FHWA Road Safety Audit Guidelines

RSA
Making Your Roads Safer

U.S. Department of Transportation
Federal Highway Administration

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FHWA Road Safety Audit Guidelines

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Preface

The toll from highway crashes remains an important health and economic issue in the United States. Each year nearly 43,000 individuals are killed and 3 million are injured. The estimated societal cost of these highway crashes is more than $230 billion annually.

The Federal Highway Administration (FHWA) of the United States Department of Transportation (USDOT) is strongly committed to continuous improvement in road safety.

FHWA's current efforts reflect its support for new tools such as Road Safety Audits (RSAs), which serve to bring an improved understanding of crash cause and countermeasures to bear in a proactive manner.

Well-documented experience in Europe, Australia, and elsewhere shows that RSAs are both effective and cost beneficial as a proactive safety improvement tool. For example, a Surrey County, United Kingdom, study found that, after implementation, the average number of fatal and injury crashes at project sites that were audited fell by 1.25 crashes per year (from 2.08 to 0.83 crashes per year) while the post-implementation reduction in crashes at comparable, non-audited sites was only 0.26 crashes per year (from 2.6 to 2.34 crashes per year).

Experience with RSAs in the United States indicates that RSA teams often identify safety concerns that would not otherwise have been discovered by a traditional safety review. For example, New York DOT reports a 20% to 40% reduction in crashes at more than 300 high-crash locations treated with low-cost improvements recommended as a result of RSAs.

Low RSA costs and minimal project delay.

These safety improvements resulting from RSAs can be achieved at a relatively low cost and with minimal project delay. As PennDOT trials of RSAs indicated, the cost of RSAs is "very little for the amount of success."

Conducting RSAs and implementing their recommended safety improvements in design is estimated to typically cost 5% of overall engineering design fees.

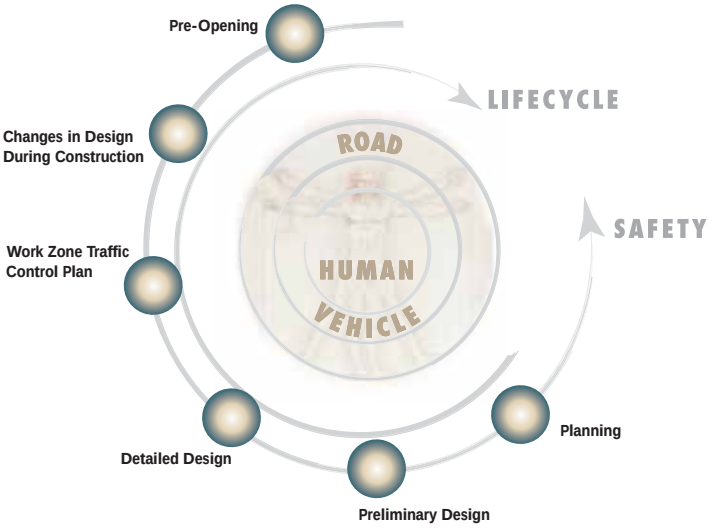
As illustrated in Exhibit 1, conducting RSAs earlier in a road project's lifecycle (e.g. during preliminary design), results in less implementation cost than later in the process, such as during detailed design or construction.

What is a Road Safety Audit?

A Road Safety Audit (RSA) is a formal safety performance examination of an existing or future road or intersection by an independent audit team.

The RSA team considers the safety of all road users, qualitatively estimates and reports on road safety issues and opportunities for safety improvement.

EXHIBIT 1



Depending on the size of the project, RSAs, if planned appropriately, require less than 1 week to conduct. The investment is a unique opportunity to draw upon the depth and breadth of knowledge represented by a diverse RSA team and is an excellent opportunity to reflect upon and document engineering decisions made regarding safety.

RSAs enhance other road safety strategies.

RSAs build on other road safety improvement strategies and techniques already in place and do not replace them. International experience shows that effective road safety management programs should exercise an optimal balance between reactive and proactive strategies in each jurisdiction, based on local conditions. Public agencies implementing RSAs should view them as one of an integrated range of tools intended to further the goals and objectives of a comprehensive road safety management program.

Most public agencies have established traditional safety review processes through their high hazard identification and correction programs. However, an RSA and a traditional safety review are different processes. It is important to understand the difference.

Viewpoint

"We view RSAs as a proactive, low-cost approach to improve safety. The RSAs helped our engineering team develop a number of solutions incorporating measures that were not originally included in the projects. The very first audit conducted saved SCDOT thousands of dollars by correcting a design problem."

Terecia Wilson, Director of Safety
South Carolina Department of Transportation

The role of RSAs in overall safety policies and procedures.

There is currently a diversity of views and opinions about the appropriate scope, role, and application of RSAs. Recognizing that these differing views and opinions exist, public agencies need to make RSAs work for them. Integrating RSAs within an existing design and safety management framework may require a different approach in each circumstance.

However, each RSA conducted should include certain key elements such as the use of an independent, multidisciplinary team and the completion of a response report. The RSA key elements should be applied equally across all possible RSA applications.

Reflecting this philosophy, this guideline provides a foundation for public agencies to draw upon when developing RSA policies and procedures and when conducting RSAs within their jurisdiction. It is hoped that this guideline, developed specifically for application in the United States, will further the integration of RSAs into everyday engineering practice.

What is the difference between RSA and Traditional Safety Review?

Road Safety Audit	Traditional Safety Review
Performed by a team independent of the project	The safety review team is usually not completely independent of the design team
Performed by a multi-disciplinary team	Typically performed by a team with only design and/or safety expertise
Considers all potential road users	Often concentrates on motorized traffic
Accounting for road user capabilities and limitations is an essential element of an RSA	Safety reviews do not normally consider human factor issues
Always generates a formal RSA report	Often does not generate a formal report
A formal response report is an essential element of an RSA	Often does not generate a formal response report

Part

A

CHAPTER 1

BACKGROUND TO ROAD SAFETY AUDITS

1.0 Introduction

1.1 Purpose

The primary purpose of this guideline is to provide a foundation for public agencies to draw upon when developing their own Road Safety Audit (RSA) policies and procedures and when conducting RSAs within their jurisdiction. The availability of a consistent guideline is anticipated to lead to a better understanding of the core concepts of RSAs and to promote their use.

These guidelines are intended to promote the implementation of RSAs in the United States.

1.2 Scope of Guidelines

These guidelines were developed by building upon experiences gained in the United States and in other countries. They are meant to present basic RSA principles, to encourage public agencies to implement RSAs, and to embrace them as part of their everyday practice. When used they should be tailored to suit local conditions.

1.3 What are Road Safety Audits?

An RSA is a formal safety performance examination of an existing or future road or intersection by an independent audit team. It qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users.

RSAs represent an additional tool within the suite of tools that currently make up a multidisciplinary safety management system aimed at improving safety.

As such, RSAs are not a replacement for:

- Design quality control or standard compliance checks also known as "safety reviews of design"
- Traffic impact or safety impact studies
- Safety conscious planning
- Road safety inventory programs
- Traffic safety modeling efforts

What are Road Safety Audits.

Confusing RSAs with the quality control of design is the most common misinterpretation of the role and nature of an RSA. Compliance with design standards, while important, does not necessarily result in an optimally safe road design and, conversely, failure to achieve compliance with standards does not necessarily result in a design that is unacceptable from a safety perspective.

What are road safety audits?

RSAs are:

- Focused on road safety.
- A formal examination.
- Proactive in nature.
- Conducted by a multidisciplinary team (more than one auditor).
- Conducted by an audit team that is independent of the design team.
- Conducted by an audit team that is adequately qualified, both individually and as a team.
- Broad enough to consider the safety of all road users and road facilities.
- Qualitative in nature.

What road safety audits are NOT!

RSAs are:

- Not a means to evaluate, praise or critique design work.
- Not a check of compliance with standards.
- Not a means of ranking or justifying one project over another.
- Not a means of rating one design option over another.
- Not a redesign of a project.
- Not a crash investigation or crash data analysis (although the crash history of an existing road is reviewed to make sure that previous crash patterns have been addressed).
- Not a safety review.

The aim of an RSA is to answer the following questions:

- What elements of the road may present a safety concern: to what extent, to which road users, and under what circumstances?
- What opportunities exist to eliminate or mitigate identified safety concerns?

2.0 Implementation of Road Safety Audits

Public agencies with a desire to improve the overall safety performance of roadways under their jurisdiction should be excited about the concept of Road Safety Audits (RSAs). An RSA program can range from something very simple to the full integration of safety into every stage of each project. The goal of this chapter is to highlight how simple and completely customizable a public agency's RSA program can be and to encourage the implementation of an RSA program that fits with an agency's safety goals and objectives.

The FHWA encourages agencies to call their road safety audit program whatever the agency is comfortable with. While some agencies use the term road safety audits, others have selected different terms such as road safety assessments, road safety evaluations or safety impact teams.

Road Safety Audit Process: Typical RSA Steps Include:

Step 1: Identify project or road in-service to be audited.

Step 2: Select RSA team.

Step 3: Conduct a pre-audit meeting to review project information.

Step 4: Perform field observations under various conditions.

Step 5: Conduct audit analysis and prepare report of findings.

Step 6: Present audit findings to Project Owner/Design Team.

Step 7: Project Owner/Design Team prepares formal response.

Step 8: Incorporate findings into the project when appropriate.

2.1 Getting Started – Steps to Introduce Road Safety Audits in your Organization

Integration of RSAs as a component of a comprehensive road safety management system in a jurisdiction requires several equally important elements: management commitment, an agreed-upon policy, informed project managers, an ongoing training program, and skilled auditors. RSA champions, who will devote energy to driving the RSA implementation forward and who are empowered by management to do so, are critical to getting a successful RSA program started.

Generally, a "top down" strategic approach is recommended for introduction of RSAs. For example, a public agency may pilot one or more RSA projects, adopt the audit process, and develop a policy on RSAs. Through an agreed process of regulation, funding, or encouragement this policy is then implemented "down" through other departments (planning, design, traffic engineering/operations, maintenance) or through other parts of the agency (districts).

"Top down" strategic approach for the introduction of RSAs.

A "top-down" approach typically includes:

- Piloting RSA projects.
- Development of the formal RSA policy.
- Continued monitoring, refinement, and promotion of the RSA process.

Piloting RSA Projects

The best way to initiate the RSA process is to conduct one or more pilot projects involving both selected professionals who will become the champions of RSAs and a small number of project managers who can explore the ways in which it is possible to respond and react to audit reports.

Pilot RSA projects rapidly bring a number of engineers up to a level of understanding that allows them to become "champions" of the audit process. In addition, pilot RSA projects enable public agencies to fine-tune RSA guidelines to fit with other processes and practices and provide a good basis for the development of an agency's formal RSA policy.

Conducting pilot RSA projects typically includes the following steps:

Conducting RSA pilot projects.

- Getting management commitment.
- Appointing an RSA coordinator empowered to manage the RSA pilot program. The role of the RSA coordinator will require a person with good knowledge of the general RSA process and experience in road safety engineering or highway design. This individual should be enthusiastic about RSAs and able to bring together and manage a diverse, multidisciplinary team. Ideally the person should also be an employee of the public agency who is familiar with its internal processes and procedures.
- Selecting RSA pilot projects from different stages of the highway lifecycle; e.g., preliminary design, detailed design, construction, pre-opening, post-opening, and roads in-service. The RSA process may also be piloted with projects undergoing value engineering review to provide an understanding of how the RSA process can be incorporated with the agency's value engineering processes.
- Selecting RSA teams that may be comprised of both internal staff and external resources with the skill sets best suited to specific projects.
- Providing safety audit training to the RSA teams and internal staff that will be involved in the RSA process.
- Gathering the information needed to conduct the audits.

Development of the Formal RSA Policy

Developing formal RSA policy suited to local conditions.

Using experience gained in conducting RSA pilot projects, agencies will be able to develop a formal RSA policy that is suited to local conditions. Key elements of a formal RSA policy include:

- Criteria for selecting projects and existing roads for RSAs.
- Procedures for conducting and documenting RSAs and Response Reports.
- Programs for providing RSA training.

Criteria for selecting projects to be audited differ between agencies. Some example criteria are provided in section 2.2. Chapter 4 of this guideline provides a comprehensive reference for the development of the local RSA procedures. Section 2.5 discusses the training programs of various U.S. agencies.

FHWA is successfully conducting RSA training courses throughout the US. Agencies may use the FHWA courses to support development of their own training programs.

An agency's training program should involve a core group of staff that are to become knowledgeable in the management and implementation of RSAs.

Continued Monitoring, Refinement and Promotion of the RSA Process

Implementation of RSAs does not end with the endorsement of a formal RSA policy. Periodic reviews are required to ensure the policy reflects both the level of acceptance and success achieved by RSAs as well as the agencies' level of preparedness to move forward. Policy reviews may lead to the expanded application of RSAs over time and/or the requirement for RSAs on all projects of a specific type; e.g., projects designed utilizing "context sensitive design principles."

The benefits and successes of RSAs need to be communicated throughout the implementation process. Management needs be assured on a continuing basis that the RSA process is providing positive, low-cost safety benefits to projects.

Other Approaches to Implement RSAs

Strategy for RSA implementation tailored to local conditions.

Local conditions may dictate a different strategy for implementing RSAs. For example, many agencies already undertake safety-related tasks that, taken together, may constitute an informal audit process. These tasks may include independent safety and design reviews conducted from the road user perspective that examine new alignments and/or existing road segments and intersections slated for rehabilitation or expansion. These agencies may be able to formulate a formal RSA policy on the basis of this experience without the need to conduct RSA pilot projects.

The Kansas Department of Transportation (KDOT) provides a good example of tailoring process to needs. In their program, safety performance plays a significant role in programming for future projects: safety performance and updated field data are used to assess improvement options at the corridor or intersection level. KDOT auditors use video-log information to "virtually" return to an intersection or road segment and review safety concerns that may have been overlooked in the field, such as illumination, pavement shoulder edge drop off, signs, pavement markings, delineation, and other road user guidance concerns.

KDOT's RSA program is a tool for internal staff use only. The organization in general undertakes a wide range of safety activities; however, their RSA-designated activities focus strictly on existing roads.

The program began in 1997 out of the simple desire to be more proactive in identifying safety deficiencies on existing roads under State jurisdiction. A plan was developed for audit teams to visit State highways within all 105 counties over a 3 year period. Conditions affecting safety, including crash performance, geometry, traffic control devices, speeds, horizontal and vertical curvature, and a variety of other factors, were reviewed from a road user perspective.

Instead of fearing what might be found, KDOT has used their RSA process in a proactive manner: to stay on top and ahead of safety issues, to generate both small and large improvement projects, and evaluate their potential for safety improvement.

It is important to recognize that getting started does not lock an agency into performing the same tasks repeatedly. For example, KDOT has completed their first round of RSAs and prepared final reports for each county - reports that will form a beneficial foundation for the second round of RSAs. On the basis of this initial effort, KDOT expects the next round of RSAs to take only 2 years and to focus on other features affecting road safety.

But KDOT's is only one approach, and RSAs can be conducted on many types of projects depending on the focus and goals of the individual State agency. The following section describes some of the projects conducted by the Pennsylvania DOT, the Iowa DOT, and other State DOTs on which RSAs have been conducted and provides insight into the safety benefits to each.

Capital improvement projects

RSAs of capital improvement projects generally provide significant safety benefits, particularly when conducted early in the design process. The flexibility inherent in capital improvement projects often provides more time to undertake the audit, along with greater scope and opportunity to implement RSA suggestions. Larger funding allocations and the fact that these projects often already involve right-of-way acquisition provides the flexibility to implement a broader range of safety enhancements.

Rehabilitation projects

RSAs of rehabilitation projects may result in significant safety benefits. The scope of these projects is generally broad. Funding allocations are often substantial and they often include the acquisition of additional right-of-way. This provides needed flexibility in implementing RSA suggestions. Incorporating safety improvements in rehabilitation projects is often achievable with only minor changes in the overall design.

