obtained from the booklet Montana Road Log. This publication provides data relative to:

1. project numbers for roadways,
2. the year a roadway was built, and
3. the roadway's surface width.

The project number will provide the designer with a useful index to roadway plans within the Department's records. Road log information will also inform the designer of the age of the existing roadway and its general cross-sectional characteristics.

42.3.2 Roadway Plans

As-built roadway plans for the roadway and/or intersection under study should be obtained and reviewed. These plans contain geometric data (e.g., curb-to-curb widths, median widths) that may be needed for the study and will provide an excellent site plan for developing alternative countermeasures if deficiencies are found at the crossing. The plans may also be used to illustrate data collection locations, inventory data and other useful information.

42.3.3 Photo Log and/or Aerial Photos

A search through the Department's photo log and/or aerial photos should be conducted before the field investigation. These photographs, if available, help the designer to:

1. review the study area before visiting the site,
2. examine potential data collection locations, and
3. identify key study elements and potential problems.

42.3.4 Traffic Control Devices Information

The Department's records should be researched for information on highway signing, pavement markings and traffic control devices that are within the study area. This information should be verified by comparing it to field observations. The types and locations of any planned or programmed traffic control improvements should also be researched and included in the study.

42.3.5 Previous Engineering and Traffic Investigations

The Department may have conducted previous engineering and traffic investigations at the school crossing or at other locations within the study area. If so, these records should be researched to determine if they are relevant to the current investigation.

42.3.6 Speed Zone Files

An understanding of the travel speed profile on the section of roadway under investigation is necessary. Speed zone files maintained by the Traffic Investigations Unit contain valuable information on the approved speed zones and the date of the last investigation. If the site has undergone significant change, if substantial time has elapsed since the last data was collected or if there is simply insufficient data, then the existing speed profile should be obtained with the current investigation. The data collection process should follow the procedures outlined in Chapter Forty. Section 42.6.7 presents the Department's criteria on special speed zones involving schools and school crossings.

42.3.7 Vehicular and Pedestrian Data

The Department's traffic data files should be researched to determine the relevancy of existing vehicular and pedestrian data. This information is useful in determining if additional data is needed and will provide insight into field observations. If the school crossing study will include a signal warrants analysis, traffic counts will be consistent with informational criteria outlined in the MUTCD.

42.3.8 Highway Crash History

It is important to research the Department's crash analysis data to identify the type and frequency of crashes that may exist within the study area. This information will be useful in assessing symptoms, patterns, probable causes and potential safety improvements. Information on highway crash history may be retrieved from the Safety

Management File of the Transportation Information System. The designer should consider the following when researching this data:

1. type of crash;
2. time of occurrence;
3. vehicle and/or pedestrian direction;
4. location of crash;
5. crash frequency and patterns; and
6. any other contributing factors (e.g., vehicle type, environment, weather).

A collection of one to three years of crash statistics should be sufficient for the school crossing study. See Chapter Forty-three for additional information on traffic crash data and analyses.

42.3.9 School and Local Officials

During the preliminary research activity, the designer should contact the school administration and other local officials, as needed, to obtain information on the existing or proposed:

1. school hours and scheduled days in sessions;
2. school bus and walk routes;
3. student walking patterns;
4. student drop-off and pick-up areas (e.g., parents, buses);
5. school boundaries and facilities (e.g., modifications, expansion);
6. jurisdictional responsibilities;
7. local roadway and pedestrian facilities;
8. local traffic control;
9. land use within the study area (e.g., changes, growth); and
10. parking and truck loading/unloading facilities.

42.3.10 Preliminary Site Review

If an initial meeting with the requesting party is necessary, a preliminary site review should be conducted before the meeting. This review will provide a better understanding of the apparent problem and will ensure a familiarity with the site should the meeting involve a discussion that concerns existing field conditions.

42.4 FIELD INVESTIGATION AND DATA CONSIDERATIONS

42.4.1 Traffic Studies

The scope of the investigation will define the traffic studies that are necessary to evaluate the school crossing. These studies must be well coordinated to accommodate the data needs of the analyses. Before the field investigation, the designer should assess the need to conduct each of the following traffic studies:

1. inventory studies (e.g., roadway, pedestrian facilities, traffic control devices);
2. traffic volume and gap studies (e.g., counts, classification, gap interval and distribution);
3. pedestrian studies (e.g., group size, arrival frequency, walking speed);
4. speed studies (e.g., speed profiles);
5. intersection studies (e.g., geometry, capacity);
6. crash studies;
7. sight distance studies (e.g., parking restrictions, roadside obstacles); and
8. traffic control devices studies (e.g., operating parameters, warrants).

The data collection methods and analytical procedures for these and other relevant traffic studies are documented in Chapter Forty, Chapter Forty-three and the ITE publications School Trip Safety Program Guidelines, Manual of Transportation Engineering Studies and Traffic Engineering Handbook.

42.4.2 Equipment and Personnel Requirements

When planning the field investigation, the designer should consider the following factors on data collection equipment and field personnel requirements:

1. field personnel requirements (e.g., number of people, training requirements);
2. manual or automated collection (e.g., tally boards, pneumatic tubes);
3. data collection forms (e.g., vehicular and pedestrian counts, gap data, speed data);

4. any special equipment (e.g., radar units, stop watches, cameras, video recorders); and

5. safety considerations (e.g., location, safety vests, traffic cones).

The advantages of using relatively inexpensive cameras and video recorders are as follows:

1. Video Tape. Video tape provides a permanent record of the existing study area. This is an economical method of data collection that allows a subsequent viewing of the site at the office by either the designer or others who may not have been present during the field investigation.

2. Photographs, Digital Photographs and Slides. For documentation and illustrative purposes, an area of the site that captures the essence of the apparent problem should be photographed. Photographs are economical and extremely useful during analysis, report preparation and presentations. As a permanent record of the site, they offer similar advantages as video tape.

42.4.3 Field Inventories

The extent of the inventory data that is required from the field depends on the scope of the investigation. The inventory data is needed to evaluate existing conditions and will provide the basis from which analyses of potential improvements can be performed. During the investigation, the designer should consider the field inventories that are discussed in the following sections.

42.4.3.1 Roadway Facilities Inventory

The field investigation should include an inventory of the roadway facilities that are within the study area. The following factors should be considered during this inventory:

1. roadway classification (e.g., street type children will cross);

2. geometric data (e.g., cross-sectional, horizontal, vertical);

3. number, direction and width of travel lanes;

4. median type, width and adaptability as a pedestrian refuge (i.e., greater than 6 ft (1.8 m));

5. intersection geometry and approach lane designations;

6. location and cause of sight restrictions (e.g., parking, trees, buildings, vertical curves); and

7. approach density.

Chapter Forty-three offers the designer additional information on sight distance and vision obstruction studies. If a median is present at the crossing, its width should be measured, and the designer should determine if it is suitable for use as a pedestrian refuge. If a median is 6 ft (1.8 m) or greater in width, it is generally acceptable as a refuge. If a median is less than 6 ft (1.8 m) in width, it is generally not a viable pedestrian refuge. A median refuge will allow pedestrians to make two separate crossings (i.e., curb-to-median then median-to-curb). Field observations should record if a median is being used in this manner.

