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Adapting Safety Audits for Small Cities

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ABSTRACT

In this research, a practical approach to identifying street safety needs for local governments has been developed. These governments are responsible for high street mileage carrying relatively low traffic volumes. Improving safety on these streets is given only limited focus in most small cities. Due to the limited funding, manpower, and traffic engineering expertise available, traditional safety improvement programs generally are beyond the means of the agencies. An effective safety program must recognize the reality of local governments. A regional survey was conducted to examine current methods and practices used by city traffic safety programs. Results from the survey were used in development of the prototype Street Safety Audit procedure. A set of simple checklists covering fundamental intersection and traffic sign issues also were developed from this research. The Street Safety Audit procedure presented is a useful tool for small cities to begin addressing basic safety needs on their streets.

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INTRODUCTION

The number of traffic crashes on America's roads is a national tragedy. In 1996, approximately 43,300 people died in motor-vehicle crashes and another 2.6 million people sustained disabling injuries [12]. Motor-vehicle crashes are the seventh leading cause of death among all Americans [12]. In addition, the economic cost of traffic crashes is alarming. The estimated total cost of traffic crashes was more than $176 billion in 1996 [12], roughly two percent of the national Gross Domestic Product. Many correctable safety needs still exist on our roadways. A continuation of safety efforts is needed to reduce crashes and save lives.

The objective of this project was to develop a safety tool for use by small cities on their local streets. The project's goals were three-fold:

1. Examine the methods currently used by cities in the region to identify and correct safety needs on their streets.
2. Develop a set of Street Safety Audit checklists applicable for small cities.
3. Incorporate the checklists into a practical and comprehensive program for use by local agencies.

LITERATURE REVIEW

Many challenges face local governmental agencies when improving safety on streets under their jurisdiction. Local governments are responsible for 86 percent of the entire urban street network. A great majority of the streets are functionally classified as local streets and carry relatively low traffic volumes. In addition, local governments have less funding and fewer resources available than state governments. Research conducted in 1991 by Walzer and Chicoine found that more than half of the towns and townships surveyed reported inadequate funding. Another 34 percent reported adequate revenue for their current services; however, they lacked additional funding to expand services or add new programs [25]. In many small jurisdictions, traffic engineering responsibilities often belong to local staff having no formal traffic engineering training [8]. These facts make it difficult for local agencies to conduct traditional safety improvement programs.

Several traffic safety programs were examined as part of this research, including the Highway Safety Improvement Program, Safety Management System, Risk Management Program, and Road Safety Audit. In general, these programs are often beyond the means of local governments due to data and manpower requirements. However, several of the individual components of the traffic safety programs were potentially feasible for use on local streets. In particular, the use of Road Safety Audit checklists tailored to small city safety problems was further examined.

The Road Safety Audit program is a relatively new traffic safety approach. Key safety audit aspects are that it is a formal, independent examination of the roadway, restricted specifically to safety issues, and conducted by a qualified and knowledgeable audit team. Road safety audits are conducted on the feasibility, preliminary design, detailed design, pre-opening stages, and/or an existing road. Audit projects ranging from major construction to minor maintenance and audits for any stage of project are potentially beneficial.

METHODOLOGY

To further define local street safety programs, a regional mail survey was conducted for cities in the states of Montana, North and South Dakota, Utah, Wyoming, and Colorado. The safety survey examined the procedures and methods currently used by city traffic safety programs. Five main topic sections were designed covering background city and safety program information, traffic safety program methods and procedures, evaluation of project and overall program safety benefits, inventories and management systems used, and miscellaneous and legal issues.

According to the regional city population distribution, a set of randomly chosen cities was selected. A mailing database was created using the U.S. Census Bureau and the respective state's municipal directory. In all, 260 surveys were completed and returned — nearly a 60 percent return rate. This resulted in a calculated confidence level of 95 percent with a 5.5 percent proportion of error.

Results were statistically analyzed using a crosstabulation analysis and the chi-square statistic. The joint frequency distributions of the survey data were examined for statistically significant relationships between variables. In addition, the Bonferroni procedure was used to adjust the individual test confidence interval for making multiple inferences from the same data set. This provided assurance about the correctness of the entire series of statistical tests performed on the survey data.

RESULTS AND ANALYSIS

A regional survey was developed and conducted to obtain the current state of safety practices used by local cities agencies. Data collected by the Local Street Safety Survey were analyzed for differences in safety practices between city population and individual state categories. The results were used to develop a prototype street safety audit for small cities. The key findings of the survey follow:

1. Political organizations or "other" groups often were the primary organization responsible for identifying safety needs in smaller cities.
2. Significant percentages of small cities did not address safety needs on their street network.
3. The availability of local funding influenced the overall scope of a city's safety program.
4. Lack of funding and lack of manpower were often cited reasons why a safety improvement program was not used. In addition, significant percentages of smaller cities indicated a safety improvement program was not needed.
5. The methods used by smaller cities to identify safety needs, select appropriate countermeasures, and prioritize projects were not performed or were less technical than those used by larger cities.

6. Use of street/sign inventories and pavement management systems was significantly less for small cities.

7. Small cities often lacked computer resources to analyze crashes and conduct roadway inventories and management systems.

8. The local governments of small cities often possessed less formal traffic engineering resources.

9. A statistically significant relationship was not found between cities reporting sovereign immunity and those that did not identify safety needs.

10. The safety practices of cities in the region were not found to significantly vary by state.

STREET SAFETY AUDIT FOR SMALL CITIES

The Australian Road Safety Audit program provided basic structure for developing the Street Safety Audit procedure [17]. Modifications to the specific safety audit steps were made according to the identified needs of small cities. For simplicity and brevity, fundamental city safety issues were addressed. As designed, the modified procedures and checklists are a viable starting point for cities to begin a systematic process for examining safety needs.

Safety audits are a proactive approach to crash prevention. Though intended for small cities, it also is applicable for larger cities to use on their local street network. The key steps follow.

1. Select an auditor
2. Conduct the street safety audit
3. Produce a street safety report
4. Hold a follow-up evaluation

The selection of an auditor or auditors depends on several factors related to the city and audit project. Ideally, the audit should be conducted by a team of independent, experienced, knowledgeable individuals. However, is the selection of auditors independent of the available resources of the city?

The main objective when selecting the auditor(s) is to choose qualified and knowledgeable individuals available in the city's resources. The objectivity and independence of the auditor are important and desirable characteristics.

Hiring qualified consultants is an option for cities with sufficient funding. For small cities with limited funding, use of an audit team consisting of local personnel is a potentially acceptable alternative. Individuals with various backgrounds related to transportation and street issues should be considered for selection. Larger cities often have staff with an adequate level of traffic safety engineering skills. Potential disadvantages with this approach include insufficient auditor experience and knowledge, as well as, a lack of independence from the project and street organization.

An initial safety audit of existing streets must begin a systematic process of reviewing all street facilities. Before conducting the audit, a review of the checklists is recommended. An on-site inspection is then conducted. It is important to evaluate safety of the existing street network considering all road users and the road's function and use. The safety checklists are intended for use during the site evaluation. The checklists serve as a memory aid during site inspection to ensure that major safety issues are not overlooked. They are not all encompassing; however, key areas to be examined on existing streets are addressed.

After completion of each street safety audit, a final report is produced providing a description of the identified safety needs. Highlighted in the report are problems which require immediate attention. It is desirable that the report be kept as concise as possible. General recommendations of possible corrective actions also may be included.

A follow-up meeting provides an opportunity to discuss the findings of the street safety audit between the auditor(s), individuals with jurisdiction over the street network, and those responsible for the budget of street projects and improvements. Documenting the safety actions and project scope, including programming and scheduling, are recommended. Considering the need for additional assistance when addressing the identified safety needs in the report also is important.

Documentation of this program will provide an important defense against future tort liability suits. All actions taken with respect to the safety audit must be documented, especially reasons for rejecting any improvements and the scheduling of improvements.

The independence and objectivity associated with the audit program is an important selling point when requesting resources to conduct safety improvements. The produced safety audit report provides an effective and credible reference when proposing and justifying safety improvement projects to groups responsible for the funding and programming of street activities.

CONCLUSIONS AND RECOMMENDATIONS

Several conclusions were drawn based on the results of the Local Street Safety Survey and the literature review. The conclusions follow.

1. Currently, a significant number of small cities do not recognize a need for a traffic safety program for streets. Thus, an important component of any safety program is its promotion and marketing to potential users.
2. A practical safety tool is needed for small cities to begin addressing safety needs.
3. Development of traffic safety programs need to address the lack of resources related to manpower, funding, and traffic engineering skills in local governments.
4. The safety audit procedure is a feasible approach for local governments to improve street safety.

The following recommendations for additional research concerning existing street safety audits for small cities are:

1. Field tests must be conducted on the prototype street safety audit and checklists by local city agencies.
2. A training program must be developed, which assists local personnel in conducting road safety audits on existing streets.

3. Uniform street safety audit procedures and checklists must be adopted by local city agencies.

CHAPTER 1

INTRODUCTION

Background

The number of traffic crashes on America's roads is a national tragedy. In 1996, approximately 43,300 people died in motor-vehicle crashes and another 2.6 million people sustained disabling injuries [12]. These numbers equate to one person killed in the United States every 12 minutes and another suffering a disabling injury every 12 seconds. For individuals between the ages of one and 24, traffic crashes are the leading cause of death. For those between 25 and 35 years of age, motor-vehicle fatalities are the second leading cause of death, and for all ages, motor-vehicle crashes are the seventh leading cause of death [12].

Traffic crashes are a major public health concern, adversely affecting the nation's welfare and prosperity. The overall price to the American public includes increased medical costs, property loss, and social costs. Crashes negatively impact individuals and their families, result in lost productivity, and contribute damage to the infrastructure and the environment. The economic cost of traffic crashes is alarming. The estimated total cost of motor-vehicle crashes was more than $176 billion in 1996 [12]. This cost is more than 2 percent of the national Gross Domestic Product.

Despite the large numbers, significant progress has been made in traffic safety. Even as the number of registered vehicles and total miles of travel increases, fatality and injury rates on America's roads have declined. The fatality rate per hundred million vehicle miles was 5.7 in 1966, compared with 1.76 in 1996, a reduction of more than two-thirds [12].

In spite of this impressive progress, the overall traffic crash cost to society is still too high. Safety is sometimes a secondary issue in roadway design and construction [16]. In addition, the application of safe design standards does not necessarily result in a safe final product [16,24]. Many correctable safety needs still exist on our roadways. A continuation of safety efforts is needed to reduce crashes and save lives.

Objective

The objective of this project was to develop a safety tool for use by small cities on their local streets. The project's goals are three-fold:

1. Examine the methods currently used by cities in the region to identify and correct safety needs on their streets.
2. Develop a set of Street Safety Audit checklists applicable for small cities.
3. Incorporate the checklists into a practical and comprehensive program for use by local agencies.

Report Organization

Chapter 2 contains a literature review associated with current information pertaining to local streets and traffic safety programs. The methodologies used in this project are presented in Chapter 3. Chapter 4 presents the results and findings of the project. The prototype street safety audit is reported in Chapter 5. The summary, conclusions, and recommendations are included in Chapter 6.

CHAPTER 2

LITERATURE REVIEW

In this chapter, relevant traffic safety programs and issues facing local governments will be presented. Several traffic safety programs currently exist; however, these programs have been developed based on the funding and manpower resources available to state agencies rather than local governments.

Many challenges face local governmental agencies when improving safety on streets under their jurisdiction. Local governments are responsible for many street miles with low traffic volumes. They also have less funding and fewer resources available than state governments. These facts make it difficult for local agencies to conduct traditional safety improvement programs.

The need for improved safety on local streets is best illustrated when one looks at crash rates. In both fatalities and injuries, the rates on local streets were greater than those for all urban streets (Table 2.1). Statistics show that the fatality rate was 26 percent higher and the injury rate was 81 percent higher on local streets than on all urban streets combined. This difference is even greater when examining pedestrian crashes. The pedestrian fatality rate on local streets was 48 percent higher and the injury rate was 188 percent higher than that on all streets. These statistics stress the need for additional emphasis on local street safety improvements.

Table 2.1 Fatality and Injury Rates* on Urban Streets (1996) [20].

	All Persons		Pedestrians	
Rates	Local Streets	All Streets	Local Streets	All Streets
Fatalities	1.5	1.2	0.37	0.25
Injuries	310	170	19	6.4

* per 100 million vehicle-miles of travel

Issues Facing Local Governments

Local governments are responsible for more than 713,000 miles (1,150,000 km) of urban streets [20]. This equates to approximately 86 percent of the entire urban street network. Of these streets, more than three-quarters are functionally classified as local streets [20]. Local streets comprise the lowest order of the functional classification structure. Their primary purpose to is provide direct land access and move traffic to higher order streets. The design and control of local streets promote lower vehicle speeds and discourage through-traffic movement. An estimated 36 percent of all local streets have an average traffic volume less than 500 vehicles per day. The low traffic volumes and size of the street mileage make the justification of safety improvements difficult. To be cost effective, inexpensive safety improvements are necessary since few total crashes occur at any specific location [7,8,19].

A major dilemma for local governments is the availability of fiscal resources. Research conducted in 1991 found that more than half of the towns and townships surveyed reported inadequate funding. Another 34 percent reported adequate revenue for the current services; however, they lacked additional funding to expand services or add new programs [25]. Unfortunately, decreases in federal and state transportation funding at the local level also are likely. In addition, local government's ability to raise additional revenue is limited due to a declining tax base and public resistance to higher taxes [25]. When examining funds per mile to maintain and improve roads, it has been estimated that local governments have 62 percent of the funding available to state governments [2]. The financial problems are further compounded with increasing construction and maintenance costs. Budgetary pressures ultimately have created conflicts between maintaining basic road maintenance and conducting safety improvement projects.

Local governments also have limited manpower and technical resources [1,26,27]. In many small jurisdictions, traffic engineering responsibilities often belong to local staff who have no formal traffic engineering training. Though dedicated, these individuals often have neither the time nor the expertise required to properly identify, analyze, and correct the safety deficiencies on their roadway systems [8].

Limited manpower and resources are the reality of local government and require that a safety program be simple and easy to use. The combination of high mileage and low traffic volumes faced by local governments necessitates that an effective program use a minimal amount of time and data. A desirable safety program focuses on developing a consistent roadway, minimizing tort liability, and identifying and implementing low cost improvements based on solid traffic safety principles.

Crash Analysis on Local Roads

The analysis of crash data is a widely practiced method for identifying and selecting safety improvements. However, several publications have questioned the use of crash history to identify safety problems on local roads [7,8,26]. Rationale against the use of crash records include absent or inaccurate data and the unique characteristics of low volume roads.

Crash and traffic information on local roads must be used with caution. Often, information on traffic volume and/or crash history of the local road network is never collected. With limited local street data, using basic crash rates is questionable at best [8,26]. In addition, if inaccuracies exist in the location of a crash, determination of the actual roadway defect and an appropriate countermeasure is difficult.

The low traffic volumes and high mileage, common to local roads, present additional problems when identifying safety deficiencies. Local street data are limited, as is reported crash information. Small numbers of reported crashes negate the use of prevalent crash characteristics as the primary analysis tool [8]. Crashes on low volume roads also tend to be distributed randomly along the network. As few locations exhibit abnormal frequencies, area-wide analysis of crash frequency generally has not been effective in identifying hazardous locations [8,19].

With little crash information available, reliable post crash conclusions on potential roadway deficiencies and possible corrective actions generally are not possible at a specific location. Problems associated with post crash investigation methods emphasize the importance of addressing street safety improvements using a proactive process [26].

Safety Legislation History

In the early 1960s, increasing fatality rates and annual accident costs on America's roads focused national attention on the highway safety issue. In the mid-1960s, the Federal Highway Administration responded by providing funding for the identification and correction of specific high crash locations.

The landmark Highway Safety Act of 1966 was a major step forward in federal participation of programs addressing traffic safety. This legislation established guidelines for the development of states' safety programs. State governors were responsibile for programs which were required to be in accordance with uniform safety standards involving driver, vehicle, and roadway elements [18]. Federal funding incentives also were included in the legislation. In 1973, Congress passed another highway safety act, which established and provided categorical funding for several specific programs including rail highway grade crossings, projects for high hazard locations, and the elimination of roadside obstacles [5].

In 1968, the Federal-Aid Highway Act established the Traffic Operations Program to Increases Capacity and Safety (TOPICS). The program reduced urban traffic congestion and increased traffic efficiency and safety. Matching federal funds were provided for traffic flow improvement and elimination of urban roadway defects. Many improvements were eligible for TOPICS funding including channelization of intersections, upgrade of traffic control systems and lighting, establishment of traffic surveillance systems, and construction of pedestrian grade separations. Some regulations were placed on TOPICS projects with respect to the development and scheduling of eligible projects. This resulted in a large amount of administration work along each stage of the project [6].