Surface improvement projects

Surface improvement projects probably have the greatest potential to benefit from RSAs. RSAs of these projects often identify low-cost, high-value safety enhancements capable of being implemented in conjunction with surface improvements. For example, New York State's SAFETAP program incorporates RSAs as a component of the planning and design of NYDOT's maintenance paving projects. Surface improvements, along with the implementation of low-cost audit suggestions at over 300 high-crash locations, have resulted in a 20% to 40% reduction in crashes.

Bridge reconstruction projects

PennDOT's experience with RSAs on bridge rehabilitation projects shows that broad-scope projects, such as those involving a complete rehabilitation, were more successful in incorporating major improvements suggested by RSAs than projects with a narrower scope, such as deck replacement projects. However, these narrower projects may also benefit from RSA suggestions for improvements to illumination, signs, markings and delineation, and for accommodating the needs of pedestrians and bicyclists.

Safety projects

Safety projects utilizing Federal Hazard Elimination Funds already emphasize and focus on safety. However, they typically utilize only reactive (collision analysis) techniques in identifying hazards. Incorporating RSAs into these projects brings the knowledge and capabilities of a multidisciplinary team to bear as well as providing a proactive approach to safety. RSAs both identify potential hazards by looking at roads in-service from the perspectives of different road users and offer suggestions for improvement that do not rely on a crash history for validation.

Developer-led projects

PennDOT's experience indicates that RSAs of developer-led projects may offer enormous opportunities and benefits. However, developer resistance to iterative reviews and redesigns must be recognized and managed.

The Iowa Department of Transportation (Iowa DOT) offers an example of customizing the RSA process to public agency needs. Their RSA program focuses strictly on the design of rehabilitation, restoration, and resurfacing (3R) projects. An audit team of engineers, elderly drivers, technicians, safety engineers, and occasional university staff completes a field review, thoroughly assesses the crash performance of the highway, and provides feedback on the safety-related features of the proposed design.

This narrow focus is a good fit with Iowa DOT's overall safety review process. Safety features on all new roadway designs are comprehensively reviewed under an existing program. Small or medium sized communities in Iowa that do not have staff to support reviews intended to identify and address safety problems may obtain technical assistance under Iowa's Traffic Engineering Assistance Program (TEAP).

2.2 Selection of Projects for Road Safety Audit

Varying criteria for selecting projects for RSAs.

RSA programs may encompass projects of any size being undertaken at any point in the highway lifecycle. Agencies must make their own decisions about what projects to audit and when to audit them based upon statewide and/or local issues and priorities. Selection criteria, too, may be simple in focus initially but may be modified in response to emerging needs and issues. These issues and priorities may vary over time, even year to year, and programs should be regularly reviewed and adjusted in response.

Existing practices in the United States and elsewhere encompass a broad range of criteria for selecting which projects to audit and when to audit them. Some agencies require that all major road projects designed utilizing "context sensitive design principles" be audited. Others require audits of all projects with a construction cost exceeding a pre-determined threshold. Some agency criteria require that a proportion of all projects be audited or that a minimum number of RSAs be conducted each year.

Benefits of an RSA program

- RSAs pro-actively address safety
- RSA audited designs should produce fewer, less severe crashes.
- RSAs identify low-cost/high-value improvements.
- RSAs enhance consistency in how safety is considered and promote a "safety culture."
- RSAs provide continuous advancement of safety skills and knowledge.
- RSAs contribute feedback on safety issues for future projects.
- RSAs support optimized savings of money, time, and – most importantly – lives.

Agencies may also have varying criteria for existing roads. RSAs may be initiated on the basis of stakeholder concerns, or due to policies that mandate that a proportion of the road network be assessed on an annual basis, or because road sections have been identified in network screening studies as having poorer than expected safety performance. Regardless of the type of criteria an agency may use to select the projects it will audit, RSAs may benefit a wide variety of projects.

What types of projects may benefit from RSAs?

One approach to determining what types of projects may benefit from RSAs is through the application of nominal and substantive safety concepts, where nominal safety refers to compliance with standards and substantive safety refers to crash performance. The examples below illustrate the application of these concepts to existing roads:

- An intersection or road segment that does not meet current design standards (nominal safety issues) and also has a poor record of safety performance (substantive safety issues) should be considered a high-priority candidate for RSA as the potential for safety improvement, and the likelihood of its achievement, is also high.
- An intersection or road segment that meets current design standards (no nominal safety issues) but has a poor record of safety performance (substantive safety issues) should also be considered as a priority candidate for RSA as the potential for safety improvement, and the likelihood of its achievement, is significant.
- An intersection or road segment that does not meet current design standards (nominal safety issues) but has a satisfactory record of safety performance (no substantive safety issues), should be considered as a lower priority candidate for an RSA relative to those above, which exhibit substantive safety issues, as the potential for safety improvement, and the likelihood of its achievement, is low to moderate.

2.3 Impact on Project Schedule

Potential impacts of RSAs on individual project schedules.

The impact of an RSA on a project's schedule depends largely on the complexity of the project, how the RSA program is organized, when in the project lifecycle the audit is undertaken, the scope and implications of suggestions which result from the RSA, and how those suggestions are to be addressed. Public agencies should fully understand these scheduling implications when beginning an RSA program.

The relationship between RSA tasks and other project activities is an important consideration, and potential impacts should be identified and planned for at the outset. Provisions should be made in the overall project schedule to ensure that time is set aside to conduct the RSA, evaluate suggestions, respond to the audit report, and implement those suggestions that are accepted. In general, the earlier an RSA is performed in the project lifecycle, the easier it is to implement suggestions without disruption to the project schedule. Lead times for changes in project scope, right-of-way acquisition, design revisions, and subsequent reviews are more easily accommodated if they are identified early in the project lifecycle.

Public agencies should examine their existing project activities on an individual basis and develop a process for integrating RSAs into each.

2.4 Costs and Benefits

A number of reports suggest that the RSA process is cost-effective, although most reference qualitative rather than quantitative benefits. Establishing and meeting a target benefit/cost ratio for RSAs is not the motivating factor behind support for RSAs at PennDOT, KDOT or Iowa DOT. These agencies suggest that the benefits of RSAs are substantial, but largely immeasurable. Nonetheless, the major quantifiable benefits of RSAs can be identified in the following areas:

- Throwaway costs and reconstruction costs to correct safety deficiencies identified once roads are in-service are either avoided or substantially reduced.
- Lifecycle costs are reduced since safer designs often carry lower maintenance costs (e.g., flattened slope versus guardrail).
- Societal costs of collisions are reduced by safer roads and fewer, less-severe crashes.
- Liability claims, a component of both agency and societal costs, are reduced.

Quantifiable benefits of RSAs.

The most objective and most often-cited study of the benefits of RSA, conducted in Surrey County, United Kingdom, compared fatal and injury crash reductions at 19 audited highway projects to those at 19 highway projects for which audits were not conducted.

It found that while the average yearly fatal and injury crash frequency at the audited sites had dropped by 1.25 crashes per year (an average reduction from 2.08 to 0.83 crashes per year), the average yearly fatal and injury crash frequency at the sites that were not audited had dropped by only 0.26 crashes per year (an average reduction from 2.6 to 2.34 crashes per year).

This suggests that audits of highway projects make them almost five times more effective in reducing fatal and injury crashes.

Other major studies from the United Kingdom, Denmark, New Zealand and Jordan quantify the benefits of RSAs in different ways; however, all report that RSAs are relatively inexpensive to conduct and are highly cost effective in identifying safety enhancements. An example of U.S. data on the quantitative safety benefits of RSAs conducted on existing roads comes from the New York DOT, which reports a 20% to 40 % reduction in crashes at more than 300 high-crash locations that had received surface improvements and had been treated with other low-cost safety improvements suggested by RSAs.

The South Carolina DOT RSA program has had a positive impact on safety. Early results from four separate RSAs, following 1-year of results, are promising. One site, implementing 4 of the 8 suggested improvements saw total crashes decrease 12.5 percent, resulting in an economic savings of $40,000. A second site had a 15.8 percent increase in crashes after only 2 of the 13 suggestions for improvements were incorporated A third site, implementing all 9 suggested improvements saw a reduction of 60% in fatalities, resulting in an economic savings of $3.66 million dollars. Finally, a fourth location, implementing 25 of the 37 suggested safety improvements, had a 23.4 percent reduction in crashes, resulting in an economic savings of $147,000.

The cost of RSAs may vary greatly based upon project size, scope and complexity; the composition of the RSA team; and the level of detail of the audit. The cost of human resources to conduct RSAs may range from a one-day field review by in-house audit team members to maintaining full-time auditors working on a statewide basis. Costs may also be higher if consultants are retained to conduct the audit or to supplement staff expertise on audit teams. Overall, the cost of RSA programs are dependent on an agency's creativity in integrating audit activities within existing project tasks, practices and resources, and on the decision-making methodology used to evaluate and implement audit suggestions.

The Kentucky Transportation Cabinet initially hired consultants to complete comprehensive, county-wide RSAs of several of their largest counties. Subsequent audits were conducted by trained, in-house staff and RSA costs were dramatically reduced. The Kentucky program provides ongoing RSA training for staff, facilitates continuous improvements in roads, and allows for monitoring of internal processes and policies.

Average cost of an RSA.

PennDOT indicates that their average cost of conducting RSAs ranges from $2000 to $5000. This is comparable with estimates produced in the United Kingdom and Australia and is, according to PennDOT, "very little for the amount of success." The results of PennDOT's own RSA pilot program concluded that RSA teams identified safety concerns that would not otherwise have been discovered as part of a standard safety review. As a result, the safety value of projects where the RSA process was applied was significantly enhanced.

2.5 Training

National Highway Institute (NHI) RSA training course.

Based on experience gathered while conducting RSA training in different jurisdictions, the FHWA's National Highway Institute (NHI) has developed an RSA training course that is available to all who are interested. Information on this course may be found at http://www.nhi.fhwa.dot.gov. In addition, FHWA has developed a training course on Road Safety Audits for Local Agencies. Information on this course can be found at: http://safety.fhwa.dot.gov/rsa.

Hands-on training that involves in-house staff in real-world situations is often preferred. For example, Kentucky has a team of six auditors who, over a 3-year period, wrote a separate audit report for each of the 105 counties within the State. These reports serve as a reference for potential new auditors, who are initially teamed with the six original auditors to gain experience.

A different approach was taken in Iowa. The Iowa DOT partnered with The Center for Transportation Research and Education (CTRE) at Iowa State University. Together, they developed and implemented an RSA process that focused on resurfacing, rehabilitation, and restoration (3R) projects. Audit teams were staffed by the two agencies and recently completed 3R projects were field-evaluated in-service. Findings were communicated to design teams planning future 3R projects and, together, the RSA and design teams discussed design goals, issues, evaluation criteria, and identified improvements based on advancements in construction methods and as-constructed results. Iowa DOT's RSA program will result in the entire State highway system being audited over a 20-year period. These audits will provide valuable feedback on the safety performance of 3R projects and facilitate continuous safety improvement.

Based on established RSA practices for 3R projects, CTRE developed a training program for staff within each of the six district offices. The program includes a "mini" RSA process, which can be completed on each 3R project designed at the local level. Both district and headquarters staff commented that the process is simple, adds significant safety value to locally-designed 3R projects, and supplements and enhances the skills and knowledge of the design team.

The Kentucky training program provides another excellent example. They provided RSA training to all 12 of their highway districts, training 2 districts at a time. Those receiving training included staff from design, maintenance, traffic and permit administration. Consultants also received the training.

To facilitate learning, each district provided a planning or design project which was then assigned to an RSA team from another district. A training location within an hour's drive of each project site was selected.

The training was conducted over two and half days. The first morning, an overview of RSAs was presented to address background and principles along with the steps involved in conducting RSAs. In the afternoon, staff from each district presented their design project. Plans, project planning reports, environmental documents, aerial photos, collision diagrams, etc. were then turned over to the district that would conduct the RSA.

After reviewing the documentation, audit teams conducted a day and a night review of their project site. The next morning, each audit team prepared their RSA report and then presented their suggestions to staff from district that owned the project. This allowed each team to present a design, conduct an RSA, present their findings, and receive the findings of another RSA team.

Other agency approaches to RSA training have included the following:

- One-to-one pairing between States that currently have RSA programs and those wishing to implement one, with cross-training of staff through participation in audits with knowledgeable team leaders.
- Training by engineering faculties of universities.
- Participation by State safety staff in university outreach programs.
- Staff attendance at Road Safety Audit courses.
- Participation in website forums that provide relevant guidelines, documents, and links to established RSA programs, allowing agencies to share effective practices, discuss implementation challenges, and communicate successes.

2.6 Legal Issues

Considering legal implications of RSA programs.

*Note: The information provided here is not legal advice, but is meant to assist public agencies in discussions with their attorneys on developing a policy for the implementation of Road Safety Audits.

Some State and local agencies have been hesitant to conduct RSAs due to a fear that RSA reports will be used against them in tort liability lawsuits, which are lawsuits in which a plaintiff may sue for compensation for an injury resulting from a design or engineering flaw. In this case, such a suit would assume that RSA documents could be cited as proof that State or local agencies oversaw implementation of a road design that was not safe or that somehow contributed to an individual's injury.

A survey of State Departments of Transportation was conducted as part of NCHRP Synthesis project #336, Road Safety Audits. The survey asked questions about States' sovereign immunity, the doctrine that Government agencies (Federal, State, city, county) are immune to lawsuits unless they give their consent to the lawsuit. A summary of the information in the synthesis follows:

There appeared to be no specific correlation in the application of RSAs (to new projects or to existing roads) and whether or not the State had sovereign immunity. Two States implementing RSAs indicated full immunity and three indicated partial immunity. For States that use RSAs (in the design stage or on existing roads but not both), two indicated full immunity, four had partial immunity, and four had no immunity.

The same survey also received this response related to liability, "Liability is one of the major driving factors in performing a good audit; it demonstrates a proactive approach to identifying and mitigating safety concerns. When findings cannot be implemented, an exception report is developed to address liability and mitigating measures. Our attorneys say that once safety issues are identified, and we have financial limitations on how much and how fast we can correct the issues, then the audit will help us in defense of liability..."

RSAs in defense against liability.

In the case of Kansas DOT, the RSA program was implemented to be proactive in identifying and fixing safety issues. They report their RSA results are for internal staff use only and are not available to the public or to lawyers representing claims against the State. There have been instances where these records were requested by outside legal counsel and to date the information has remained at KDOT.

The only instance where a RSA report was released was in a case where the State was being sued but the claim did not ask for any money. [Public disclosure laws require release of this information in many States. However, some States do not allow information gathered under public disclosure laws to be used in lawsuits.]

The Iowa DOT has had no instances of RSA records being requested or used in court by outside legal counsel. In both cases above, these States have successfully implemented RSA programs which significantly improve the safety along public agency roads and assist in decision making agency wide.

Federal law affords evidentiary and discovery protections that assist State and local highway agencies in keeping data and reports compiled or collected pursuant to various Federal safety improvement programs from being used in tort liability actions. However, Federal law does not protect data and reports from Freedom of Information Act requests.

The Highway Safety Act of 1973 was enacted to improve the safety of our Nation's highways by encouraging closer Federal and State cooperation with respect to road safety improvement projects. The Act included several categorical programs to assist States in identifying highways in need of improvements and in funding these improvements, including 23 U.S.C. § 152 (Hazard Elimination Program, "Section 152").[1] States objected to the absence of any confidentiality with respect to their compliance measures under Section 152, fearing that any information collected could be used as an effort-free tool in litigation against governments.