42.4.3.2 Pedestrian Facilities Inventory

An inventory of the facilities that are used by pedestrians should be compiled during the field investigation. The following factors should be considered for an inventory of pedestrian facilities:

1. type and width of pedestrian facility (e.g., crosswalk);
2. location of pedestrian facility (e.g., mid-block, intersection, commercial area);
3. width and condition of sidewalks, pathways and bike lanes;
4. quality and elevation of grade-separated structures (i.e., relative to road grade);
5. height and purpose of fencing, railing and barriers; and
6. presence of lighting and luminaires.

42.4.3.3 Traffic Control Devices Inventory

During the field investigation, an inventory of the existing traffic controls and devices within the study area should be made. The designer should consider the following factors:

1. location, type, size and mounting height of traffic and pedestrian signs;

2. sign legend and operation (e.g., flashing beacons, variable message);

3. traffic signal location (e.g., mid-block, intersection);

4. traffic signal actuation and phasing (e.g., pedestrian actuated, exclusive phases);

5. type, location and condition of pavement markings (e.g., crosswalk);

6. type and location of protective barriers (e.g., guardrails, median barriers);

7. regulatory speed limit, speed zone length and limit period (e.g., when flashing); and

8. parking location, restriction limits and practices (e.g., no standing).

Vehicles that park near intersections and crosswalks typically obscure the line-of-sight between drivers and pedestrians. Figure 19.4B illustrates the parking restrictions relative to crosswalks. See Chapter Forty-three for additional information on parking control studies and traffic control device inventories.

42.4.4 Vehicular Data Considerations

If used during the study, the vehicular data records obtained in the preliminary research activity should be verified with field observations. When assessing the data needs of the study and preparing for the field investigation activity, the following factors should be considered for vehicular data:

1. observer location, collection purpose and method (e.g., pneumatic tubes, radar);
2. weather conditions and day of observation (e.g., typical school day);
3. major generators, seasonal variations and events (e.g., games, assemblies);
4. locations of data collection (e.g., mid-block, intersection);
5. time period of collection (e.g., beginning and end of school, commuter peaks);
6. time interval data is collected (e.g., 15 minute);
7. interval and distribution of gaps in traffic stream;
8. traffic volume data (e.g., turning movement, through movement);
9. vehicular classification (e.g., passenger vehicles, large trucks, buses);
10. presence and cause of vehicle platooning; and
11. approach speeds.

Vehicular gap data is typically required for a school crossing study. This data is used in gap adequacy analyses and is obtained by measuring the time interval between moving vehicles. Typically, the Department collects vehicular gap data by automated counters. Figure 42.4A also illustrates a data form that can be used to collect this data.

The designer should collect spot-speed samples. Speed data is necessary if the study request includes a reduction in the regulatory speed limit. See Section 42.6.7 for information on special speed zones involving schools. Chapter Forty discusses the Department's procedures for conducting speed studies and presents typical speed data collection forms.

42.4.5 Pedestrian Data Considerations

The field investigation will permit the observation of existing pedestrian habits and patterns at the site. The following factors should be considered when assessing the pedestrian data needs of the study and preparing for the field investigation:

1. purpose of data, collection method and location of observer;
2. weather conditions and day of observation (e.g., typical school day);
3. location of data collection (e.g., mid-block, intersection);
4. time period data is collected (e.g., beginning and end of school, lunch period);
5. time interval data is collected (e.g., 5 minute, 10 minute, 15 minute);
6. pedestrian volume data (e.g., total number, grouping, jaywalkers);
7. mix of pedestrians (e.g., elementary, high school, workers, bicycles);
8. age and grade of pedestrians (e.g., 5 through 8 years, K through 4^{th} grade);
9. major generators, seasonal variations and events (e.g., games, assemblies);
10. stature, mental capabilities, reaction time and walking speed of children;
11. requirements of disabled pedestrians;
12. potential vehicle and pedestrian conflicts; and
13. school bus activity.

Figures 42.4A through 42.4F illustrate the pedestrian data collection forms that are typically used by the Department.