With the increased emphasis on highway safety, a decline in fatality rates occurred during the 1970s and 1980s. In 1991, Congress again addressed highway safety with the passage of the Intermodal Surface Transportation Efficiency Act. This act set requirements for the development of a Safety Management System (SMS) [24]. Although initially the SMS was required, it became voluntary due to state pressures; however, many states have continued its use.

Also in the early 1980s, a new approach to highway safety, the Road Safety Audit (RSA), was developed in the United Kingdom. This program is a proactive approach to enhance safety for all roadway users. An independent audit, with a series of checklists, is used to review any stage of the roadway project. These two safety tools (SMS and RSA) are discussed in later sections. In the following section, the safety tool frequently used by states' Department of Transportation has been presented.

Highway Safety Improvement Program

The Federal Highway Administration formally defined the Highway Safety Improvement Program (HSIP) in 1979 [5]. This program served as the basis for the development and implementation of a comprehensive highway safety program for each state. The HSIP reduced the number and severity of accidents and decreased the potential for accidents on all highways.

The Highway Safety Improvement Program was developed as comprehensive approach to improving safety on a roadway network. The general methodology of the program involves the development of a priority list of safety improvements to be implemented; scheduling, design, and construction of safety projects; and determination of the value of individual projects and the entire safety program.

The three major components of the HSIP are planning, implementation, and evaluation [5]. The components are interconnected and provide information back to the program. Each component is composed of processes and subprocesses, and each subprocess has recommended procedures to accomplish that task.

The planning component involves development of a crash, roadway, and traffic database and identification of high crash locations through crash-based and non-crash-based techniques. Next, engineering studies and benefit-cost ratios are used to select appropriate countermeasures, and finally, prioritization of the developed projects is conducted using programming methods or an incremental benefit-cost ratio.

The implementation component involves the scheduling, design, and construction of the safety projects. Funding is then allocated for each project and an operational review conducted shortly after completion to examine the project against its expected performance.

The evaluation component reviews the individual improvement projects and the entire program. The purpose of this component is to provide input for future reference into the planning and implementation processes based on the actual costs and benefits of constructed improvement projects. The administrative evaluation's purpose is to assess the effectiveness of the implementation activities. An outline of the entire program is presented in Figure 2.1.

The Highway Safety Improvement Program is a complex program. This program requires a large database of roadway information and uses several costly and time consuming formal engineering studies. Due to the size and complexity of the HSIP, it is often beyond the available manpower and financial resources of local governments.

I. PLANNING

Process 1. Collect and Maintain Data
Subprocess 1. Define the Highway Location Reference System.
Subprocess 2. Collect and Maintain Crash Data
Subprocess 3. Collect and Maintain Traffic Data
Subprocess 4. Collect and Maintain Highway Data

Process 2. Identify Hazardous Locations and Elements

Process 3. Conduct Engineering Studies
Subprocess 1. Collect and Analyze Data at Identified Hazardous Locations
Subprocess 2. Develop Candidate Countermeasure(s)
Subprocess 3. Develop Projects

Process 4. Establish Project Priorities

II. IMPLEMENTATION

Process 1. Schedule and Implement Safety Improvement Projects
Subprocess 1. Schedule Projects
Subprocess 2. Design and Construct Projects
Subprocess 3. Conduct Operational Review

III. EVAULATION

Process 1. Determine the Effectiveness of Highway Safety Improvements
Subprocess 1. Perform Crash-Based Project Evaluation
Subprocess 2. Perform Non-Crash-Based Project Evaluation
Subprocess 3. Perform Program Evaluation
Subprocess 4. Perform Administrative Evaluation

Figure 2.1 Outline of the HSIP Structure [5].

Safety Management Systems

The 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) set mandates for the creation and implementation of a Safety Management System for states. The Safety Management System's goal is to reduce the number and severity of traffic crashes.

The SMS is a systematic, coordinated, comprehensive approach to enhance traffic safety from the perspective of the driver, roadway, and vehicle. The SMS ensures communication, coordination, and cooperation of a diverse coalition of groups having safety responsibilities or roles. Possible organizations involved in this coalition include state and local government, public health, safety advocacy, and community groups that represent a wide range of disciplines including engineering, law enforcement, education, and emergency response. A successful Safety Management System ensures better coordination of state and local safety efforts and provides an exchange of information between safety organizations. The decision making process is assisted with additional and more comprehensive information provided by the SMS.

The major areas considered in the Safety Management System include [18]:

- coordinating and integrating broad-based safety programs
- developing processes and procedures to ensure that the major safety problems are identified and addressed
- ensuring early consideration of safety in all highway transportation programs and projects
- identifying safety needs of special user groups
- routinely maintaining and upgrading safety hardware, highway elements, and operational features

Each state is responsible for the development and implementation of their own Safety Management System. The organizational structure is flexible and fits the state's individual strengths and needs. A lead state agency and center of operations form the basic structure of the SMS [18]. The operational center is responsible for the identification of key agency participants and coordination of the entire system. The SMS was developed for administration at the state level. The program includes participation from local agencies; however, it is not intended to be conducted completely at the local level and local issues are generally not the focus.

Tort Liability

Over the past few decades, tort liability has been a growing concern for governmental agencies. The annual number of tort liability cases have been increasing nationally. In 1991, at least 32,000 suits were filed against state highway agencies and the estimated total cost of tort actions, against all government levels, was between $400 and $850 million [10].

Tort liability is defined as a civil wrong or injury. A tort action seeks repayment for damages to property and injuries to individuals. National Cooperative Highway Research Program, Synthesis of Practice 106, [11] lists the following elements for a valid tort action.

1. The defendant must owe a legal duty to the plaintiff.
2. There must be a breach of duty. The defendant must have failed to perform or to properly perform that duty.
3. The breach of duty must be a proximate cause of the accident that resulted.
4. The plaintiff must have suffered damages as a result.

Not every governmental act is suspect to tort liability. Governmental actions are classified as discretionary or non-discretionary acts. Discretionary acts, such as planning and design, still carry some immunity against tort liability. Non-discretionary acts are liable and pertain to construction and maintenance activities [22]. The criteria for discretionary acts, as given by the National Association of County Engineers (NACE) [22], follow.

1. An authorized individual or agency must have been given the power and duty to make a decision.
2. The decision must be made from a set of valid alternatives.
3. The individual or agency must exercise independent judgment in making the selection. Discretionary acts may include planning and design.

For transportation agencies, legal duty is established as the agency, with jurisdiction over the roadway, has a responsibility to the public to provide reasonably safe travel. The breach of legal duty is the major issue in most tort cases as the plaintiff seeks to prove negligence by the defendant. Negligence is failure to exercise such care as a reasonably prudent and careful person would use under similar circumstances. It falls into one of two categories: wrongful performance or omission of performance (when some act ought to have been performed and was not) [11].

Agencies also have a duty to remedy or take other appropriate action when notice is received of a roadway defect. Warning of the defect occurs when the agency responsible for the system involving the defect has received notice of the condition. This notice is actual, such as a public complaint, or constructive, meaning the agency had a reasonable time to notice the defect [22]. Courts require that an agency act on the notice within a reasonable response time. Each situation does not require an immediate response; however, an agency cannot fail to take some sort of positive action. The agency is required to warn the using public if complete repair of the problem will take a significant time to remedy.

This review of tort liability emphasizes the importance of a program to identify and correct safety deficiencies on the street network. To minimize potential for a lawsuit, agencies must respond in a timely fashion to identified defects and have an established set of guidelines for the correction of roadway problems.

Sovereign immunity still is present in some states. This immunity from tort suits, while having monetary benefits to the local and state agencies, probably adversely affects safety programs. In jurisdictions where tort liability is a reality, risk management programs often have been established. The programs are discussed in the following section.

Risk Management Programs

In general, risk management seeks to minimize cost and expenditures related to insurance claims of all types, as well as general tort liability claims. For a transportation agency, a comprehensive risk management program is needed to enhance roadway safety and mitigate exposure to tort liability. Objectives of managing tort liability are to reduce the number and severity of crashes, reduce claims, handle or dispose of minor claims, enhance the defensive posture of the agency, vigorously defend the agency in claims carried through the litigation process, and implement loss-prevention measures [10].

The program anticipates and identifies high frequency problems on road systems and establishes procedures to eliminate them. Components of a risk program include the establishment of formal responsibilities and duties in the organization, development of communication lines to ensure that identified problems are received by the appropriate agency, and proper insurance coverage [10]. The most frequent causes of lawsuits against county road agencies, as stated by NACE [22], are malfunctioning traffic signals, sign defects, roadside hazards, guardrails, shoulder maintenance, road surface maintenance, geometrics of the road and intersections, snow and ice removal, and removal of highway debris.

An effective risk management program involves accurate record keeping, regular review and inspection of the roadway network, employee education, proper documentation of crashes and the overall program. Good records establish appropriate programs, allocate resources, and defend the agency against litigation. Inspections and preventative maintenance also are important as they reduce reliability of the agency on complaints from the public or law enforcement agencies to identify problems. The risk management program is a continuous process using extensive legal resources. These resources often are beyond those possessed by local agencies. An alternative to the HSIP, SMS, and risk management program is the road safety audit.

Road Safety Audit

The Road Safety Audit originated in the United Kingdom during the 1980s. Today, the approach is used by the United Kingdom, Australia, New Zealand, and Denmark as part of their national safety programs. The United States currently is examining the program for integration into its safety programs. A road safety audit is defined by Austroads as "a formal examination of an existing or future road or traffic project, or any project which interacts with road users, in which an independent, qualified examiner reports on the project's accident potential and safety performance." [17]

A road safety audit is a proactive approach to crash prevention. It ensures a high level of safety for all road users on new and existing roads through the identification of potential safety problems and consideration of methods to eliminate or reduce the crash potential. Established safety principles are applied to the planning, design, construction, maintenance, and operation aspects of the roadway. Safety is considered from the viewpoint of all roadway users including motorists, motorcyclists, pedestrians, and bicyclists.

The road safety audit is a useful component of a comprehensive safety program. Its key components, as given by a recent Federal Highway Administration publication [23], are that it is:

- a formal process
- an independent process
- carried out by a team or individual with appropriate experience and training
- restricted to road safety issues
- a report that identifies road safety deficiencies and, if appropriate, makes recommendations aimed at removing or reducing deficiencies
- a report, which must be formally addressed by the appropriate roadway decision-makers

Road safety audits are performed on the feasibility, preliminary design, detailed design, pre-opening stages, and/or an existing road. It is possible to audit projects ranging from major construction to minor maintenance. The focus of the road safety audit differs for each stage of the roadway. Every stage of a road does not have be audited to obtain safety benefits, but in general, auditing the initial stages of a roadway will be more cost effective than remedial treatments.

To ensure the most objective and thorough road safety audit, an independent, experienced auditing team is recommended. A comprehensive set of checklists has been developed for each stage of a roadway project for use by the auditors. The checklists are a prompt for common topics and areas to be investigated. The key steps identified by Austroads [17] in a road safety audit are:

1. select an appropriate auditor
2. obtain all the relevant background information
3. conduct an effective site inspection
4. provide a written report

Recommendations from the audit may or may not be accepted; however, it is important that all recommendations and actions be documented. The benefits attributed to a road safety audit include reduction of crashes and crash severity, increased awareness and importance of safety, and reduced costs of remedial corrective action and total community costs [17].

Common Urban Crash Locations and Tort Litigation

An examination of urban crash statistics, reported in Table 2.2, reveals that intersections are the most common crash location and that two-vehicle, angle crashes are the most common crash type. Single-vehicle and pedestrian crashes account for a majority of the fatalities. Two-vehicle, angle crashes resulted in the third highest number of deaths. The statistics highlight critical areas to be addressed by an urban safety improvement program.

Table 2.2 Urban Crash Statistics (1993) [4].

Urban Crashes

Type of Crash	Number of Crashes	Percent of All Urban Crashes
2-Vehicle (angle collision)	2,330,000	28.8
2-Vehicle (other)	2,220,000	27.4
2-Vehicle (rear-end collision)	2,150,000	26.5
1-Vehicle	1,060,000	13.1
Other	340,000	4.2
Total	8,100,000	100.0

Urban Fatalities

Type of Crash	Number of Crashes	Percent of All Urban Fatalities
1-Vehicle	4900	35.8
Pedestrian	3400	24.8
2-Vehicle (angle collision)	1900	13.9
2-Vehicle (other)	1500	10.9
2-Vehicle (head-on)	900	6.6
Other	600	4.4
2-Vehicle (rear-end)	500	3.6
Total	13,700	100.0

An examination of tort liability cases also provides insight into common areas of safety needs. Intersection design issues and traffic control devices are common elements in tort litigation against roadway agencies. Frequently cited intersection issues involve the placement of needed traffic controls or the lack of maintenance, i.e. vegetation control. Defects associated with traffic control devices, such as missing, improperly placed, or poorly maintained signs, are another frequently claimed tort element, particularly against local jurisdictions [4].

The two court cases describe below illustrate this reality. In a June 1989 case, *Eason v. NJAFIUA and Township of Montclair* (N.J. Super. A.D. 1994), a woman suffered severe injuries when her vehicle collided with another vehicle at an intersection. The stop sign on the approach to the intersection was missing at the time of the crash. The woman sued the other driver and township responsible for the missing stop sign. The court found that the township was liable for the maintenance of the existing stop sign [14].

In another case occurring in 1978, $900,000 was awarded to a Louisiana man who sustained permanent paralysis in an accident involving an improperly installed stop sign. The Louisiana Office of Highways and Calcasieu Parish, Louisiana were held liable. After the case, Calcasieu Parish's insurance premium doubled and they dropped their insurance [3].

Summary of Literature Review

Several programs to improve traffic safety were presented in this chapter. In general, these programs were designed for the greater resources of state agencies. The HSIP uses complex and data intensive procedures. The manpower and technical resources needed to implement and perform the HSIP often are beyond the ability of local government.

The Safety Management System is designed for implementation at the state level. The organizational needs are beyond the means of most local agencies. The presented risk management program also is not often feasible for small local agencies due to the necessary legal expertise and resources used. The road safety audit is a relatively new approach to traffic safety. Many of the concepts used in the RSA approach are potentially applicable for local agencies. Currently, few small cities have implemented any of the programs described above. Even though the entire programs are not practical, several elements are promising for use on local streets. The potential use of road safety audit checklists for local agencies is examined further in the following chapters.

CHAPTER 3

METHODOLOGY

To further define local street safety programs, a mail survey was conducted on cities in the Mountain-Plains Consortium region. This region includes the states of Montana, North and South Dakota, Utah, Wyoming, and Colorado. The objectives of the safety survey were to examine the current procedures and methods used by city traffic safety programs; provide background information for development of the street safety audit procedure and checklists for small cities; and determine differences in safety practices due to city population and state influence. The data collection methods and statistical analysis used in this research are discussed next.

Survey Design

The format of the Local Street Safety Survey was chosen to promote the greatest possible response rate. The survey was limited to one page of text, front and back. Wording of the questions was kept as simple and straight forward as possible, and technical jargon was avoided. Most questions used a multiple choice format to simplify response and data input. Color was added to the survey to enhance its appearance. The final 21 question survey is located in Appendix A.

The survey questions were based on the methodologies, practices, and engineering studies used by existing safety programs. The first section assessed background information on the city and its safety program. Another section examined the methods used to identify safety needs, select appropriate countermeasures, and prioritize improvements. Also, questions were asked regarding the evaluation of a project's safety benefits and the implementation process for safety projects. The next section identified types of inventories and management systems maintained by the city. The final set of questions examined miscellaneous issues relating to available computer resources, use of partnerships for safety, sovereign immunity, and the number of tort cases filed against the city.

A preliminary testing of the draft survey was conducted. The draft survey was sent to each state Department of Transportation (DOT) in the region and the Laramie, Wyoming, city engineer and street superintendent. The DOT respondents were individuals from the safety departments of their respective organization. The received comments (contained in Appendix B) were used to modify the survey as appropriate.

Survey Process

An appropriate sample size was calculated for a desired confidence level and maximum proportion of error. The size of the sample also depended on size of the sample population. The sample size for a finite population was calculated using the following equation:

$$n = \frac{\left(\frac{z_{\alpha/2}\sigma}{E}\right)^2}{1+\frac{\left(\frac{z_{\alpha/2}\sigma}{E}\right)^2}{N}}$$

where:

n = sample size
N = finite population
E = proportion of acceptable error
$z_{\alpha/2}$ = confidence level
σ = standard deviation

Using the given sample size equation, it was calculated that 172 survey responses were needed for a 95 percent confidence level with a 7 percent error. Assuming a 45 percent return rate, a total mailing size of 450 cities was used.

A database of city names and populations for each state in the region was obtained from the U.S. Census Bureau's web page. This information was then sorted into seven city population categories. The seven categories are as follows: greater than 25,000; 25,000-10,000; 10,000-5,000; 5,000-2,500; 2,500-1,000; 1,000-400, and less than 400. The regional distribution of city populations was determined using this information. The survey sample was divided into proportions according to city population distribution to ensure an appropriate representation of each category. Cities were drawn randomly from the database using the Minitab statistics program. Presented in Table 3.1 are the distributions of the city populations and returned surveys by city size category. The distribution of the total population and the survey are nearly equal, ensuring results from a specific city size are not over represented in the results.