23 U.S.C. § 409 ("Section 409") was enacted to address this concern. This law expressly forbids the discovery or admission into evidence of reports, data, or other information compiled or collected for activities required pursuant to several Federal highway safety programs (Sections 130, and 152 (now 148)), or for the purpose of developing any highway safety construction improvement project, which may be implemented utilizing federal aid highway funds, in tort litigation arising from occurrences at the locations addressed in such documents or data.[2] In 2003, the U.S. Supreme Court upheld the Constitutionality of Section 409, indicating that it "protects all reports, surveys, schedules, lists, or data actually compiled or collected for § 152 purposes" (emphasis on original).[3] Some States consider information covered by Section 409 as an exemption to its public disclosure laws, but courts may not agree with this interpretation.[4]

Another approach could be to use RSA reports in tort liability suits to show the courts that the State or local agency is proactively trying to improve safety.

Many litigants and their lawyers will hire an expert witness to conduct their own safety review of the location in question. The RSA report can be used to refute or counter the expert witness's report and to show the public agency's efforts at improving safety in that location. It is important to have a response to the RSA report in the file to show how the agency plans to incorporate the suggestions or why the RSA report suggestions will not be implemented.

Legal and liability information provided in this guideline is not a substitute for legal advice.

(1) Under the Surface Transportation Act of 1978, these categorical programs were merged into the Rail Highway Crossing program (23 U.S.C. 130) and the Hazard Elimination Program (23 U.S.C. 152). To be eligible for funds under Section 152, the statute states that a State or local government must "conduct and systematically maintain an engineering survey of all public roads to identify hazardous locations, sections, and elements, including roadside obstacles and unmarked or poorly marked roads, which may constitute a danger to motorists, bicyclists, and pedestrians; assign priorities for the correction of such locations, sections, and elements; and establish and implement a schedule of projects for their improvement." The recently enacted section 1401 of SAFETEA-LU (Pub. L. 109-59, August 10, 2005) establishes a new Highway Safety Improvement Program in 23 U.S.C. § 148, which incorporates the elements of section 152 and which will be the source of funding for the activities eligible under that section. As a result of this provision of SAFETEA-LU, 23 U.S.C. § 409, cited in the next footnote, now references section 148, not section 152. Because activities eligible under section 152 will be funded under section 148, they will continue to be protected pursuant to section 409.

(2) Section 409 in its entirety states "Notwithstanding any other provision of law, reports, surveys, schedules, lists, or data compiled or collected for the purpose of identifying, evaluating, or planning the safety enhancement of potential accident sites, hazardous roadway conditions, or railway-highway crossings, pursuant to sections 130, 144, and 148 [152] of this title or for the purpose of developing any highway safety construction improvement project which may be implemented utilizing Federal-aid highway funds shall not be subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists, or data."

(3) Pierce County, Washington v. Guillen, 537 U.S. 129 (2003).

(4) The New York Supreme Court recently held that 409 protects only from requests in litigation and, thus, does not create a public records exemption in New York. See Newsday v. State DOT, Supreme Court Appellate Division, Third Judicial Department (July 1, 2004).

3.0 Overview of Road Safety Audit Process

The purpose of this chapter is to provide the user with a general overview and understanding of the RSA process.

3.1 Essential Elements of an RSA

Essential elements of the RSA process.

An RSA possesses some similar qualities to other types of reviews, but to be considered an RSA, the process should contain several essential elements. They are:

Formal Examination

RSAs are a formal examination of the design components and the associated operational effects of a proposed or existing roadway from a safety perspective.

Team Review

RSAs are performed by a team (at least three auditors) who represent a variety of experience and expertise (design, traffic, maintenance, construction, safety, local officials, enforcement personnel, first-responders, human factors) specifically tailored to the project.

Independent RSA Team

The audit team members must be independent of the design team charged with the development of the original plans, or, in the case of an RSA of an existing road, the team leader should be independent of the facility owner. Nevertheless, engineering, maintenance, and other representatives of the facility owner may and should participate provided they haven't been involved in prior decisions on the project. This independence insures a fair and balanced review.

Qualified Team

The auditors must have the appropriate qualifications specific to the RSA. More detail on selecting RSA team members is provided in Section 4.2.

Focus on Road Safety Issues

The principal focus of the RSA is to identify potential road safety issues caused by the design, or by some operational aspect of the design. The RSA should not focus on issues such as standards compliance unless non-compliance is a relevant road safety issue.

Includes All Road Users

The RSA should consider all appropriate vehicle types/modes and all other potential road users (elderly drivers; pedestrians of different age groups, including children and the physically-challenged; bicyclists; commercial, recreational, and agricultural traffic, etc).

Proactive Nature

The nature of an RSA should be proactive and not reactive. The team should consider not only safety issues demonstrated by a pattern of crash occurrence, but also circumstances under which a cause and effect link is not so clear. These include potential safety issues relating to time of day/year, weather, or situational issues that may exist or that may occur as a result of road user expectations.

Qualitative Nature

The primary products of an audit are qualitative in nature, rather than quantitative (e.g. numerical). These include lists of identified issues, assessments of relative risk, and suggested corrective measures.

Field Reviews

RSAs are much more effective when they include day and night field reviews. Even RSAs at the pre-construction stage benefit from field reviews.

3.2 Road Safety Audit and Other Processes

A Road Safety Audit (RSA) is a formal safety performance examination of an existing or future road or intersection by an independent audit team. The RSA team considers the safety of all road users, qualitatively estimates and reports on the road safety issues identified, and presents suggestions for safety improvement.

How RSAs differ from other design and construction review processes.

It is important to differentiate between RSAs and other review processes and tools currently in use, such as those associated with the review of safety or operations in roadway planning, design and construction projects. RSAs represent an additional tool, within the suite of tools that currently make up the road safety management system, aimed at improving safety. Review processes associated with roadway design and construction that are not substitutes for RSAs include:

Traditional Safety Reviews

Some public agencies currently include a safety review in their design process. A safety review actively seeks to identify safety concerns before a final design is established and built. This process differs from the RSA in several important aspects. While usually performed by a team, the traditional safety review team does not usually include representation from multiple disciplines. The team is often not completely independent of the design team and the review often does not result in formal review and response reports. Traditional safety reviews also miss such essential elements of RSAs as consideration of capabilities and limitations of potential road users and the importance of day/night field visits.

Traffic Impact Study

The focus of these studies is estimating the volume of traffic associated with a land development project and the impacts that traffic will have on the operation of the adjacent street and road network in terms of capacity and levels of service.

Safety Conscious Planning (SCP)

SCP is an outgrowth of the requirement in the TEA-21 legislation that "each statewide and metropolitan planning process shall provide for consideration of projects and strategies that will increase the safety and security of the transportation system for motorized and non-motorized users." The scope of SCP is too broad to be applied to a specific project.

Existing review processes as compared to RSA.

Interactive Highway Safety Design Model (IHSDM) Tools

The IHSDM is a set of computer software analysis tools used to evaluate the safety and operational effects of geometric design decisions. IHSDM evaluates a design and furnishes quantitative information on its predicted safety and operational performance.

It differs from RSAs in that it provides quantitative output on safety performance based on the application of the software. It lacks the qualitative aspect of RSA and is focused on optimal design solutions rather than being focused exclusively on safety. IHSDM, therefore, is a complementary tool that can provide quantitative input to RSAs during the design phase of projects.

Design Review and Prompt Lists

These are tools used by the design team to evaluate items related to: standards, details, exceptions, right-of-way issues, or cost and material estimates. The review is not conducted by an independent, multi-disciplinary team. Furthermore, these design reviews are not primarily looking for safety issues nor is there always an adequate focus on all types of road users.

Standards Compliance Reviews

This is a review to determine if all applicable standards (national, state, or local) have been met or exceeded. Compliance reviews do not always consider the safety aspects of the design for different road users. Standards compliance reviews do not exercise one of the major road safety principles inherent to RSA: "adherence to the design standards does not guarantee that the road is optimally safe".

National Environmental Policy Act of 1969 (NEPA)

This Act does cover elements of public health and safety relative to any project subject to this regulation. However, the requirements of the Act do not consider the specific elements of a design as RSA would.

Value Engineering Studies

Using RSA results in Value Engineering studies.

Value Engineering is defined as systematic application of recognized techniques by a multi-disciplined team to identify the function of a product or service, establish a worth for that function, generate alternatives through the use of creative thinking, and provide the needed functions to accomplish the original purpose of the project, reliably, and at the lowest life-cycle cost without sacrificing safety, necessary quality, and environmental attributes of the project. Past experience does indicate that RSAs can be integrated with the value engineering method and the results of RSAs can be used in value engineering studies. However, a Value Engineering study that does not integrate an RSA is not a viable substitute for an RSA.

Quality Assurance Processes

This is a management process that is used to ensure that the quality of goods or services meets the agreed standards. Quality assurance, even when the safety aspects of a project are reviewed, is mainly checking compliance with standards and is not done by a multi-disciplinary team possessing qualifications necessary to examine safety performance of a road for all road users. RSAs and quality assurance do not negate one another, but rather they may be complimentary. Specifically, quality assurance procedures may be modified to include specific requirements of RSAs, e.g., required skills and experience of the auditors, the size of the team, the RSA process to be followed, and others. More detail on selecting RSA team members is provided in Section 4.2.

3.3 Who Should Conduct Road Safety Audits?

The level of success that can be achieved in using the RSA process is highly dependent on the characteristics of the auditors, both individually and as a team. By possessing certain knowledge, skills, experience, and attitudes, the team will be able to review project data critically, get the most from field visits, and engage in the kind of dialogue that leads to the identification of road safety issues.

Experience with RSAs in the United States to date has shown that there are many workable variations to the RSA process and, accordingly, many questions arise as to who should be involved in the RSA.

Making RSAs successful.

Specific issues to be addressed include the following:

Number of Team Members

One of the benefits of the RSA process is the synergy created by the members of the audit team. The knowledge and experience of the team as a whole are greater than the sum of these attributes as vested in the individual members, so the process benefits from being conducted by a team. But what size team is optimal? While three members may be adequate for some project types, that number may not be sufficient for larger, more complex projects or those requiring specific expertise. The best practice is to have the smallest team that brings all of the necessary knowledge and experience to the process.

Team Background

The RSA will benefit from bringing different types of expertise to the process. Professional experience in the design, operations, and safety areas is very important. However, what may be more important is multidisciplinary experience. Team members possessing more than one area of specialty (e.g., design and operations) should be more valued than members possessing only one skill.

Independence of the RSA Team

RSA team members may be selected from within the same public agency, but must be able to truly act independently of the team generating the original designs.

Team Leadership:

Within the team, there should be a leader who is thoroughly knowledgeable in the RSA process, capable of directing the other team members, and able to communicate effectively with the design team and the project owner.

Local Representatives:

An audit team should have an individual knowledgeable of the project location. Representatives of State or local law enforcement or leaders of local organizations (a traffic safety task force or bicycle/pedestrian committee) may be considered for this role, or may be used as a special resource while not necessarily being a team member.

3.4 Roles and Responsibilities

There are varying roles and responsibilities for all of the parties involved in the RSA. Further, these roles and responsibilities can vary significantly from one organization to another. The following descriptions give general guidance on the roles and responsibilities of each RSA team member.

Project Owner

The project owner is a representative of the State or local highway (or road) department. For the RSA process to work, there has to be the highest level of commitment from the top administration within the public agency. This sense of commitment must permeate throughout the public agency and demonstrate to all of the parties involved that RSAs are a permanent feature of the public agency's roadway safety program. Without this organizational endorsement, the integrity of the process can be undermined, making the RSA less of a safety tool to be used and more of an organizational hurdle to be overcome.

The project owner must also work to make sure that key RSA features, such as the formality of the RSA, the use of a qualified, independent multi-disciplinary RSA team, and the inclusion of all road users are part of and remain part of all RSAs.

In managing the RSA process, the project owner must set up ground rules regarding how information requests will be handled, how meetings and other activities of the RSA team mesh with the overall timetable for the development of the project, and how identified problems and suggested solutions are presented to the design team. Further, he or she must create an environment that avoids possible conflicts between the design team and the audit team and establish how conflicts, if they occur, will be arbitrated.

Design Team Leader

Role of the RSA design team leader.

The design team leader may have the most important role in that he or she is the single point of contact for the public agency for all activities related to the design and RSA process.

To perform well in this role the design team leader must balance the activities of the design team with the information requirements and the final output of the RSA team. The design team cannot think of the RSA process as some sort of "rubber stamp."

The design team leader must explain to the design team the importance of the RSA process, and he or she must assure the designers that the RSA is not being conducted to monitor performance or criticize efforts.

One of the main roles of the design team leader is to provide the proper information to the RSA team (scoping or planning the study, plans, aerial photos, environmental documents, etc.) and to arrange for objective and careful consideration of the RSA team input. Requests for information from the RSA team must be expedited, and procedures must be established regarding how the input of the RSA team will be incorporated back into the project.

RSA Team

Relationship between the auditors and designers.

The RSA team must fully understand the agency's RSA policies, the parameters established for their RSA, and their individual roles. Is the team responsible for identifying specific safety issues or only areas of concern? When in the road lifecycle is the RSA to be conducted and within what timeframes? Is the team to suggest potential solutions to any of the safety concerns they noted?

A well-defined role for the audit team, which is communicated to both the design team and the audit team, will smooth out the relationship between designers and auditors. Above all, the RSA team is responsible for reporting on all safety concerns they identify, even if the items may be considered controversial. This will allow the RSA process to achieve its peak effectiveness.

3.5 Which Roads or Projects Should be Audited, and When?

Applying RSAs early in the planning and preliminary design of roads.

RSAs may be conducted practically at every stage in the lifecycle of a transportation facility. RSAs applied early in the planning and preliminary (functional) design of roads offer the greatest opportunity for beneficial influence. As a design progresses into detailed design and construction, changes that may improve safety performance typically become more difficult, costly, and time-consuming to implement.

Exhibit 3.1 illustrates a method of grouping RSAs by phase (pre-construction, construction, and post-construction) and by stage (planning, preliminary design, etc.). Parts B and C of this guideline have been structured according to this grouping. An overview of each RSA phase and stage follows.

Pre-construction Phase Road Safety Audits

Pre-construction RSAs are performed at those points in the project lifecycle before the construction of the facility begins. In this phase, changes may still be made with limited delay to the project and with less expense. There are three RSAs that may be conducted during this phase. These include:

- Planning (feasibility) RSAs.
- Preliminary design RSAs (functional design RSAs).
- Detailed design RSAs (final design RSAs).

Planning Stage

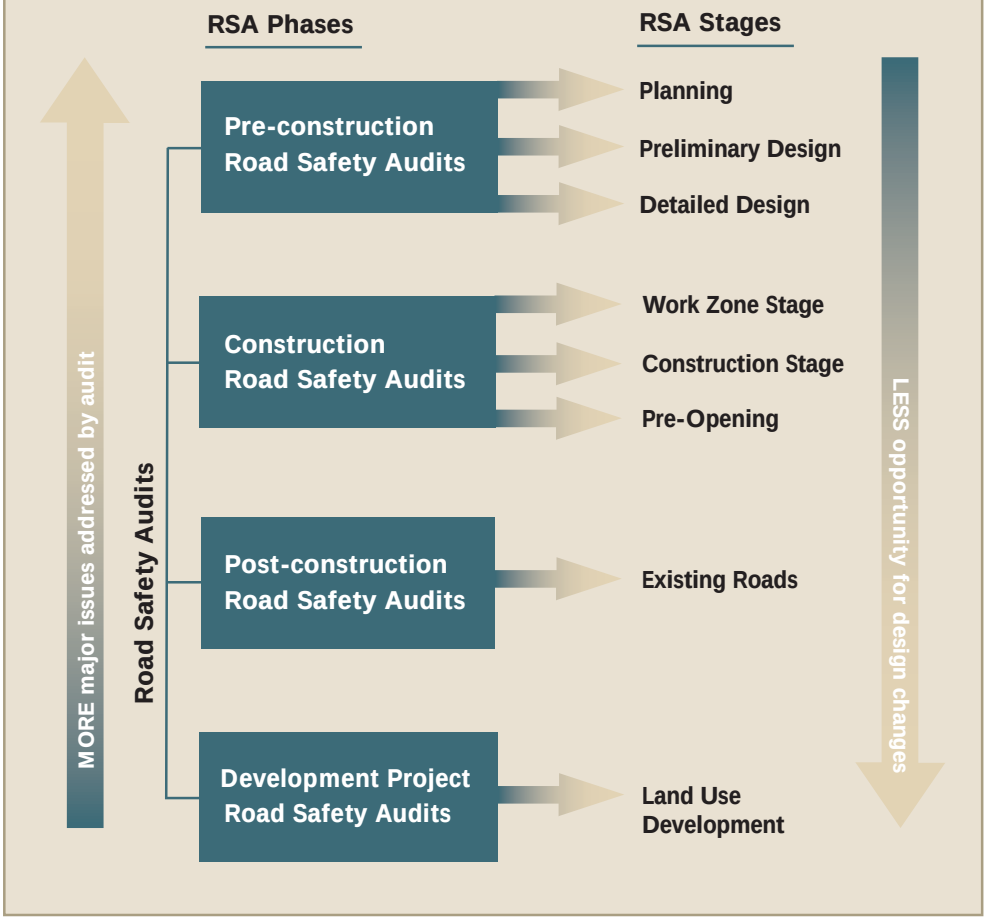
Planning projects, by their nature, have little information about the details of the design. A preliminary layout or route may be available along with information about the basic design issues (e.g., functional classification, general intersection configuration).

Despite limited information, at this stage there may be significant opportunity to incorporate safety enhancements into the design at the lowest cost. The audit team may give special consideration to issues such as the accommodation of all user groups, design consistency, and operational features.

The RSA suggestions at this stage may include major changes such as different route options, cross-section options, changes to spacing of intersections/interchanges, construction stages, pedestrian/bicycle routing and facility options.

EXHIBIT 3.1

Types of Road Safety Audits Grouped by Phase and Stage



Preliminary Design Stage RSA (plans 30-40% complete)

Identifying opportunities to improve safety at different project stages.

At this stage plans are 30-40% complete, and projects should have sufficient information about the details of the design, such as alignment and grade or lane and shoulder widths, so that the auditors may begin to identify critical design details and make suggestions regarding safety. The primary design stage is covered in more detail in Section 5.1.

While fundamental decisions concerning route choices are already made at this stage, substantive safety improvements may still be made without significant costs or delays. The RSA suggestions may include: changes to access points, horizontal and/or vertical alignments, provision of a median, lane and shoulder width, provision of bicycle lanes and sidewalks, channelization, landscaping, lighting, etc.

Detailed Design Stage RSA (plans 60-80% complete)

At this stage, plans are 60-80% complete. This is a critical stage as this is the audit team's last opportunity to review the design before it is finalized and construction begins. Right-of-way acquisition has likely commenced, so it is vital that the RSA is thorough. Efforts to undertake major physical changes in the design at this stage may be both time-consuming and expensive, and may delay project tendering. The RSA suggestions may include changes to signs, delineation and road marking, traffic signal placement/operation, roadside safety hardware (types and placement), raised channelization, landscaping, lighting etc.

Construction Phase Road Safety Audits

Construction RSAs are generally performed during preparations for construction, during actual construction, and during the pre-opening period. In this phase, the audit team may actually view the project as-built, along with the final detailed plans, so that their review may be more comprehensive. There are three RSAs that may be conducted during this phase, as follows:

- Work Zone Traffic Control Plan RSAs.
- Changes in Design During Construction RSAs.
- Pre-opening RSAs.

RSA of Work Zone Traffic Control Plan

RSAs may be conducted to ensure that safety is adequately considered in the Maintenance of Traffic Plan and the Work Zone Traffic Control Plan. This RSA could be accomplished before the project is tendered to construction, before the work zone is open to traffic, and/or after it is open.

When performing this type of RSA, the team needs to be mindful of several issues. They must evaluate the safety of all temporary roadways and transition areas. They should consider the appropriateness of all traffic control devices and be cognizant of any conflicting information given to the road users by the permanent and/or the temporary traffic controls. Further, they need to think about the other road users besides passenger automobile operators (e.g., pedestrians, including the disabled; bicyclists; large trucks; school buses; etc.) because work areas often fail to properly accommodate users from these other groups.

RSA of Changes in Design During Construction Stage

RSAs conducted at this stage relate to situations where a construction process leads to identification of unforeseen construction problems or cost saving design alternatives that may not have been obvious during the design process. Some of the changes may have a bearing on safety and may need to undergo an RSA.

Pre-Opening Stage RSA

Considerations with Pre-opening RSAs.

These RSAs are similar in nature to detailed design RSAs in that they offer another opportunity for the team to consider the safety aspects of the design before the facility is opened to the public. It should be noted that this is the first time the reviewers will be able to actually see and drive (walk, bicycle) the facility in its finished state instead of relying on the design plans. This field review must be comprehensive and thorough. The RSA suggestions will likely focus on changes to illumination, signs, delineation, pavement markings, roadside barriers, removal of fixed object hazards or minor structural changes (e.g., addition of a wheelchair ramp). Yet even minor changes to the road facility may significantly reduce safety risk at a minimal cost.

Post-construction Phase Road Safety Audits

RSAs of existing roads are conducted on a previously opened roadway or intersection. This type of RSA is somewhat different from those conducted during the pre-construction or construction phases. The procedure used for conducting an RSA of an existing road uses different project data; specifically, if plans are reviewed, they should be "as built" plans. By performing a day and night review the audit team will be able to observe how road users are interacting with the road facility.

RSA's are different from traditional crash analysis.

Near the conclusion of the field review portion of a post-construction phase RSA, or even as a part of reviewing project information, some public agencies encourage the review of existing crash data. However, an RSA of existing roads is intended to be different than a traditional analysis of a high crash location. See Section 7.1 for more detail on RSAs of existing roads.

The real objective for this type of RSA is to identify road safety issues for different road users that might result in a crash given the operational characteristics of the road in question. For this reason, RSAs of existing roads are proactive. Available crash data are used to validate RSA results and make sure that existing safety problems are not overlooked. RSAs of existing roads may be conducted even if crash data are unavailable.

Development Project Phase Road Safety Audits

Development project RSAs may be conducted on industrial, commercial, or residential land use development projects that may have an impact on the characteristics of the existing adjacent roads. Since development projects have a great potential to change the traffic volumes, traffic patterns, vehicle mix, road environment, or user perception of the road, a development RSA would consider the internal layout of the new development as well as impacts to the existing road network.

Part

B

CHAPTER 4

THE ROAD SAFETY AUDIT PROCESS

4.0 Conducting Road Safety Audits

The purpose of this chapter is to present the RSA process in detailed steps. The description of each step will include:

- The objective of each step.
- Typical roles and responsibilities for each step.
- Guidance common to all RSA stages and types of RSAs.
- Specifics related to RSA stages and types of RSAs.

The typical eight-step RSA procedure is presented in Exhibit 4.1. Further information on conducting pre-construction, construction, and post-construction phase RSAs is found in chapters 5, 6 and 7, respectively.

4.1 Step 1: Identify Project or Existing Road to be Audited

The objective of this step is to identify the project or existing road to be audited and to set the parameters for the RSA.

Putting RSA policy into action.

When selecting a project for an RSA, the public agency should adhere to a pre-determined policy. This approach will eliminate questions and concerns as to why or how projects were audited.

Once a project is identified, the project owner should help establish clear parameters for the RSA. The parameters should define the following:

- Scope.
- Schedule for completion.
- Team requirements.
- Audit tasks.
- Formal audit report contents and format.
- Response report expectations.

The RSA team must remain independent and not be directed by the project owner.

Scope of and RSA project.

The scope of the RSA should be defined in terms of the geographical area, the aspects of the project to be reviewed, and what is considered to be out of scope. The project owner, in consultation with the RSA team leader, should specify how many individuals will be on the audit team and what qualifications they should possess. The size and qualifications of the team will vary depending on the scope and type of project being audited.

EXHIBIT 4.1

Road Safety Audit Process: Typical RSA steps include:

Step 1: Identify project or existing road to be audited
As a result of this step, the project or existing road to be audited is determined and the parameters for a RSA are set.

Step 2: Select RSA Team
As a result of this step, an independent, qualified, and multidisciplinary team of experts suitable for the specific RSA stage is selected.

Step 3: Conduct a pre-audit meeting to review project information
The meeting brings together the project owner, the design team and the audit team to discuss the context and scope of the RSA and review all project information available.

Step 4: Perform field reviews under various conditions
The objective of project data review is to gain insight into the project or existing road, prepare for the field visit and identify areas of safety concerns. The field visit is used to get further insight into the project or existing road and to further verify/identify areas of safety concern.

Step 5: Conduct audit analysis and prepare report of findings
As a result of this step, the safety issues are identified and prioritized and suggestions are made for reducing the degree of safety risk. The RSA results are then succinctly summarized in the formal RSA report.

Step 6: Present audit findings to Project Owner/Design Team
In this step, audit team orally reports the key RSA findings to the project owner and design team in order to facilitate the understanding of RSA findings.

Step 7: Prepare formal response
Once submitted, the formal response becomes an essential part of the project documentation. It outlines what actions the project owner and/or design team will take in response to each safety issue listed in the RSA report and why some of the RSA suggestions could not be implemented.

Step 8: Incorporate findings into the project when appropriate
This final step ensures that the corrective measures outlined in the response report are completed as described and in the time frame documented.

The project owner and the RSA team leader should set a schedule for key dates such as presentation of the RSA findings to the project owner and design team, and for preparation of the response report. These dates may be critical to the project schedule. Clear understanding and adherence to them will minimize any delay.

The project owner should specify the required tasks for all involved parties. The audit team may also be required to complete tasks unique to the project, such as reviewing a previous safety evaluation or RSA or focusing on a particular vulnerable road user group potentially at risk. The design team may be required to provide specific data to the audit team that will assist the auditors in conducting the RSA.

Finally, the project owner should work with the RSA team leader to specify requirements for the content and format of the RSA report and the response report.

4.2 Step 2: Select an RSA Team

The objective of selecting an audit team is to choose an independent, qualified, and multidisciplinary team of experts who can successfully conduct a road safety audit.

RSA team composition.

The project owner is responsible for selecting the RSA team leader. The project owner and the RSA team leader need to select a set of qualified individuals from within the agency, from another public agency, or from outside sources. Regardless of where they find the team members, the audit team itself must be independent of the project being audited.

Should the project owner choose to use individuals from within the agency, these individuals must be impartial and must not have been involved in the design process. The key element to consider when deciding if the team is truly independent is whether the auditors can act independently of the project owner/design team, and not whether they are drawn from internal or external resources. The freedom, ability and comfort of auditors to comment frankly on potentially controversial safety issues is crucial to the success of the RSA.

RSA team size.

The project owner and RSA team leader should also ensure that the audit team represents a group of individuals that, combined, possess a set of skills that will ensure the most critical aspects of the project are addressed. One person may possess a combination of skills in a number of different areas, but the audit team should consist of at least three individuals to ensure that no aspect of the RSA is overlooked. On projects of a more complex nature, a larger team should be considered.

RSA team background.

RSA team members should have a background in road safety, traffic operations and/or road design. Knowledge of human factors/positive guidance is an asset. At least one member should be an independent local representative. The audit team leader, having the final word on the RSA report and being the primary point of contact between the project owner, the design team, and the audit team, should have a thorough understanding of the RSA process and possess excellent communications and leadership skills.

Role of human factors/positive guidance.

In addition, individuals representing other areas of specialty may also be considered depending on the type of project. These individuals may represent maintenance, enforcement, and first responders. Depending on the specifics of the project, potential team members may also have expertise in pedestrian and bicycle treatments, transit operations, commercial vehicle operations, intelligent transportation systems, or the design of special facilities (e.g., toll plazas, bridges, tunnels, complex freeway structures, roundabouts, traffic calming, etc.). These individuals may not necessarily participate fully in the RSA; rather, they could be called in to provide specific input in their areas of specialty.

Areas of specialty that would further supplement the core skills will vary depending on the RSA phase (pre-construction, construction, or post-construction).

In the pre-construction phase, members of the RSA team must rely on drawings to determine what the project will entail. They need to be able to visualize the road in three dimensions with all its appurtenances. A field investigation of the site of a proposed road will help in visualizing the design and will assist the audit team in better understanding how the new project will transition into existing roads. A preliminary design stage RSA should have a road design engineer skilled in horizontal and vertical road alignment, road cross-section elements, and intersection layout.

A detailed design stage RSA should have a traffic operations engineer skilled in traffic signal control; traffic signs; delineation; pavement markings; pedestrian, bicycle, and transit facilities; and a road design engineer skilled in roadside protection. Consideration should also be given to individuals with experience in road maintenance, enforcement, first response, schools, highway-rail grade crossings and others of useful expertise. Note that it is not necessary to include experts in these fields as formal team members.

In the construction phase, during the pre-opening stage RSA where an on-site review can be conducted, the audit team should have areas of specialty in human factors/positive guidance and maintenance and enforcement.

In the post-construction phase, in which the site can be visited during regular traffic conditions and where crash data would be available to the team, the RSA team may want to have an expert in crash investigation and reconstruction and either a State or local enforcement officer represented.

RSA Team Backgrounds

Road Safety Specialist – The individual should have recognized expertise in the understanding of causal factors that lead to crashes and effective treatments that would address the occurrence of such crashes. The person should be actively involved in conducting road safety audits or evaluations.

Traffic Operations Engineer – The individual should be qualified in the field of traffic operations and know the principles of traffic flow, the relationship between capacity and demand, and what causes congestion. This person should have an understanding of the proper placement and use of signs, pavement markings, traffic signal operations and the impact of different treatments on traffic operations. A traffic operations engineer may be critical for urban projects where congestion is more of an issue.

Road Design Engineer – The individual should have extensive road design experience and be familiar with Federal, State, and local standards in road design. They should understand how different roadway and roadside elements contribute to the relative safety of road users, including both vehicular traffic and vulnerable road users (such as pedestrians and bicyclists), and be familiar with Americans with Disabilities Act (ADA) requirements for road facilities that will be used by pedestrians.

Local Contact Person – The individual should be familiar with the area under review and the traffic safety issues experienced there. A police officer would be ideal to fill this role.

Other areas of specialty – Specialists in human factors, maintenance, enforcement, first response, pedestrian and bicycle treatments, transit operations, ITS, etc. could be called in to provide specific input in their areas of expertise.

Reasonable size of RSA team.

Having a variety of qualifications, while beneficial, should not be achieved through an unreasonably large RSA team. Experience shows that such teams become less effective. The best practice is to have the smallest team that brings all of the necessary knowledge and experience to the process, while consulting with people who have other needed skill sets.

Finally, if selecting the RSA team from outside the public agency, the project owner should remember that the cost of the RSA should be less important than ensuring the team is experienced and qualified. A qualified audit team will have a clear understanding of safety issues arising from the design-and the interaction of road users with the design-and will be able to predict accurately where crashes have the potential to occur independent of the availability of any crash data.

4.3 Step 3: Conduct a Pre-audit Meeting to Review Project Information and Drawings

The objective of the pre-audit meeting is to set the context for the RSA by bringing together the project owner, the design team, and the audit team to discuss its scope and review all information available.

The most effective and efficient way to acquaint the audit team with the project is to have a pre-audit meeting. The purpose of the pre-audit meeting is to:

- Hand over all relevant information to the audit team.
- Review the scope and objectives of the RSA.
- Delegate responsibilities.
- Agree upon a schedule for the completion of the RSA.
- Set up lines of communication between the audit team leader, the project owner, and the design team.
- Communicate matters of importance to the audit team.

Providing project information to the RSA team.

Prior to the pre-audit meeting, the project owner is responsible for ensuring that all relevant project information is provided to the RSA team. This will involve some coordination with the design team, who should be notified well in advance of the RSA. The type of data being provided will vary depending on the RSA stage.

At the meeting, the RSA team leader may provide an overview of the process the team will be undertaking, including the method the it will use to qualitatively evaluate the extent of safety concerns. The design team should inform the RSA team of design criteria, constraints, standards used, the results of previous RSAs, if available and any other pertinent issues. The project owner should ensure that the team understands the scope of the RSA. At the end of the meeting, all three parties should have a clear understanding of the RSA to be undertaken and the roles and responsibilities of each. Both RSA and design teams must have clear understanding that no matter what design constraints exist, if they adversely affect safety, the RSA team will need to identify them as safety concerns and estimate the extent to which safety may be affected.

Understanding your role in the RSA team.

For pre-construction and construction phase RSAs, the project owner will need to provide the RSA team with the design parameters and specifications used, data on traffic and environmental characteristics, and any other documents showing the proposed road design/improvement. The RSA team may also request that the project owner provide them with a listing of all relevant project standards, guidelines and manuals, including, but not limited to, Federal standards such as the Manual on Uniform Traffic Control Devices, NCHRP reports, and State and local design policies, standards and manuals. Minutes of public meetings and agreements with stakeholders for accommodating needs of local communities, and if applicable previous RSA reports and RSA response reports, should also be included in the data made available to the RSA team.

The design parameters that need to be communicated to the RSA team include road function, classification, environment, design speeds, design vehicles, a list of departures from the design standards in the design, and the justification for those departures.

The traffic and environmental characteristics (vehicular, pedestrian/bicyclists volumes on the surrounding road network, unique weather conditions, topography, etc.) are usually included in the operations study report and environmental assessment report. Crash data may be helpful as well, especially for rehabilitation/reconstruction projects. For new construction, crash data for the surrounding road network are not as important; however, they may provide insights into prevailing crash patterns and safety issues in the study area. The required level of detail of the documents showing the proposed road design/improvement is dependent on the design stage, as follows:

- At the preliminary design stage, drawings may be at a relatively small scale (1:3000 - 1:5000 for road sections and 1:1000-1:2500 for intersections). The plan should be sufficient to show the horizontal and vertical alignment of the road, the cross section, connections to adjoining roadways, and proposed traffic control devices at any intersections. For freeways, the basic ramp configuration and lane arrangements should be shown.
- At the detailed design stage and pre-opening stage, the drawings should be of a suit able scale (1:500-1:100 for road sections and 1:300- 1:50 for intersections) and should show all signs, delineation, illumination, pavement markings, lane configuration, landscaping, roadside appurtenances, traffic signal placement, phasing and timing, and roadside protection.

For post-construction RSAs, the project owner will need to provide the audit team with information about road function, classification, environment, traffic and environmental characteristics of the road and adjacent road network (including traffic circulation scheme), crash data detailing the location, type, and severity of each crash for at least a three-year period, as-built drawings at a suitable scale (1:500), and aerial photographs which will be useful to have on hand during the field review.

As with the pre-construction and construction phase RSAs, the post-construction RSAs will benefit from the analysis of previous RSA reports and RSA response reports, as well as results of any previous safety evaluations (e.g., traffic conflict studies). If the records of residents' complaints, police observations of speeding/unsafe behavior, and agreements with stakeholders for accommodating needs of local communities are available, these should be made available to the RSA team as well.

4.4 Step 4: Conduct Review of Project Data and Field Review

The objective of conducting a project data review is to gain insight into the project or existing road, to prepare for the field visit, and to identify preliminary areas of safety concern. The field visit is used to gain further insight into the project or existing road, and to further verify/identify safety concerns.

Review of Project Data

The review of design drawings and other project information is to be conducted prior to and after the field review. Field reviews should be conducted as part of every RSA no matter the stage or type of project. The review of design drawings (including the base map, alignment, and profile) will be crucial to understanding the interaction between the proposed road and its users at the Pre-construction phase while the field reviews are crucial for identifying safety issues on the built road (as in the construction phase during pre-opening RSAs and the post-construction phase during existing road RSAs).

The RSA team should examine the design drawings in detail, imagining how the road would appear from the perspective of road users (including drivers of different vehicle types and older drivers) and, if applicable, cyclists and pedestrians (including pedestrians of different age groups and abilities). A useful approach is to review the design drawings systematically in one direction at a time for each road section and to review each movement individually at freeway interchanges and at-grade intersections.

Individual and team review of project data.

Reviews of the project data and design drawings are performed individually and in a team setting. Individual auditing allows an in-depth consideration of different aspects of the design while "brainstorming" in the team setting can lead to the identification of new safety issues and better ways to mitigate or eliminate safety concerns.

The RSA team members may refer to the checklists described in chapter 8 of this guideline as a means of reminding themselves of relevant aspects of the RSA. During the field review, it may be possible to verify identified issues and identify additional safety issues that might not be evident from the design drawings/project data.

Clarifying or gathering missing data.

In situations where design documentation contains missing or misleading information that the audit team feels is critical to carrying out the RSA, the design team should be contacted and asked for an explanation before the site visit is conducted. This should be done in a cooperative manner, as a means of gaining a better understanding of the proposed project.

The RSA team should restrict its comments to those issues having a bearing on the safety of road users. Their comments may be either specific to a particular location or broad-based, such as mentioning that a particular element of the road design may lead to aggressive driving. Issues relating to aesthetics, amenities, or congestion may also be commented upon, but only if they will lead to less-safe conditions. Comments on safety issues that may be identified outside of the project limits should not be included unless it is a safety issue that would arise as a result of the project itself, such as the potential for traffic to shortcut through an adjoining residential area as a result of an additional traffic congestion during construction on a busy arterial.

Containing comments to issues having a bearing on the safety of road users.

The RSA team should fully review any project data provided to them prior to the field review to familiarize themselves with the location. However, there might be a merit in setting aside for later review the project data that identifies past safety issues (e.g., through crash data) so that it may be used to confirm and complement the RSA findings. Such an approach would allow the RSA team members to remain completely objective during the field review.

The Field Review

The field review is a key task that the RSA team should undertake in all audits. The safety of the RSA team and of all road users during field reviews is a key consideration and should be planned-for at the outset. Proper safety equipment and traffic controls should be used at all times, and the potential for adverse impacts on road traffic and audit team safety must be managed at all times during a field review.

The field review: a key task.

One approach to field reviews is that each RSA team member reviews the entire site independently, noting anything of importance. The team then reviews the site together, discussing the various issues each team member has identified independently. This approach encourages all RSA team members to participate and not to defer to an individual team member who may be perceived to be more experienced. Another approach is for the team to move through the site as a group, with each team member noting issues as they encounter them.

Issues identified in the review of project data should be verified in the field. Photographs and possibly video footage should be taken of anything that may need to be reviewed or revisited while writing the RSA report or while presenting the RSA findings to the project owner and design team.

During the field review, the RSA team must consider all possible movements. On freeways and road sections, both directions of travel should be considered starting at a point beyond the project limits. At interchanges, movements on each ramp, deceleration and acceleration lanes, weaving sections, and ramp terminal intersections should be investigated. At intersections, right, through, and left-turning movements on each approach should be considered. Pedestrian and bicyclist facilities should also be investigated, particularly at points where they come into conflict with vehicular traffic. The audit team should freely refer back to notes made during their review of the project data, design drawings, and checklists to further verify any safety concerns initially identified.

Consider future tie in during pre-construction phase audits.

In the pre-construction phase, the RSA team will not be able to see the actual layout of the site as it will appear upon completion. The audit team should see how the planned road improvement would tie in to the existing road network and examine adjacent roadways to determine how consistent the design will be from the perspective of road users. They should also consider prevailing climatic conditions, surrounding vegetation, and topography.

In the pre-opening stage of construction phase RSAs, the RSA team will have the advantage of seeing the site firsthand prior to opening (driving through the site in all directions and approaches, and walking and bicycling key stretches of the site to gain the perspectives of motorist, pedestrians, and bicyclists). Limitations and specific requirements of drivers of different vehicle types, older drivers, pedestrians of different age groups, disabled persons, etc. should be considered.

The RSA team should also conduct a nighttime visit to identify any issues under conditions.

Observe road users in post-construction audit.

In the post-construction phase, the RSA team will be able not only to observe the site first-hand but also to observe how road users are interacting with the road environment. Post-construction phase audits located in urban areas should be scheduled for the peak periods so that the audit team may observe the road under heavy traffic conditions. Afternoon observations may facilitate remaining on site into the evening so the audit team may observe lower volume conditions and issues relating to inadequate lighting and visibility of roadway delineation. Locations with pedestrian traffic should be reviewed on foot. The RSA team may also take advantage of reviewing the route during periods of inclement weather.

At the end of the field review, the RSA team should have clear understanding of potential safety issues inherent in the design plans and other project data reviewed or observed in the field.

4.5 Step 5: Conduct Audit Analysis and Prepare Report of Findings

The objective of conducting RSA analysis and preparing the RSA report is to succinctly report the findings of the audit team through identification and prioritization of safety issues. Suggestions should then be made for reducing the degree of risk.

Providing guidance on the level of risk associated with safety issues identified.

In the previous step, the audit team will have identified a number of safety issues. Next, the team will finalize the RSA findings and develop suggestions. When considering audit suggestions, the audit team may want to give the design team and the project owner guidance on the level of risk associated with the various safety issues identified (e.g., low, medium or high), according to guidelines established with the project owner at the pre-audit meeting. Each audit team should establish how they wish to evaluate risk and prioritize safety concerns.

Upon completion of the RSA analysis, the audit team leader is ready to write the RSA report. In some instances, the RSA report will need to be written immediately after completion of the site visit, such as in a pre-opening RSA. Other RSAs are typically completed within a relatively short timeframe (two weeks).

The report should be concise. Where possible, the report should include pictures and diagrams as may be considered useful to further illustrate points made. The audit team should number each safety issue identified and, as appropriate, provide a map indicating its location. References to other reports, standards, policies or published research on road safety may also be made within the RSA report.

In the introduction, there should be a brief description of the project, including the scope and objectives and any special issues raised by the project owner or design team. The stage of RSA should be identified. Design and operational elements reviewed and not reviewed should be mentioned. It should be emphasized that some design elements will not be reviewed because of the stage of the RSA.

For example, a planning design audit in the Pre-construction Phase will not contain a review of signs and pavement markings. A pre-opening audit in the Construction Phase will not contain a review of interchange configuration. The project limits should be clearly defined – preferably through use of a map or plan.

Background information should be given identifying the audit team member names, their affiliation and qualifications as well as the date of the pre-audit meeting and dates and times that the RSA was conducted.

Data provided by the project owner and/or design team should be acknowledged. General observations made regarding the site visit should be included such as day and time of visit, traffic, lighting and weather conditions and other extenuating circumstances. The RSA team may want to summarize the features of the road or design that will help, or are helping, to improve safety at that location.

Level of detail of RSA report.

The main body of the report will contain all of the identified safety issues. The audit team may wish to group safety issues into broad topics (e.g. General, Design Issues, Alignment Details, Intersections, Special Road Users, etc.) that are further broken down into subtopics (e.g., Design Standards, Typical Cross Sections and Recovery Zones, Effect of Cross Sectional Variation etc). Alternatively, for smaller projects the audit team may report on safety issues that are high risk first, leaving lower priority concerns until later in the report.

Sample outline of an RSA report

1.0 Introduction

- Scope and purpose of RSA.
- Identification of project stage or existing road or, items reviewed and not reviewed.
- Project limits.

2.0 Background

- Audit team, affiliation and qualifications.
- Commentary on data received from project owner and design team.
- General observations regarding site visit.

3.0 Findings and suggestions

- Safety Issue 1 - Description of issue, evaluation of safety risk, suggestions.
- Safety Issue 2 - etc.

4.0 Formal statement - concluding statement signed by RSA team members indicating that they have participated in the RSA and agreed or reached consensus on its findings.

Each safety issue should be identified in the report with a brief description of why it poses a risk. The issue identified should be specific. An appropriate example of how to word a safety issue in an RSA report may be:

"Because the horizontal curve immediately west of the Black Street overpass is sharp there is a higher risk of run off the road crashes associated with this location. Consideration could be given first to realignment of the curve. If that is not feasible, the addition of advance warning signing and/or delineators for drivers at this location would highlight the presence of the curve."

Broad descriptions of safety issues should be avoided. An inappropriate example of a safety issue description would be:

"Horizontal alignment at many locations along Smith Freeway is not acceptable and may cause crashes to occur."

Do's and don'ts in documenting RSA suggestions.

Terms such as "unsafe", "sub-standard", "unacceptable", and "deficient" should be avoided.

Suggestions for improvement should be constructive and realistic (bearing in mind the costs involved), and should recognize that the project owner may have several different options to achieve the desired result. The audit team leader should not demand specific corrective measures. It will be up to the project owner and design team to review the safety issue and determine how best to implement the suggestion.

Suggestions should be appropriate to the stage in the RSA and the elements being examined. In a pre-opening RSA in the Construction Phase, it would not be appropriate to suggest making modifications to the vertical alignment of the roadway due to sight distance issues approaching a STOP controlled intersection. More appropriate suggestions may be warning signs, rumble strips, or the removal of trees to improve sight distance. Conversely in a preliminary design RSA in the Pre-construction Phase, it would not be appropriate to suggest installing a guard rail along a sharp curve. A more appropriate suggestion would be flattening the curve itself.

Framing RSA suggestions.

After the main body of the report, the audit team leader may suggest that another RSA be conducted at a later point in the project or on subsequent changes to the road design, if significant design alterations were suggested in the RSA report.

At the end of the report, the audit team leader may consider including a statement signed by each audit team member. The statement would declare that the audit team members listed in the report participated in the RSA and agree with its findings.

4.6 Step 6: Present Audit Findings to Project Owner/Design Team

The objective of presenting audit findings to the project owner and design team is to report orally the key findings of the audit as presented in the audit report.

Sharing positive findings and identifying opportunities to improve safety.

The RSA team should begin by reviewing the scope of the audit and may want to consider starting by sharing some "positives" as noted in the RSA. They may also preface the meeting with a reminder that the intent of a RSA is to identify opportunities to improve safety, rather than critique the work of the design team.

If safety concerns are identified, comments should be kept as specific as possible. Issues identified should be described in terms of where they are located and how they represent a safety risk. Pictures or video footage may be shown to the project owner and design team to further illustrate the issue. This opportunity allows informal feedback from the project owner, for the RSA team to clarify its findings and suggestions, and to ensure that findings are within the scope of the RSA.

Should the RSA findings be discussed with the project owner before the RSA report is finalized?

PennDOT found that it is very beneficial to meet with the project owner before the RSA report is finalized and review the preliminary findings. In a number of cases, the project owner was aware of the safety issue and had considered the suggestions, but had additional knowledge and information concerning the issue that the RSA team was not aware of. PennDOT believes the use of a preliminary findings meeting makes the RSA report more valuable and acceptable to the owner and reduces the amount of unnecessary paperwork documentation by the project owner.

On the other hand, there is a risk that the project owner might try to defend issues and then use his/her influence to dictate the contents of the RSA report, which would defeat the purpose of an independent review. A written record of the meeting with the project owner will help avoid the appearance of arbitrary decisions. Also, if such meeting is properly documented, it will provide a background if an RSA report does not contain certain safety issues.

4.7 Step 7: Prepare Formal Response

The objective of responding to the audit report is for the project owner and the design team to document their response to the findings of the audit report

Once the project owner and the design team have reviewed the audit report, they should jointly prepare a written response to its findings. The response should outline what actions the project owner or design team will take related to each safety concern listed in the audit report. The documentation of a formal response is especially beneficial if the project owner and the design team are not planning on addressing all of the safety issues outlined in the RSA report. A letter report format, signed by the project owner, is a valid method of responding to the RSA report.

In responding to the RSA report, the project owner and design team will have to bear in mind all of the competing objectives involved in a project, some of which may be seen as conflicting with safety. The project owner and design team may consider the following in choosing whether or not to proceed with a suggestion:

Considerations in proceeding with an RSA suggestion.

- Is the RSA report finding within the scope of the project?
- Would the suggestion made in the RSA report address the safety issue, reducing the likelihood of occurrence and/or resultant severity?
- Will the suggestion made in the RSA report lead to mobility, environmental, or other non-safety related problems?
- What would be the cost associated with implementing the suggestion? Are there more cost-effective alternatives that would be equally effective?

Based on the outcome, the project owner and/or design team may agree that a valid safety issue has been identified. In this situation, they may either:

- Agree with the suggestion described by the audit team and commit to its implementation, outlining a schedule for the completion of the suggestion.
- Disagree with the suggestion described by the audit team and commit to an alternative, outlining a schedule for the completion of the alternative. In doing so, the project owner and design team should provide a valid reason as to why they choose not to adopt the audit team's suggestion.

Documenting reasons in RSA response.

- Choose not to implement any improvement at all due to project constraints. In doing so, the project owner and design team should document the reasoning behind their decision.

Alternatively, in rare situations, the project owner and/or design team may disagree with the audit team regarding the safety issue, believing that there is no increased risk associated with the concern raised by the audit team. In doing so, the project owner and/or design team must document the reasoning behind their decision.

4.8 Step 8: Incorporate Findings into the Project when Appropriate

The objective of the final step is to incorporate findings into the project when appropriate and to ensure that the RSA process is a learning experience for all parties.

Once the response report is sent to the RSA team, the project owner and design team will need to ensure that the agreements described in the response report are completed as described and in the time-frame documented.

Using RSAs as a learning opportunity.

Having committed to a process of RSAs, the project owner and design team should use the RSA as a learning opportunity. Internally, the recipients of the RSA report should have gained a better understanding of road safety and principles of road design, operations, and human factors that either contribute to or take away from the elements of risk on their road network. This knowledge may then be applied to future projects and, therefore, through repeated experiences, the project owner and design team will ultimately be managing and designing a safer road network.

The project owner and design team should also review the RSA process to aid in refining future audits. Key questions they may ask themselves are:

Key questions to consider when reviewing the RSA process.

- Was the RSA done at the correct stage?
- Would it have been more effective to conduct the RSA at an earlier stage where the safety issues could have been addressed in a more cost-effective way?
- Were the parameters established at the beginning of the RSA appropriate in meeting the desired objectives?
- Did the audit team get all of the data they required to conduct the RSA?
- Was enough time allocated for the RSA?
- Was the audit team timely in their response?
- Did the audit team satisfy the requirements of the RSA?
- Were the safety issues identified and suggestions made by the audit team responded to in an appropriate way and in a timely fashion?
- Is there any evidence that safety has been improved at the study location?

5.0 Pre-construction Road Safety Audits

In the pre-construction phase, the audit team has the greatest potential to improve safety as they are examining the design before a road facility is built. Pre-construction phase RSAs can be conducted on any proposed project that is likely to alter interactions between different road users or between road users and the road environment.

This chapter will discuss two stages of RSAs that may occur within the pre-construction phase:

- Preliminary design stage RSAs (plans 30-40% complete).
- Detailed design stage RSAs (plans 60-80% complete).

As shown in Exhibit 3.1, RSAs may also be conducted at the planning stage; however, this version of the guideline does not provide details on how to conduct planning stage RSAs. **Prompt list 1** provided at the end of this guideline lists the items that would be within the scope of a planning stage RSA.

If a land use development proposal forms part of the design or may impact the design or the adjacent road network, it should be included in the RSA. **Prompt list 7** provided at the end of this guideline lists the items that would be within the scope of land use development proposal RSAs.

5.1 Preliminary Design Road Safety Audits

Preliminary design RSAs are conducted on the preliminary (functional) design drawings. At this stage, design drawings may show only general details regarding road alignment and the profile of the road along with typical cross-sections. Design drawings for intersections and interchanges should be at a larger scale to allow for closer scrutiny by the RSA team. A base map may show vertical contours, watercourses, and existing roads, structures, and property lines.

What to consider in preliminary design RSAs.

During preliminary design RSAs, the RSA team will not be able to see the actual layout of the site as it will appear upon completion, but should still conduct a field investigation.

The RSA team should see how the planned road improvement will tie in to the existing road network and examine adjacent roadways to determine how consistent the design will be from the perspectives of different road users. They should consider prevailing climatic conditions, surrounding vegetation, and topography.

At this point in the life of a project, fundamental decisions regarding route choice, the overall design, and layout of the project have already been decided.

However, the audit team may still suggest significant physical changes, such as horizontal and vertical alignment, provision of a median, lane and shoulder width, provision of bicycle lanes and sidewalks, and channelization. Access provided (driveways, intersections, interchanges) should be reviewed for upstream/downstream effects, potentially conflicting movements, and sight distances. Consolidation of access points may still be considered at this time.

If alternative options are still being considered, the RSA team should review each of the alternatives. Where significant land acquisition is involved in the project, the RSA should be conducted before acquisition is finalized in the event that the RSA team recommends significant changes to horizontal alignment that would require additional land.

What is the purpose of a preliminary design RSA?

- Avoid wasting significant time and effort in redesigning at a later point in the project (during detailed design).
- Ensure safety isn't compromised when project elements meeting minimum design standards interact.
- Evaluate whether departures from standards will significantly impact safety.
- Evaluate horizontal and vertical alignments (roadway and roadside cross-sections), interchange configuration, intersection layout, and access location,
- Determine how any project staging will impact safety.
- Determine if the needs of all road user groups are being met.

If staged implementation of the project is to be carried out, each stage should be considered as well as the transition between each stage. The ability of the design to accommodate any future widening, expansion, or extension should be considered.

5.2 Detailed Design Road Safety Audits

A detailed design RSA is conducted before completion of the final design drawings (plans 60-80% complete) for the construction of a road facility. The project owner may consider providing intersection and interchange layouts at an even larger scale to allow for a more thorough examination. The base map will show in significant detail existing vegetation, vertical contours, watercourses, and existing roads and property lines at a large scale. Design drawings made available to the RSA team will be large scale and will show significant detail, as follows:

Information available in a detailed design RSA.

- Horizontal and vertical alignment: drawings showing the alignment and vertical profile.
- Cross section: number and width of lanes, bike lanes, shoulders, drainage, curbs and gutters, boulevards, medians, sidewalks, clear zone, roadside barriers, significant road side structures, and potential roadside hazards.
- Intersection layout: including all traffic control devices, signs, pavement markings, number of lanes on each approach, medians, and channelization.
- Interchange layout: including advance and exit and exit direction signs, length and width of acceleration/deceleration lanes, delineation, gore area treatments, and road side barriers.

- Pedestrian treatments: curb ramps, crosswalks designed to be accessible for pedestrians with a disability, accessible pedestrian paths, pedestrian signals, special pavement surfaces, and fencing.
- Bicycle treatments: bike lanes and bike paths.
- Other details: driveway accesses, landscaping and traffic calming devices, illumination, signs, marking, and delineation.

What is the purpose of a detailed design RSA?

- Identify and address any design issue prior to the construction stage.
- Evaluate whether departures from standards will significantly impact safety.
- Evaluate the safety of road features not previously made available to the audit team (such as signage, pavement markings, clear zone, roadside protection and landscaping).
- Determine if the needs of all road users have been adequately and safely met.
- Review the interaction of the various design elements with each other and with the surrounding road network.
- Identify anything missed during a previous audit.
- Follow-up on any issue identified in a previous audit.

The audit team may wish to ask the project manager about any other details pertinent to the RSA that are absent from the design drawings. If alternative plans are still being considered, the audit team should review each alternative option as well.

During detailed design RSAs, if road grading has started, the audit team will have a greater opportunity to appreciate the layout of the roadway in the context of its location through a field investigation. They should see how the planned road improvement would tie in to the existing road network and examine adjacent roadways to determine how consistent the design will be from the perspective of road users.

Detailed design RSAs provide the last opportunity to change the design before actual construction of the road commences. Land acquisition may be finalized at this stage and will prevent the audit team from making any recommendations involving significant changes to road alignment or road cross section.

As with preliminary design RSAs, if staged implementation of the project is to be carried out, each stage should be considered as well as the transition between each stage. The ability of the design to accommodate any future widening, expansion, or extension should also be considered.

Prompt list 3 provided at the end of this guideline lists the items that would be within the scope of the RSA of the detailed design.

6.0 Construction Road Safety Audits

In the lifecycle of a project, when the detailed design drawings are complete, the project is ready to proceed to the construction phase. As shown in Exhibit 3.1, three different types of RSAs are possible during the construction phase, as follows:

- An RSA of a work zone traffic control plan.
- An RSA of changes in design during construction.
- A pre-opening RSA.

Prompt list 4 provided at the end of this guideline lists the items that could be within the scope of a work zone traffic control plan RSA. **Prompt lists 3 and 5** may be of assistance in conducting RSAs of changes in design during construction. RSAs of changes in design during construction and RSAs of work zone traffic control plans are not discussed further in this version of the guideline.

This chapter will discusses pre-opening RSAs. This type of RSA permits the RSA team to conduct a thorough on-site investigation of the existing road that will complement design drawings and other project data provided to the audit team.

6.1 Pre-Opening Road Safety Audits

When pre-opening RSAs are usually performed.

Pre-opening RSAs are usually performed on newly constructed road facilities immediately prior to their opening. They represent the last opportunity that an RSA team has to identify potential safety concerns before the facility is opened to road users.

What is the purpose of a pre-opening RSA?

- Identify and address any safety issue prior to the post-construction stage.
- Evaluate the safety of road features not apparent or indicated on the detailed design drawings.
- Determine if the needs of all road users have been adequately and safely met.
- Confirm that any temporary signage, temporary pavement markings, construction equipment, barriers, fencing, materials and debris have been removed from the newly constructed road facility.
- Review firsthand the interaction of the various design elements with each other and with the surrounding road network.
- Identify anything missed during a previous audit.
- Follow-up on any issue identified in a previous audit.

The RSA team will have an opportunity to conduct a detailed inspection of the road facility and points of connection with the existing road network. They will want to conduct the field investigation by driving through the site and walking along key stretches by foot to see the entire road facility first hand, both in daylight and in darkness. A review at night will be extremely helpful as the layout of the road will look completely different in darkness. Issues of inadequate lighting, misleading delineation, and hidden roadside hazards may be identified during the nighttime review.

The field investigation will be a critical component of the RSA team's evaluation. In addition, the RSA team may be under a time constraint and may need to provide a quick response to the project owner and design team. To expedite the process, the RSA team may conduct their field investigation and then meet with the project owner and design team immediately afterwards while still on-site to show them firsthand any identified safety issues and suggested improvements.

This will allow the project owner and design team to address the identified safety issues immediately, minimizing any delay to the opening of the road facility. The RSA team may then follow up with their audit report, and the project owner and design team may complete the corresponding response report after the opening of the road facility.

Coordinating activities to reduce delay.

During the site visit, RSA team members with a police and maintenance background may prove to be a valuable addition to the RSA team.

Since the road facility will have been built in its entirety, it will likely not be feasible for the RSA team to make suggestions involving any physical changes to the cross section, layout, or alignment of the roadway. Suggestions will likely focus on changes to illumination, signage, delineation, pavement markings, roadside barriers, removal of fixed object hazards, or on minor structural changes (addition of a wheelchair ramp). Yet even minor changes to the road facility can significantly reduce safety risk at a minimal cost.

Scope of suggestions in pre-opening RSAs.

Along with any additional project data provided by the project owner and design team, adjacent facilities such as hospitals, fire stations, nursing homes, schools, playgrounds, and warehouses will provide clues as to what types of road users may be present.

Pre-opening RSAs should not be seen as simply conformance checks against existing standards, or even a check to ensure that the road facility was built according to the design drawings, although both of these may be determined in the field.

7.0 Post-construction Road Safety Audits

RSAs in the post-construction phase (referred to here as an RSA of existing roads) will have a different focus from a traditional safety review or investigation of crash history.

7.1 RSA of Existing Roads

Traditional safety reviews and investigations of crash history rely primarily on crash data to determine what safety issues are occurring at the site. They are reactive as they mainly identify safety issues after a crash or pattern of crashes have occurred and are often initiated in response to an unusually high number of crashes occurring along a section of road or at a particular intersection or interchange.

What is the purpose of an RSA on existing roads?

- Evaluate all roadway and roadside features, design elements and local conditions (glare, night visibility, adjacent land uses, etc.) that would increase the likelihood and severity of a crash.
- Review firsthand the interaction of the various design elements with each other and the surrounding road network.
- Observe how road users are interacting with the road facility.
- Determine if the needs of all road users have been adequately and safely met.
- Explore emerging operational trends or safety issues at that location.

In contrast, RSAs of existing roads rely mainly on the site visit, as-built design drawings (if kept up to date), and other project data (e.g., previous reports) to determine what safety issues are expected to arise at the site. This will provide the RSA team with an accurate picture as to the level of safety on the road. For this reason, RSAs are proactive as they can identify where crashes will likely occur and what will be their resultant severity. Crash data, if available, should be used to supplement any findings made as a result of the site visit and review of project data. However, the RSA team may choose not to examine the crash history until after the project data review and site visit have been completed so that their evaluation is not biased by the crash data. Also, crash data is often dated and does not always help in determining emerging operational trends or safety issues at a location.

The following project data may be provided to/requested by the RSA team:

- As-built design drawings (noting whether these accurately reflect existing conditions).
- Previous crash investigations conducted.
- Crash data (by location, crash type, and severity).
- Volume data.
- Speed data.
- Signal timing plans (if applicable).
- Roadway functional classification.
- Existing policies, standards, and guidelines.
- Previous audit reports.

Range of scope for existing road RSAs.

RSAs of existing roads may vary in scope. Three different, commonly-conducted types of RSAs on existing roads are as follows:

- RSAs of specific locations.
- RSAs of an entire highway section, freeway section, or road network.
- RSAs of a specific feature or design element within an entire highway section, freeway section, or road network.

Observing driver behavior during the field visit.

When conducting RSAs of existing roads, the RSA team will have the advantage over pre-construction and construction phase audits in that they may not only observe the various road features and how they complement each other but also see how road users are interacting with the road facility. They may observe incidents of driver behavior that suggest something inherently wrong, misleading, or absent in the road design. Vulnerable road users (e.g. elderly drivers or pedestrians, visually impaired pedestrians, children) may be observed having particular difficulty negotiating through a site being investigated. Alternatively, they may observe motorists committing traffic offenses (e.g. excessive speed, red light running, failing to yield to pedestrians) and may suggest an enforcement or education-based treatment.

Examining physical evidence of past crashes and off-road excursions.

Another advantage of conducting RSAs of existing roads over RSAs in the pre-construction or construction phase is the RSA team's ability to observe physical evidence of past crashes and off-road excursions, such as:

- Damage to curbs, roadside barriers, trees, utility poles, delineator posts, and signs.
- Scuff marks on curbs and concrete barriers.
- Skid marks, broken glass, oil patches on the road.
- Vehicle tracks or rutting in the ground adjacent to a roadway

Such evidence will assist in diagnosing possible areas of elevated safety risk. Where damage has occurred such that a roadside feature has been compromised, this should be noted and reported in the audit as a maintenance concern.

For RSAs of existing roads, unless otherwise directed by the project owner, all roadway and roadside features or elements are to be considered as within the scope of the RSA, as in a detailed design stage RSAs.

Another feature of RSAs of existing roads is that, at the outset, the RSA team will want to consider whether the road facility under review has the same function and classification as it did when it was originally designed and constructed. Changes in traffic volume, vehicle mix, increased presence of vulnerable road users, or adjoining land use developments may have rendered the original classification and design of the facility obsolete. Standards, policies and guidelines may be a starting point for the RSA team in identifying roadway/roadside elements or features that are no longer consistent with the function and classification of the road, and are potentially posing a risk to road users.

Part C

CHAPTER 8

ROAD SAFETY AUDIT TOOLS

8.0 Road Safety Audit Prompt Lists

8.1 Purpose of Prompt Lists

Using RSA prompt lists.

The purposes of RSA prompt lists are to help the RSA team identify potential safety issues and to ensure that they do not overlook something important. The prompt lists may also be used by designers to help them identify potential safety issues proactively as they develop their design.

RSA prompt lists, even the most detailed ones, should be viewed as a prompt only. They are not a substitute for knowledge and experience; rather, they are an aid in the application of knowledge and experience. The RSA high-level prompt lists appended to this guideline are not all-inclusive, nor will they cover all potential issues and circumstances.

8.2 Organization of Prompt Lists

High-level prompt lists and an example of a detailed prompt list are included in this section. They provide a high-level outline of the topics typically considered to be within the scope of RSAs conducted at each stage and highlight areas that should be examined for safety issues. More detailed prompt lists are provided on the FHWA website at http://safety.fhwa.dot.gov/rsa.

The RSA prompt lists provided are organized as follows:

Prompt lists for each RSA stage.

Pre-construction Phase

- **Prompt List 1** – Planning Stage.
- **Prompt List 2** – Preliminary Design Stage.
- **Prompt List 3** - Detailed Design Stage.

Construction Phase

- **Prompt List 4** – Work Zone Traffic Control Plan Stage.
- **Prompt List 5** – Pre-Opening Stage.

Post-construction Phase

- **Prompt List 6** – Existing Roads Stage.

Development Projects

- **Prompt List 7** – Land Use Development.

More detailed prompt lists are available at http://safety.fhwa.dot.gov/rsa.

8.3 When to Use the Prompt Lists

The prompt lists are for use during RSAs when:

- Reviewing project data, in particular, when project drawings are being examined.
- Conducting site visits.
- Conducting the RSA analysis.
- Writing the RSA report.

During project data and plan review, prompt lists may assist the RSA team in identifying missing information relevant to the scope of the RSA.

During pre-construction phase RSA site visits, a review of prompt lists may assist the RSA team in visualizing and assessing how the proposed design will integrate with existing road and environmental features. During construction phase and post-construction phase RSA site visits, the prompt lists provide a means of ensuring no safety-related elements are overlooked.

When filled out during project data and plan review, and during the field visits, the information contained in the comment fields of the prompt lists may subsequently be used to facilitate writing the audit report more rapidly and accurately.

Prompt lists should not be appended to the RSA report. The written RSA report should contain a sufficient explanation of the identified safety issues, the extent of safety concern, and the resulting suggestions, without any need to refer to notes or prompt lists.

8.4 How to Use the Prompt lists

Using prompt lists to facilitate RSAs.

Prompt lists, if used, should be applied in a way that best meets each RSA team member's needs. The prompt lists are structured to support the RSA team regardless of how they choose to undertake their work (independently then collectively, by progressing through the project in the same manner as a road user, or by examining each feature as it manifests itself in the project). Just as there is no single way to identify safety issues, there is no single way to use prompt lists.

Even the most detailed prompt lists cover only the more common elements of design and practice. Prompt lists are not exhaustive. RSA team members should use their own skills and judgment about the safety of any feature. If a listed topic is not apparently relevant to the project being audited, a broad view of the topic should be taken to see if it prompts a relevant question. For example, sight lines may be obstructed by features not listed in the prompt lists, but only at particular times of day or during a particular season of the year. Where a land use development proposal forms part of the design, may impact the design, or may impact the adjacent road network, the prompt list for the land use development should be used to complement the prompt lists for the related RSA stage. An understanding of the general environment around the project will help auditors make the best use of prompt lists.

A General Procedure for Using Prompt Lists

The following outlines a general procedure of using prompt lists:

Approach to using prompt lists.

- Before starting, the RSA team should decide collectively if they want to use prompt lists, and if so, which prompt lists to use, and how to use them. The prompt lists appended to this guideline are general prompts only. The RSA team may wish to photocopy the prompt lists provided. More detailed, printable prompt lists are downloadable from the FHWA RSA website. Alternatively, electronic prompt lists may be downloaded from the website, and installed on RSA team computers.
- Some RSA team members may find it useful to tailor the electronic prompt lists to a specific scheme to be audited (delete non-relevant items or adding specific questions to be prompted);
- The prompt lists are generally designed to help the RSA team members to think about broader issues first ("general topics") and to get into specific details after the more general issues are considered. Note that even though some checklist items may seem similar, they appear in different sections and are supposed to be interpreted differently; i.e., in relation to the topic of the section (e.g., "General Topics" as opposed to "Intersections," etc.).
- In the RSA process, the RSA team may note on the prompt lists any issues that represent a safety concern or require further review and provide their comments. Additional details can be logged on the plans and drawings. It is helpful to take photographs illustrating the identified safety concerns and reference them in the prompt lists. These graphics may be used during RSA analyses and may subsequently be appended to the RSA report.

PROMPT LIST 1

Planning Stage Audit

General Topics	Design Issues	Intersections	Interchanges	Environmental Constraints	Safety Aspects Not Already Covered
1 Scope of project, function, traffic mix, road users	1 Route choice	1 Location, spacing types	1 Location, spacing	1 Surrounding terrain	Flooding, rail crossings, roadside parking, special events, emergency vehicles, rest areas, etc
2 Type and degree of access to property and developments	2 Impact of continuity with the existing net-work	2 'Readabilityí (perception) by drivers	2 Types, layouts	2 Weather, sunlight	
3 Major generators of traffic	3 Broad design standards	3 Road users, traffic mix	3 Ramps, terminal intersections	3 Noise barriers, animal fencing	
4 Staging of construction	4 Design speed	4 Design consistency	4 Design consistency	4 Animal crossings	
5 Future reconstruction projects	5 Design volume and traffic characteristics	5 Number of lanes	5 Number of lanes	5 Visual distractions	
6 Wider network effects	6 Right of way			6 Unstable land	
	7 Combination of features				

PROMPT LIST 2

Preliminary Design Stage Audit

General Topics	Design Issues	Alignment Details	Intersections	Interchanges	Special Road Users	Lighting, Signs and Delineation	Traffic Management	Environmental Constraints	Safety Aspects Not Already Covered
1 Drainage	1 Design Standards	1 Geometry of horizontal and vertical alignment	1 Visibility to and visibility at intersections	1 Visibility	1 Adjacent land	1 Lighting	1 Traffic flow and access restrictions	1 Surrounding terrain	Special events, consequent unusual or hazardous conditions, oversize vehicles, etc.
2 Landscaping	2 Typical cross sections and recovery zones	2 Visibility and sight distance	2 Layout, including the appropriateness of type	2 Layout, control	2 Pedestrians	2 Signs	2 Passing and merges	2 Weather, sunlight	
3 Utility accommodations	3 Effect of cross sectional variation	3 New/existing road transitions	3 'Readability' (perception) by drivers	3 Lanes, shoulders	3 Bicyclists	3 Marking and delineation	3 Rest areas and stopping zones	3 Noise barriers, animal fencing	
4 Access to property and developments	4 Roadway layout	4 'Readability' (perception) of the alignment by drivers	4 Pedestrians, bicyclists	4 Ramps	4 Older drivers		4 Construction and operation	4 Animal crossings	
5 Adjacent developments	5 Shoulders and edge treatment		5 Design consistency	5 Pedestrians, bicyclists	5 Motorcyclists			5 Visual distractions	
6 Emergency vehicles and access	6 Effect of departures from standards or guidelines			6 Design consistency	6 Equestrians and stock			6 Unstable land	
7 Future reconstruction projects (widening and/or realignments)	7 Flexibility of the design			7 Clearances, visual perception of structures	7 Motor carriers				
8 Staging of construction	8 Design consistency				8 Public transport				
9 Maintenance					9 Road maintenance vehicles				
10 Human factors					10 Snowmobiles and ATVs				
11 Changes since previous audit					11 Special (slow moving) vehicles				

PROMPT LIST 3

Final Design Stage Audit

General Topics

1 Drainage

2 Landscaping

3 Utilities

4 Access to property and developments

5 Emergencies; break downs; emergency and service vehicle access

6 Future reconstruction projects (widening and/or realignments)

7 Staging of construction

8 Adjacent developments

9 Stability of cut and fill

10 Skid Resistance

11 Maintenance

12 Human Factors

13 Changes since previous audit

Design Issues

1 Geometry of horizontal and vertical alignment

2 Typical cross sections and recovery zones

3 Effect of cross sectional variation

4 Roadway layout

5 Shoulders and edge treatment

6 Effect of departures from standards or guidelines

Alignment Details

1 Visibility and sight distance

2 New/existing road transitions

3 'Readability' (perception) of the alignment by drivers

4 Detail of geometric design

5 Transitions to bridges and culverts

6 Combinations of features

Intersections

1 Visibility to and visibility at intersections

2 Layout

3 'Readability' (perception) by drivers

4 Pedestrians, bicyclists

5 Detailed geometric design

6 Traffic signals

7 Signing and marking

8 Roundabouts

9 Other Intersections

10 Lighting

Interchanges

1 Visibility

2 Layout

3 Lanes, shoulders

4 Ramps

5 Pedestrians, bicyclists

6 Signing and marking

7 Clearances, visual perception of structures

8 Lighting

Special Road Users

1 Adjacent land

2 Pedestrians

3 Bicyclists

4 Older drivers

5 Motorcyclists

6 Equestrians and stock

7 Motor carriers

8 Public transport

9 Road maintenance vehicles

10 Snowmobiles and ATVs

11 Special (slow moving) vehicles

Lighting, Signs and Delineation

1 Lighting

2 Signs

3 Marking and delineation

Roadside

1 Median barriers

2 Poles and other obstructions

3 Roadside barriers

4 Pedestrian railing

5 Bridges, culverts and causeways/floodways

Environmental Constraints

1 Weather, sunlight

2 Noise barriers, wildlife fencing

3 Animal crossings

4 Visual distractions

5 Unstable land

Safety Aspects Not Already Covered

Special events, consequent unusual or hazardous conditions, oversize vehicles, etc.

PROMPT LIST 4

Work Zone Traffic Control Plan Audit

Road Function, Classification, Environment	Traffic Management	Alignment	Parking and Servicing	Signs and Marking	Landscaping	Safety Aspects Not Already Covered
1 Office documentation and set up of work zone	1 Traffic controls	1 Signs	1 Temporary traffic signals	1 General	1 Pavement defects	
2 Alignment	2 Speed management	2 Day/night sign requirements	2 Location	2 Elderly and disabled access	2 Skid resistance	
3 Turning radii and tapers	3 Work site access	3 Traffic control	3 Visibility	3 Bicyclists	3 Ponding/icing/ snow accumulation	
4 Traffic lane safety and visibility		4 Delineation and reflective markers	4 Signal display			
5 Night time safety		5 Pavement marking	5 Traffic movements			
6 Maintenance		6 Detours				
7 Access to property						
8 Safety barriers						
9 Human factors						
10 Work zone inspections						

PROMPT LIST 5

Pre-Opening Stage Audit

General Topics

1 Drainage

2 Climatic conditions

3 Landscaping

4 Utilities

5 Access to property and developments

6 Emergency vehicles and access

7 Side slope treatment

8 Shoulders and edge delineators

9 Signs and markings

10 Surface treatment, skid resistance

11 Changes since previous audit: translation of design into practice

12 Contrast with markings

13 Roadside hazards

14 Natural features

15 All road users

16 Speed zoning

17 Human factors

Alignment Details

1 Visibility, sight distance

2 New/existing road transitions

3 'Readability' (perception) of the alignment by drivers

4 Bridges and culverts

Intersections

1 Visibility of intersection

2 Visibility at intersection

3 'Readability (perception) by drivers

4 Pedestrians, bicyclists

5 Traffic signals

6 Signing and marking

7 Roundabouts and approach islands

8 Lighting

Interchanges

1 Visibility, sight distance

2 'Readability' (perception) by drivers

3 Signing, marking, delineation

4 Pedestrians, bicyclists

5 Lighting

Special Road Users

1 Adjacent land

2 Pedestrians

3 Bicyclists

4 Older drivers

5 Motorcyclists

6 Equestrians

7 Motor carriers

8 Public transport

9 Road maintenance vehicles

10 Snowmobilies and ATVs

11 Special (slow moving) vehicles

Lighting, Signs and Delineation

1 Lighting

2 Signs

3 Marking and delineation

Roadside

1 Median barriers

2 Poles and other obstructions

3 Roadside barriers

4 Pedestrian railing

5 Bridges, culverts and causeways/floodways

Operation

1 Operation

2 Traffic management

3 Removal of temporary traffic control/ management devices

Safety Aspects Not Already Covered

PROMPT LIST 6 (1 OF 2)

Existing Road Audit

Road Function, Classification, Environment	Road Alignment and Cross Section	Auxiliary Lanes	Intersections	Interchanges	Signs and Lighting	Marking and Delineation	Barriers and Clear Zones	Traffic Signals	Pedestrians and Bicyclists
	1 Visibility, sight distance	1 Tapers	1 Location	1 Visibility, sight distance	1 Lighting	1 General issues	1 Clear zones	1 Operations	1 General issues
	2 Design speed	2 Shoulders	2 Visibility, sight distance	2 Lanes, shoulders	2 General signs issues	2 Centerlines, edge-lines, lane lines	2 Barriers	2 Visibility	2 Pedestrians
	3 Speed limit/speed zoning	3 Signs and markings	3 Signing and marking	3 Signing, marking, delineation	3 Sign legibility	3 Guideposts and reflectors	3 End treatments /Crash cushions	3 Placement of signal heads	3 Bicyclists
	4 Passing	4 Turning traffic	4 Layout and 'read-ability' (perception) by drivers	4 Pedestrians, bicyclists	4 Sign supports	4 Curve warning and delineation	4 Pedestrian railing		4 Public transport
	5 'Readability' (perception) of the alignment by drivers		5 Pedestrians, bicyclists	5 Lighting			5 Visibility of barriers and fences		
	6 Human factors		6 Lighting						
	7 Widths								
	8 Shoulders								
	9 Cross slopes								
	10 Side slopes								
	11 Drains								
	12 Combinations of features								

PROMPT LIST 6 (2 OF 2)

Existing Road Audit

Older Drivers

1 Turning operations (receiving lane widths, radii)

2 Channelization, opposing left turn lanes

3 Sight triangles

4 Signing, marking and delineation

5 Traffic signals

Bridges and Culverts

1 Design features

2 Barriers

3 Pedestrian and recreational facilities, delineation

Pavement

1 Pavement defects

2 Skid resistance

3 Ponding/icing/snow accumulation

4 Loose stones/material

5 Manholes

Parking

Provision For Heavy Vehicles

1 Design issues

2 Pavement/shoulder quality

Floodways and Causeways

1 Ponding and flooding

2 Safety of devices

Other Safety Issues

1 Landscaping

2 Temporary works

3 Headlight glare

4 Roadside activities

5 Signs of possible problems (pavement, roadside)

6 Rest areas

7 Environment

8 Median curbing

PROMPT LIST 7

Land Use Development Proposals Audit

Road Function, Classification, Environment	Traffic Management	Alignment	Parking and Servicing	Signs and Marking	Landscaping	Safety Aspects Not Already Covered
		1 Horizontal alignment	1 Parking provision			
		2 Vertical alignment	2 Servicing facilities			

Prompt List 1 - Detailed (Sample portion)

Planning Stage Audit

Intersections

1. Location, spacing, types

- Are all intersections located safely with respect to the horizontal and vertical alignment?
- Where intersections occur at the end of high-speed environments (e.g., at approaches to towns); are there traffic control devices to alert drivers?

2. Readability (perception) by drivers

- Is the form and function of the intersection clear to drivers on all approaches? (Check by driving.)
- Are all conflict points between vehicles safely managed?
- Is the intersection layout obvious to all road users?
- Is the alignment of curbs obvious and appropriate?
- Is the alignment of traffic islands obvious and appropriate?
- Is the alignment of medians obvious and appropriate?
- Can all likely vehicle types be accommodated?
- Are merge tapers long enough?
- Is the intersection free of capacity problems that may produce safety problems?
- Are there sufficient visual cues to prevent overshooting into the conflicting traffic?

3. Road Users, traffic mix

Pedestrians, bicyclists

- Are the sight lines adequate for the safety of all pedestrian groups?
- Is the movement of vulnerable road users safely accommodated at all intersections?

4. Design Consistency

.....

APPENDIX A

Reactive and Proactive Approaches to Road Safety

Limitations to the reactive approach to road safety.

A **reactive approach** *to road safety is associated with the identification of locations experiencing safety problems (screening), problem definition (diagnosis), and the identification and implementation of countermeasures (cure).*

A **proactive approach** *to road safety is associated with the prevention of safety problems before they manifest themselves in the form of a pattern of crash occurrence.*

Both prevention and cure should be inherent elements of an overall road safety management system.

A **reactive approach** to road safety is based on the analysis of existing crash data. Road safety improvements proposed are considered in reaction to identified safety problems brought to light by crashes that have occurred after the road has been designed, built, and opened to the traveling public. Traditional reactive road safety engineering processes include such activities as information collection and management (crash information systems), identification of problem locations on the road network, analysis, development and implementation of countermeasures. The Hazard Elimination Program or a jurisdictions high crash location list are examples of reactive approaches to crash frequency and/or severity reduction.

Limitations of the reactive approach are as follows:

- It requires the identification of high crash locations before improvement plans may be developed and implemented;
- The supporting crash data is often dated, incomplete and/or insufficient to support accurate diagnosis and intervention; and
- It may also be more costly, since improvement plans are necessarily implemented on a road already built and open to public.

Despite these limitations, no road safety management system can be considered complete without a reactive component as it is a powerful tool for addressing existing safety problems.

A **proactive approach** focuses on the evolving "Science of Safety", that is, what is known about the evolving specific safety implications of highway design and operations decisions. The proactive approach applies this knowledge to the roadway design process or to the implementation of improvement plans on existing roads to diminish the potential of crashes occurring prior to the road being built or reconstructed. Conducting RSAs is an example of a proactive road safety strategy.

Benefits of a proactive approach to road safety.

The advantages of a proactive approach include:

- Crash prevention: It is not necessary for crashes to occur before crash prevention measures are taken; and
- Lower costs: Changing plans is easier and less costly than to implement an improvement plan on a road open to the public.

Effective road safety management programs should exercise an optimal balance between reactive and proactive strategies.

While each jurisdiction will determine an optimal balance based on local conditions, the potential benefits of implementing RSAs are clearly significant.

APPENDIX B

Evolution of Road Safety Audits

The concept of RSAs originated in the United Kingdom (UK) during the early 1980's. The concept evolved out of concerns that some newly constructed roads were experiencing high crash frequencies or severities that could have been prevented through more safety-conscious design decisions. By 1991, the UK Department of Transport made RSAs mandatory for all national trunk roads and freeways. National guidelines adopted in 1996 recommend that ideally all projects should be subjected to a RSA if it is achievable, within available resources.

By the early 1990's, RSAs were being introduced in Australia and New Zealand. Individual states in Australia use their own policies to select projects for auditing. Through the 1990s, RSAs were introduced to other countries such as Denmark, Canada, the Netherlands, Germany, Switzerland, Sweden and South Africa. In recent years RSAs have been actively implemented in the developing countries such as Malaysia, Singapore, Bangladesh, India, Mozambique and United Arab Emirates. Presently, the World Bank and European Transport Safety Council are actively promoting RSAs as part of national road safety programs.

Recognizing a potential for RSAs to become an effective proactive tool in road safety management systems in the US, the FHWA sponsored a scanning tour in Australia and New Zealand in 1996. The conclusion was that RSAs hold promise in maximizing the safety of roadway designs and operations and should be piloted in the US. The FHWA National Highway Institute (NHI) offers a training course on RSAs and FHWA has developed a new course on road safety audits for local agencies. Information on these training courses as well as basic information and success stories relating to RSAs can be found at http://safety.fhwa.dot.gov/rsa.

Visit the FHWA RSA website at http://safety.fhwa.dot.gov/rsa.

A major step towards implementation of RSAs in the US was the FHWA RSA pilot program. Pennsylvania DOT developed a program to implement RSAs at the design stages of projects. New York DOT developed a program to integrate RSAs into their pavement overlay program. Iowa DOT developed a program to integrate RSAs into their 3R projects (pavement rehabilitation, restoration and resurfacing). The first application of RSAs to a mega-project in the US occurred in 2003, when designs for the Marquette Interchange upgrade in Milwaukee, Wisconsin were audited. RSAs for existing local roads are also being conducted by the Metropolitan Planning Commissions of New Jersey and Vermont.

NCHRP Synthesis of Highway Practice 3-36: "Road Safety Audits: State of the Practice".

Experience from the pilot RSAs indicates that they have a proven positive road safety effect and should be further integrated into road safety management systems. The pilot programs also revealed a diversity of opinions and views that currently exist regarding the role, scope, and application of RSAs. Details on RSA practice in the US are contained in the NCHRP Synthesis of Highway Practice 3-36: "Road Safety Audits: State of the Practice" available from the Transportation Research Board (TRB) bookstore at http://trb.org/bookstore/ or call (202) 334-3213.

This synthesis includes documented information, results of surveys of state and local transportation agencies along with detailed case study information and profiles of innovative agencies and practices.

Road Safety Audit of Preliminary Design:
US Route 1 - Grading, Drainage, Base and Sidewalk
Camden, Maine

CASE STUDY 1

The Maine Department of Transportation (DOT) was implementing a project to improve a 1.7 mile length of US Route 1 in the vicinity of Camden State Park near Camden, Maine. The project was to include sidewalk, drainage, shoulder, and utilities work.

The community and the engineers were concerned about the best way to provide safe access for sidewalks along and across the highway and to reduce vehicle travel speeds in the vicinity of the park. To address these considerations, the engineers conducted a road safety audit to identify the best way to provide the sidewalk and pedestrian crossing in the vicinity of the park.

The project was in the preliminary design stage, so several alternative roadway cross-sections and sidewalk treatments had been developed. Five people participated in the audit: the Camden Police Chief, two people from the maintenance and operations division, an urban and arterial engineering technician, and a project manager from the Bureau of Planning.

Team members conducted a field visit and reviewed preliminary plans, crash data, project history, Maine Access Management rules, the Maine Highway Design Guide, and the Manual on Uniform Traffic Control Devices. Through the review, the report identified both general and specific findings. In general, the auditors provided comments for the design alternatives, including possible applications of mountable curbs, emergency stopping locations, applicability of bollards, construction traffic management plans, potential seasonal flooding issues, overhead signs, and striping.

Relative to travel speed and pedestrian safety, the auditors made specific recommendations for locations of overhead signs, cross-walk locations, locations where the shoulder might be widened to separate vehicle door swings from bicyclists passing by, guardrail locations to optically narrow the road, the location of speed reduction zones, and a monitoring program to test for improvements. The auditors further recommended that if suitable speed reduction was not achieved, then a pedestrian tunnel should be considered. The RSA report was three pages long.

CASE STUDY 2

Road Safety Audit Program:
South Carolina Department of Transportation

CASE STUDY 2

The South Carolina Department of Transportation (SC DOT) has established a Road Safety Audit (RSA) program. Following development of all of the management policies, program structure, training, and implementation guidelines, the SC DOT had a goal of conducting audits on 10 projects per year. To achieve this goal an Advisory Committee was established that included engineering directors for such activities as traffic, construction and safety, and district engineering administrators. The Advisory Committee was responsible for overseeing program development, training, goals and visions, and implementation. The following activities are included in the overall program:

- The Advisory Committee solicited interest from all State technical staff for possible participation in RSA training. Sixty staff members were selected for training and 2-year terms as road safety auditors.
- Annually, staff submits applications for project road safety audits. The Advisory Committee selects the widest array of projects possible, including projects from different areas of the State, on different types of road facilities, in different stages of development, and that are either typical or unusual.
- With training complete and projects selected, the RSA Coordinator arranges teams and completes logistics (e.g., travel, scheduling, billings, etc.) for each of the audits.
- The audit team travels to the site, conducts field visits, reviews project documentation, and meets with the District Engineering Administrator. Subsequently, the audit team prepares an audit report documenting findings and recommendations in priority order.
- The District Engineering Administrator then has 45 days to prepare a formal written response to the audit report. This response outlines what will and won't be implemented and provides justification for each decision; thus documenting the actions of the "reasonable and prudent engineer."

The SC DOT has conducted 11 audits (2 on new facilities, 5 on facilities under construction, and 4 on existing facilities). The response to the audits has been positive and it is anticipated that the RSA program will continue to grow.

Road Safety Audit of Existing Roads:
Hughes County, South Dakota

CASE STUDY
3

Since receiving Road Safety Audit (RSA) training, South Dakota has conducted RSAs on existing roads in their county road systems, including Hughes County. This RSA was conducted when the County Highway Superintendent identified a need and contacted the South Dakota Local Transportation Assistance Program (SDLTAP) to organize the audit. The SDLTAP requested aid from the Department of Transportation (DOT) Traffic & Safety Engineer in the DOT Office of Local Government Assistance and from the FHWA Traffic & Safety Engineer.

Seven team members participated in the audit, including three representatives from SDLTAP, two representatives from FHWA, a guest County Highway Superintendent, and the DOT Traffic & Safety Engineer. The DOT Traffic & Safety Engineer served as the leader of the audit team.

The audit team reviewed five existing roadway facilities, which were previously classified by the County Highway Superintendent responsible for the roadways as rural roads that were either major or minor, and either high-, medium-, or low-speed highways. The team conducted a field visit to the existing facilities and prepared a report summarizing the findings. The RSA summarized the classification, posted speed, and conditions of the existing road and classified the recommended improvements as: 1) items where immediate safety improvements should be made, 2) items where low cost improvements could have a positive impact on safety and should be considered in a reasonable period of time, and 3) items identified as high-cost improvements that should be considered as funds become available for a major rehabilitation or reconstruction of the roadway. These recommendations pertained to improvements such as relocating utility poles, modifying signing and striping, maintaining landscaping, and improving grading.

At the end of the RSA, the items listed in the report were reviewed in a closeout meeting with the Highway Superintendent responsible for the roadway. The Traffic & Safety Engineer prepared the final report and forwarded it the Highway Superintendent. A master copy of the report was also stored in the Office of Local Government Assistance files. The RSA report was nine pages long.

CASE STUDY 4

Road Safety Audit of Preliminary Design:
Minnehaha County, South Dakota

CASE STUDY
4

The South Dakota Department of Transportation (SDDOT) was planning a project to upgrade existing interchanges and build a new interchange on I-29 in Sioux Falls, South Dakota. The interchange upgrades were planned on I-29 at the SD 42 interchange, which consisted of work on I-29 from Skunk Creek to the vicinity of Russell Street and on SD 42 between Marion Rd and Lyons Boulevard. The new interchange was being constructed at the intersection of I-29 and Madison Street.

When the project was in the preliminary design phase. Six people participated in the audit: a representative from Road Design at SDDOT, a Pavement and Materials Engineer from FHWA, the Sioux Falls City Traffic Engineer, the Sioux Falls Assistant Public Works Director, a traffic engineering specialist from the DOT Local Government Assistance, and the SDDOT Region Traffic Engineer.

Team members reviewed preliminary project plans, crash data, traffic volume data, and typical design manuals including: the AASHTO Road Design Manual, the Federal Manual on Uniform Traffic Control Devices (MUTCD), the State of South Dakota Standard Specifications, and the Highway Capacity Manual. Through the RSA, the report identified 35 safety concerns and findings ranging from access management, to drainage improvements, to grading improvements, to modifying construction phasing, to meeting ADA requirements. The safety benefits of some recommendations were stated explicitly, such as in the discussion of snow removal and snowmelt run off on the ramps. The report explained that lack of direct sunlight could cause slick ramp conditions for extended periods of time. The safety benefits of other improvements were implied as in the recommendation to remove the proposed curb along the Interstate shoulders and ramps in the design. The RSA report was six pages long.

Preliminary Design Stage Audit: Route 22/Spring Street Intersection – Upgrade; Westbrook, Maine

CASE STUDY 5

The Maine Department of Transportation (Maine DOT) was implementing a project to widen the Route 22/Spring Street intersection in the Town of Westbrook, Maine, to provide additional through lanes as well as dedicated left-turn lanes. The existing intersection was experiencing capacity issues and was identified as a high-crash location by the Maine DOT. To address the safety issues, the engineers conducted a Road Safety Audit (RSA).

The project was in the preliminary stage of design. Six people participated on the audit team representing four different divisions of the Maine DOT. This included two traffic engineers, one division engineer, one assistant engineer, one representative from the Regional Program, and one representative from Traffic Engineering.

Consistent with many other RSAs, the audit team conducted a 2-hour field visit and reviewed preliminary plans and crash data. However, a unique element of this report is that it specifically stated the following "The audit was conducted based on the assumptions that the existing highway was built to the design standards at the time of construction, the plans for the proposed improvements were according to current design standards, the utilities would be moved outside of the clear zone, the pedestrian and bicycle traffic had been considered, the capacity issues had been considered, and all traffic signals and signing would be consistent with the Manual on Uniform Traffic Control Devices." The audit team felt it would be useful to outline the context and considerations for the audit.

Based on the team's review, the RSA identified 11 safety issues whose correction ranged from minor modifications such as providing wider median islands to accommodate signs, to more extensive changes such as redesigning the locations of accesses and minor street intersections in the vicinity of the Route 22/Spring Street intersection. The RSA report was three pages long.

Road Safety Audit of Existing Roads:
District 3. Iowa

CASE STUDY 6

District 3 of the Iowa Department of Transportation (DOT) conducted a Road Safety Audit for seven existing rural highways throughout the District in Iowa. The audit was conducted by driving and walking along the subject roads.

The road safety audit team consisted of ten participants from the Office of Traffic and Safety, the Federal Highway Administration, Iowa State University's Center for Transportation Research and Education, maintenance, engineering, and design, and included one consultant. The audit team reviewed the crash summaries prior to the field visit.

Through the review, the team identified many general observations, such as a lack of sidewalks on many routes, particularly in the community of Denison. In addition, the team paid special attention to horizontal and vertical curves on three of the reviewed highways. There were cases where left curves were followed by vertical crest curves, which the report explained are particularly vulnerable to crashes. The report discussed treatment options such as chevrons, curve widening, shoulder super elevation, and rumble strips, as well as many other improvements.

The report also discussed the potential safety implications of reduced roadside mowing, including reduced site distance and obstacles in the clear zone. Based on the review, the district suggested that mowing and roadside maintenance be added to the "Safety Review Checklist" maintained by the Office of Traffic and Safety. The RSA report was six pages long.

Walkability and Bikeability Checklist

Pedestrian and Bicycle Information Center, walkinginfo.org

CASE STUDY 7

The Pedestrian and Bicycle Information Center has developed a walkability and bikeability checklist for community members to use in assessing facilities in their neighborhoods.

In the walkability checklist, residents are asked to pick a typical route that they travel (e.g., to the store, or to school) and to walk the route with the checklist in hand. Some of the questions on the checklist included:

- Is there space to walk?
- Is it easy to cross streets?
- Do drivers behave well?
- Is it easy to follow safety rules?
- Is your walk pleasant?

Residents are then provided with tools for scoring the results, and most importantly, a list of ideas for addressing concerns.

While these tools do not follow the formal RSA process, they are effective tools in raising awareness of safety issues. Local or State planners and engineers could encourage residents to use these surveys as part of a project's public involvement process. The results of the survey provide information about the user's perceptions of safety on a facility. These perceptions are important complementary information to the crash, roadway, and traffic volume data that is typically readily available to city or state staff.

The walkability checklist is available at www.walkinginfo.org

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