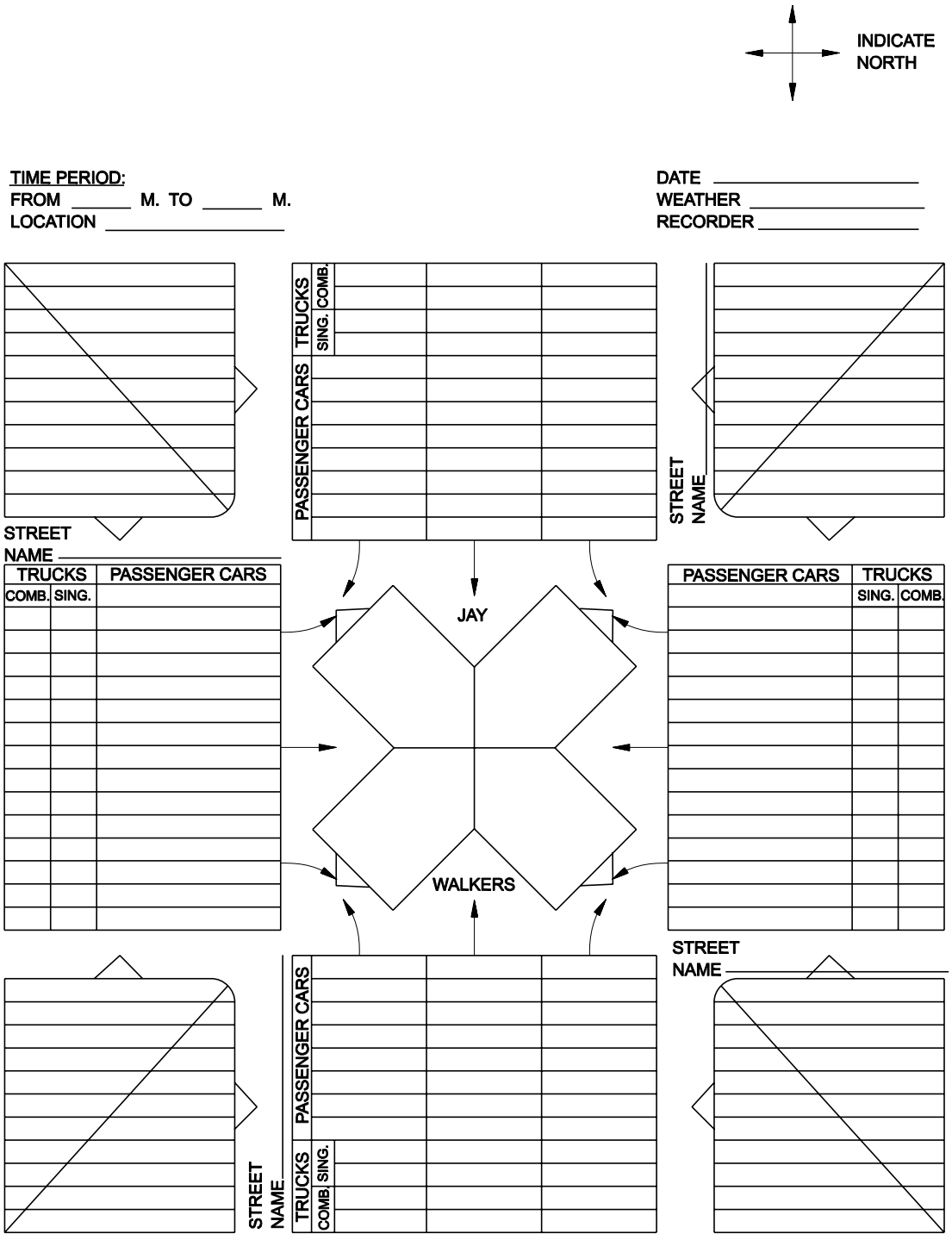
DATE _____ BEGIN _____

LOCATION _____ END _____

TIME	GAP	TIME	GAP	TIME	GAP	TIME	GAP

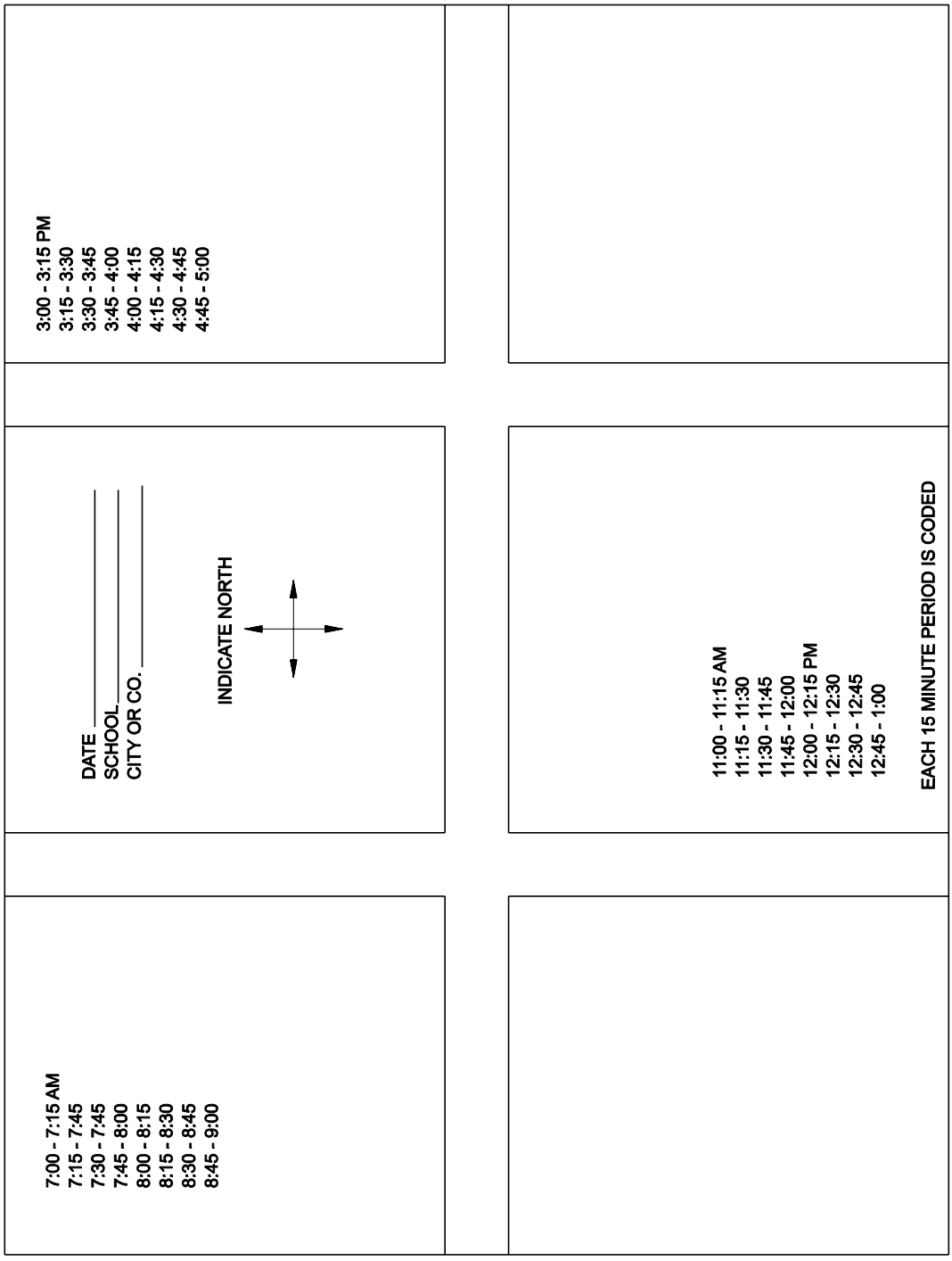
GAP DATA COLLECTION SHEET

Figure 42.4A



VEHICLE AND PEDESTRIAN VOLUME TALLEY SHEET

Figure 42.4B



SCHOOL PEDESTRIAN COUNT SHEET

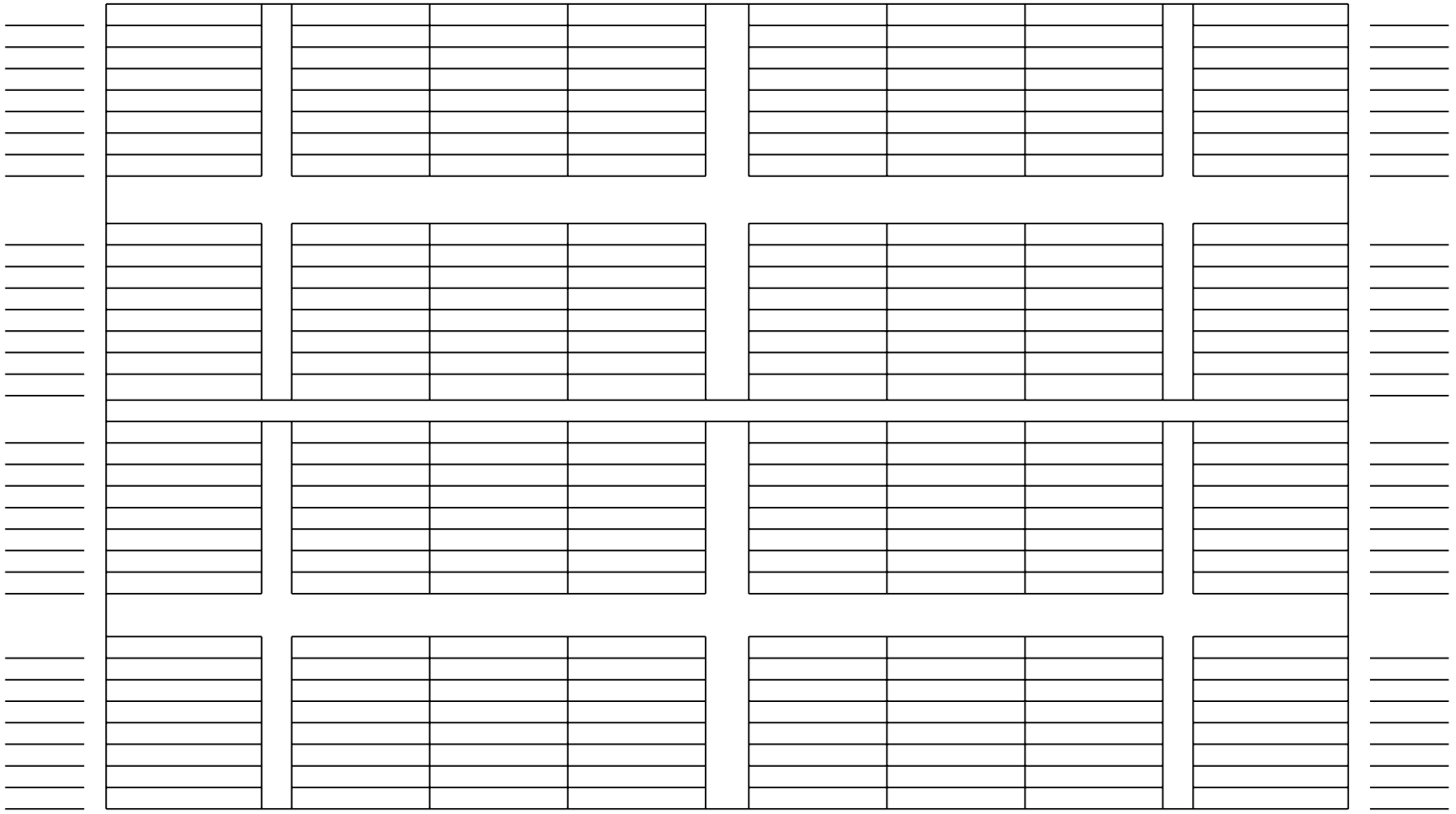
Figure 42.4C

LOCATION: DATE: TIME:

WEATHER:

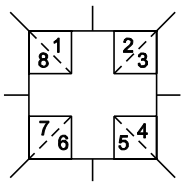
REMARKS:

INDICATE NORTH



SCHOOL AND PEDESTRIAN CROSSING COUNT SHEET

Figure 42.4D



CITY _____ LOCATION _____ DATE _____ WEATHER _____ INITIAL _____

TIME INTERVAL	1	2	3	4	5	6	7	8	J	TOTAL
7:00 - 7:15										
7:15 - 7:30										
7:30 - 7:45										
7:45 - 8:00										
8:00 - 8:15										
8:15 - 8:30										
8:30 - 8:45										
8:45 - 9:00										
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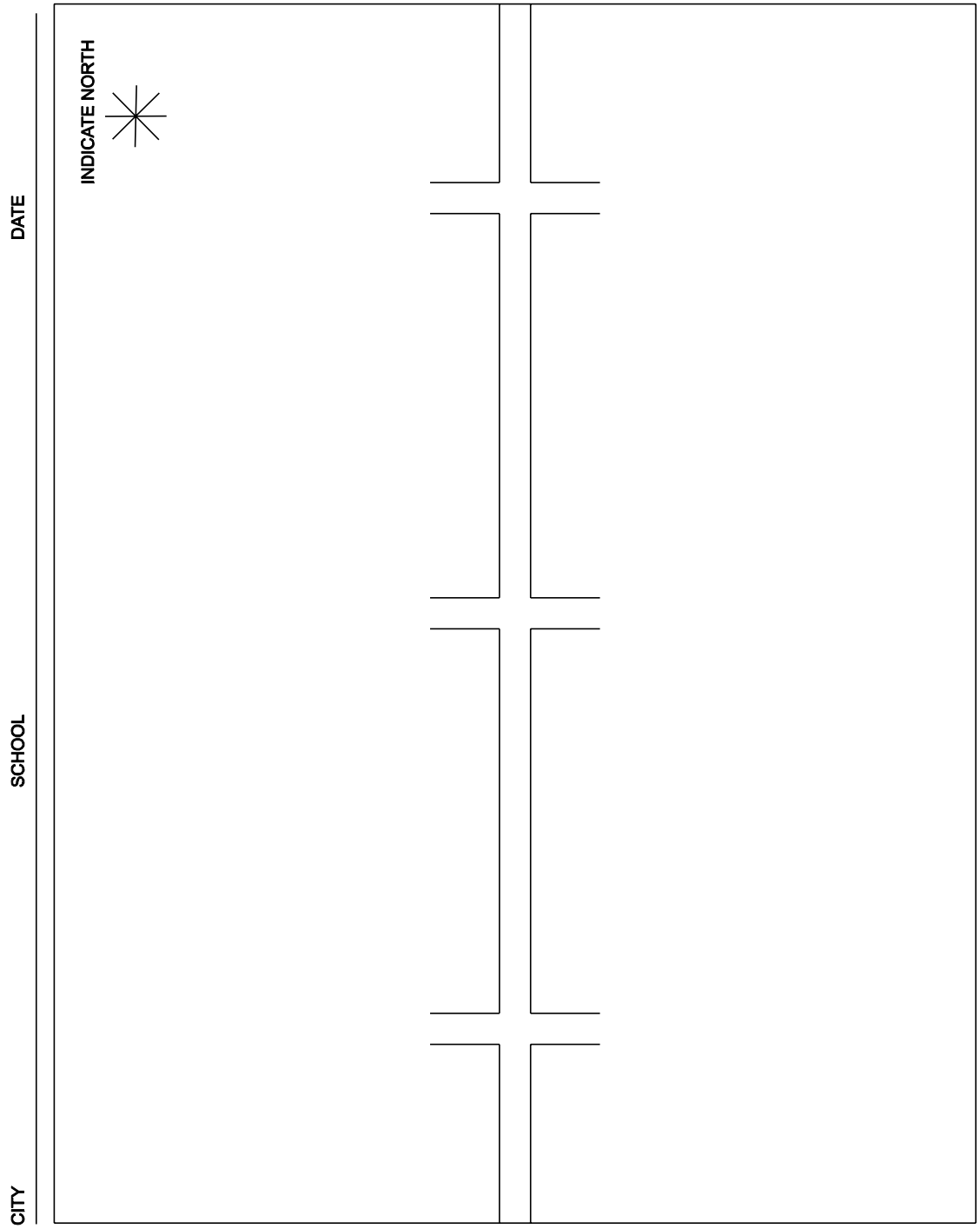
5:15 - 5:30										
5:30 - 5:45										
5:45 - 6:00										
TOTAL										
PEAK HOUR										

PEDESTRIAN VOLUME SUMMARY SHEET

Figure 42.4E



SCHOOL AND PEDESTRIAN CROSSING SUMMARY SHEET

Figure 42.4F

42.5 ENGINEERING AND TRAFFIC ANALYSES

42.5.1 Scope

The information and data acquired through the preliminary research and field investigation activities should be analyzed to identify the significance of or specific deficiency at the school crossing. The scope of the investigation will define which analyses are necessary to effectively understand the deficiency so that an appropriate countermeasure can be developed. The analytical objective of the study is to determine if the school crossing requires:

1. no additional measures for warning or regulatory control,
2. a non-gap producing countermeasure,
3. a gap-producing countermeasure, or
4. some combination of the latter two.

In general, if the average peak volume of children (existing or projected) crossing the roadway is less than 10 during the crossing period, then the implementation of a traffic control measure is not usually undertaken. However, if the crossing demand is greater than 10 children, a primary concern of the study is to determine whether or not the children can safely negotiate existing or projected vehicular gaps. This section presents the designer with information on the gap adequacy analysis and other analyses and factors that should be considered during the school crossing study.

42.5.2 Gap Adequacy Analysis

The data collected from the studies conducted during the field investigation (e.g., gap, vehicle, pedestrian and inventory studies) will provide the information necessary to perform a gap adequacy analysis. The purpose of the analysis is to determine if the available gaps in the traffic stream are sufficient to accommodate the safe crossing of children during the peak school crossing period. This analysis is typically conducted for:

1. a crossing over the uncontrolled leg of an intersection, or
2. a mid-block school crossing.