Table 3.1 Distribution of Surveys and Cities by Population.

City Population	Percent Distribution		Number of Returned Surveys
	Total Population	Returned Surveys	
>25,000	3.0%	4.6%	12
10,000-25,000	4.0%	5.0%	13
5000-10,000	4.2%	5.8%	15
2500-5000	6.0%	5.0%	13
1000-2500	16.0%	19.0%	48
400-1000	21.0%	20.0%	52
0-400	45.0%	41.0%	107

An address database using a current copy of each state's municipal officials directory was created for the random sample. The database consisted of a contact person, job title, and city address. From the listed city job positions, the individual most likely to be involved with the traffic and roadway operations of the city was selected as the contact. The basic contact hierarchy descended from city engineer, public works director, street foreman, city maintenance worker, town clerk, and finally the mayor.

To enhance response rate, every reasonable effort was made to personalize the survey and accompanying cover letter. A survey and cover letter were mailed to each city with a pre-paid postage return envelope. Approximately 10 days later, a follow-up postcard was sent to cities that had not returned a survey. A second cover letter and survey was mailed to all cities that had not yet returned a completed survey approximately three weeks later. Two hundred and sixty surveys were completed and returned, resulting in nearly a 60 percent return rate. The final confidence level of 95 percent with an error of 5.5 percent was obtained.

Statistical Analysis

Results from the Local Street Safety Survey were analyzed using a crosstabulation analysis. Crosstabulation (contingency table) analysis examines interrelationships between categorical variables. This analysis involves construction of tables containing the frequency distributions for two or more categories of variables. The joint frequency distributions are statistically analyzed by tests of significance to determine whether or not variables are statistically independent [15].

The chi-square test of statistical significance determines if a systematic relationship exists between two variables. The chi-square statistic is calculated by [9]:

$$\chi^2 = \sum_{i=1}^{r}\sum_{j=1}^{c}\frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

where:

O_{ij} = observed frequency in cell (i,j)
E_{ij} = expected frequency for cell (i,j)

The degrees of freedom associated with the chi-square equal (r-1)(c-1).

where:

r = number of rows in the contingency table
c = number of columns in the contingency table

The chi-square test computes expected cell frequencies using row and column totals from the contingency table and assumes no relationship exists between the variables. The actual cell values are then compared to the expected cell frequencies. The greater the difference between the expected and actual cell values, the larger the chi-square statistic.

The null hypothesis for this chi-square analysis is that the frequency distributions of the rows and columns are independent. The p-value is used to accept or reject the null hypothesis. When the p-value is less than the level of significance, the null hypothesis is rejected and it is accepted that the variables are related in some fashion.

An example of a 7 x 3 contingency table analysis using the chi-square statistic is presented in Table 3.2.

Table 3.2 Contingency Table Example.

City Population	Projects Evaluated for Safety Benefits After Construction			Row Totals
	Yes	No	Uncertain	
> 25,000	7	5	0	12
10,000-25,000	4	8	1	13
5000-10,000	4	9	2	15
2500-5000	7	6	0	13
1000-2500	18	20	10	48
400-1000	21	18	13	52
0-400	33	38	35	106
Column Totals	94	104	61	259

The $\chi^2 = 20.4$ with 12 (6 x 2)degrees of freedom. The critical chi-square value for an alpha level of 0.05 and 12 degrees of freedom is 21.026. The p-value associated with the calculated chi-square value is 0.06. The null hypothesis is accepted since the obtained chi-square value is less than the critical value. It is concluded that the two variables are independent of each other.

Assurance was needed about the correctness of the entire series of statistical tests for the data analysis and was accomplished using the Bonferroni procedure. This procedure develops joint confidence intervals for individual variables or tests when making more than one inference from the same set of data. The individual confidence coefficients are adjusted upward, which ensures that the group confidence coefficient is at least a given base level. Because this procedure is conservative, a family confidence coefficient of 90 percent usually is specified.

The Bonferroni inequality is presented below [13]:

$$P\left(\bigcap_{i=1}^{g} \overline{A}_i\right) \geq 1 - g\alpha$$

where:

g = the number of interval estimates
α = the level of significance
P = the family confidence coefficient

For the research analysis, a family confidence level of 90 percent and 20 interval estimates were used as inputs in Bonferroni inequality. This resulted in an individual alpha level of 0.005. This analysis criteria is strict due to the number of statistical tests performed on the survey.

The statistical analysis procedure presented in this chapter was used to evaluate the data collected from the Local Street Safety Survey. The survey results provided background information for the development of a street safety audit procedure to be used by small cities. The analysis and results of the data are reported in Chapter 4.

CHAPTER 4

ANALYSIS AND RESULTS

Presented in this chapter are results from the Local Street Safety Survey, which were used in development of a prototype street safety audit for small cities. As stated in Chapter 3, the regional city survey was examined statistically using cross-tabulation analysis and the chi-square statistic. The Bonferroni procedure was used to find the individual test coefficient necessary for a 90 percent family confidence level. It was determined that a p-value less than 0.005 was needed to reject the null hypothesis of independence between categorical variables.

For some survey questions, a chi-square statistic was not initially computed due to insufficient cell values in the contingency table. For those questions, categories of survey data with similar overall characteristics were combined in a logical fashion, increasing the individual cell value to an acceptable level. After the survey data was consolidated, a valid chi-square statistic was computed.

Data collected by the Local Street Safety Survey were analyzed for differences in safety practices between city population and individual state categories. A summary of the statistical analysis for each question including any needed consolidation of survey data is reported in Appendix C. A summary of the survey responses by city population is included in Appendix D. From the statistical analysis, several questions were found to have statistically significant differences among city categories at an alpha level of 0.005. The major findings of the survey are outlined in the next section.

Survey Analysis by City Population

The first section of the survey contained questions pertaining to the background of the city and its safety funding and practices. Survey results found that for smaller cities, local political organizations or "other" groups often were the primary organization responsible for identifying safety improvement needs. As shown in Table 4.1, the majority of responses from all cities, excluding those from cities less than 400 people, indicated that the Public Works Department was the primary safety organization for streets. A majority of cities, with a population under 400, reported utilizing city councils and "other" organizations (36 percent and 23 percent respectively). Typical "other" responses included county, none, and city maintenance. Of all city populations, those between 2,500 to 5,000 people reported the highest percentage of police departments and multiple agencies (15 percent and 23 percent respectively). The specific combinations of individual agencies sharing safety responsibilities varied widely between cities.

Table 4.1 Primary Organization Responsible for Identifying Safety Needs.

City Population	Percent of Cites Using:					
	Pub. Works Dept.	Trans./Street Dept.	Other	Police Dept.	City Council	Multiple Agencies
> 25,000	64	9	18	0	0	9
10,000-25,000	46	31	15	8	0	0
5000-10,000	80	7	7	0	0	7
2500-5000	54	8	0	15	0	23
1000-2500	33	29	8	13	0	17
400-1000	40	23	8	10	12	8
0-400	19	17	23	0	36	5

It also was found that the scope of the safety program relating to street coverage varied by city size. More than 90 percent of cities larger than 5,000 people identify safety needs on the entire street system (Table 4.2). Approximately 29 percent of all cities less than 400 people reported that safety needs were not identified on any of their streets.

Table 4.2 Scope of Safety Program by Street Coverage.

City Population	Percent of Cities Identifying Safety Needs on:			
	All Streets	Major Streets	Minor Streets	No Streets
> 25,000	100	0	0	0
10,000-25,000	92	8	0	0
5000-10,000	93	0	0	7
2500-5000	77	15	0	8
1000-2500	70	6	13	11
400-1000	56	6	18	20
0-400	56	8	8	29

Though no statistical relationship was determined, the availability of local funding for safety improvements decreased with city population. More than 33 percent of cities less than 1,000 people reported no local funding specifically for safety improvements. A statistical relationship ($p\text{-value} < 0.005$) was found between the identification of safety needs by street category and the availability of local funding for safety projects by street category. Cities without local funding were less likely to identify safety needs on their streets.

The number of cities that had a written, comprehensive Safety Improvement Program (SIP) was relatively small regardless of city population. The program was indicated by approximately 33 percent of cities with a population greater than 25,000. For cities under 2,500, 6 percent or less reported having a SIP. The percentage of cities that cited at least one reason for not having a written, comprehensive SIP ranged between 67 percent of cities with a population greater than 25,000 to 94 percent of cities with a population less than 400. Lack of funding, lack of manpower, and unawareness of the program were often cited reasons why a SIP was not used (Figure 4.1). In addition, 50 percent of the smallest cities reported that a SIP was not needed. The results indicate that generally cities in the region were not implementing comprehensive SIPs due to lack of resources and information about the program.

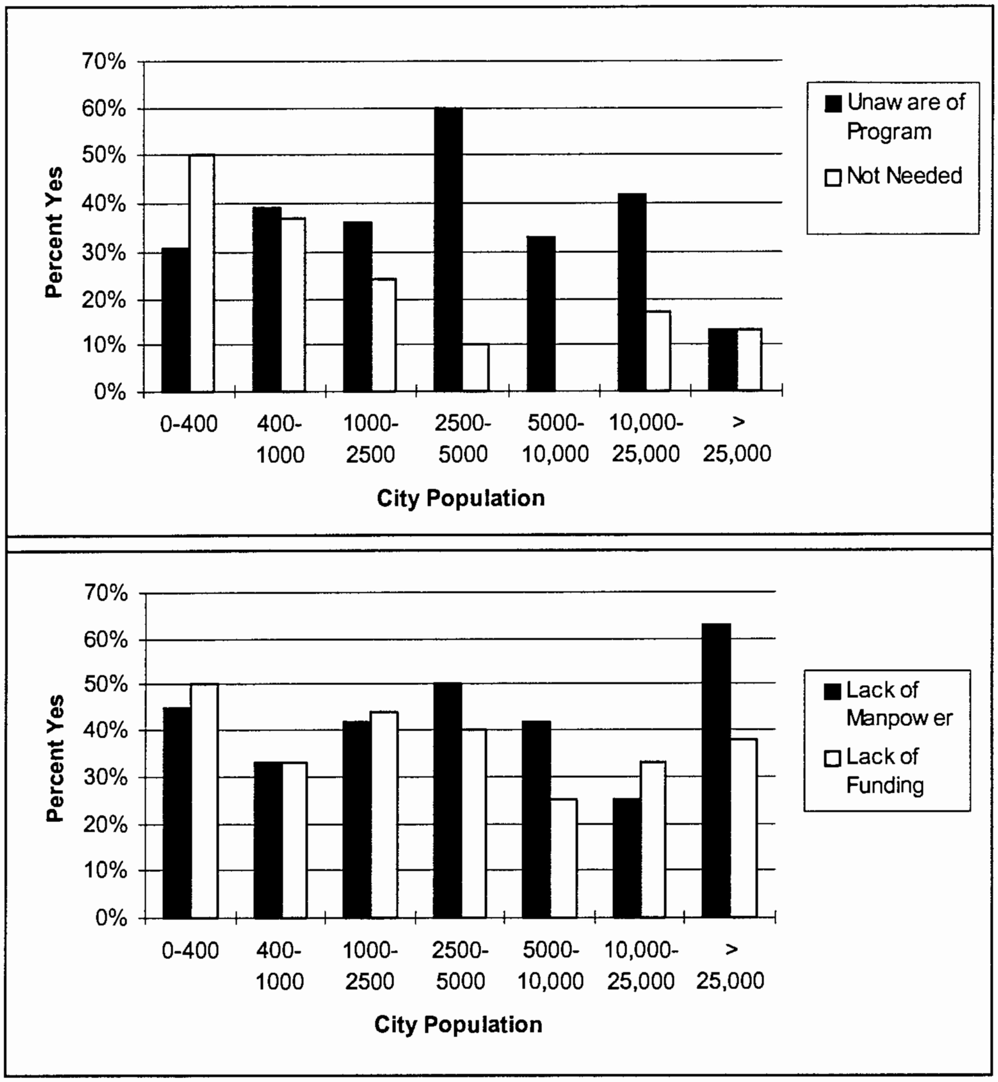

Figure 4.1 Reasons for Not Using a Safety Improvement Program.

Survey results (Figure 4.2) show that the percentage of cities that functionally classify their streets decreases dramatically for cities less than 10,000 people. Street mileage also rapidly declines with city size.

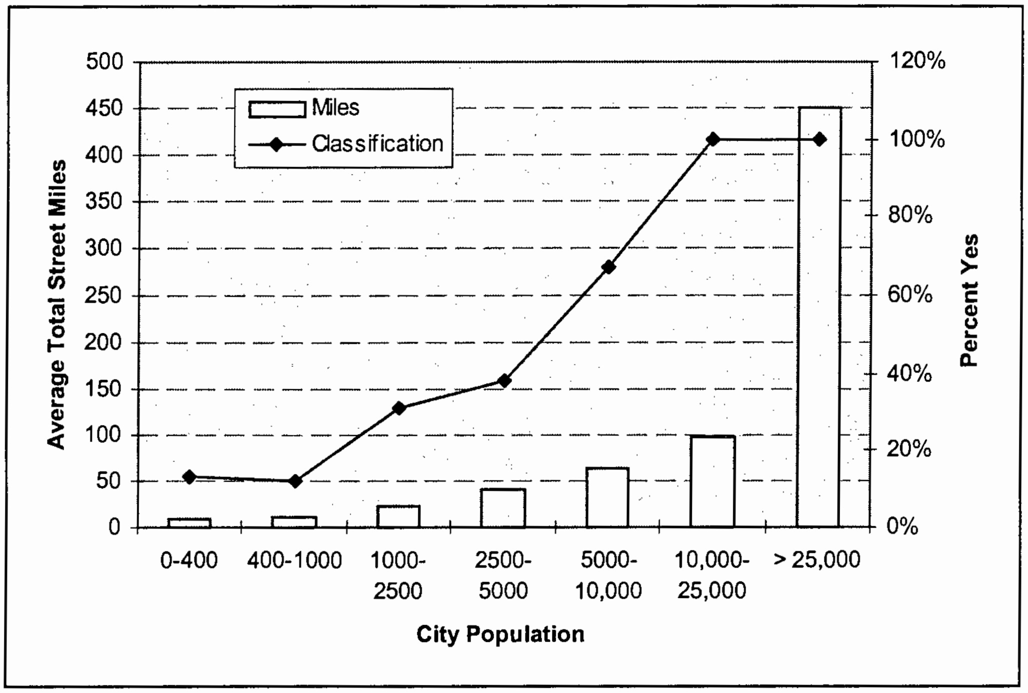

Figure 4.2 Functionally Classified Streets and Average Total Street Miles.

The next series of survey questions examined the specific methods and practices used by cities in their safety program. Results showed that less technical methods were used by smaller cities to identify locations for safety improvements. Of all cities, only those greater than 25,000 people reported using a written, comprehensive SIP. The use of accident record analysis and safety studies also varied significantly with city size (Figure 4.3). The reported use of input from law enforcement and public officials/employees by larger cities was significantly more than that of small cities (Figure 4.4).

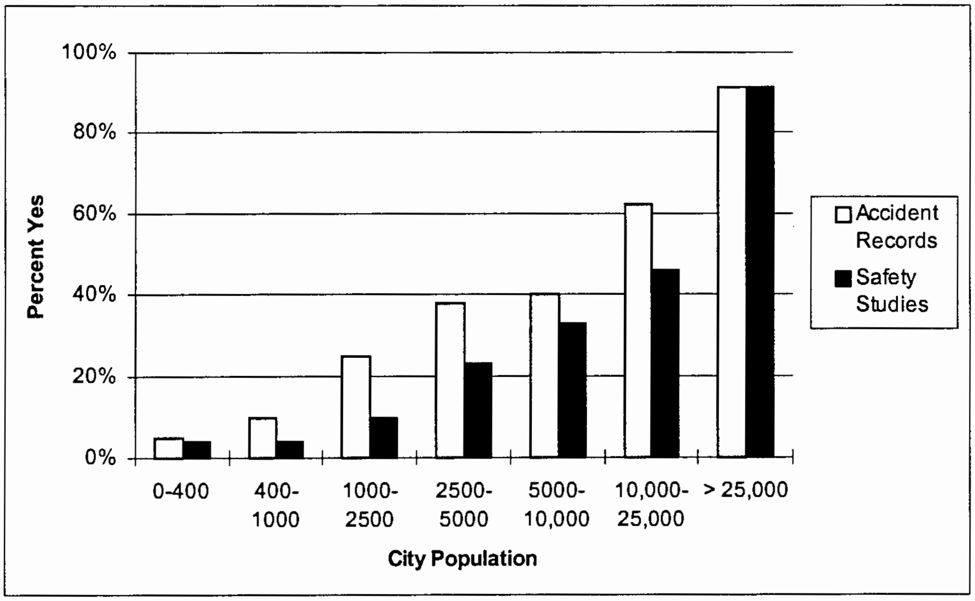

Figure 4.3 Formal Engineering Methods Used to Identify Safety Improvement Locations.