Such an analysis is typically not necessary for studies at locations where vehicular gaps are naturally available (e.g., signalized intersections). The results of the gap adequacy analysis will help determine if a gap-producing countermeasure is needed (e.g., pedestrian-actuated signal) or whether some other countermeasure should be considered.

The designer should consider the following factors when performing this analysis:

1. Adequate Gap Interval. An adequate gap in the traffic stream may be defined as the time interval between vehicles that will accommodate 85% of all waiting groups of children to safely walk across the roadway within the school crossing.

2. Acceptable Gap Distribution. An acceptable gap distribution is, on average, one adequate gap or more per minute. Insufficient gaps tend to result in impatience in pedestrians and a temptation to cross during inadequate gaps. This is a very important consideration where young children are concerned.

3. Crossing Period Increments. When using an automated traffic counter to collect the gap information, the gap data should be recorded during the same interval as the school pedestrian count. This interval should not exceed 15 minutes.

4. Undivided Roadways. On an undivided roadway or a roadway with a median width less than 6 ft (1.8 m), the resulting vehicular gaps between opposing traffic streams should be analyzed to determine if they are adequate for children to safely cross all travel lanes (e.g., crossing curb-to-curb).

5. Divided Facilities. If a median of a divided facility is 6 ft (1.8 m) wide or wider and can be used as a pedestrian refuge, then the designer may consider the gap adequacy of each directional flow of traffic separately (e.g., crossing curb-to-median then median-to-curb).

6. Roadway and School Crossing Width. The width of street that a student has to cross is measured from curb to curb if the street is curbed. For streets without curbs, the width is measured from the outside edge of the paved shoulder to edge of the far side of the traveled way.

7. Walking Speed of Small Children. Because of their smaller stature, younger children tend to walk slower than adult pedestrians. Field observations should be used to corroborate the walking speed of 4 ft/s (1 m/s).

8. Perception/Reaction Time of Younger Children. Younger children tend to have a longer perception/reaction time than do adult pedestrians. They also have a greater difficulty judging vehicular speeds and the adequacy of vehicular gaps. Use three seconds for perception/reaction time.

9. Size and Breadth of Pedestrian Groups. The size and breadth of the pedestrian group will affect the time required for the group to cross the roadway safely. The larger the number of pedestrians in the group, the longer it will require the group to cross.

10. Pedestrian Group Arrival. The arrival of pedestrian groups should be compared to the distribution of adequate gaps to determine whether or not there is sufficient capacity for the overall group demand to negotiate the traffic stream safely.

11. Jaywalkers. Some children may have been observed jaywalking during the field investigation. Jaywalkers should be included in the total pedestrian demand.

For additional information on conducting vehicular gap and pedestrian group size studies and performing gap adequacy analyses, see the ITE publications School Trips Safety Program Guidelines, Manual of Transportation Engineering Studies and Traffic Engineering Handbook.

42.5.3 Volume Projections and Assignment

During the analysis, consideration should be given to changes in traffic volumes, pedestrian demand and travel patterns that may result from:

1. historic and seasonal traffic volume changes on the facility under investigation;
2. changes in existing land use (e.g., redevelopment, rezoning);
3. additional land development (e.g., platted and approved developments);
4. construction zones;
5. population growth changes;
6. new expanded school facilities or school closure;
7. changes to school boundaries;
8. addition of school buses or drop-off zones; and
9. changes in other modes of transportation.

If it appears that such changes may impact the school crossing, then the designer should consider generating the appropriate trips and assigning them to the local roadway and pedestrian facilities so that the impact to the school crossing may be adequately assessed.

42.5.4 Impacts of Truck Traffic

If a school crossing is located in an industrial, commercial or urban area, an unusually high percentage of trucks may exist. Trucks generally:

1. require a greater turning radius (e.g., at intersections);
2. pose sight restrictions either in motion or while parked;
3. require a greater length of time to accelerate and decelerate; and
4. make it is difficult for the driver to see objects either beside or behind the vehicle.

The designer should consider the impact that truck traffic has at the school crossing location.

42.5.5 Age Considerations of Students

A primary concern of the school crossing study is the impact on school children that are in kindergarten through 4th grades. The mental and physical characteristics of these students (e.g., reaction time, walking speed, stature) typically require the consideration of some measure of adult supervision at the crossing. Students in the 5th through the 8th grades are usually able to cross most roadways alone, and older students require minimum protection. The small stature of elementary students in general makes it difficult for them to be seen by motorists, especially in areas where there are parked or standing vehicles, piles of snow or other obstructions in the vicinity of the crossing.

42.5.6 Vehicular Speed Considerations

The speeds of vehicles approaching the crossing should be considered during the analyses. Faster vehicles require a greater stopping distance. A major concern is that young children have difficulty judging the speed of approaching vehicles and may be tempted to cross within an unsafe gap. Also, travel speed is a major variable in the motorist's sight distance evaluation. Chapter Forty discusses the Department's procedures for conducting speed studies, and Section 42.6.7 discusses special speed zones involving schools and school crossings.

42.5.7 Traffic Control Devices Analyses

The adequacy of existing traffic controls and the need for additional control devices should be analyzed during the study. The designer should ensure that existing devices (e.g., highway signs, traffic signals, pavement markings) convey the intended message to both motorists and pedestrians and are consistent, properly located and adequately spaced. Any new control devices warranted at the location must be installed to support and complement existing traffic controls. If the school crossing is located at an existing signalized location, operational analyses of capacity, delay, actuation and phasing may be necessary to determine if the signalized crossing can safely and efficiently accommodate the pedestrian movements. Based on the information obtained during the field investigation and the results of other analyses, a signal warrants analysis may be necessary at an unsignalized location.

42.5.8 Sight Distance Considerations

During the study, the designer should ensure that sufficient sight distance is provided for vehicular operating speeds at the school crossing location (e.g., mid-block, intersection). Crossings that are located on crest vertical curves and sharp horizontal curves are of particular concern. Sight distance can also be affected by temporary interferences such as parked vehicles and piled snow in the vicinity of the crossing. Chapter Forty-three provides additional information on sight distance and vision obstruction studies.

42.5.9 Crash Analysis

The designer should prepare a table and a graphical presentation of any crash data obtained during the preliminary research activity to assess crash patterns, probable causes and potential safety improvements. The identified patterns may suggest the need for a specific countermeasure. A before-and-after comparison of crash statistics will indicate the countermeasure's effectiveness. Some locations may exhibit a strong crash potential but the number of crashes may be so small that a crash analysis will have little meaning. Chapter Forty-three provides additional information on traffic crash data and analyses.

42.6 MITIGATION GUIDELINES

42.6.1 School Crossings Without Traffic Control

Establishing a marked school crosswalk or other warning or regulatory traffic control measure at a school crossing for a few children is both uneconomical and unrealistic. Regardless of other factors (e.g., gap adequacy, traffic volume), if the average peak volume of school children (existing or projected) crossing the road facility at the school crossing is less than 10 during a crossing period, traffic control devices at the school crossing are usually not recommended, subject to a case-by-case review of other possible options.