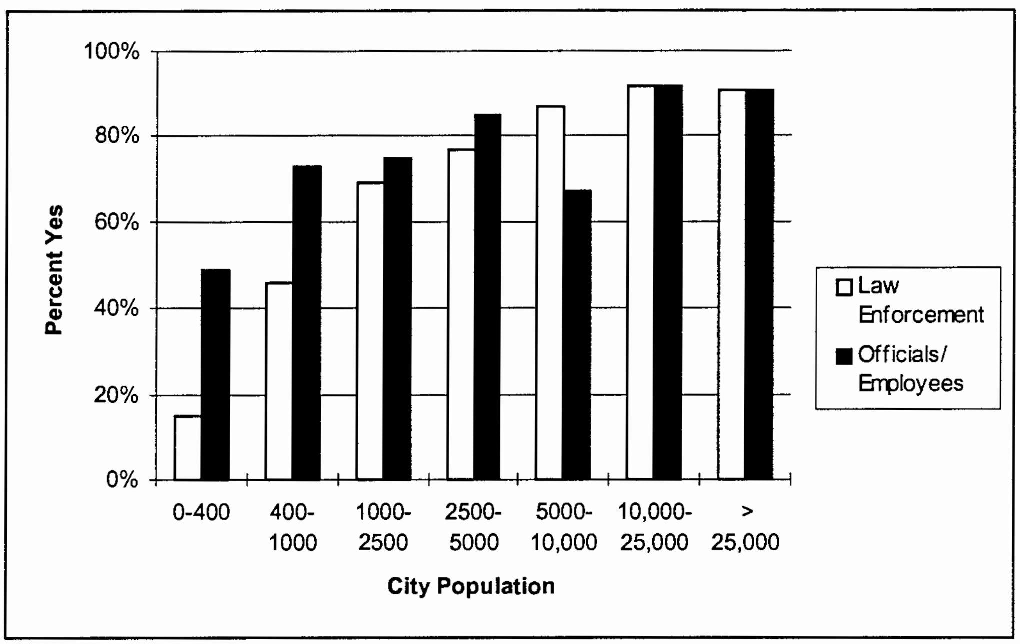

Figure 4.4 Input Sources Used to Identify Safety Improvement Locations.

Routine inspections and ratings were reported by about one-third of all cities with a population greater than 400 (Table 4.3). More than 35 percent of cities with less than 5,000 people responded that public input was used. Nearly 28 percent of cities with less than 400 people reported that no methods were used to identify safety needs.

Table 4.3 Methods Used to Identify Safety Improvement Locations.

City Population	Percent of Cities Using *:			
	Operational Problems	Routine Inspections and Ratings	Input from the Public	None
> 25,000	45	36	18	0
10,000-25,000	23	38	0	0
5000-10,000	27	33	27	0
2500-5000	46	31	38	8
1000-2500	21	31	35	6
400-1000	13	27	37	10
0-400	7	13	44	28

* Due to multiple responses, row percentage summation is not 100 percent.

Results also showed that smaller cities used less technical methods to select appropriate countermeasures to a safety need. The reported use of engineering judgment declined from 100 percent of the largest cities to 9 percent of the smallest city size (Table 4.4). The most technical method, accident reduction analysis, was indicated by more than 23 percent of the cities greater than 5,000 people and less than 8 percent of cities of less than 1,000 people. Nearly one-third of cities less than 1,000 people responded that no methods were used to select appropriate countermeasures. As compared to other questions in this section, a larger percentage of "other" responses were given. The frequently reported "other" responses, such as city council meetings, common sense, public input, and budget check for funding, indicated that simple or political means often were used to develop safety projects.

Table 4.4 Methods Used to Determine the Best Countermeasure for a Safety Need.

City Population	Percent of Cities Using *:				
	Engineering Judgment	Crash Reduction Analysis	None	Benefit Cost Ratio	Other
> 25,000	100	33	0	75	0
10,000-25,000	92	23	0	46	8
5000-10,000	87	33	0	27	7
2500-5000	69	15	8	15	15
1000-2500	54	19	17	44	10
400-1000	33	2	27	40	19
0-400	9	8	33	42	23

* Due to multiple responses, row percentage summation is not 100 percent.

It also was found that smaller cities used less technical methods to prioritize safety improvement projects. Significant differences by city size were found relating to the usage of engineering judgment, accident rate, and traffic volume (Figure 4.5). The reported usage of engineering judgment and accident rate dropped from more than 80 percent of the largest cities to nearly 10 percent of the smallest cities. The opposite was reported for traffic volumes with approximately a 20 percent usage by cities greater than 25,000 people rising to more than 60 percent by cities with less than 400 people.

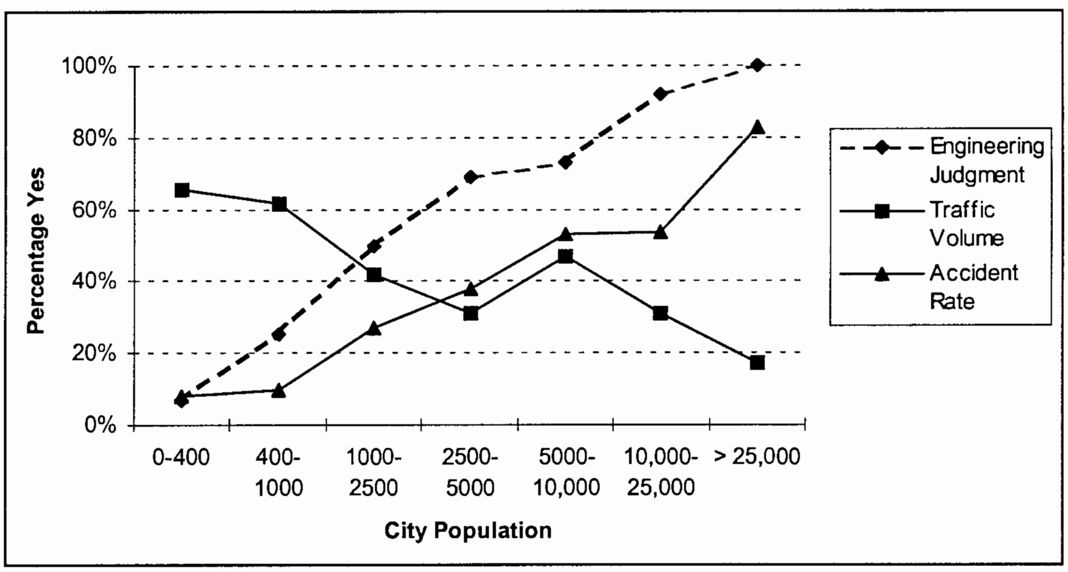

Figure 4.5 Safety Project Prioritization Methods.

More than 23 percent of cities less than 1,000 people reported that no methods were used for prioritizing safety projects (Table 4.5). Use of the hazard severity and benefit cost ratio methods were not found to statistically vary by city size.

Table 4.5 Methods Used to Prioritize Safety Projects.

City Population	Percent of Cities Using *:			
	Classification of Street	None	Benefit Cost Ratio	Severity of Hazard
> 25,000	42	0	58	92
10,000-25,000	46	0	31	85
5000-10,000	27	0	7	67
2500-5000	15	8	38	54
1000-2500	19	1	33	60
400-1000	2	23	35	56
0-400	6	35	32	44

* Due to multiple responses, row percentage summation is not 100 percent.

Next, the survey examined city practices related to the review and application of safety projects. The evaluation of the individual project safety benefits before or after construction (indicated by roughly half of all cities) did not statistically vary by city population (Table 4.6). Also, the percentage of cities reviewing their entire safety program for overall effectiveness did not statistically vary by city size.

Table 4.6 Evaluation of Safety Benefits for Projects and Overall Program.

City Population	Percent of Cities:		
	Before Construction	After Construction	Overall Safety Program
> 25,000	75	58	17
10,000-25,000	58	31	8
5000-10,000	60	27	14
2500-5000	31	54	23
1000-2500	50	38	21
400-1000	46	40	23
0-400	27	31	21

Survey results showed that application of safety improvements on the street network varies with city population (Table 4.7). Applying improvements at spot locations only was indicated by 100 percent of cities greater than 25,000. More than 20 percent of cities between 1,000 and 25,000 people apply safety projects to the entire street system. About one-third of cities below 400 people reported not performing any safety improvements, which was consistent with results obtained in the rest of the survey.

Table 4.7 Application of Safety Improvement Projects.

City Population	Percent of Cities Performing Projects at: Spot Locations Only	Same Classification of Street	Entire Street System	Not Applicable
> 25,000	100	0	0	0
10,000-25,000	69	0	31	0
5000-10,000	67	0	27	7
2500-5000	62	8	23	8
1000-2500	63	6	25	6
400-1000	65	0	17	17
0-400	50	5	15	30

The use of inventories and management systems by local agencies also was examined. The percentage of cities that indicated using at least one of the inventories or a pavement management system is reported in Table 4.8. Larger cities have greater use statistically of street and sign inventories, traffic signal inventories, and pavement management systems (Table 4.9).

Table 4.8 Cities that Reported Using at Least One Inventory or Pavement Management System.

City Population	Percent of Cities
> 25,000	100
10,000-25,000	100
5000-10,000	93
2500-5000	85
1000-2500	88
400-1000	74
0-400	55

Table 4.9 Inventories and Management Systems Used by Cities.

City Population	Percent of Cities that Conduct a *:			
	Street Inventory	Sign Inventory	Traffic Signal Inventory	Pavement Management System
> 25,000	100	100	92	92
10,000-25,000	92	77	73	69
5000-10,000	87	67	33	79
2500-5000	83	69	17	67
1000-2500	76	77	22	54
400-1000	49	74	11	47
0-400	42	51	8	31

* Due to multiple responses, row percentage summation is not 100 percent.

The final section of the survey contained miscellaneous questions relating to administration and legal issues. The survey examined the use of computers for accident analysis or inventories and management systems. Results indicated that computers were used for those purposes by approximately 92 percent of the largest cities as compared to only about 3 percent of the smallest cities.

Larger cities also used a greater percentage of partnerships to promote or enhance safety on their streets (Table 4.10). Larger cities also were more likely to have partnerships with several agencies. County partnerships were reported the most for cities with a population under 400 (19 percent).

Table 4.10 Agency Partnerships to Promote and Enhance Safety.

City Population	Percent of Cities Partnered with:					
	Multiple Agencies	County	State DOT	Other	Police	None
> 25,000	75	8	8	0	0	8
10,000-25,000	38	0	23	0	0	38
5000-10,000	33	0	13	13	7	33
2500-5000	15	8	15	0	8	54
1000-2500	21	6	10	6	6	50
400-1000	13	4	10	6	12	56
0-400	7	19	4	4	3	64

Each city was asked if sovereign immunity limited liability with respect to the street system. On average, more than 50 percent of respondents reported uncertainty in the sovereign immunity status of their city Figure 4.6). A statistical relationship was not found between cities indicating sovereign immunity and those that did not identify safety needs.

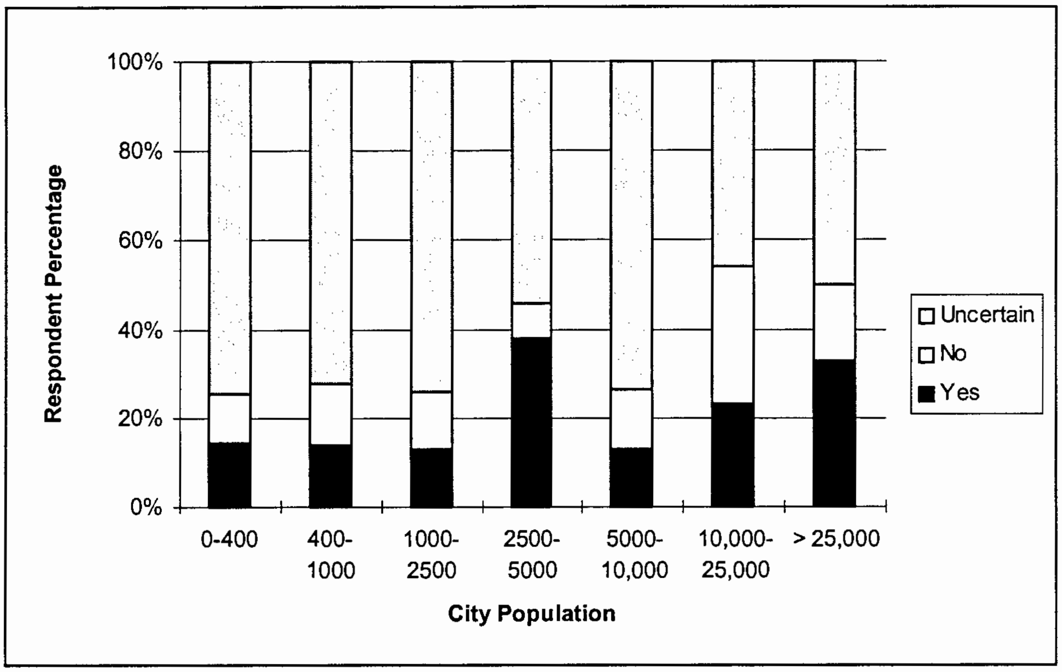

Figure 4.6 Sovereign Immunity Limiting City Street Liability.

Cities were next asked to report the approximate number of filed tort liability claims over the last five years. The results varied dramatically between city sizes with the average number approximately 10 for cities greater than 25,000 and nearly zero for cities less than 10,000.

Next, local attitudes with respect to safety programs and tort liability were examined. The respondents were asked "Do you think that identifying safety deficiencies, as part of a correction program, will increase your exposure to tort liability?" The survey results, presented in Figure 4.7, found no statistical difference among responses between city size. An examination of these responses with respect to job title also found no statistically significant relationship. The summary of results indicated that the identification of safety deficiencies and the exposure to tort liability was not known by many respondents.

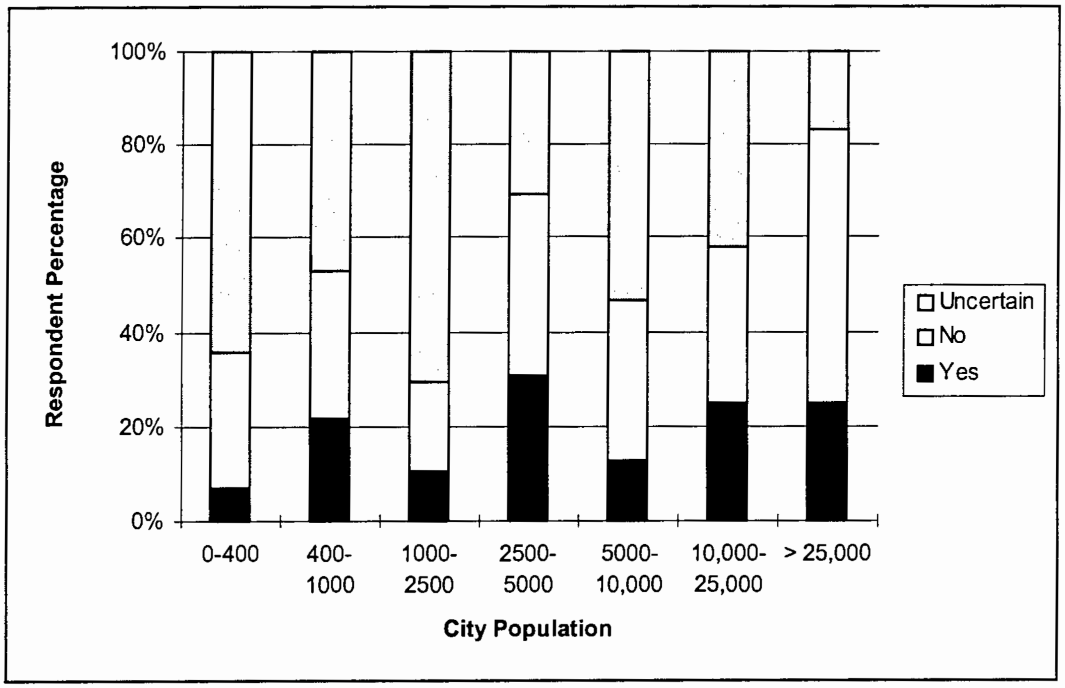

Figure 4.7 Do you think that identifying safety deficiencies, as part of a correction program, would increase exposure to tort liability?

The final survey question determined the job title of the respondent. As discussed in Chapter 3, the survey was sent to the person identified as most likely to handle the street responsibilities for the city. The results, reported in Table 4.13, found that the occupation of the respondents varied with city population. For cities larger than 5,000 people, more than 80 percent of the respondents were engineers or public works directors. For cities under 400, 77 percent of the respondents were administration staff such as mayors, clerks, treasurers, and city council members.

Table 4.11 Job Title of Survey Respondent.