42.6.2 Pavement Markings

The pavement markings (e.g., crosswalk, stop bar, striping) that are used to emphasize warning and regulatory traffic controls at a school crossing must be designed and implemented according to the criteria presented in Chapter Nineteen. The designer should consider the following factors where pavement markings are used in school areas and at school crossings:

1. Supplemental Use Only. Pavement markings should never be used as the sole protective measure for children in the vicinity of schools. They should only be used to supplement the standard traffic controls that are recommended at the location because the markings may become ineffective due to:

   a. wet or snowy pavement conditions,
   b. wear, or
   c. the vehicles ahead of the driver obscuring the trailing driver's view.

2. Application Limits. Pavement markings that are used expressly for school crossings should be limited to those roadways that are adjacent to or in the vicinity of the school grounds. The marking of roadways at a considerable distance from the school grounds tends to weaken their effectiveness.

42.6.3 Highway Signing

42.6.3.1 General

All highway signing used near a school or for a school crossing must be uniformly designed and implemented according to the criteria in the MUTCD. The designer will find additional information on highway signing in Chapter Eighteen.

42.6.3.2 Parking Restriction Signing

Vehicles that park near crosswalks and intersections may obscure the line-of-sight between drivers and pedestrians. Figure 19.4B illustrates the parking restrictions near crosswalks. These restrictions will apply to all Montana school crossings. The following factors should also be considered for parking restrictions:

1. stopping, standing and parking prohibitions should be considered where the visibility of pedestrians using the school crossing is limited;

2. stopping, standing and parking prohibitions should be considered at locations directly in front of any school entrance; and

3. parking prohibitions during student arrival and departure periods should be considered along the school side of all roadways that are directly adjacent to the school facility.

42.6.4 Traffic Signals

A traffic signal may be warranted at an established school crossing if the study determines that the gap intervals are inadequate or if the distribution of adequate gaps is unacceptable. If the study determines that a gap-producing countermeasure is necessary at the school crossing, then the final need for signalization will be based on the warrants presented in Chapter Twelve and the MUTCD. The following provides additional information on school crossings under signal control:

1. Pedestrian Actuation. Pedestrian actuation is desirable unless the signal is part of a fixed-time system. At intersections, pedestrian actuation should be considered at least for each designated school crosswalk.

2. Sight Restrictions. At crossings, the prohibition or removal of sight restrictions (e.g., parking, piled snow) should be considered not less than 20 ft (6 m) in advance and beyond the school crosswalk. The designer needs to verify the sight distances.

3. Supplemental Traffic Control Devices. Although a traffic signal may be recommended at the school crossing, the designer should ensure that the cost of providing supplemental traffic control devices (e.g., signing, pavement markings) is included in the alternative analyses. Where used for a school crossing, a traffic signal at either an intersection or mid-block location will usually require some measure of supplemental traffic control.

4. Conflicts with Turning Movements. If located at an intersection that has exceptionally heavy turning-movement volumes, special consideration should be given to the pedestrian interval. Signal phasing may have to be used that specifically prohibits conflicting turning-movements during the pedestrian interval. This may require an additional signal phase. As a result, pedestrians may wait longer before they are permitted to cross. Pedestrians must obey the signal indications for this countermeasure to be effective. Younger school children (i.e., kindergarten through 4th grades) will usually require crossing supervision.

5. Crossing Supervision. Traffic signal control does not eliminate the need for school crossing supervision. Section 42.6.6 provides the designer with additional information on crossing supervision.

Before a signalized countermeasure is implemented, the designer should ensure that all other viable gap-producing countermeasures are evaluated first.

42.6.5 Marked School Crosswalks

Marked school crosswalks are economical and have a significant safety value because they provide better visual recognition of the crossing. The following sections discuss the recommendations for school crosswalks and present information on its implementation.

42.6.5.1 Marked School Crosswalk

A marked school crosswalk may be considered if the average peak volume of school children (existing or projected) that cross the road facility at the school crossing is greater than 10 during a crossing period.

A marked school crosswalk does not produce gaps in the traffic stream. If a school crosswalk is recommended at a location with insufficient vehicular gaps, then the addition of a gap-producing countermeasure (e.g., traffic signal) should also be considered.

42.6.5.2 School Crosswalk Pavement Markings

Section 42.6.2 provides the designer with information on the design and implementation of pavement markings. Section 19.4.4 provides additional information. A crosswalk that is marked specifically for a school crossing at a roadway intersection should only be applied across the leg of the intersection that is part of the school walk route. At a

roadway intersection where two or more school walk routes intersect, more than one leg of the intersection may be marked but in no case should all four legs be marked.

School crossings should be marked as illustrated in Figure 42.6A. A series of 8 ft (2.4 m) long, 2 ft (600 mm) wide, solid white longitudinal lines should be marked across the full width of the pavement to identify the crosswalk. If practical, avoid placing the stripes in the typical vehicular wheel paths. A white stop bar 2 ft (600 mm) wide should be placed 4 ft (1.2 m) in advance of and parallel to the cross walk and span all approach lanes. Pavement markings for school crossings should only be used with the appropriate signing.

42.6.5.3 School Crosswalk Signing

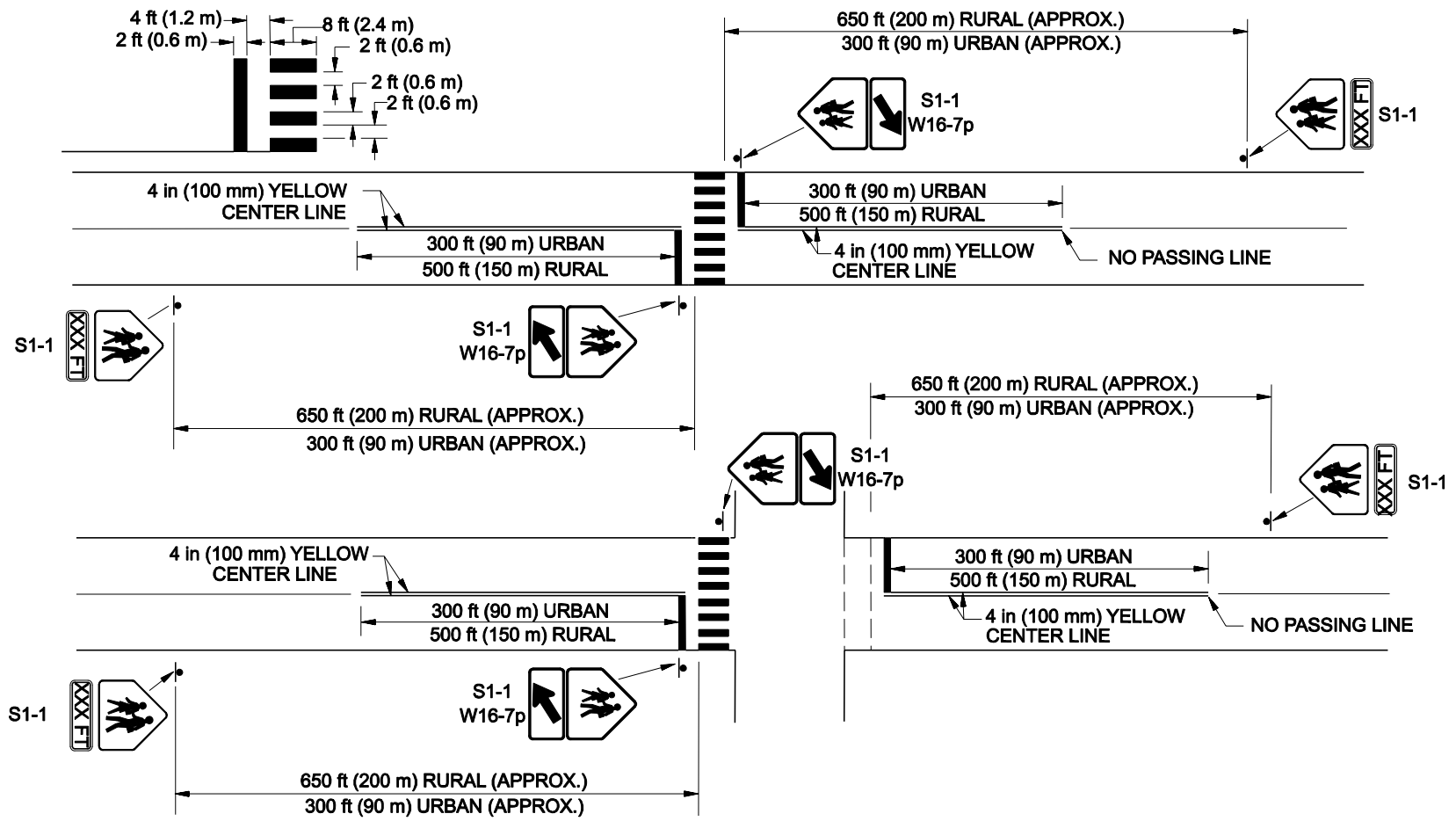
Section 42.6.3 provides information on the design and implementation of highway signing. Figures 18.8D and 18.8F illustrate the Department's miscellaneous sign details for school crosswalks, and Figure 42.6A presents additional signing criteria. The proper signing should be in place, if practical, at the time the pavement markings are placed. In addition to sign placements shown in Figure 42.6A, school crossing signs should be placed according to MUTCD and the following:

1. School Advance Warning Sign Assembly. The S1-1 school advance warning sign and its appropriate supplemental panels should be located in advance of a designated school crosswalk. This sign assembly shall be used at a crossing where an S1-1 school crosswalk warning sign assembly is used.

2. School Crosswalk Warning Sign Assembly. The S1-1 school crosswalk warning sign and diagonal arrow panel should be located at an established marked school crosswalk. This sign is not necessary at a school crossing that is controlled by a stop sign.

3. Multi-lane Facilities. For a single school crossing across a multi-lane facility, a ground-mounted school advance warning sign assembly should be placed prior to the crossing and an overhead school crosswalk warning sign assembly at the crossing.

4. Multiple Crossings. Where there are multiple school crossings across a facility, a school advance warning sign assembly should be placed overhead prior to the first crossing with ground-mounted school crosswalk warning sign assemblies at each crossing.



Note: When advanced school crossing flashing beacons are mounted on sign S1-1, its location may vary from project to project, but will normally be placed 150 ft (45 m) in advance of the crosswalk.

SCHOOL CROSSINGS
(Signing and Pavement Markings)

Figure 42.6A

5. Signalized Intersections. Where the school crossing is at a signalized intersection, the school crosswalk warning sign assembly should be placed on the signal pole with a ground-mounted school advance warning sign assembly placed prior to the intersection.

6. Flashing Beacons. Flashing beacons may improve the effectiveness of the school crosswalk. They are mounted on school crossing signs to attract the motorist's attention to these warning devices. The installation of sign-mounted flashing beacons may be considered if the average peak volume of school children (existing or projected) that cross the roadway is approximately 50 during a crossing period. The minimum pedestrian volume threshold may be reduced by engineering judgment if, for example:

   the sight distance falls below the minimum stopping sight distance for existing approach speeds;

   the approach speeds exceed 50 mph (80 km/h); or

   the roadway has four or more lanes that are not divided by a median that is acceptable for use as a pedestrian refuge (i.e., 6 ft (1.8 m) or greater in width).

   Flashing beacons should only be in operation during those hours in which school children use the crossing.

42.6.6 Crossing Supervision

The establishment of crossing supervision is encouraged at school crossings. It is the responsibility of the local officials to establish, train and maintain crossing supervision. It is generally used to supplement the school crossing's traffic warning and control devices. Their primary objective is to teach young children how to recognize a safe gap in the traffic stream and how to employ safe walking and crossing habits.

42.6.7 Special Speed Zones Involving Schools and School Crossings

42.6.7.1 Definitions

The following definitions apply to this Section:

1. Near a School. "Near a school" is defined as that area extending beyond 400 ft (120 m) in any direction from the boundary of a school property that has an active classroom facility.

2. Designated School Crosswalk. "Designated school crosswalk" is limited to a "designated crosswalk," as defined in Section 61-1-209 of the Montana Code Annotated, that has both pavement markings and warning signs that explicitly identify a school crossing.

3. Local Authority. "Local Authority" is defined as being any of those entities prescribed in the Montana Code Annotated under Section 61-1-306.

42.6.7.2 Montana Legal Statute

The Montana Transportation Commission has exclusive jurisdiction to set special regulatory speed limits on all Federal-aid highways and their extensions into all municipalities and urban areas except as provided under Subsection 1d of Section 61-8-310, Montana Code Annotated. This Code permits a local authority to decrease the regulatory speed limit on a Federal-aid highway in an area near a school or at a designated school crosswalk to not less than 80% of the limit that would normally be set on the basis of an engineering and traffic investigation (i.e., speed study), rounded down to the nearest whole number that is evenly divisible by 5 but not less than 15 mph (25 km/h). Chapter Forty documents the Department's procedures for conducting speed studies.

42.6.7.3 MDT Responsibilities

As discussed in Chapter Forty, it is the responsibility of the Traffic Investigations Unit to conduct speed studies and present regulatory speed limit recommendations to the Montana Transportation Commission. If a local authority requests a decrease in this limit for the purpose of establishing a speed zone near a school or at a designated school crosswalk, the Traffic Investigations Unit will perform the following activities:

1. Research Original Speed Study. Review the speed study that provided the basis for setting the existing speed limit and determine if the study is relevant to existing site conditions. If the existing speed limit is warranted, the local authority will be notified that they may reduce the speed as stated in Section 42.6.7.2 without the Montana Transportation Commission's approval.

2. Conduct New Speed Study. If the speed study is not on file or is out of date, a new speed study will be conducted according to the procedures in Chapter Forty. The entire speed zone within the area near the school or the designated school crosswalk will be included in the study. If a modification to the existing speed limit is warranted, a recommendation will be submitted to the Montana Transportation Commission for approval, and the local authority will be notified.

3. Advise Local Authority. When notified pursuant to the above paragraph, the local authority will be advised that it may alter the regulatory speed limit according to Subsection 1d, Section 61-8-310 of the Montana Code Annotated. Upon receipt of a duly adopted ordinance or resolution, the Department will erect the applicable signs.

42.6.7.4 Highway Segment Eligibility

The Federal-aid highway segments that are eligible for a reduction in the regulatory speed limit if altered by a local authority for a school speed zone are as follows:

1. the highway segment that passes immediately by the classroom facility and its adjoining recreational grounds plus an approximate distance of 400 ft (120 m) beyond the boundary of the school's property in each direction, and

2. the highway segment within the limits of the advanced warning signs of a designated school crosswalk.