City Population	Engineer/ Public Works Director	Street Super. / Utilities Manager	City Administration	Other
> 25,000	82	9	0	9
10,000-25,000	85	8	0	8
5000-10,000	87	0	0	13
2500-5000	59	33	0	8
1000-2500	37	37	27	0
400-1000	30	28	36	6
0-400	6	14	77	3

Survey Analysis by State

The objective of the state analysis was to identify state characteristics or governmental policies and programs that influenced city safety practices. A preliminary statistical analysis was conducted. It was determined that city population factors were influencing the results. A final analysis of the survey data examining state trends was then performed using a three-way contingency table controlling for city population. The survey data were divided into only two categories based on city size to maintain adequate contingency cell values. The categories were cities with a population greater than 2,500 and those less than 2,500.

The analysis found no statistically significant differences between survey responses and state characteristics. However, two areas demonstrated a potential association between states, but were eliminated due to the strict confidence level necessary for this analysis. The areas involved the primary organization used to identify safety needs and the use of a street inventory system.

Surprisingly, a difference was not found among states in the responses concerning the sovereign immunity of the city street system even though state statues do vary in the region. This is mostly likely explained by the large percentage (more than 50 percent) of uncertain responses received, indicating that many local city officials are unaware of their respective state statutes concerning governmental immunity.

The next step of this research project was to develop a safety audit procedure for small cities on their existing streets. The prototype procedure and checklists are presented in Chapter 5.

CHAPTER 5

STREET SAFETY AUDIT FOR SMALL CITIES

The goal of this research was to develop a street safety audit procedure for small cities. Results from the regional survey and information collected in the literature review were used in the development of the street safety audit procedure and the selected set of checklists.

Development of the Street Safety Audit and Checklists

The focus of the safety audit procedure and checklists was for existing small city streets. Generally, these cities lack the resources and traffic engineering skills to conduct formal safety programs. In addition, many smaller cities do not perceive safety as an issue; therefore safety needs are not identified or corrected. The following key components were identified for an effective safety audit tool to have utility in smaller cities:

1. An effective safety tool needs to promote and market its usefulness for small cities
2. The limited resources of local city agencies necessitate a program that is simple and easy to use
3. The reliance of the program on crash and roadway data should be minimized
4. The program must identify and implement low cost improvements and reduce exposure to tort liability by promoting a system wide, problem specific approach to safety

The Australian Road Safety Audit program provided the basic structure for developing the Street Safety Audit procedure. Modifications to the specific safety audit steps were made according to the identified needs of small cities. For simplicity and brevity, fundamental city safety issues were addressed. As reported in Chapter 2, intersections often are the location of city crashes and fatalities. In addition, traffic control devices and intersection related elements frequently are involved in tort liability suits. Traffic control placement and/or maintenance are often cited as a contributing cause of the crash by the plaintiff. The model Street Safety Audit procedure provides a viable starting point for cities to begin a systematic process for examining safety needs. Presented next is the prototype safety tool for small cities.

Model Street Safety Audit Procedure

The prototype safety audit is a proactive approach to crash prevention. It is intended as a practical safety tool for smaller cities to use when beginning to address fundamental safety needs on their streets. Though intended for small cities, it also is an effective tool for larger cities to use when addressing safety needs on their local street network. The key steps are to:

1. select an auditor
2. conduct the street safety audit
3. produce a street safety report
4. hold a follow-up evaluation

Auditor Selection

The selection of an auditor or auditors depends on several factors related to the city and audit project. Under ideal conditions, an audit team composed of two or more members knowledgeable in the areas of traffic safety and management, road design, and crash investigation and prevention is preferred. It also is important that auditors are trained and experienced in street safety audits and have the ability to review the city streets in an independent and objective manner.

However, the selection of auditors regularly depends on the available resources of the city. The main objective when selecting the auditor(s) is to choose qualified and knowledgeable individuals available in the city's resources. An auditor's objectivity and independence when performing the audit is important. The greater the auditor's independence from the organization responsible for the street network, the greater the probability that previously unknown safety problems will be identified and reported.

Hiring qualified consultants is an option for smaller cities with sufficient funding. Organizations with potentially qualified individuals include the state DOT, local engineering firms, the county highway department, and a neighboring city's engineering or public works department.

For small cities with limited funding, use of an audit team consisting of local personnel is a potentially acceptable alternative. It is desirable to choose individuals with various backgrounds related to transportation and street issues. Possible auditors include individuals from the maintenance department, local law enforcement, the county, safety partnerships with other organizations, and the Public Works department. Larger cities often have staff with an adequate level of traffic safety engineering skills. The use of "in-house" personnel is a variation from the traditional road safety audit approach. Potential disadvantages with this arrangement include auditors who don't possess the experience and skills needed to review the project from the perspective of all roadway users and an inability to conduct the audit in an independent and objective manner. One possible solution to increase the auditor's level of independence is to select local staff from the county or neighboring cities. A program of sharing personnel between city agencies (swapping local auditors) is another potential solution.

The "independence" and objectivity of an individual or team is valuable. The use of independent, qualified auditors will provide a maximum benefit in the planning or design stages of a project and is recommended for major new city projects. However, analysis of existing city streets must be practical and affordable. Considering safety needs of the existing street network, using a proactive approach as discussed in the following sections will provide existing cities with a start on safety improvements.

Conducting the Safety Audit

An initial safety audit of existing streets must begin a systematic process of reviewing all street facilities. A street classification system is useful for prioritization and scheduling of safety audits. This system will help ensure that the overall program is conducted in an efficient and effective manner. One possibility is to begin with the higher order streets. However, a program focusing on intersections and a documented plan to complete the entire network is needed. Implementation of a safety audit program must be promoted as a realistic approach to improving city street safety. Substantial changes in the traffic volume, adjacent land use, or traffic characteristics on a street section are all possible factors prompting another street safety audit.

Before conducting the audit, a review of checklists and other necessary information is recommended. An on-site inspection is then conducted. It is important to evaluate the safety of the existing street network considering all road users and the road's function and use. The safety checklists are intended for use during site evaluation.

A selected set of checklists covering intersection and traffic sign issues were developed from this research. The format and content of the checklists were tailored for use by local officials in addressing safety on their streets. The checklists serve as a memory aid during site inspection and ensure that major safety issues are not overlooked. They are not intended as a substitute for auditor knowledge and experience. The checklists are not all encompassing; however, key areas to be examined on existing streets are addressed. The checklists also provide a reference when completing the safety audit report.

While performing the audit, the incorporation of the following four key points is important:

1. Consider safety from the perspective of all street user groups (motorists, pedestrians, children, bicyclists, etc.).
2. Consider all possible traffic movements.
3. Consider the possible effect of environmental conditions (day, night, rain, fog, etc.).
4. Consider how a more consistent street environment will enhance driver expectancy and promote safety.

Safety Report

After completion of each street safety audit, a final report is produced providing a description of the project with a list and brief description of the identified safety needs. Highlighted in the report are problems, which require immediate attention. It is desirable that the report be kept concise. General recommendations of possible corrective actions may be included.

Follow-up Evaluation

A follow-up meeting provides opportunities to discuss the findings of the street safety audit between the auditor(s), individuals with jurisdiction over the street network, and people responsible for budgeting street projects and improvements. Documenting safety actions and project scope, including programming and scheduling, are recommended. It also is important to consider the need for additional assistance when addressing the identified safety needs in the report. If there is uncertainty whether a safety problem exists or what the most appropriate corrective action to an identified safety need maybe, qualified individuals should be consulted. Limited funds often prevent implementation of all safety projects; therefore, it is necessary to set priorities among improvements.

Documentation of the safety program will provide an important defense against future tort liability suits. All actions taken with respect to the safety audit must be documented, especially reasons for rejecting any improvements and the scheduling of improvements.

The independence and objectivity associated with the Street Safety Audit program is an important selling point when requesting resources to conduct safety improvements. The produced safety audit report provides an effective and credible reference when proposing and justifying safety improvement projects to groups responsible for the funding and programming of street activities.

Major new city projects and development often have significant impact on the use and safety of the surrounding street network. Typical major traffic generators such as schools, office buildings, subdivisions, food and convenience stores, and restaurants have the potential to result in unsafe conditions unless access by all users is considered carefully. The application of design standards does not necessarily result in a safe final product. For these reasons, safety is an important consideration during the planning and design of new facilities. Two major benefits of addressing safety at this stage include a reduction in the crash potential of the street network and the need for costly remedial work. For the projects, the application of street safety audit principles is one possible method for recognizing and addressing safety issues.

Several funding options exist for local agencies when implementing safety improvements on their street network. The Federal Highway Administration has funding for highway safety related activities. This funding, called the "402 Program," provides support for the construction of safety and operational improvements. Financial aid is also often obtained by completing a grant proposal to state agencies. The proposals generally outline the type of improvement being considered, its benefits, and necessary funds. Often, the innovative sources of funding available to local governments vary from state to state. An example of a 402 funding proposal is provided in Appendix E.

Field Test of Street Safety Audit

A field test of the street safety audit procedure was conducted on several streets in Laramie, Wyo. The auditor used in the review was familiar with traffic safety issues and traffic engineering and had no connection with the Laramie street department. The safety audit report (Appendix F) highlighted several safety needs concerning intersection sight distance and sign placement and mounting height. Sight distance needs were determined by driving the streets at the posted speed limit and noting locations where it felt uncomfortable as a motorist. A potential problem usually exists at these locations and further examination is necessary often.

The need for adequate sight distance at intersections is crucial as serious sight restrictions place a large visual and mental burden on drivers approaching the intersection, increasing the potential for crashes. These conflicts are minimized when an approaching driver has an unobstructed view of both the intersection and any approaches. The sight triangle must be checked at all quadrants of an intersection (Figure 5.1).

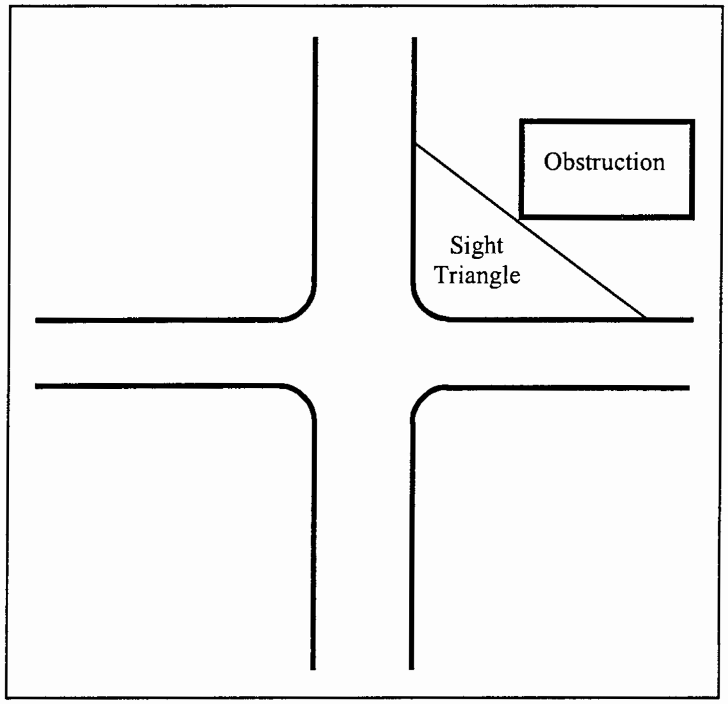

Figure 5. Sight Triangle Diagram.

The necessary sight distance triangle for an intersection depends on several factors including the type of traffic control used, vehicle speeds, and the required motorist actions. The Manual on Uniform Traffic Control Devices (MUTCD) and applicable state/local standards should be referenced for guidance as needed.

Several options exist when improving sight distance restrictions. One of the more effective measures is for local political organizations (i.e. city councils, town boards, etc.) to regulate the placement of obstructions within set sight distance boundaries at intersections. Even small sight distance improvements are beneficial at most locations. All practical measures should be taken to improve sight distance before the installing of traffic control measures. Possible options for improving sight distance include:

- cut back vegetation and/or embankments as far as possible
- restrict parking
- remove walls, fences, signs or other obstructions in the right of way

Traffic control options include:

- placing two-way or four-way stop signs where adequate sight distance has not been obtained or
- installing traffic signals.

Presented next are the developed street safety audit checklists for intersections and traffic signs. The checklists are intended to be used as a guide for assessing the safety needs of existing streets. Included in Appendix H are an additional set of checklists, which address these and other intersection and traffic sign safety issues in greater detail.

SAFETY AUDIT CHECKLISTS FOR EXISTING STREETS

Auditor(s):____________________________________ Date:__________

Location (Reference Map included):____________________________________

TRAFFIC SIGNS

Traffic signs need to: 1) Fulfill a need, 2) Command attention, 3) Convey a clear, simple message, 4) Command respect of road users, and 5) Give adequate time for proper response. When correcting problems, priority is recommended for regulatory signs (i.e. Stop, Yield, Speed Limit, Do Not Enter, and Road Closed) and for major warning signs (i.e. Stop Ahead, Yield Ahead, Turn, Curve, and Railroad Crossings).

Check

☐ Are signs visible, **both day and night**, at a distance that provides response time for motorists.

☐ Is sign visibility affected by:
- Vegetation, Dirt, Other Materials?
- Sharp Curves?
- Steep Hills?
- Other Signs?
- Poor Lighting?
- Reflectivity at Night?

☐ Have damaged, vandalized, or missing signs been repaired or replaced?

☐ Does the sign have a clear and simple message?

☐ Are signing practices consistent at similar locations?

☐ Are signs correctly positioned with respect to:
- Lateral Clearance? (2 feet recommended)
- Height? (7 feet to bottom of the sign recommended)

☐ Are sign supports break-away or yielding?
- If not, are the sign supports located to minimize exposure to traffic.

It is emphasized that site specific factors may require engineering judgment. The Manual on Uniform Traffic Control Devices (MUTCD) is the basis for all traffic control device standards. It and applicable state and local standards should be referenced as needed. The necessary advance warning distance depends on several factors such as vehicle speed, site conditions, and required motorist action; consult the MUTCD for further guidance.

SAFETY AUDIT CHECKLISTS FOR EXISTING STREETS

Auditor(s):____ Date:____________

Location (Reference Map included):____

INTERSECTIONS

It is emphasized that site specific factors often require engineering judgment. The Manual on Uniform Traffic Control Devices (MUTCD) and applicable state and local standards should be referenced as needed for guidance as to the appropriate traffic control and sight distance for an intersection. The signing checklist provides a more detailed examination of signing issues.

Check

☐ Is the visibility of the intersection or any approaches limited by:

- Parked or Queued Traffic?
- Signs, Utility Poles, Fences?
- Embankments?
- Buildings?
- Vegetation?
- Other Sight Obstructions?

☐ Has an effort been made to improve the sight distance of the intersection before installing traffic control measures?

- An engineering study is usually necessary for the placement of traffic control.
- Stop signs are not recommended to be used for speed control.

☐ Are hidden or unexpected intersections located on:

- Hills or Curves?
- At the End of High Speed Streets?
- Streets that Do Not Intersect at 90°?

If so, additional warning for the motorist may be necessary.

☐ Are pedestrians (children, bicyclists, etc.) and motorists readily visible at the intersection?

Supplemental Safety Issues

The following section contains three programs that compliment the prototype street safety audit. The procedures are simple, require a minimum amount of resources, and enhance street safety when used alone or with the street safety audit.

A formal and logically developed street classification system is recommended to assist street safety improvement decisions. Road classification is the process of grouping roadways with similar characteristics together. Classification systems are based on administrative, financial, jurisdictional, or functional properties. In a functional classification, roadways are grouped according to the intended access and mobility provided by the street. This classification is an important management tool in the establishment of realistic improvement standards, for individual roadways and for the entire system.

It also is recommended that local agencies develop a sign inventory system. Missing, damaged, or poorly visible signs are a serious street hazard and contribute to crashes. Good sign maintenance increases traffic safety and reduces the potential for tort liability. A sign inventory system improves the speed and effectiveness of sign maintenance and inspection activities. Sign maintenance is an important activity for any agency, as courts have found that the maintenance of traffic signs and signals, once installed, is not immune from tort liability. In addition, governmental agencies have been held liable for failure to make timely repair of defective traffic control devices after receiving actual or constructive notice. A documented sign inventory program helps to identify signs in need of repair through routine inspection and public reports and aids in defense against tort liability. Documented maintenance and inspection records also are an important tool for protection against tort liability.

Citizen and employee input is an effective and inexpensive method to identify street defects and conditions. For these reasons, it also is recommended that a systematic procedure be established to receive and act upon public/employee input. A sample public complaint form is provided in Appendix G. The recommend key components of a complaint system are:

- a single person or office handles all complaints or notices

- a standardized form, collecting all needed information is completed
- the complaint or notice is directed to the appropriate person or department to determine the remedial action to be taken
- a record of the complaints and actions taken in maintained

The developed Street Safety Audit presented in this chapter is a practical and effective approach for cities to identify and correct safety needs on local streets. Use of this program will produce a reduction traffic crashes and their severity, and will provide defense against tort liability suits. Presented in the next chapter is a summary of the research project followed by conclusions and recommendations.

CHAPTER 6

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The primary goal of this research project was the development of a street safety audit procedure for small cities. In addition, a selected set of checklists were developed covering traffic sign and intersection issues. These issues were chosen due to their frequency in urban crashes and tort litigation.

A literature review covering issues facing local governments, traffic safety programs, and urban crash statistics was conducted. Much of the literature highlighted the limited resources available to local governments. It also was found that most traffic safety programs have been designed and implemented for the resources of state DOTs and larger urban areas. However, several Road Safety Audit concepts were found to be feasible for use by local governments.

A regional survey was developed and conducted to obtain the current state of safety practices used by local cities agencies. Survey results also were used in the development of a safety tool for small cities. The key findings of the survey included:

1. Political organizations or "other" groups were often the primary organization responsible for identifying safety needs in smaller cities.
2. Significant percentages of small cities did not address safety needs on their street network.
3. Availability of local funding influenced the overall scope of a city's safety program.
4. Lack of funding and lack of manpower where often cited reasons why a safety improvement program was not used. In addition, significant percentages of smaller cities indicated that a safety improvement program was not needed.

5. Methods used by smaller cities to identify safety needs, select appropriate countermeasures, and prioritize projects were not performed or were less technical than those used by larger cities.
6. Use of street/sign inventories and pavement management systems was significantly less for small cities.
7. Small cities often lacked computer resources to analyze crashes and conduct roadway inventories and management systems.
8. The local governments of small cities often possessed less formal traffic engineering resources.
9. A statistically significant relationship was not found between cities reporting sovereign immunity and those that did not identify safety needs.
10. The safety practices of cities in the region were not found to significantly vary by state.

Results from the regional survey and information collected in the literature review were used in the development of the Street Safety Audit procedure and the intersection and traffic sign checklists. The identified needs and resources of small cities were used to tailor the specific methodology used in the safety audit. The major steps in the prototype Street Safety Audit procedure, based on the Austroads manual [17], were to:

1. select an auditor
2. conduct the street safety audit
3. produce a street safety report
4. hold a follow-up evaluation

Use of this safety audit procedure must begin a systematic review of all streets. The selection of independent, qualified auditor(s) will provide the maximum benefit when evaluating the audit project. When conducting the audit, it is important to examine the safety of the streets from the perspective of all road users and promote a consistent street environment. The final outcome of this procedure is a documented list of identified safety needs and actions for their correction. The Street Safety Audit is intended as a practical tool for small cities to address fundamental safety needs on their streets. Its focus is to develop a consistent roadway for all roadway users, minimize tort liability, and identify and implement low cost improvements based on solid traffic safety principles.

Conclusions

Presented in the following section are the conclusions based on the results of the Local Street Safety Survey and the literature review.

1. Currently, a significant number of small cities do not recognize a need for a traffic safety program for their streets. Thus, an important component of any safety program is its promotion and marketing to potential users.
2. A practical safety tool is needed for small cities to begin addressing safety needs.
3. Development of traffic safety programs need to address the lack of resources related to manpower, funding, and traffic engineering skills in local governments.
4. The safety audit procedure is a feasible approach for local governments to improve safety on their streets.
5.

Recommendations

This section presents the recommendations for additional research concerning existing street safety audits for small cities.

1. Field tests must be conducted on the prototype street safety audit and checklists by local city agencies.
2. A training program must be developed to assist local personnel in conducting road safety audits on existing streets.

3. Uniform street safety audit procedures and checklists must be adopted by local city agencies.

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APPENDIX A

"Local Street Safety Survey"
Cover Letter and Questionnaire

February 9, 1998

Name
Title
Address
City, State

Dear:

I am a University of Wyoming Civil Engineering graduate student conducting research on local street safety programs. My project will examine the procedures local governments currently practice to enhance the safety of streets in their communities. The purpose of this research is to develop a safety program for use by small cities. Ease of implementation, cost effectiveness, and the overall safety benefits will be taken into account when developing the final safety program.

Please take a few minutes to complete the survey regarding information about your city and its safety improvement practices. It is important that each questionnaire be answered and returned to ensure a complete and accurate study. Please feel free to forward this questionnaire if it may be more easily answered by someone other than yourself. Your identity and responses will be kept confidential. The number at the top of each survey will enable me to organize responses by city size only.

Please return this survey as soon as possible, along with information you think may benefit this study. If you have any questions, please contact me by phone at 1-800-231-2815, by fax at 307-766-6784 or by email at haiar@uwyo.edu. My advisor, Dr. Eugene Wilson, may also be contacted at 307-766-3202. The results of this project will be made available to you or your agency upon request. Thank you for your time and participation.

Sincerely,

Keith Haiar
Research Assistant

Enclosure

Local Street Safety Survey

Please answer the following questions regarding street safety in your community.

1. Check the primary organization responsible for identifying street safety improvement needs.
   - ○ Local Public Works Department ○ Local Police Department ○ Local Street Department
   - ○ Local Transportation Department ○ Consultant ○ State Agency
   - ○ Other ______________________

2. Check the street categories where individual safety improvement needs are identified?
   - ○ All Streets ○ Major Streets Only ○ Minor Streets Only ○ No Streets

3. Local funding is available specifically for street safety improvements on:
   - ○ All Streets ○ Major Streets Only ○ Minor Streets Only ○ No Streets

4. Does your city have a written, comprehensive Safety Improvement Program?
   - ○ YES ○ NO ○ UNCERTAIN

5. If a Safety Improvement Program is not in use, check all reasons that apply.
   - ○ Lack of Manpower ○ Unaware of Program ○ Not Needed
   - ○ Lack of Funding ○ Program too Complex ○ Other ______________________

6. Are your city's streets functionally classified?
   - ○ YES ○ NO ○ UNKNOWN (Skip to question 8)

7. ESTIMATE the total number of miles for each street classification in your community:

Classification	Total Miles		Your Classification	Total Miles
Major Arterial	________		________	________
Minor Arterial	________		________	________
Collector	________	OR	________	________
Local	________		________	________
Alley	________		________	________

8. Which methods are used to identify locations for safety improvements? Check all that apply.
   - ○ Analysis of Accident Records ○ Safety Studies (*street analysis*) ○ Operational Problems
   - ○ Routine Inspections and Rating Activities ○ Input/Comments from the Public ○ Pin Map
   - ○ Input from Public Officials/Employees ○ Input from Law Enforcement ○ None
   - ○ Comprehensive Safety Improvement Program ○ Other ______________________

9. After a safety need is identified, what methods are used to determine the best countermeasure? Check all that apply.
   - ○ Engineering Judgment ○ Benefit/Cost ratio
   - ○ Accident Reduction Analysis ○ Other ______________________
   - ○ None

10. Which methods are used to prioritize proposed safety improvement projects? Check all that apply.
    - ○ Engineering Judgment ○ Benefit/Cost ratio ○ Severity of Hazard
    - ○ Classification of Street ○ Traffic Volume ○ Accident Rate
    - ○ None ○ Other ______________________

11. Are individual projects evaluated specifically for their safety benefits before construction?
    - ○ YES ○ NO ○ UNKNOWN

12. Are individual projects evaluated for their safety benefits after construction?
○ YES ○ NO ○ UNKNOWN

13. Is the entire safety program reviewed for overall effectiveness?
○ YES ○ NO ○ UNKNOWN

14. After a safety need is identified, improvements are made:
- ○ At that specific spot location
- ○ At that location and similar locations on the same classification of street
- ○ At that location and similar locations over the entire street system
- ○ Not Applicable

15. For each of the following inventories or management systems, indicate which are or are not used in your community. If used, check the appropriate street categories. *Please complete the entire question.*

	Yes	No	Unknown	Major Streets	Minor Streets
Street Inventory	○	○	○	○	○
Sign Inventory	○	○	○	○	○
Traffic Signal Inventory	○	○	○	○	○
Pavement Management System	○	○	○	○	○
Safety Management System	○	○	○	○	○
Maintenance Management System	○	○	○	○	○
Risk Management System	○	○	○	○	○
Road Safety Audit	○	○	○	○	○
Access Management	○	○	○	○	○
Other ____________	○	○	○	○	○

16. Is a computer used for accident analysis or with any of the inventories or management systems given above.
○ YES ○ NO

17. List local agencies you have partnerships with to promote or enhance transportation safety.

____

____

18. Is the city's liability regarding the street system limited due to sovereign immunity?
○ YES ○ NO ○ UNKNOWN

19. During the last 5 years, approximately how many transportation related tort liability claims have been filed against your city? _________

20. Do you think that identifying safety deficiencies, as part of a correction program, will increase your exposure to tort liability? ○ YES ○ NO ○ UNCERTAIN

21. Please list your job title? ______________________________

Please place comments on the back of this survey. If you know of a city agency or person whose input would benefit this project, please contact me.

— Thank You —

Please Return to:
Keith Haiar
Wyoming Technology Transfer Center
Box 3295 University of Wyoming
Laramie, WY 82071

APPENDIX B

Preliminary Survey Comments

Preliminary Comments on Local Street Safety Survey

(The survey question number is given on the left in bold before the respective comments.)

#2. • Small cities may not know the term "sovereign immunity", you may want to add unknown.
- Vague, assume you mean with respect to liability

#3. • Add unknown
- Add in accordance with AASHTOs green book

#4. • Change miles to kilometers

#6. • Omit alleys category

#8. • Don't understand what private organization responsible for identifying safety needs means.
- Should an MPO, Public Works, or city planning agency be included
- What if there is more than one agency involved in identifying needs

#10. • Should this question be broken into more detail for each category
- Make a category for law enforcement

#11. • Expand on the factors used for accident reduction analysis and benefit/cost ratio
- May use more than one method

#12. • Add accident rate or number of accidents category

#13. • Question ambiguous

#14. • Define safety effectiveness
- Don't understand intent. Post construction

#16. • Do you want one answer or to know what types of safety improvements are done

#17. • Does street inventory include all potential hazards

#18. • What if several types are marked in question #17

#21. • Define operations

#23. • What percentage of people's time is spent on safety issues

#26. • Do you plan to follow up in finding out what are the local street standards.
- Not clear
- You have assumed that all agencies use the green book

Additional • Does your city have a traffic safety committee? How is it organized and what is its involvement with low volume street safety?

APPENDIX C

Summary of Statistical Analysis

A summary of the statistical analysis results of the survey data with respect to city population is contained in the following tables. These results are presented according to the major topic sections contained in the survey. In some instances, survey data were combined to obtain sufficient cell values to compute a valid chi-square statistic. These questions are denoted with a superscripted number and reference describing the specific data consolidation. This analysis examined whether statistical differences in city traffic safety programs were present with respect to city population. It does not reflect the actual percentages of city responses to survey questions, these are given in Chapter 4 (Results and Analysis).

Results of Statistical Analysis of Survey by City Population Categories.
(Questions with P-values less than 0.005 were statistically significant.)

City and Safety Program Background

P-value	Survey Question
0.000	Org. Responsible for Identifying Safety Needs (1,2)
0.000	Scope of Safety Program by Street Coverage(1)
0.007	Availability of Local Funding (1)
0.017	Possess a Formal SIP(1)
	Reasons Why a Formal SIP Not Used
0.544	Lack of Manpower
0.427	Lack of Funding
0.427	Unaware of Program
0.644	Program too Complex (1)
0.000	Not Needed
0.691	Other (1)
0.000	Streets Functionally Classified

NOTES:

(1) The survey data from city categories greater than 2500 people were consolidated to calculate a valid chi-square statistic.

(2) To calculate a valid chi-square statistic, the question response options were consolidated. The specific combinations include: Local Transportation Dept. with Local Street Dept.; and Consultant and State Agency, together with Other.

Results of Statistical Analysis of Survey by City Population Categories (Cont.).
(Questions with P-values less than 0.005 were statistically significant)

City Traffic Safety Program Methods and Practices

P-value	Survey Question
	Methods Used to Identify Safety Improvement Locations
0.000	Analysis of Accident Records
0.058	Routine Inspections
0.000	Employee Input
*	Comprehensive SIP
0.000	Safety Studies
0.055	Public Input
0.000	Law Enforcement Input
0.430	Other (1)
0.001	Operational Problems
*	Pin Map
0.000	None
	Methods Used to Determine Best Countermeasure
0.000	Engineering Judgment
0.002	Accident Reduction Analysis
0.002	None
0.094	Benefit Cost ratio
0.171	Other
	Methods Used to Prioritize Safety Projects
0.000	Engineering Judgment
0.000	Classification of Street
0.000	None
0.202	Benefit Cost Ratio
0.001	Traffic Volume
0.661	Other
0.008	Severity of Hazard
0.000	Accident Rate

*A valid chi-square statistic was not computed due to insufficient cell values in the contingency table.

NOTES:

(1) The survey data from city categories greater than 2500 people were consolidated to calculate a valid chi-square statistic.

Results of Statistical Analysis of Survey by City Population Categories (Cont.).
(Questions with P-values less than 0.005 were statistically significant)

Evaluation of Project and Overall Program Safety Benefits

P-value	Survey Question
0.005	Evaluate Safety Benefits of Project Before Construction
0.060	Evaluate Safety Benefits of Project After Construction
0.953	Evaluate Safety Benefits of Overall Program
0.001	Application of Safety Improvement Projects (1)

Inventories and Management Systems

P-value	Survey Question
	Inventories and Management Systems Used
0.000	Street Inventory (2)
0.002	Sign Inventory (1)
0.000	Traffic Signal Inventory (1)
0.000	Pavement Mgt. System (1)
0.760	Safety Mgt. System
0.515	Maintenance Mgt. System
0.016	Risk Mgt. System (2)
0.615	Road Safety Audit
0.576	Access Management

Miscellaneous and Legal Questions

P-value	Survey Question
0.000	Computer Usage
0.004	Local Agency Safety Partnerships
0.329	Sovereign Immunity
0.011	If Identifying Safety Deficiencies Increases Tort Liability
0.000	Job Title of Respondent

NOTES:

(1) The survey data from city categories greater than 2500 people were consolidated to calculate a valid chi-square statistic.

(2) The survey data from city categories greater than 5000 people were consolidated to calculate a valid chi-square statistic.

A summary of the statistical analysis results of the survey data with respect to state category is contained in the following tables. These results are presented according to the major topic sections contained in the survey. In some instances, survey data were combined to obtain sufficient cell values to compute a valid chi-square statistic. These questions are denoted with a superscripted number and reference describing the specific data consolidation. This analysis examined whether statistical differences in city traffic safety programs were present with respect to specific states. It does not reflect the actual percentages of city responses to survey questions.

Results of Preliminary Statistical Analysis of Survey by State Categories.

(In this analysis, influences due to city population were not controlled.)

City and Safety Program Background

P-value	Survey Question
0.000	Org. Responsible for Identifying Safety Needs [1,2]
0.225	Scope of Safety Program by Street Coverage
0.557	Availability of Local Funding
0.491	Possess a Formal SIP
	Reasons Why a Formal SIP Not Used
0.051	Lack of Manpower
0.079	Lack of Funding
0.430	Unaware of Program
0.486	Program too Complex [1]
0.000	Not Needed
0.571	Other
0.001	Streets Functionally Classified

NOTES:

(1) The survey data from the Wyoming and Montana categories were consolidated to calculate a valid chi-square statistic.

(2) To calculate a valid chi-square statistic, the question response options were consolidated. The specific combinations include: Local Transportation Dept. with Local Street Dept.; and Consultant and State Agency, together with Other.

Results of Preliminary Statistical Analysis of Survey by State Categories (Cont.).

(In this analysis, influences due to city population were not controlled.)

City Traffic Safety Program Methods and Practices

P-value	Survey Question
	Methods Used to Identify Safety Improvement Locations
0.016	Analysis of Accident Records
0.713	Routine Inspections
0.007	Employee Input
0.308	Comprehensive SIP
0.001	Safety Studies
0.064	Public Input
0.001	Law Enforcement Input
0.503	Other (1)
0.001	Operational Problems
*	Pin Map
0.000	None
	Methods Used to Determine Best Countermeasure
0.018	Engineering Judgment
0.282	Accident Reduction Analysis
0.001	None
0.101	Benefit Cost Ratio
0.866	Other
	Methods Used to Prioritize Safety Projects
0.001	Engineering Judgment
0.014	Classification of Street
0.001	None
0.225	Benefit Cost Ratio
0.001	Traffic Volume
0.906	Other(1)
0.026	Severity of Hazard
0.001	Accident Rate

*A valid chi-square statistic was not computed due to insufficient cell values in the contingency table.

NOTES:

(1) The survey data from the Wyoming and Montana categories were consolidated to calculate a valid chi-square statistic.

Results of Preliminary Statistical Analysis of Survey by State Categories (Cont.).

(In this analysis, influences due to city population were not controlled.)