42.6.7.5 School Speed Limit Signs

School speed limit signs are required at locations where a reduced speed limit will be enforced for the safety of school children. School speed limit signs must be designed and implemented consistent with the criteria in the MUTCD and in Chapter Eighteen. Where school speed limit signs are implemented, variable message signs equipped with alternating flashing beacons are recommended to post the special limits. However, if the route is under local maintenance jurisdiction, an alternative installation may be used.

The school speed limit signs should be removed, covered or rendered inoperable during the non-school season of the year. The variable message signs accomplish this automatically. The operation of the sign should be coordinated with local school officials.

42.6.8 Pedestrian Barriers

Pedestrian barriers should be considered if it is necessary to prohibit children or other pedestrians from crossing major roadways where these crossings may cause an exceptional hazard or impede and delay vehicular traffic.

42.6.9 Roadway Shoulders and Sidewalks

In urban areas and along sections of major rural highways, paved sidewalks or paved shoulders are usually incorporated in the school walk route so that the children walking to and from school can do so without vehicular conflict. If it is determined that the school crossing should be relocated to a different location, the designer should ensure that the new location accommodates this need.

42.6.10 Geometric Revisions

If based on the analyses, any deficiency at the school crossing is related to a specific geometric problem (e.g., insufficient median width for use as a pedestrian refuge), then the designer should consider the costs and benefits of revising the geometric design of the roadway to improve the school crossing.

42.6.11 Light Conditions and Luminaires

Consideration should be given to the particular time-of-day the children use the crossing. Children may have to cross the roadway during periods of darkness due to the seasonal changes, the effect of daylight savings time or the arrival and dismissal schedules of students. Under such conditions, luminaires may be considered.

42.6.12 Coordination with School and Local Officials

When necessary, coordinate with school and local officials to adequately mitigate the deficiency at the school crossing. The following discusses alternative countermeasure that may be considered:

1. Changing School Boundaries. Changing the school boundaries can remove existing walkers from a problem crossing by reassigning them to either an alternative walking route or bus route for the school destination.

2. Removing or Relocating the Crossing. Coordinating with school officials to either remove or relocate the school crossing to another location may be necessary to effectively mitigate a deficient crossing.

3. Educational and Enforcement Programs. Educational and enforcement programs on safe walking and crossing habits should be an integral part of any school's safety program. Although not a direct mitigating measure, the long-term benefits of such actions are substantial.

4. Additional School Buses and Route Changes. Providing additional school buses and bussing routes may eliminate the need for some crossings.

5. Rescheduling School Hours. Crossing conflicts may be minimized by rescheduling the opening and closing hours of schools to avoid periods of heavy vehicular traffic. This is especially important during the early morning hours when darkness and fog may result in poor visibility.

6. Car Pool/Van Pool. School officials may coordinate and implement a car pool/van pool program as an alternative mitigation measure.

42.6.13 Grade-Separated School Crossings

Typically, school crossings at locations where an especially high volume of school children must cross a road facility that has an extremely high volume of traffic are provided with traffic signal control. However, as an alternative, grade separated crossings may be considered at locations where:

1. at-grade crossings are not permitted under management of the particular type of roadway (e.g., Interstate); or

2. roadway operating characteristics do not favor an at-grade crossings.

In both of the above situations, the surrounding terrain must be favorable to implement the grade separation. When recommended, fencing or other barriers may be necessary to channelize the movements of pedestrians to the facility, thus preventing them from avoiding the structure and possibly using a more hazardous route.

42.7 SCHOOL CROSSING STUDY CORRESPONDENCE AND REPORT

42.7.1 School Crossing Study Letters and Memorandum

Section 2.2 provides the Department's criteria for preparing general correspondence to individuals, groups or units inside and outside of the Department. The type of correspondence in Section 2.2 should be employed during the School Crossing Study.

42.7.2 School Crossing Study Report

Upon completing the study, the Traffic Investigations Unit must prepare the School Crossing Study Report. The Report will provide written documentation of the study's procedures, findings, conclusions and recommendations.

Once signed by the Traffic Engineer, the Report will be placed in the project file and copies distributed to the following:

1. Traffic and Safety Engineer,
2. District Administrator,
3. Project Engineer, and
4. any other individual deemed appropriate.

The Report should be prepared consistent with the format that is documented in this Section. This will provide a uniform presentation of similar studies and will ensure that all appropriate information is addressed. Not all subject areas listed below will be required and adjustments may be necessary. The coverage on each item will vary with each study. Although not comprehensive, the Report should include sufficient detail for the reader to comprehend the deficiency at the school crossing and the recommended countermeasures. Analytical details may be incorporated in appendices. The following presents the order of topic areas that should be addressed in the Report:

1. Introduction. The introduction should note the name of the requesting party and the purpose of the request. It should also summarize the results of any meetings that occurred between the requesting party, local officials and the Department.

2. Study Location and Limits. A brief description should be provided of the study location and its limits. Some of the descriptions that may be used to briefly describe the location include:

    a. county name,
    b. city/town name,
    c. school district,
    d. Indian reservation,

e. route number,
f. functional classification,
g. reference points,
h. study length,
i. crossing routes and/or local streets,
j. distance and direction from nearby towns/cities, and
k. direction of route.

3. Physical Characteristics. A brief description of the study area's physical characteristics may include a discussion of the following:

a. year when the existing road/bridge was built or reconstructed and when it was last overlaid or rehabilitated;

b. number of lanes and widths;

c. paved width of roadway;

d. general terrain of the area;

e. rural or urban location;

f. general description of the existing horizontal and vertical alignment, including all features that may be contributing to the problem;

g. development type (e.g., residential, commercial, industrial);

h. location of key features (e.g., school facility, residential developments);

i. parking conditions;

j. unique physical characteristics; and

k. special features within the study limits (e.g., National Forest, State parks).

4. Traffic Data. The traffic data that is relevant to the study should be presented in this section and may include:

a. current AADT,
b. DHV,
c. turning-movement volumes,
d. peak-hour traffic volumes,
e. number and percent of trucks,
f. vehicular gap interval and distribution,

g. pedestrian volumes,
h. pedestrian group size,
i. pedestrian/bicyclist characteristics,
j. 85th-percentile speed,
k. pace speed,
l. median speed,
m. existing approved speed limit, and
n. existing school speed zone limit and operation.

5. Crash History. This section should briefly summarize the following crash history data:

a. number of crashes by year (generally for the past three years);

b. types of crashes;

c. a listing of the crash study locations and lengths;

d. listing of locations with a high number of crashes;

e. overall crash and severity rates for the study locations;

f. truck crash and severity rates for the study location, if applicable;

g. Statewide average crash and severity rates for similar routes, if available;

h. a description of specific crash trends; and

i. a description of why a higher than normal number of crashes may be occurring.

6. Studies. The Report should briefly discuss any other studies that were performed. A brief description of how each study was conducted and an overview of its results. Not all of the studies listed below will be necessary. The Report may address:

a. volume and gap studies,
b. pedestrian studies,
c. speed studies,
d. traffic control devices studies,
e. inventory studies,
f. intersection studies,
g. sight distance studies,

h. crash studies, and
i. any other study or analysis deemed appropriate.

7. Miscellaneous Features. This section may include a discussion on any relevant feature that was not covered elsewhere in the Report. This section may also address the use of special speed zones for schools and school crossings.

8. Conclusions and Recommendations. This section should summarize the issues and concerns that have been identified by the study. It should clearly define the recommended deficiency countermeasures. Maps or plan sheets should be considered for illustrative purposes.