Evaluation of Project and Overall Program Safety Benefits

P-value	Survey Question
0.348	Evaluate Safety Benefits of Project Before Construction
0.917	Evaluate Safety Benefits of Project After Construction
0.698	Evaluate Safety Benefits of Overall Program
0.086	Application of Safety Improvement Projects (1)

Inventories and Management Systems

P-value	Survey Question
	Inventories and Management Systems Used
0.000	Street Inventory
0.052	Sign Inventory (1)
0.400	Traffic Signal Inventory (1)
0.359	Pavement Mgt. System (1)
0.605	Safety Mgt. System
0.360	Maintenance Mgt. System
0.019	Risk Mgt. System
0.101	Road Safety Audit
0.170	Access Management

Miscellaneous and Legal Questions

P-value	Survey Question
0.004	Computer Usage
0.000	Local Agency Safety Partnerships(1)
0.354	Sovereign Immunity
0.599	If Identifying Safety Deficiencies Increases Tort Liability
0.000	Job Title of Respondent(1)

NOTES:

(1) The survey data from the Wyoming and Montana categories were consolidated to calculate a valid chi-square statistic.

Results from Statistical Analysis of Interrelationships Between Survey Questions.

(Questions with P-values less than 0.005 were statistically significant.)

P-value	Contingency Table Analysis of Questions:
0.473	If Identifying Safety Deficiencies Increases Tort Liability **versus** Job Title of Respondent
0.284	Sovereign Immunity **versus** No Methods Used to Identify Locations for Safety Improvements
0.022	Sovereign Immunity **versus** No Methods Used to Determine Best Countermeasure
0.030	Sovereign Immunity **versus** No Methods Used to Prioritize Safety Projects
0.000	Availability of Local Funding **versus** Scope of Safety Program by Street Coverage

Three-Way Contingency Table Example.

Case 1 (Cities with a population over 2500):

Chi-Square = 0.227, DF = 3, P-Value = 0.973

Safety Studies	Responses by State				Total
	CO	WY, MT, & ND	SD	UT	
Use Method	10	4	2	8	24
Do Not Use Method	10	5	3	10	28
Total	20	9	5	18	52

Case 2 (Cities with a population below 2500):

Chi-Square = 8.580, DF = 3, P-Value = 0.035

Safety Studies	Responses by State				Total
	CO	WY, MT, & ND	SD	UT	
Use Method	5	2	2	2	11
Do Not Use Method	27	76	62	31	196
Total	32	78	64	33	207

Results of Final Statistical Analysis of Survey by State Categories.

(For this analysis, a three-way contingency table was utilized, controlling the influence of city population on the results. A P-value less than 0.005 was required in both cases before the question was concluded as statistically significant.)

P-Value		Survey Question
Case 1	Case 2	
0.055	0.028	Org. Responsible for Identifying Safety Needs (2)
		Reasons Why a Formal SIP Not Used
0.787	0.001	Not Needed (2)
0.665	0.079	Streets Functionally Classified (1)
		Methods Used to Identify Safety Improvement Locations
0.973	0.035	Safety Studies (1)
0.418	0.112	Law Enforcement Input (2)
0.448	0.323	Operational Problems (2)
*	*	None
		Methods Used to Determine Best Countermeasure
*	*	None
		Methods Used to Prioritize Safety Projects
0.253	0.254	Engineering Judgment (2)
*	*	None
0.597	0.125	Traffic Volume (1)
0.443	0.120	Accident Rate (1)
		Inventories or Management Systems Used
0.057	0.014	Street Inventory(2)
0.912	0.142	Computer Usage (1)
0.884	0.000	Local Agency Safety Partnerships (2)
*	0.224	Job Title of Respondent(2)

*A valid chi-square statistic was not computed due to insufficient cell values in the contingency table.

Case 1 - City category containing cities with a population greater than 2500.

Case 2 - City category containing cities with a population less than 2500.

NOTES

(1) The survey data with respect to the Wyoming, Montana, and North Dakota categories were consolidated to calculate a valid chi-square statistic.

(2) The survey data with respect to the Utah and Colorado categories were consolidated. In addition, the survey data from Wyoming, Montana, North Dakota, and South Dakota were consolidated to calculate a valid chi-square statistic.

APPENDIX D

Summary of Survey Data by City Category

Statistical Question #1. The primary organization responsible for identifying street safety improvement needs.

City Size	Public Works Dept.	Transportation Dept.	Other *	Police Dept.	Consultant	Street Dept.	State Agency	City Council	Multiple Agencies	No Response
> 25,000	7	1	2	0	0	0	0	0	5	0
10,000-25,000	6	0	2	1	0	4	0	0	4	0
5000-10,000	12	0	1	0	0	1	0	0	8	0
2500-5000	7	0	0	2	0	1	0	0	3	0
1000-2500	16	1	4	6	0	13	0	0	1	0
400-1000	21	0	3	5	0	12	1	6	0	0
0-400	20	2	21	0	1	16	2	38	1	2

* Frequently listed "Other" responses: Blank (No Organization), County, City Maintenance, Local Engineering Department

Question #2. The street categories where individual safety improvement needs are identified.

City Size	All Street	Major Street	Minor Street	No Street	No Response
> 25,000	12	0	0	0	0
10,000-25,000	12	1	0	0	0
5000-10,000	14	0	0	1	0
2500-5000	10	2	0	1	0
1000-2500	33	3	6	5	1
400-1000	28	3	9	10	2
0-400	58	8	8	30	3

Question #3. The street categories where local funding is available specifically for street safety improvements.

City Size	All Street	Major Street	Minor Street	No Street	No Response
> 25,000	11	1	0	0	0
10,000-25,000	11	0	0	2	0
5000-10,000	11	2	0	2	0
2500-5000	10	2	0	0	1
1000-2500	35	1	2	7	3
400-1000	28	3	2	18	1
0-400	57	7	4	34	5

Question #4. If the city has a written, comprehensive Safety Improvement Program.

City Size	Yes	No	Uncertain	No Response
> 25,000	4	7	1	0
10,000-25,000	0	11	2	0
5000-10,000	3	12	0	0
2500-5000	2	10	1	0
1000-2500	3	38	7	0
400-1000	1	45	6	0
0-400	3	88	15	1

Question #5. Reasons a Safety Improvement Program is not is use. (Number of Yes responses)

City Size	Lack of Manpower	Lack of Funding	Unaware of Program	Program too Complex	Not Needed	Other*
> 25,000	5	3	1	1	1	2
10,000-25,000	3	4	5	0	2	1
5000-10,000	5	3	4	0	0	2
2500-5000	5	4	6	1	1	0
1000-2500	19	20	16	1	11	3
400-1000	15	15	18	1	17	5
0-400	45	50	31	6	50	7

* Frequently listed "Other" responses: small town, just not done, daily inspection, safety addressed through other means

Question #6. Functionally classified streets.

City Size	Yes	No	Uncertain	No Response
> 25,000	12	0	0	0
10,000-25,000	13	0	0	0
5000-10,000	10	2	3	0
2500-5000	5	3	4	1
1000-2500	15	18	13	2
400-1000	6	20	24	2
0-400	14	36	51	6

Question #7. Estimated total miles of streets.

City Size	Number of Cities Responding	Average Total Miles including Alleys
>25,000	9	449
10,000-25,000	12	97
5000-10,000	8	64
2500-5000	7	42
1000-2500	25	22
400-1000	18	11
0-400	34	7.5

Question #8. The methods used to identify locations for safety improvements (Number of Yes responses).

City Size	Accident Records	Inspections and Rating	Employee Input	SIP	Safety Studies	Input from Law Enforcement	Other*	Operational Problems	Pin Map	None	Public Input
> 25,000	10	4	10	3	10	10	1	5	0	0	9
10,000-25,000	8	5	12	0	6	12	0	3	0	0	13
5000-10,000	6	5	10	0	5	13	0	4	0	0	11
2500-5000	5	4	11	0	3	10	1	6	0	1	8
1000-2500	12	15	36	0	5	33	0	10	0	3	31
400-1000	5	14	38	0	2	24	1	7	0	5	33
0-400	5	14	52	0	4	16	5	8	0	30	60

* All listed "Other" responses: all of the above considered those shaded primary for analysis, city council, insurance carrier, computer inventory maintenance program, town board, county commissioners, community concerns, State DOT, observations.

Question #9. Methods used to determine the best countermeasures after a safety need is identified (Number of Yes responses).

City Size	Engineering Judgment	Accident Reduction Analysis	None	Benefit Cost Ratio	Other*
> 25,000	12	4	0	9	0
10,000-25,000	12	3	0	6	1
5000-10,000	13	5	0	4	1
2500-5000	9	2	1	2	2
1000-2500	26	9	8	21	5
400-1000	17	1	14	21	10
0-400	9	8	34	43	24

* Frequently listed "Other" responses: budget check for funding, city council meeting, common sense, just fix it, police input, public input, regular street maintenance, use US Traffic Safety Manual.

Question #10. The methods used to prioritize proposed safety improvement projects (Number of Yes responses).

City Size	Engineering Judgment	Classification of Street	None	Traffic Volume	Other*	Severity of Hazard	Accident Rate	Benefit Cost Ratio
> 25,000	12	5	0	10	1	11	10	7
10,000-25,000	12	6	0	9	0	11	7	4
5000-10,000	11	4	0	8	0	10	8	1
2500-5000	9	2	1	9	0	7	5	5
1000-2500	24	9	5	28	1	29	13	16
400-1000	13	1	12	20	1	29	5	18
0-400	7	6	37	36	5	47	8	34

* All listed "Other" responses: public input, we fix the problem, safety concerns are completed ASAP, street repair, cannot say, general need, town council.

Question #11. If individual projects are evaluated for their safety benefits before construction.

City Size	Yes	No	Uncertain	No Response
> 25,000	9	3	0	0
10,000-25,000	7	3	2	1
5000-10,000	9	5	1	0
2500-5000	4	7	2	0
1000-2500	24	16	8	0
400-1000	24	15	13	0
0-400	29	37	40	1

Question #12. If individual projects are evaluated for safety benefits after construction.

City Size	Yes	No	Uncertain	No Response
> 25,000	7	5	0	0
10,000-25,000	4	8	1	0
5000-10,000	4	9	2	0
2500-5000	7	6	0	0
1000-2500	18	20	10	0
400-1000	21	18	13	0
0-400	33	38	35	1

Question #13. If the entire safety program is reviewed for overall effectiveness.

City Size	Yes	No	Uncertain	No Response
> 25,000	2	8	2	0
10,000-25,000	1	8	3	1
5000-10,000	2	9	3	1
2500-5000	3	7	3	0
1000-2500	10	25	13	0
400-1000	12	26	14	0
0-400	22	49	34	2

Question #14. Application of improvements after a safety need is identified.

City Size	Application of safety improvements				
	Spot Location Only	Street Classification	Entire Street System	Not Applicable	No Response
> 25,000	11	0	0	0	1
10,000-25,000	9	0	4	0	0
5000-10,000	10	0	4	1	0
2500-5000	8	1	3	1	0
1000-2500	30	3	12	3	0
400-1000	34	0	9	9	0
0-400	52	5	16	32	2

Question #15. The inventories or management systems used (Number of Yes responses).

City Size	Inventories			Management Systems					Road Safety Audit
	Street	Sign	Traffic Signal	Pavement	Safety	Maintenance	Risk	Access	
> 25,000	12	12	11	11	5	7	6	4	0
10,000-25,000	12	10	8	9	1	3	3	2	1
5000-10,000	13	10	4	11	2	6	2	2	2
2500-5000	10	9	2	8	2	7	3	2	2
1000-2500	34	33	8	22	10	26	9	6	4
400-1000	21	35	4	21	5	24	5	2	5
0-400	36	47	6	26	15	39	7	12	11

Question #16. If a computer is used for accident analysis or with the inventories and management systems.

City Size	Yes	No	No Response
> 25,000	11	1	0
10,000-25,000	7	6	0
5000-10,000	3	11	1
2500-5000	3	10	0
1000-2500	7	40	1
400-1000	2	50	0
0-400	3	102	2

Question #17. Agencies that are partners to promote safety with cities.

City Size	None	Police	State DOT	County	Other Single Agency	Multiple Agencies
> 25,000	1	0	1	1	0	9
10,000-25,000	5	0	3	0	0	5
5000-10,000	5	1	2	0	2	5
2500-5000	7	1	2	1	0	2
1000-2500	24	3	5	3	3	10
400-1000	29	6	5	2	3	7
0-400	68	3	4	20	4	7

Question #18. If the city's liability of the street system is limited due to sovereign immunity.

City Size	Yes	No	Uncertain	No Response
> 25,000	4	2	6	0
10,000-25,000	3	4	6	0
5000-10,000	2	2	11	0
2500-5000	5	1	7	0
1000-2500	6	6	35	1
400-1000	7	7	36	2
0-400	15	12	78	2

Question #19. Number of transportation related tort liability claims filed against the city in the last five years.

City Size	Number of Cities Responding	Total Regional Tort Liability Claims Over the Last 5 Years	Average Total Regional Tort Liability Claims Over the Last 5 Years per City
>25,000	8	77	9.6
10,000-25,000	9	20	2.2
5000-10,000	10	0	0.0
2500-5000	10	3	0.3
1000-2500	43	13	0.3
400-1000	50	2	0.0
0-400	104	4	0.0

Question #20. If the respondent thought that identifying safety deficiencies, as part of a correction program, would increase exposure to tort liability.

City Size	Yes	No	Uncertain	No Response
> 25,000	3	7	2	0
10,000-25,000	3	4	5	1
5000-10,000	2	5	8	0
2500-5000	4	5	4	0
1000-2500	5	9	34	0
400-1000	11	16	24	1
0-400	7	30	66	4

Question #21. The respondent's job title.

City Size	Engineer	Public Works Director	Street Superintendent	Utilities/ Maintenance	City Clerk/ Mayor	Other
> 25,000	9	0	1	0	0	1
10,000-25,000	7	4	1	0	0	1
5000-10,000	6	7	0	0	0	2
2500-5000	2	5	4	0	0	1
1000-2500	2	14	13	3	12	0
400-1000	3	12	9	5	18	3
0-400	0	6	4	10	77	3

Number of Cities that indicated at least one option in Question #5 and Question #15 (only Street, Sign, Traffic Signal Inventory, and Pavement Management System)

City Size	Question #5	Question #15
> 25,000	8	12
10,000-25,000	12	13
5000-10,000	12	14
2500-5000	10	11
1000-2500	45	42
400-1000	46	38
0-400	101	59

Summary of Survey Comments

The following comments were received from the survey. They are divided into their respective city categories.

City Size- 10,000 and 25,000

- Your survey is a little vague and hard for one department to fill out completely. You might do better by calling and doing a telephone survey and talk to: engineering, public works, and police. I am a little uncertain about some of the answers and do not have time to call everyone for you.

City Size- 1000 to 2500 people

- We require a traffic plan on new developments which is reviewed by our engineer and assigned deputy. We have very few accidents. We get a lot of complaints of speeding in residential streets. This usually results in a short study by our deputy and a new stop sign.
- Aside from state highway on one side of town, entire town is residential and "walled".

City Size- 400 to 1000 people

- We are a small city under 500 people. Dont have even one traffic light and have had no accidents for years.
- We are so small this survey hardly deals with our needs.
- Only 2 people that do all maintenance for the town, 1 is part time. Most street work is contracted out.
- We have only a few streets (some gravel and some paved). We grade the gravel streets as needed, usually twice a year, and usually water and roll them. The pavement are crack sealed and spot repaired as needed. If major rehabilitation is apparent, we usually budget for this project. Usually apply for grants from FLB to accomplish this. We drive the streets to check for problems around town which include street needs themselves.
- Just what we need! Another program when local officials do the same thing on their own.

City Size- 0 to 400 people

- We are a small town with gravel streets and a population of 19.
- We're just a small town 50-60 people. If something needs to be done we do it.
- Our town is small, 45 people, so we have no street department.
- This city is only about 60 people and the county highway department is right through town.
- A small town of under 400. Do not do anything this fancy to keep up its streets.
- Town of 80 people. There are no paved streets in town. The police dept is actually a passing highway patrolman or sheriff. There are no traffic lights and a few stop signs. The town has a low tax base and therefore little money for street improvements, ect.
- We are a small town with dirt streets. We have stop signs at all appropriate intersections. All the streets are taken care of by regular maintenance. We have had no accidents in past years. We do have a railroad crossing maintained by the UP railroad.

- Town of about 250. Safety precautions and repairs are handled through the town council at monthly meetings.
- Streets and alleys are graveled. Small town of about 20 people. This survey really does not apply to our village.
- Our town has only 65 residents and none of these questions would actually pertain to us.
- Naples is a small town with about 10 houses in all - 2 gravel streets - Clark County has a road grader that comes in once in awhile and goes over our streets. The county highway takes care of the highway that goes through our town.
- We are a town of about 95 with about 10 blocks of streets, all of which are gravel. We have 6 stop signs in town.
- We are just a very small township. Have no paved streets. We do not get very much money to repair the streets.
- Our town is very small. Most questions you ask, dont pertain to us. We do not have a police or street department. All repairs on our unpaved streets are repaired as needed on the decision of the town council.
- Manila has a great need for road improvement. Most of our asphalt road need to be resurfaced and our dirt roads keep washing out. We only receive about 8-9000 a year and most of that is spent on gravel and labor to spread it. Because of the high water level, extra maintenance has been required and our present storm drain system needs to be improved in order to protect our dirt roads.
- We are so small we just maintain our roads as best we can.
- This community is very isolated. We are four miles off of the state highway. There is not through access. If you came in the valley you have to turn around to go back out. There are about 100 families in the town and a population of 280. I dont believe we make a good survey member for this particular survey.
- Dallas is a very small community and we do our best to keep our streets safe with limited funds.
- We are a town of a population of 90. Our streets our all gravel and marked with stop signs where needed. Not every corner has a sign. We also have street signs at all intersections. This survey doesnt apply to us at all.
- Sorry this is late. I only work one day a week and need to prioritize my items of business. Town Clerk
- One county road and the rest are dirt.
- Population 19. Most questions do not apply.
- I don't believe a city the size of Leal can enhance your survey results. Leal has a population of 27 with 3 yield signs, 4 dead end streets, 1 mile of gravel streets.
- We are a town of 300. None of this really applies to us.
- Sorry for delay, change in personnel and tremendous backlog. Expect significant change as this little town come into the later part of the 20^{th} century and becomes awake! We have one full time town employee and 3 part-time and community service.
- We are a small town about 32. We have about 3 mile of total city streets so your safety questionnaire does not apply to us. We have no program at all.
- This survey was not completed because we have no street dept, no separate funding, or safety improvement programs. We are a small town of 300 people and the streets are maintained by me as needed. The survey would be better put to use by a large town.
- We have a population of 15 people. We have the county fix our streets when needed. Then we pay the county for the work done.
- For a town of 70 people, no real organization or program is planned.

APPENDIX E

Example of a 402 Funding Proposal Form

LETTER OF INTENT

APPLICATION FOR SECTION 402 FUNDING

WYOMING DEPARTMENT OF TRANSPORTATION
HIGHWAY SAFETY PROGRAM

DATE:

TITLE:

APPLICANT:

PROBLEM STATEMENT:

PROJECT DESCRIPTION:

PROJECT SCHEDULE:

PROJECT BUDGET REQUEST OF WYDOT:

PROJECT SUPPORT:

APPENDIX F

Field Test of Model Street Safety Audit and Checklists

STREET SAFETY AUDIT REPORT

Auditor: ______________________________ Date: ___________

Brief Project Description:

An existing street safety audit was conducted on the residential streets of Canby and Sulley between 9th and 15th street and on Harney from 9th to 30th street. The total project length was approximately 2 miles. The signing and intersection checklists were used as references. The audit was conducted during the night and day. Approximate audit time was 1.2 hours. Included in this report is a map of the area and the checklists.

Audit Findings and Recommendations:

Sight Distance

39. Vegetation obstructed sight distance at the intersection of 11th and Sulley, 13th and Sulley, and 10th and Canby. The vegetation made the observation of approaching vehicles difficult.
40. Embankments limit sight distance on the approaches at the intersection of 22nd and Harney. Difficult to observe motorists and pedestrians until at the intersection.

Sign Height

41. At 15th and Canby, Stop sign height inadequate.
42. At 11th and Canby, school sign height inadequate.

Sign Placement

43. At 13th and Sulley, Stop sign located in brushes.
44. At 10th and Harney, crosswalk sign hidden by light pole.
45. At 13th and Canby, Stop sign located in brushes.

Recommended that all identified safety needs be addressed by routine maintenance.

SAFETY AUDIT CHECKLISTS FOR EXISTING STREETS

Auditor(s):____ Date:____________

Location (Reference Map included):____

TRAFFIC SIGNS

Traffic signs need to: 1) Fulfill a need, 2) Command attention, 3) Convey a clear, simple message, 4) Command respect of road users, and 5) Give adequate time for proper response. When correcting problems, priority is recommended for regulatory signs (i.e. Stop, Yield, Speed Limit, Do Not Enter, and Road Closed) and for major warning signs (i.e. Stop Ahead, Yield Ahead, Turn, Curve, and Railroad Crossings).

Check

☐ Are signs visible, **both day and night**, at a distance that provides response time for motorists.

☐ Is sign visibility affected by:
- Vegetation, Dirt, Other Materials?
- Sharp Curves?
- Steep Hills?
- Other Signs?
- Poor Lighting?
- Reflectivity at Night?

☐ Have damaged, vandalized, or missing signs been repaired or replaced?

☐ Does the sign have a clear and simple message?

☐ Are signing practices consistent at similar locations?

☐ Are signs correctly positioned with respect to:
- Lateral Clearance? (2 feet recommended)
- Height? (7 feet to bottom of the sign recommended)

☐ Are sign supports break-away or yielding?
- If not, are the sign supports located to minimize exposure to traffic.

It is emphasized that site specific factors may require engineering judgment. The Manual on Uniform Traffic Control Devices (MUTCD) is the basis for all traffic control device standards. It and applicable state and local standards should be referenced as needed. The necessary advance warning distance depends on several factors such as vehicle speed, site conditions, and required motorist action; consult the MUTCD for further guidance.

SAFETY AUDIT CHECKLISTS FOR EXISTING STREETS

Auditor(s):____ Date:___________

Location (Reference Map included):______________________________________

INTERSECTIONS

It is emphasized that site specific factors often require engineering judgment. The Manual on Uniform Traffic Control Devices (MUTCD) and applicable state and local standards should be referenced as needed for guidance as to the appropriate traffic control and sight distance for an intersection. The signing checklist provides a more detailed examination of signing issues.

Check

☐ Is the visibility of the intersection or any approaches limited by:
- Parked or Queued Traffic?
- Signs, Utility Poles, Fences?
- Embankments?
- Buildings?
- Vegetation?
- Other Sight Obstructions?

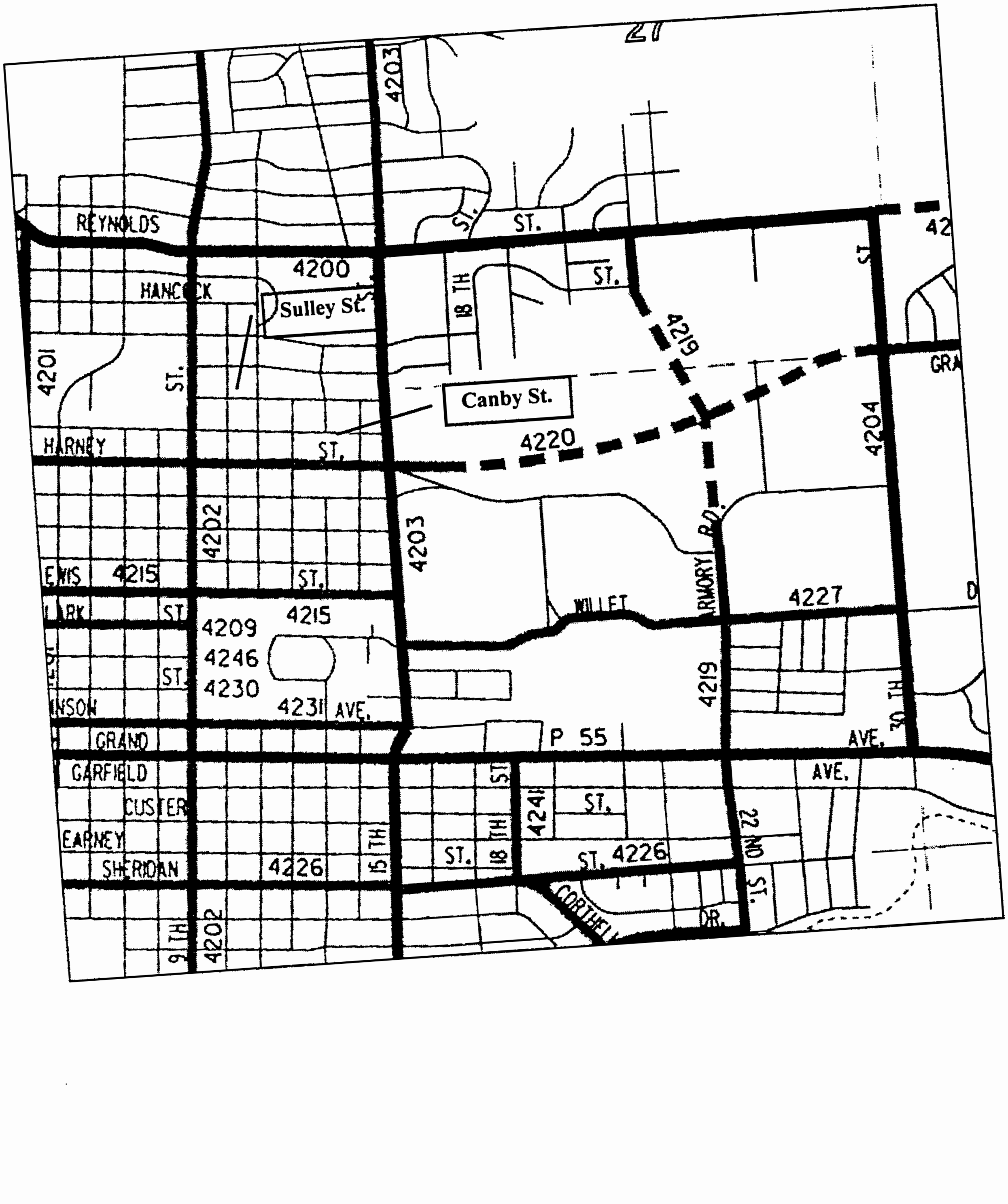
☐ Has an effort been made to improve the sight distance of the intersection before installing traffic control measures?
- An engineering study is usually necessary for the placement of traffic control.
- Stop signs are not recommended to be used for speed control.

☐ Are hidden or unexpected intersections located on:
- Hills or Curves?
- At the End of High Speed Streets?
- Streets that Do Not Intersect at 90°?

If so, additional warning for the motorist may be necessary.

☐ Are pedestrians (children, bicyclists, etc.) and motorists readily visible at the intersection?

Map of Selected Streets in Laramie, Wyoming



APPENDIX G

Sample Public/Employee Complaint Form

COMPLAINT REPORT

Complaint Recieved by: PHONE LETTER PERSON Date: ______________

Complaint Recieved by: ______________________________ Time: __________ A.M. P.M.

Complainant: ______________________________________ Telephone: ________________

Address: ____

REPORTED COMPLAINT

1. Street Name: ______________________________________

2. Location/Address (nearest cross street/landmark): ____________________________

(Circle Appropriate Items)

CLASS OF ROAD: Arterial Collector Local State Highway

SURFACE TYPE: Paved Unpaved

PAVEMENT: Rough Potholes Wash-Out Dust/Dirt Ice/Snow Settlement

SHOULDER: Rough Wash-Out Edge Drop Bush/Tree

TREES/BRUSH: Blocking Road Blocking Sign Hanging Limb Visual Obstruction

DRAINAGE: Water Over Road Flooding Private Property Ditching Request Culvert/Manhole

TRAFFIC CONTROL DEVICES:

SIGNS	Damage	Worn	Missing	Required
SIGNALS	Damage	Malfunction		Required
GUARDRAIL	Damage			Required
PAVEMENT MARKINGS	Worn			Required

MISCELLANEOUS: Property Damage Litter Pick-up Work Quality
Roadside Mowing Roadside Hazards Construction Related

REMARKS/OTHER: ____
____
____
____

DISPOSITION

Action Date: ______________

Department: ____________________________ Personnel Called: __________________

Repair or Corrective Action Taken: ____
____
____
____

Signed: ____________________________________ Date: __________________

APPENDIX H

Detailed Checklists on Intersection and Traffic Sign Issues

SAFETY AUDIT CHECKLISTS FOR EXISTING STREETS

Auditor(s):____________________________________ Date:__________

Street Audited:_______________________________________

From ____________________ To______________________

TRAFFIC SIGNS

The basic requirement of an effective traffic control device is that it: 1) fulfill a need, 2) command attention, 3) convey a clear, simple message, 4) command respect of road users, and 5) give adequate time for proper response. It is emphasized that site specific factors may require engineering judgment. The Manual on Uniform Traffic Control Devices (MUTCD) is the basis for all traffic control device standards. It and applicable state/local standards should be referenced. The necessary advance warning distance depends on several factors such as vehicle speed, site conditions, and required motorist action; consult the MUTCD for further guidance.

CHECK	ISSUES TO BE CONSIDERED
	LOCATION
☐	Are all regulatory signs located at the beginning of the location they govern.
☐	Are all warning signs located in advance of the applicable condition.
☐	Are guide signs located, where needed, to keep roadway users well informed.
☐	Are signs located at a sufficient distance to provide adequate motorist response time.
☐	Are all signing practices consistent at similar locations.
☐	Have unnecessary signs been removed.
☐	Are motorists not confused by too many signs at one location.

Comments:

Traffic Sign Checklists Cont.

CHECK	ISSUES TO BE CONSIDERED
	PLACEMENT
☐	Are all necessary regulatory, warning, and guide signs in place at: ✦ Intersections. ✦ Curves. ✦ School Zones. ✦ Cross Walks. ✦ Railroad Crossings. ✦ Sharp Changes in Street Alignment or Cross-section.
☐	Are traffic signs correctly positioned with respect to: ✦Lateral clearance. (2 feet recommended) ✦Height. (7 feet to the bottom of the sign recommended)
☐	Are all signs effective for all likely conditions. (day/night, wet/dry/fog, rising/setting sun, oncoming headlights, poor lighting)
☐	Are all signs placed so as not to restrict sight distance, particularly for turning vehicles.
☐	Are sign supports break-away or yielding. ✦ If not, are the sign supports properly shielded or located to minimize exposure to traffic?

Comments:

Traffic Sign Checklist Cont.

CHECK	ISSUES TO BE CONSIDERED
	VISIBILITY/READABILITY
☐	Do all signs have a clear, simple message.
☐	Are all signs legible far enough away to provide adequate time for motorist response.
☐	Are signs in good condition and visible both: ✦ During the day. ✦ During the night.
☐	Is the sign obscured by vegetation, dirt, and other materials.
☐	Are signs not hiding each other.
☐	Is the standard color, shape, and size used on all signs according to the appropriate guidelines.

Comments:

SAFETY AUDIT CHECKLISTS FOR EXISTING STREETS

Auditor:______________________________________ Date:____________

Street Audited:____

From ______________________ To_____________________________

INTERSECTIONS

It is emphasized that site specific factors may require engineering judgment. The Manual on Uniform Traffic Control Devices (MUTCD) and applicable state/local standards should be referenced for guidance as to the appropriate traffic control and sight distance for an intersection. The signing checklist provides a more detailed examination of signing issues.

CHECK	ISSUES TO BE CONSIDERED
	LOCATION
☐	Are intersections located on horizontal curves? ✦ If located on a horizontal curve, has additional warning been provided to the driver?
☐	Are intersections located on vertical curves? ✦ If located on a vertical curve, has additional warning been provided to the driver?
☐	Is a level vertical grade provided at the intersection and its approaches?
☐	Are motorists adequately alerted of intersections at the end of high speed streets?
☐	Are intersections between new and existing streets consistent and expected?
☐	Has consideration been given to access control and spacing?

Comments:

Intersection Checklist Cont.

CHECK	ISSUES TO BE CONSIDERED
	VISIBILITY
☐	Is the presence of the intersection obvious to motorists, especially if the intersection is stop or yield controlled?
☐	Are there no obstructions to the clear visibility of each intersection approach due to: ✦ Parked or Queued Traffic? ✦ Signs, Utility Poles, Fences? ✦ Embankments? ✦ Buildings? ✦ Vegetation? ✦ Other Sight Obstructions?
☐	Is adequate sight distance available at all approaches for the type of intersection control used? ✦ Sight Distance is most critical at intersections of higher speed or volume streets.
☐	Have efforts been made to improve sight distance before installing traffic control?
☐	Are traffic signals or other traffic control devices visible to provide motorists with an adequate response time?
☐	Are pavement markings and intersection control signs visible? ✦ During the day ✦ During the night
☐	Has a safe stopping sight distance been provided for entering and leaving vehicles?
☐	Are pedestrians crossing the intersection visible to motorists?

Comments:

Intersection Checklist Cont.

CHECK	ISSUES TO BE CONSIDERED
	CONTROLS AND DELINEATION
☐	Are pavement markings, intersection control signs, and lighting appropriate and in accordance with the guidelines?
☐	Are vehicle paths through the intersections delineated satisfactorily?
☐	Is the traffic control at the intersection appropriate for the traffic users and volumes?
☐	Are the approach speeds safe?
	LAYOUT
☐	Are the intersections free of any unusual features which may affect safety?
☐	Do the streets intersect at a 90° angle?
☐	Is the intersection layout obvious to all road users?
☐	Has the potential for parked vehicles to become safety hazards been considered?
☐	Is the alignment of curbs, islands, and medians in accordance with the appropriate guidelines?
☐	Are all turning radii, merge tapers, and diverge tapers constructed according to the appropriate guidelines?
☐	Is the intersection free of capacity problems which may produce safety problems?
☐	Have conflict points between pedestrians and vehicles been minimized?
☐	Have all potential conflict points between turning vehicles been safely avoided?

Comments: