Improving Safety on Rural Local and Tribal Roads

Site Safety Analysis – User Guide #1

August 2014

U.S. Department of Transportation
Federal Highway Administration

Safe Roads for a Safer Future
Investment in roadway safety saves lives

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16. Abstract This User Guide presents an example of how rural local and Tribal practitioners can study conditions at a preselected site. It demonstrates the step-by-step safety analysis process presented in *Improving Safety on Rural Local and Tribal Roads – Safety Toolkit* (Publication FHWA-SA-14-072). The FHWA created the Toolkit and two User Guides to assist local agency and Tribal practitioners in completing traffic safety analyses. Each Toolkit step contains a set of tools, examples, and links to resources appropriate to the needs of safety practitioners. The User Guides accompanying the Toolkit provide hypothetical yet typical local or Tribal agency safety analysis scenarios and step-by-step solutions to the scenarios using materials from the Toolkit. This report specifically addresses how to study crash conditions at a curve on a rural roadway. The User Guide provides example applications of five Toolkit steps: compile data; diagnose site conditions and identify countermeasures; prioritize countermeasures for implementation; implement countermeasures; and evaluate effectiveness of implemented countermeasures.		
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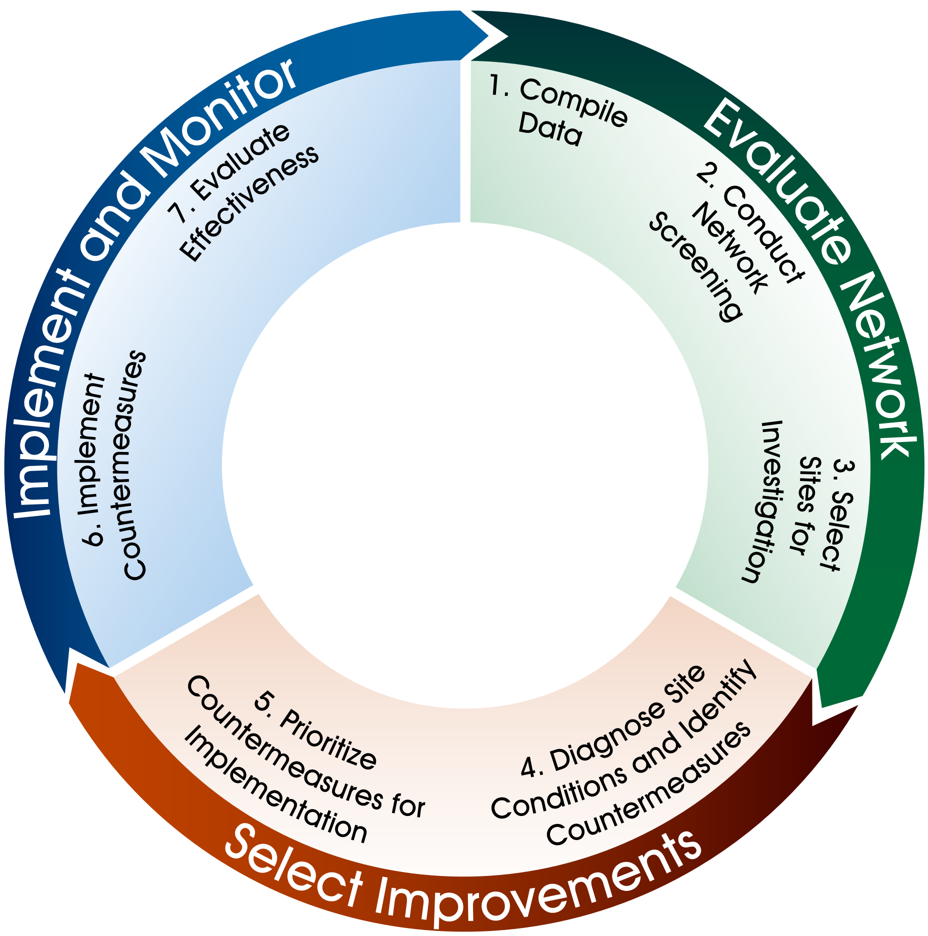
1.0 Introduction

The Federal Highway Administration (FHWA) Office of Safety created a Toolkit for Rural Local and Tribal Roadway Safety Practitioners (referred to hereafter as the Toolkit) to provide a step-by-step process to assist local agency and Tribal practitioners in completing traffic safety analyses. Figure 1 shows the safety process outlined in the Toolkit. The Toolkit includes an explanation of each step in the process and provides tools, examples, guidance, and resources for learning more about each step. The process and tools presented in the Toolkit are flexible and can be applied to assist in solving any number of safety situations.

The Toolkit has been developed to provide information about how to study road safety on rural roads under the jurisdiction of local or Tribal agencies. There are many different types of staff that could be responsible for safety on local and Tribal roads, including maintenance staff, landscapers, planners, engineers, or politicians. Throughout the Toolkit and User Guides, these people are referred to as "practitioners" or "staff," independent of whether they work for a local or Tribal road agency. Similarly, the road agency is referred to as the "agency" or "jurisdiction," whether it is a Tribal or local agency.

Figure 1. Toolkit Safety Analysis Process



What are the User Guides?

The FHWA has developed two User Guides (this document and its counterpart) to provide practitioners with examples of applying the tools presented in the Toolkit. Each User Guide presents an example scenario that is typical on rural roads and example solutions to the scenario using methods presented in the Toolkit.

The User Guides' example scenarios show intended use and application of the tools for each toolkit process step. The User Guides' example solutions provide step-by-step procedures for practitioners to apply the methods to comparable situations in any community.

There are two User Guides:

1. **User Guide #1 – Improving Safety on Rural Local and Tribal Roads – Site Safety Analysis** describes a step-by-step analysis for conducting a site-specific safety analysis. This scenario is typical of a situation where a site of concern is identified by agency staff, an elected official or someone outside of the agency based on site crash history. User Guide #1 demonstrates Step 1 and Steps 4 through 7 in Figure 1.
2. **User Guide #2 – Improving Safety on Rural Local and Tribal Roads – Network Safety Analysis** describes how to conduct a proactive analysis of a component of the transportation network such as all two-lane road segments, or all stop-controlled intersections. User Guide #2 demonstrates how to identify sites for safety improvement, diagnose conditions, implement selected countermeasures, and evaluate countermeasure effectiveness. User Guide #2 demonstrates all of the steps in Figure 1.

This is *User Guide #1 – Site Safety Analysis*. The example that follows demonstrates how to study conditions at a preselected site. In this hypothetical example, the study site has been identified from community concerns; however, the methods are applicable to any situation where one preselected site is under investigation.

Referring again to Figure 1, User Guide #1 provides example applications of:

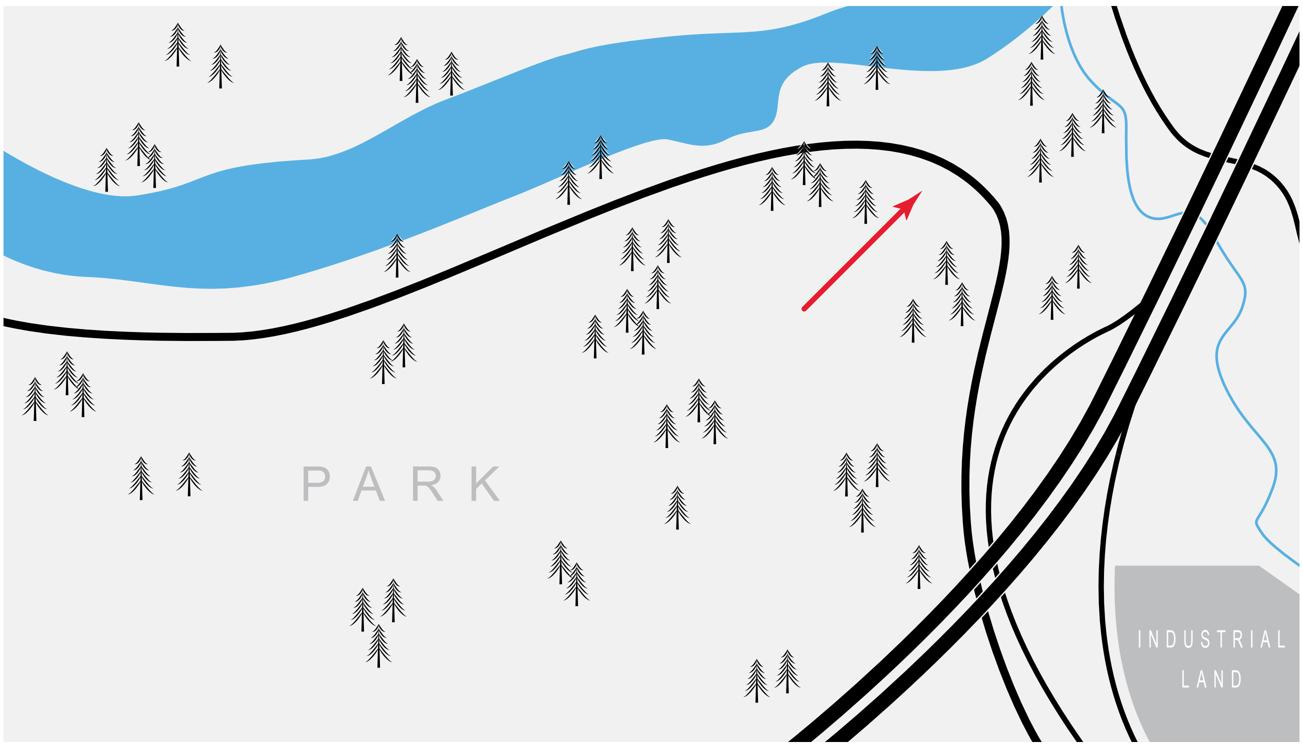
- Step 1 – Compile Data;
- Step 4 – Diagnose Site Conditions and Identify Countermeasures;
- Step 5 – Prioritize Countermeasures for Implementation;
- Step 6 – Implement Countermeasures; and
- Step 7 – Evaluate Effectiveness of Implemented Countermeasures.

Steps 2 and 3 in this User Guide have already been completed because the site of interest was selected because of a public concern; not from a data-driven process.

2.0 User Guide #1 Scenario

This scenario is set in a rural environment. There are approximately 50 miles of asphalt and gravel roads under the agency's jurisdiction. Community residents have recently voiced concerns about safety at a particular curve in the community (see Figure 2). Residents have complained that travel speeds around the curve are too high, and there are many near misses on the curve. Residents have brought their complaints to community leaders at the agency by speaking at public meetings and calling local officials.

Figure 2. Scenario Preselected Site



In response to the public concerns, community leaders have asked the manager of the Public Works department to study the location and identify what can be done to reduce public concerns and address any safety issues that may be present.

The Public Works department in this scenario has limited resources. While department staff have ample experience maintaining and operating roadways in the community, there is not a separate roadway or traffic engineering department. The police have the crash record files, but staff have not been maintaining any type of annual summary of crashes by location or type. Traffic volume and roadway characteristics data is available for locations where there have been recent road construction projects; however, the agency does not have an annual program to conduct traffic volume counts at locations throughout the community. As such, there is no historic traffic volume data for this site.

Step 1

3.0 Solution

Figure 1 shows the safety process from the Toolkit. To study safety conditions at the curve and identify if countermeasures should be implemented, and what type of countermeasures are appropriate to implement, the manager of the Department of Public Works will need to apply:

- Step 1 – Compile data and determine what data is available to help study the site;
- Step 4 – Diagnose site conditions and identify countermeasures;
- Step 5 – Prioritize countermeasures for implementation;
- Step 6 – Implement countermeasures; and
- Step 7 – Evaluate effectiveness of implemented countermeasures.

Each of the analysis steps is described below. Steps 2 and 3 are not necessary because the location of interest has been already pinpointed by the public.

Step 1. Compile Data

The first step in conducting the analysis for this scenario is to compile and evaluate the available data. The data available influences the type of analyses that can be conducted. Typically, the information available can be divided into quantitative information and anecdotal information.

Table 1 summarizes the quantitative information that might be collected for this situation, and shows the data types that this scenario assumed are available. More information about sources for and how to work with each data type follows in this section.

There also are often regional and state organizations available to provide guidance or data for conducting safety analyses. It is useful to get to know staff in the safety group at your state's DOT or planners or engineers at your Council of Governments (COG) or Metropolitan Planning Organization (MPO), as they also could assist you in conducting safety analyses.

Typically, there are statewide documents that may be available to support a site-specific traffic safety study. For example, the state Strategic Highway Safety Plan (SHSP) may contain information about crash types that are of particular concern in the state and/or countermeasures known to be applicable in the state. Some states have plans focusing on specific safety issues such as intersections or run-off-road crashes. These documents also can be resources for understanding factors contributing to crashes, possible treatments, and funding sources to address the safety concern.

Step 1

Table 1. Quantitative Information for Studying Safety at a Site

Type of Quantitative Data	Typical Data Sources and Formats	Data Available in this Scenario
Crash Data	• Paper crash records from police/sheriff about each reported crash at or near the site • Electronic crash reports from state department of transportation (DOT), summarizing each reported crash at or near the site	Paper crash records from police/sheriff about each reported crash near the site
Average Daily Traffic Volume	• Historic traffic counts available at the agency (actual or estimated through periodic processes) • Historic traffic counts available from the DOT (actual or estimated through periodic processes) • New traffic counts conducted specifically for this analysis • Perception of traffic volume as average, high, medium, or low relative to other roads in the community	Perception of roadway traffic volume as average relative to other roads in the community
Roadway Characteristics	• Characteristics information from site visit • Aerial views from Internet-based mapping providers • As-built documents on file at the agency or state DOT • State road video or photo logs if available	Able to conduct site visit and view aerial information from the Internet

In this scenario, the anecdotal information is gathered from conversations with the community officials, community residents, and road maintenance workers that travel through the curve on a regular basis. The information gathered indicates there is a perception that the curve is too sharp, and that drivers are going too fast leading into the curve. For instance, residents described "near misses" they have experienced and helping to tow cars out of the adjacent ditch. This type of anecdotal information can be a good source of information and clues as to what should be studied at the site.

Is Anecdotal Data Valuable?

Many times anecdotal data may provide information that is not reflected in the site crash history. This can include information relating to minor crashes that are below a reporting threshold, near misses, and other vehicle conflicts that do not result in a reportable crash. This information can be valuable in providing clues on where to start a data-driven investigation. The challenge with anecdotal data is sorting out what issues are the perception of safety issues versus actual addressable safety issues.

Crash Data

Background

The crash data on printed crash forms can be acquired from the local police or sheriff department, or from the state department managing the crash data, often the DOT.

Step 1

Local and Tribal police agencies typically only hold the crash records that their officers have created, so their records may be missing crashes if there are other police agencies that have jurisdiction in the area, or if the crash is not reported at all. Most states only require crashes to be reported if the dollar value of damages exceeds a minimum, or an injury occurs. Usually, the more severe the crash, the more likely the crash is reported to the police.

The state DOT, state police agency, or department of public safety in most states compile and hold all crash records from all police agencies in the state. Often, one of these organizations will publish a yearly summary of crashes in a report or database. State databases may not include crashes in Tribal areas.

When requesting crash data, it is best to collect as much data as possible. At a minimum, the practitioner should gather at least three years of crash data for a specific site. Many states have automated this request process and have on-line data request forms, or have a log-in procedure access on-line crash databases.

This Scenario

In this scenario, the crash data is acquired from the agency police department and is provided in completed paper crash forms. All crash forms use abbreviations and notations that can seem cryptic or can be misleading without a key to the form. To address this, almost every state-level crash form also has an accompanying document that details what the form abbreviations mean and give criteria for determining how to code certain data elements. Figures 3 (Michigan Crash Report Form) and 4 (Key for Crash Report Form) on pages 8 and 9, respectively, illustrate some key fields and their meanings for assessing crash data.

Understanding Crash Location

There are many ways to specify and record crash location on the crash record or in the crash database.

One common method is "road on and milepoint range." In this method the crash location is specified by recording the "road on" which the crash occurred and a "milepoint range" or distance from a beginning point. For example a crash could occur on Main Street, 0.20 miles from First Street.

Recently, many crashes are geocoded. When a crash location is geocoded, it is assigned a pair of geographic coordinates such as longitude and latitude. Crashes can then be mapped electronically using these coordinates.

What to look for on a Crash Report

Information on a crash report that can provide clues to the factors that led to the crash include:

- Date;
- Time;
- Weather conditions;
- Roadway conditions;
- Number and severity of injuries;
- Driver impairment or distraction; and
- Type of crash and vehicle direction of travel.

The officer's diagram and written description of the crash can also provide invaluable information that can assist in understanding what occurred at the crash site. Information to be gleaned from these two sources include the officer's opinion on what caused the crash and details on the vehicles' exact path when the crash occurred.

Example Email Request for Crash Data from a State DOT

Hi Ms. Smith,

My community is studying safety conditions on River Road between Third Avenue and Fir Street. In order to complete my analysis, I will need to study the available crash data for this segment. Please provide the most recent three calendar years of data you have for crashes in this segment of River Road.

Please provide the information by individual crash record so that we can summarize crashes by type, severity, time of day, day of week, and environmental conditions (for example, weather, roadway dry or wet). If possible, please provide the data in a spreadsheet so that we can more easily summarize the information. If this is not possible, that is fine too.

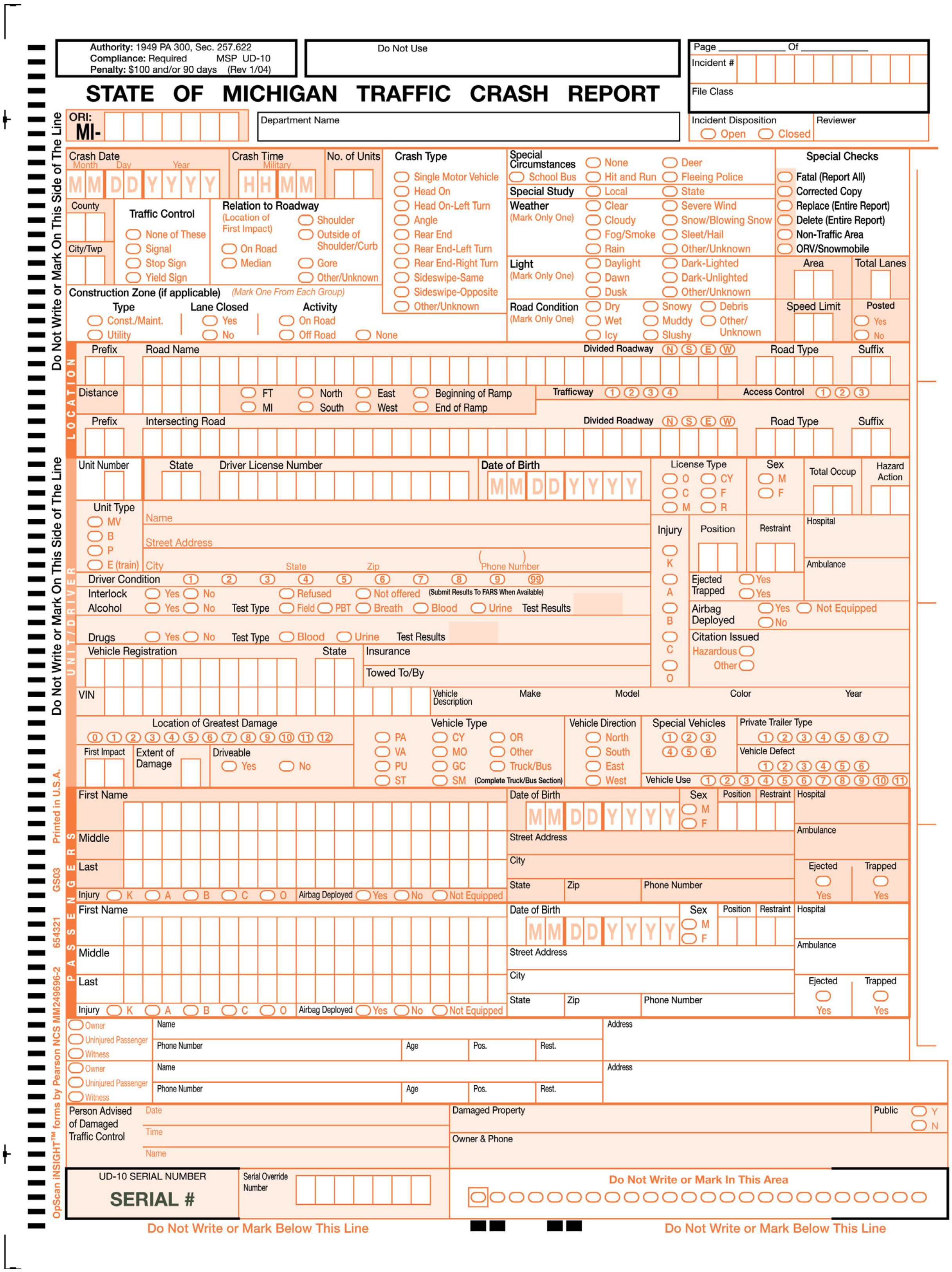
If the data contains codes to specify information such as crash type, severity, or impairment, please provide me a copy of the document defining the codes. If this is available on-line, please just provide the link to the site.

Please confirm that you have received this request and let me know when you will be able to provide the information. If you have any questions, please call me to discuss. My contact information is below.

Thanks in advance,

Clark White

Figure 3. Example Crash Form from Michigan (UD-10 Form)



Source: *Michigan Department of Transportation, UD-10 Traffic Crash Report Manual. http://www.michigan.gov/documents/UD-10_Manual_2004_91577_7.pdf.*

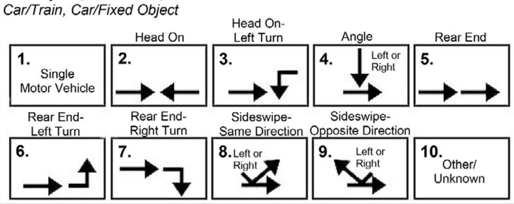
Figure 4. Example Key for Crash Form from Michigan (UD-10 Form)

STATE OF MICHIGAN TRAFFIC CRASH REPORT

Revised 09/2010

Crash Type (First Impact)

Single Motor Vehicle
Includes Car/Pedestrian, Car/Bicyclist, Car/Animal, Car/Train, Car/Fixed Object



Special Vehicles

1 Police
2 Fire
3 Bus
4 Ambulance
5 Farm equipment
6 Construction/ maintenance equip.

Vehicle Defects

1 Brakes
2 Lights/ reflectors
3 Steering
4 Tires/wheels
5 Windows
6 Other

Vehicle Use

1 Private
2 Commercial
3 In pursuit/on emergency
4 Farm
5 School/education
6 Club/church (all Y-plates)
7 Military
8 Other government
9 Utility (gas, cable, etc.)
10 Road construction/ road maintenance
11 Other

Area

Freeway
01 Entrance/exit ramp related
02 Median crossing related
03 Transition area*
04 Rest area related
05 Scale/weigh station related
06 All other freeway areas

Intersection
07 Within intersection
08 Intersection driveway related (within 150 feet of intersection)
09 Intersection related-other

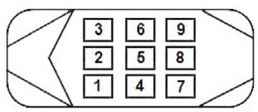
Other Non-Freeway Areas
10 Straight roadway Not related to other selections
11 Curved roadway Not related to other selections
12 Driveway related
13 Parking related (legal roadside)
14 Transition area*
15 Median crossing related
16 Rail crossing related
17 Rest area related
18 Scale/weigh station related
19 Non-traffic area
20 Other
21 Unknown

*Increase/decrease in the number of travel

Position

B Bicycle
P Pedestrian
E Engineer **(railroad/train)**

1-9 Vehicle Interior
See Representation Below



10 Sleeper section
11 Other enclosed passenger area/cargo area
12 Other unenclosed passenger area/cargo area
13 Riding in/on trailing unit
14 Riding on vehicle exterior
15 Unknown

Motorcycles, snowmobiles, etc. (In-line seating)
1 Driver
4 Passenger one
7 Passenger two
12 Other/unenclosed passenger area/cargo area

Private Trailer Type

1 Utility
2 Travel trailer
3 Boat trailer
4 Farm equipment
5 Towed auto
6 Recreation double
7 Other

Sequence of Events/ Most Harmful Events

Non-Collision
01 Loss of control
02 Cross centerline/median
03 Ran off roadway-left
04 Ran off roadway-right
05 Re-enter roadway
06 Overturn
07 Separation of units
08 Fire/explosion
09 Immersion
10 Jackknife
11 Downhill runaway
12 Cargo loss/shift
13 Individual fell from vehicle
14 Other noncollision

Had a Collision With

Non-Fixed Object
15 Pedestrian
16 Bicyclist
17 Motor vehicle in transport*
18 Parked motor vehicle
19 Engineer (railroad/train)
20 Animal
21 Other non-fixed object

Fixed Object
22 Bridge/pier/abutment
23 Bridge parapet end
24 Bridge rail
25 Guardrail face
26 Guardrail end
27 Median barrier
28 Highway traffic sign post
29 Highway signal post
30 Luminaire/light support
31 Utility pole
32 Other pole
33 Culvert
34 Curb
35 Ditch
36 Embankment
37 Fence
38 Mailbox
39 Tree
40 Railroad crossing signal
41 Building
42 Traffic island
43 Fire hydrant
44 Impact attenuator
45 Other fixed object

**In transport means a motor vehicle in motion or on a roadway.*

Unit Type

MV Motor Vehicle
B Bicyclist (all pedalcyclists)
P Pedestrian
E Engineer (railroad/train)

Restraint Use

01 No belts available
02 Shoulder belt used only
03 Lap belt only used
04 Shoulder & lap belt used
05 No belt used
06 Child restraint used
07 Child restraint not used, not available or improper
08 Restraint failure
09 Restraint use unknown
10 Helmet worn
11 Helmet not worn
12 Helmet use unknown

Code of Injury

K – Fatal Injury Any injury which results in death.
A – Incapacitating Injury Any injury other than fatal which prevents normal activities and generally requires hospitalization.
B – Non-incapacity Injury Any injury not incapacitating but evident to others at the scene.
C – Possible Injury No visible injury but complaint of pain or momentary unconsciousness.
O – No Injury No indication of injury.

Driver Condition

01 Appeared normal
02 Had been drinking
03 Illegal drug use
04 Sick
05 Fatigue
06 Asleep
07 Medication
08 Driver Distracted
09 Driver Using Cellular Phone
99 Unknown

Action Prior To Crash

Driver Action
01 Going straight ahead
02 Turning left
03 Turning right
04 Stopped on roadway
05 Involved in prior crash at same location
06 Changing lanes
07 Backing
08 Slowing/stopping on roadway
09 Slowing/stopping other area
10 Starting up on roadway
11 Starting up other area
12 Entering parking
13 Leaving parking
14 Entering roadway
15 Leaving roadway
16 Making U-turn
17 Overtaking or passing
18 Avoiding object
19 Avoiding pedestrian
20 Avoiding vehicle (front/back)
21 Avoiding vehicle (angle)
22 Driverless moving
23 Parked
35 Other
36 Unknown
37 Avoiding animal

Pedestrian Action
24 Crossing at intersection
25 Crossing not at intersection
26 Getting on/off vehicle
27 In roadway with traffic
28 In roadway against traffic
29 Standing/lying on roadway
30 Pushing/working on vehicle
31 Other working in roadway
32 Playing in roadway
33 In roadway other reason
34 Not in roadway
35 Other
36 Unknown

Trafficway

01 Not physically divided (2-way trafficway)
02 Divided highway, median strip, without traffic barrier
03 Divided highway, median strip, with traffic barrier
04 One-way trafficway

Access Control

01 No access control (unlimited access)
02 Full access control (ramp entry & exit only)
03 Other (partial access control)

Hazardous Action

00 None
01 Speed too fast
02 Speed too slow
03 Failed to yield
04 Disregard traffic control
05 Drove wrong way
06 Drove left of center
07 Improper passing
08 Improper lane use
09 Improper turn
10 Improper/no signal
11 Improper backing
12 Unable to stop in assured clear distance
13 Other
14 Unknown
15 Reckless driving
16 Careless/negligent driving

Source: Michigan Department of Transportation, UD-10 Traffic Crash Report Manual. http://www.michigan.gov/documents/UD-10_Manual_2004_91577_7.pdf.

Traffic Volume Data

Background

Quantitative traffic volume data may be available through other work conducted at or near a site. There may be an annual traffic counting program, or traffic counts may have been conducted as part of a construction project. If not available within the agency, the state DOT, Council of Governments (COG), Local Technical Assistance Program (LTAP), or Tribal Technical Assistance Program (TTAP) may have the data or can provide support in acquiring the data. If no traffic volume data is available, anecdotal perceptions of traffic volume as "low," "average," or "high" relative to comparable roads in the community can be acquired from local stakeholders familiar with the site. This information can be useful to get a perspective on the order of magnitude of exposure to the safety concern.

This Scenario

In this example, the agency does not have access to roadway traffic volume data. Even though exact traffic counts are not available, staff indicate that the traffic volume on River Road is "about the same" when compared to other roads in the county. At a minimum, this qualitative assessment of the traffic volume should be recorded in the project documentation and can provide some basis for comparison of crash histories between this segment and others in the county.

Roadway Characteristics

Background

To the greatest extent possible, a site visit should always be part of the safety analysis process to get a feel for site conditions and get an understanding of existing and potential safety issues.

The type of roadway characteristics data to collect during a site visit includes:

- Number of lanes;
- Road surface conditions;
- Road geometry;
- Signs and marking;
- Presence of motorcycles, pedestrians, or bicycles;
- Posted speed;
- Observations of travel speed;
- Adjacent land uses and driveways;
- Sight distance; and
- Evidence of problems.

Field Visits are Important to Do

It is important for the practitioner to make a field visit. Viewing the site in-person allows the practitioner to observe traffic and other features that data or photos alone cannot convey.

The type of data collected during a site visit should include number of lanes, lane width, shoulder width and type, sight distance where it appears limited, posted speed limit, and other signage. Videotape or photographs are also very helpful in documenting conditions.

A field visit after dark is also very important to evaluate the signing and pavement marking. The Road Safety Audit (RSA) Guidebook and Highway Safety Manuals have prompt lists that can assist in field visit data collection. See the Toolkit for more information on these resources.

Possible sources for the roadway characteristics data are roadway design or maintenance staff, state DOT roadway databases or as-built drawings, on-line mapping tools such as Google Street View™ mapping service, and/or an on-site field visit.

This Scenario

Roadway characteristics are used in the scenario analysis to support the diagnosis and potential countermeasure selection. Roadway characteristics are best collected by visiting the site, taking photos, and recording the physical site characteristic. The FHWA document, *FHWA Road Safety Audit Guidelines,* provides many resources for formal or informal site inspections. The document provides prompt lists, which can act as a field visit outline. It may be useful to visit the site after dark. As the safety analysis proceeds, it may be useful to visit the site again to help with the diagnosis of crash conditions.

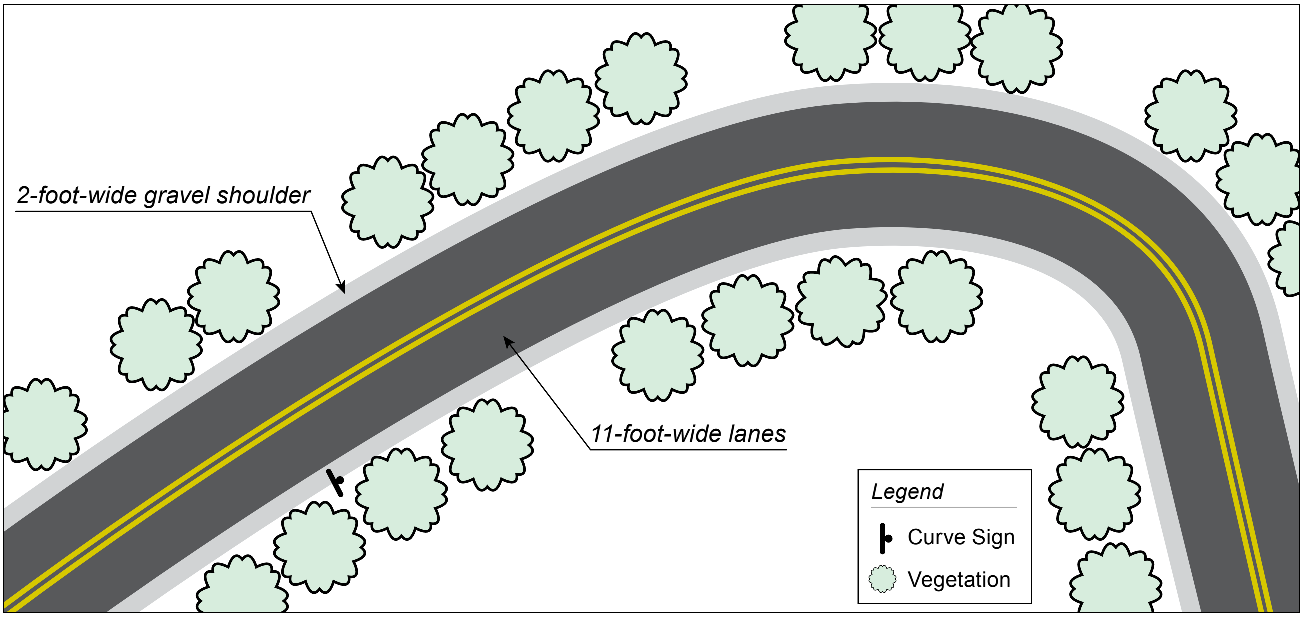
Field Evidence Demonstrating a Potential Safety Issue

Some very subtle signs of a safety problem can be uncovered during a site visit. These include skid marks on the road or shoulder, scarred or damaged trees, debris from damaged vehicles, or damaged signs.

To the greatest extent possible, site data information should be hand drawn on a site conditions map (see Figure 5).

Google Maps™ mapping service or Bing® maps, if available, can supplement a site visit. Before the site visit, it can be useful to get initial community and local perceptions of the site; and after the site visit, these perceptions can be useful reminders of the site's conditions.

Figure 5. Example Site Conditions Map



Other Documents

There may be other agency-specific or statewide documents that contain information useful for the analysis.

Summary of Data Compilation and Evaluation

The safety analysis in this scenario will be based on the site field investigation information, a summary of the crash data, and the qualitative assessment of traffic volume.

Step 4

Step 4. Diagnose Site Crash Conditions and Identify Countermeasures

With the data compiled and the field visit complete, the next steps in a site-specific safety analysis are to analyze the crash data, traffic volume data, and roadway characteristics data to begin to understand contributing factors to the safety concerns at the site. This is called "diagnosis." As an outcome of the diagnosis, it is possible to identify potential countermeasures for implementation at the site.

Diagnosis

Crash Data

Background

The crash data collected in Step 2 should be summarized in tabular form and, if possible, crash location also should be mapped. Crashes can be mapped at a site manually on a paper map, or by using free mapping tools available on-line.

This Scenario

This scenario summarizes crash counts by year, type, severity, and other environmental factors. Table 2 shows a summary of crash count by year and severity. This table shows 22 of the 37 crashes were property damage-only crash, and there was one fatal crash in 2007 and another in 2010. A summary like Table 2 can show crash frequency trends on an annual basis.

Why analyze crash data?

The purpose of analyzing crash data is to determine factors that may be common across a number of crashes. These patterns can sometimes be evident by summarizing data by factors that contribute to the safety issue. This can include environmental factors, such as wet/dry roadway, or day/night driving; and driver factors, such as distraction, age, or use of alcohol/drugs.

Crash Severity KABCO System

Crash Severity: The KABCO Scale is used to classify crashes by injury severity. The letters represent injury levels as follows:

- K – involves a fatal injury;
- A – incapacitating injury;
- B – non-incapacitating injury;
- C – possible injury;
- O – no injury; and
- PDO – property damage-only crash.

Step 4

Table 2. Summary of Crash Data by Year

Year	Fatal and Serious Injury Crashes (K, A)	Minor Injury Crashes (B, C)	Property Damage-Only Crashes (O)
2011	0	2	5
2010	1	5	3
2009	0	3	7
2008	0	1	3
2007	1	2	4
Total	**2**	**13**	**22**

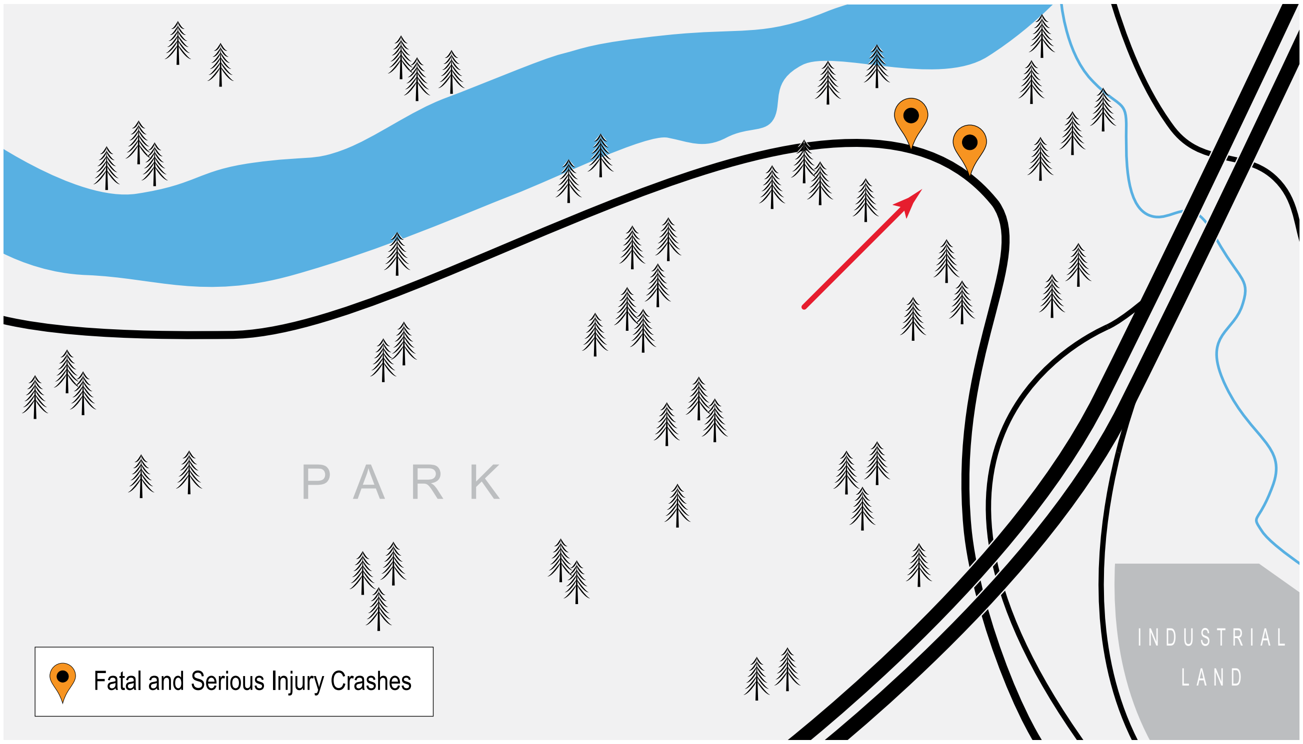
Table 3 shows the site crash data summarized by year and crash type. This table shows the most common crash type is run-off-road crashes, and most of these crashes occurred in 2009. Note that in some situations run-off-road crashes also can be fixed-object crashes if an object is hit after the road departure. The crash records should be carefully evaluated to confirm that double counting is not occurring.

Table 3. Summary of Crash Data by Crash Type

Year	Run Off The Road	Fixed Object	Head-On	Other
2011	4	2	0	1
2010	5	2	1	1
2009	7	2	0	1
2008	0	3	0	1
2007	3	3	1	0
Total	**19**	**12**	**2**	**4**

Figure 6 provides a graphical display of the location of the fatal and serious injury crashes. Alternatively, Google Map Maker™ service in Google Earth™ mapping service can be used to create an electronic map of site conditions. Specifically, the Add a Place pushpin function can be used.

Figure 6. Incapacitating Injury Crashes



Field Review

Background

After crash summaries have been developed and studied in the office, a second field visit can be useful to reconsider the site with the site's crash history in mind.

For site inspection to be productive, the person or people conducting the site visit will benefit from understanding how field conditions relate to safety issues. This understanding can be developed through knowledge of geometric design standards, the proper use of traffic control devices, and other safety-related topics. The resources presented after each step in the Toolkit provide a wealth of information for developing this knowledge base.

The field review also could be conducted as a formal Road Safety Audit (RSA). If an RSA is being conducted, agencies should develop a multidisciplinary team of experts to participate in the RSA. FHWA Road Safety Audit Guidelines provide guidance on conducting RSAs. Additionally, if needed, staff can seek out technical assistance/expertise from the state DOT, LTAP/TTAP, county engineer, or qualified consultant.

This Scenario

As an outcome of the site visit conducted for this project, the practitioner learned the following, as shown in Table 4. This table shows a field review evaluation prompt list and the information recorded during the field visit. As described in the resources section of Step 4 of the Toolkit, prompt lists like this one can be found in many different resources.

Step 4

Table 4. Summary of Site Inspection Prompt List

Topic	Field Condition
Road Function, Classification, Environment	Rural minor collector
Road Alignment and Cross-Section	• *Visibility* – Sight distance measures more than 500 feet continuously around the curve, which is more than the minimum – not an issue • *Design speed* – 20 miles per hour (advisory) • *Speed limit/speed zoning* – 45 miles per hour • *Passing* – Curve is a no-passing zone and is delineated as such • *'Readability' (perception) of the alignment by drivers* – Curve has two radii (curve gets sharper as drivers progress into it in the eastbound direction). This appears to violate what drivers expect and can catch some of them off guard as they transition into the "sharp" section of the curve. • *Lane width* – 11 feet • *Shoulders* – Curbed sections on one side, gravel approximately two feet wide • *Cross-slopes* – Appear normal, 2 percent crown or similar • *Side slopes* – 1:4 or flatter • *Drains* – None present, rural • *Combinations of features* – Not Available (NA)
Auxiliary Lanes	NA
Intersections	NA. No intersections or driveways in this segment
Interchanges	NA. No interchanges in this segment of road
Signs and Lighting	• *Lighting* – No overhead lighting • *Sign Inventory* – Curve delineation signs missing; this location would benefit from more of them • *Sign legibility* – Signs in place can be seen during daytime, night retroreflectivity is marginal but within acceptable limit • *Sign supports* – Breakaway sign supports in all cases
Marking and Delineation	• *General issues* – Retroreflectivity on pavement markings is poor, but otherwise markings in good condition • *Centerlines, edgelines, lane lines* – Centerlines and edgelines present and appear new • *Guideposts and reflectors* – NA • *Curve warning and delineation* – Existing 'curve ahead' sign covered by vegetation
Barriers and Clear Zones	• *Clear zones* – Some trees and vegetation may be in the clear zone • *Barriers* – NA • *End treatments/crash cushions* – NA • *Pedestrian railing* – NA • *Visibility of barriers and fences* – NA

Step 4

Table 4. Summary of Site Inspection Prompt List (continued)

Topic	Field Condition
Traffic Signals	NA
Pedestrians and Bicyclists	Pedestrian and bike use is minimal and not reflected in the crash data or traffic volume data
Older Drivers	Does not appear to be an issue given the type of site and the fact that less than 1 percent of crashes included an occupant 60 years or older; however, topic should be kept in mind as part of identifying potential solutions. Topics that might be particularly relevant to older drivers: • Turning operations (receiving lane widths, radii); • Channelization, opposing left-turn lanes; • Sight triangles; • Signing, marking, and delineation; and • Traffic signals.
Bridges and Culverts	NA
Pavement	• *Pavement defects* – Pavement is good condition • *Skid resistance* – Appears normal (good friction) • *Ponding/icing/snow accumulation* – None observed during visit • *Loose stones/material* – None • *Manholes* – NA • *Parking* – Not allowed in this section
Provision for Heavy Vehicles	• *Design issues* – None • *Pavement quality* – Good • *Gravel shoulder quality* – Good
Floodways and Causeways	NA
Other Safety Issues	• *Landscaping* – Trees and vegetation could be cleared to give more sight distance • *Temporary works* – NA • *Headlight glare* – Glare could be an issue on the curve • *Roadside activities* – NA • *Signs of possible problems (pavement, roadside)* – NA • *Rest areas* – NA • *Environment* – NA • *Median curbing* – NA • *Ponding, snow, or ice in winter conditions* – NA

To identify the contributing factors, feature, or crash type to investigate, crash data is compared and contrasted to the results of the field visit and summarized.

In this scenario, the site visit and crash data evaluation show:

- The roadway has a compound curve or a curve that starts at one rate of curvature, and then quickly becomes sharper. The changing curve radius appears to cause drivers to misjudge how fast they should be traversing the curve.
- There are few advanced warning signs to advise drivers of a safe speed for the curve or chevron signs to give drivers direction at night and advise them of the road's curve. Some key existing signs are partially covered by vegetation, and retroreflectivity of these signs is marginal.
- There is limited sight distance around the curve, causing drivers to be unaware of vehicles or other road obstructions in the road ahead.
- Trees in the clear zone may increase the severity of crashes during run-off-road incidents.
- Of the 37 crashes at the site in the last five years, 19 have been have been run-off-road crashes. There have been 22 property damage-only crashes; and 2 fatal and serious injury crashes.
- Crashes appear to be more frequent on this road segment when compared to other curves with similar levels of traffic.

Based on the existing crash data and field investigation, the site's run-off-road crashes included the two fatal crashes and were the most frequent crash type. The investigation also showed that existing roadway features may not sufficiently inform drivers of upcoming conditions; therefore, safety treatments should focus on the roadway departure crashes.

The FHWA Office of Safety web site has a web page focused on roadway departure crashes.[1] This web site provides information about how common roadway departure crashes, particularly on horizontal curves, and provides information about countermeasures to address these types of crashes.

It is often useful at this stage of the analysis to prepare an existing conditions memorandum/write-up to document the evaluation and current conclusions. A possible outline for documentation of the work through this stage of the analysis is shown below.

Introduction

- Description of concerns at the site; and
- Description of approach to analyzing conditions.

Data Collection and Evaluation

- Description of the data that was collected and summary of the data:
  - Crash data tables; and
  - Roadway characteristics summary or sketches.

Diagnosis Results

- Summary of the evaluation of the existing crash and roadway characteristics data:
  - Summary of recommended approach to addressing the issues.

1 http://safety.fhwa.dot.gov/roadway_dept/.

Identify Countermeasures

Step 4

Background

The most common and readily available resources for identifying possible treatments (countermeasures) to address a particular crash type are the web-based CMF Clearinghouse, Part D of the Highway Safety Manual, the National Cooperative Highway Research Program (NCHRP) 500 reports, and the FHWA Office of Safety Proven Countermeasures web page. Another useful resource is the FHWA document *Low-Cost Countermeasures for Horizontal Curve Safety*. This document is available at http://safety.fhwa.dot.gov/roadway_dept/horicurves/. These and other resources are presented in Step 4 of the Toolkit.

> **Looking for patterns in crash data**
>
> Studying the crash type, severity, and environmental conditions will provide insights for identifying potential crash contributing factors and potential treatments. For example, if a site had very high nighttime crash frequency, then lighting might be a treatment to reduce crash frequency. Or if there were many crashes on Friday nights after high school football games, education about speeding and distracted driving or speed enforcement might be a more useful countermeasure. It is important to remember that infrastructure will not always address site issues.

The Crash Modification Factors (CMF) Clearinghouse (http://www.cmfclearinghouse.org/) serves as a central on-line database of countermeasures and their associated CMFs. The CMF Clearinghouse defines a crash modification factor as "a multiplicative factor used to compute the expected number of crashes after implementing a given countermeasure at a specific site." Users are able to query the Clearinghouse database to identify treatments and the associated CMF. For each CMF, the database provides users with published information, such as how it was developed, the research quality behind the CMF, and a link to the publication from which the CMF was extracted. Based on this information, users are able to determine the most applicable CMF for their condition.

The NCHRP 500 consists of multiple reports, each report addresses a specific type of highway crash or contributing factor. *Volume 06, A Guide for Addressing Run-Off-Road Collisions* is applicable to this situation.

> **What to do if the potential safety issue is not obvious?**
>
> Sometimes, there is not an obvious pattern in the data leading to a potential safety issue or treatment. This can affect proper diagnosis of the safety issue. Options for dealing with this difficult safety situation include the following:
>
> 1. Ask a peer from another agency, the TTAP, LTAP, or state to review the site and study results and provide their opinion on the matter.
> 2. If data is missing that limits the type of study that can be completed, look for ways to collect this data over the upcoming years and continue to monitor the site.
> 3. Do a design check to verify that all minimum design criteria are met. Where possible, consider exceeding the minimum on key safety features.
> 4. Work with the local police departments to get notification of crashes that may occur in areas of concern. Visit crash sites as soon as possible after a crash event to get answers to questions that may not be in the crash record.

This document provides information about typical conditions related to run-off-road crashes, strategies for addressing the crashes, and guidance for implementing solutions. In this document, the countermeasures are reported as "proven," "tried," and "experimental." Proven countermeasures are the preferred countermeasures for implementation. Note that since this series of documents was originally published, new research may have been conducted that may have reclassified some countermeasures from "experimental" to "tried," or from "tried" to "proven."

In the case of identifying countermeasures for a specific crash type at a specific location, it is worthwhile to return to the FHWA Office of Safety web site and review the web page dedicated to "proven countermeasures" (http://safety.fhwa.dot.gov/provencountermeasures/). This web page provides information about countermeasures known to address specific crash types. The web page contains information related to rumble strips and stripes, and enhanced delineation, and friction for horizontal curves and the safety edge. Each of these countermeasures addresses run-off-road crashes and may be applicable to the study site.

This Scenario

This scenario's site diagnosis determined that countermeasures, which may reduce run-off-road crashes, are appropriate at the study site. Based on this conclusion, the scenario can identify countermeasures that address run-off-road crashes using the aforementioned resources.

> **Countermeasures and Treatments**
>
> The terms "countermeasures" and "treatments" are often used interchangeably to mean a strategy or action implemented to reduce the frequency or severity of crashes at a site.

To find countermeasures in the CMF Clearinghouse database, users query the Clearinghouse for CMFs related to a particular treatment or crash type (in this case, run-off-road crashes). There are search filters provided to help narrow the results. The search filters are by star quality or the research quality behind the CMF, crash type, crash severity, roadway type, area type, intersection type, intersection geometry, traffic control, and whether the countermeasure is in the AASHTO Highway Safety Manual (HSM). For this scenario, a search for a treatment related to run-off-road crashes with filters for all star ratings, run-off road crash types, any crash severity, and in rural area shows treatments for run-off-road crashes in the following categories of potential treatments (countermeasures):

- Roadside;
- Roadway;
- Shoulder treatments; and
- Signs.

Each of these categories contains treatments for reducing run-off-road crashes and these treatments CMF developed from research. For example, the countermeasures contained in the Signs category are:

- Install chevron signs on horizontal curves; and
- Install new fluorescent curve signs or upgrade curve signs to fluorescent sheeting.

The information about each of these treatments in the above categories needs to be studied to determine the potential application of the treatment to this scenario. For example in Figure 7, the treatment related to install chevrons in curves provides five different four-star-rated CMFs.

Step 4

Figure 7. CMF Clearinghouse Countermeasure Example
Install Chevrons

CMF	CRF (%)	Quality	Crash Type	Crash Severity	Area Type	Reference	Comments
0.96	4	★★★★☆	Non-intersection	All	Rural	Srinivasan et al., 2009	
0.94	6	★★★★☆	Head on,Non-intersection,Run off road,Sideswipe	All	Rural	Srinivasan et al., 2009	
0.84	16	★★★★☆	Non-intersection	Fatal,Serious injury,Minor injury	Rural	Srinivasan et al., 2009	
0.75	25	★★★★☆	Nighttime,Non-intersection	All	Rural	Srinivasan et al., 2009	
0.78	22	★★★★☆	Head on,Nighttime,Non-intersection,Run off road,Sideswipe	All	Rural	Srinivasan et al., 2009	
0.63	37	★★★☆☆	All	All	Not specified	Montella, 2009	
0.406	59.4	★★★☆☆	Wet road	All	All	Montella, 2009	

Source: http://www.cmfclearinghouse.org/.

To select a countermeasure, the possible treatments in each of the categories would be examined to identify how applicable the treatment is for the situation at hand. The Clearinghouse provides an option to export the query for review and evaluation in Microsoft Excel. In all likelihood, there will not be a perfect match between the countermeasures in the Clearinghouse and the specific site under investigation. However, the best available treatment can be selected for application based on good judgment and familiarity with the site conditions. Things to consider as part of CMF selection process include specific roadway type, urban, suburban rural environment, specific volume range, or addressing a particular crash type or severity. If a CMF's situation is not similar to the site at hand, the same safety effectiveness cannot be expected. Remember, the lower the CMF the greater the potential reduction in crashes. However, there may be tradeoffs or barriers to implementing the CMF with the lowest value. This is acceptable and part of the judgment process of selecting countermeasures.

If the CMF Clearinghouse does not provide an option for a treatment for the particular scenario, the FHWA Office of Safety web site and the NCHRP 500 report may also provide insight, or the state DOT might have a list of treatments and CMF values approved for use in the state.

Following review of the Clearinghouse and the FHWA Office of Safety web site, the treatments in Table 5 were selected as optional treatments applicable at the site under investigation. Figures 8 and 9 show example images of these optional treatments.

Table 5. CMFs of Potential Treatments

	Enhanced Signage	Increase Lateral Clearance	Install Edgeline Rumble Strips
Safety Effectiveness (CMF)	0.84 to Fatal and Injury Crashes[a]	0.49 to Fatal and Injury Crashes[b]	0.85 to All Crash Severity[c]

[a] *FHWA.*

[b] *CMF Clearinghouse, does not specify if relevant to curved segments, tangent segments, or both.*

[c] *CMF Clearinghouse, specific to principal arterial/other.*

Figure 8. Potential Treatment
Enhanced Signage

Source: Scott Davis, Thurston County, Washington.

Figure 9. Potential Treatment
Install Edgeline Rumble Strips

Illustrations of rumble strip for centerline (left), shoulder (middle), and across roadway (right).

Source: FHWA.

Step 5. Prioritize Countermeasures for Implementation

Background

The process for prioritizing and selecting countermeasures for implementation can range from a quantitative benefit/cost analysis to a qualitative rating process using high, medium, and low (or good, fair, poor ratings); or a hybrid of both. The purpose of the countermeasure evaluation and prioritization step is to review the potential countermeasures and select the most feasible countermeasure for the site under investigation. The types of criteria that may influence the feasibility of a particular countermeasure in a particular situation include:

- Environmental impacts;
- Construction costs;
- Stakeholder input and community preferences;
- Maintenance costs;
- Anticipated safety effectiveness;
- Right-of-way availability; and
- Consistency with other community plans and goals.

This Scenario

The criteria for selecting a countermeasure in this scenario are environmental impacts, safety effectiveness, construction costs, maintenance costs, right-of-way impacts, and timeline to implementation. Different criteria will be important in different situations and communities, and the Toolkit presents the array of criteria that could be considered.

The results of the qualitative rating process are shown in Table 6. The impacts of each optional countermeasure were compared to the selected evaluation criteria and given a high, medium, or low rating. For example, enhanced signage received a "low" rating for environmental impacts because staff are aware that signs could easily be placed with limited, if any, impact to vegetation, hillside slopes, or the adjacent creek. In contrast, increasing lateral clearance received a "high" rating in the environmental impacts category because trees would need to be removed to increase roadside clear zones. The evaluation team also noted the potential negative impacts of edgeline rumble strips on the bicyclists in the area.

Table 6. Qualitative Comparison of Potential Treatments

Evaluation Criteria	Enhanced Signage	Increase Lateral Clearance	Install Edgeline Rumble Strips
Environmental Impacts	Low	High impact to trees	Medium
Safety Effectiveness (CMF)	0.84 to Fatal and Injury Crashes[a]	0.49 to Fatal and Injury Crashes[b]	0.85 to All Crash Severity[c]
Construction Costs	Low	Medium	Medium
Maintenance Costs	Low	Medium	Medium
Right-of-Way Impacts	Low	Medium	Low
Timeline to Implementation	Low	Medium	Medium

[a] *FHWA.*

[b] *CMF Clearinghouse, does not specify if relevant to curved segments, tangent segments, or both.*

[c] *CMF Clearinghouse, specific to principal arterial/other.*

As shown above, the impacts of enhanced signage are lowest and the CMF is most specific to the study site; therefore, this countermeasure is selected for implementation.

At the end of this stage, it is appropriate to revisit the summary of existing conditions documented at the end of the previous step, and expand the memorandum/write-up to include an explanation of the analysis, countermeasure prioritization, and recommended treatments. This information also could be presented to agency leadership for review, input, and approval, if necessary. At this stage, the project documentation outline could be:

Introduction

- Description of concerns at the site; and
- Description of approach to analyzing conditions.

Data Collection and Evaluation

- Description of the data that was collected and summary of the data:
  - Crash data tables; and
  - Roadway characteristics summary or sketches.

Diagnosis Results

- Summary of the evaluation of the existing crash and roadway characteristics data; and
- Summary of recommended approach to addressing the issues.

Countermeasure Prioritization

- Summary of prioritization process, evaluation criteria and results.

Recommendations

- Brief summary of the memorandum explaining fundamental conclusions of the analysis and the recommended action.

Step 6. Implement the Countermeasures

Background

Obtaining the necessary human and financial resources to implement any safety project or program is a major consideration. Harnessing local funding sources and staff resources is often the quickest way to implement projects. For example, maintenance or public works staff can implement low-cost projects such as maintenance or replacement of signs, maintenance of striping, and/or vegetation control as part of their regular duties.

Seek Technical Assistance if Needed

If in-house expertise to work with the MUTCD or other guidelines appropriate for the project is not available, technical assistance is always available through the LTAP/TTAP, regional or metropolitan planning organization, or the state DOT.

In addition to local funds, the Local Technical Assistance Program (LTAP) web site describes the various types of local agency support provided by state DOTs – a useful first stop for identifying the resources available by state. The LTAP web site is http://www.ltap.org/resources/lpa/state.php.

This Scenario

Implementing enhanced signage is a relatively low-cost countermeasure. In some cases, enhanced signage could be implemented as part of ongoing maintenance activities. The Toolkit provides additional information about funding opportunities.

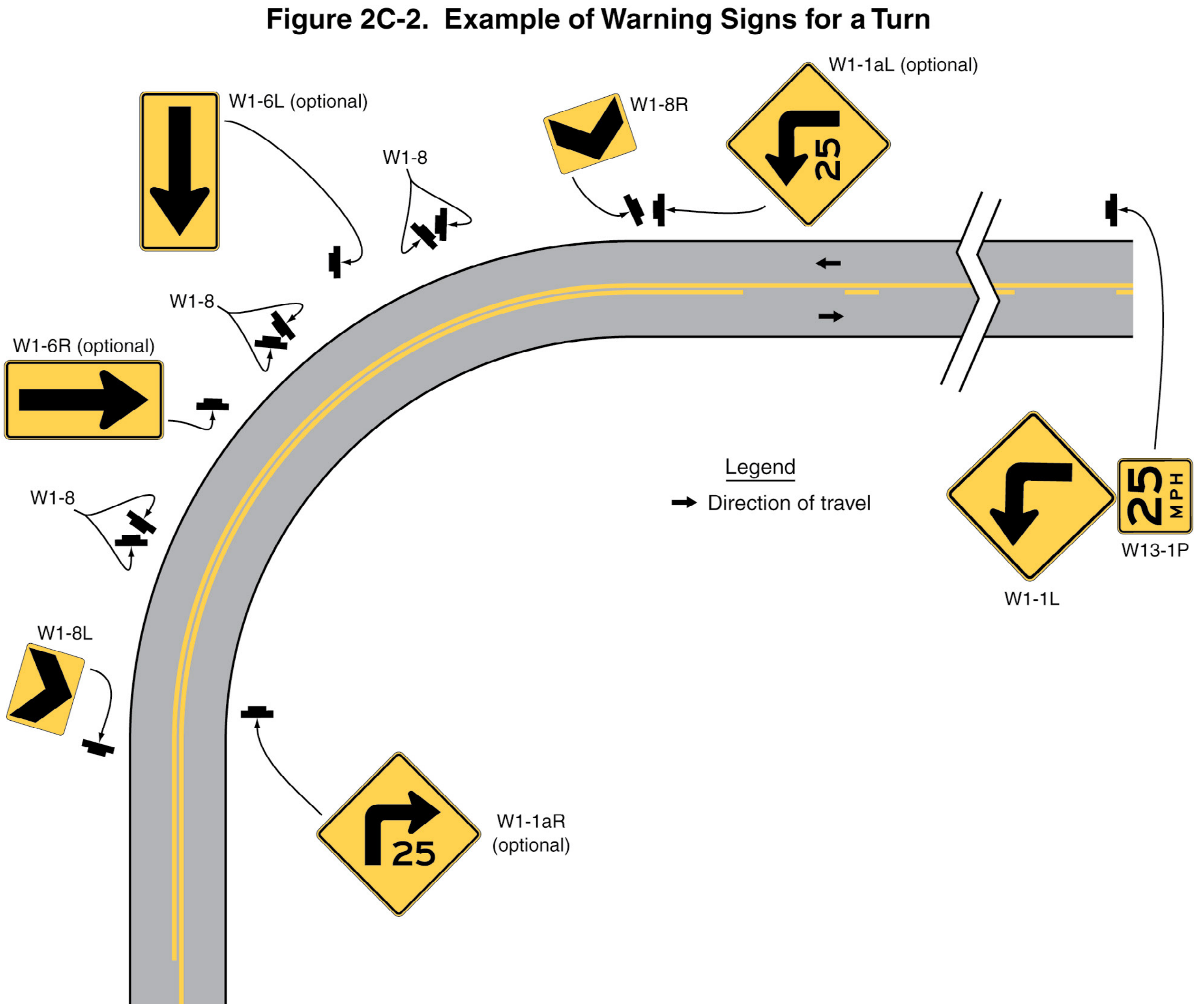
Consider Applying Results from One Study to Other Comparable Locations

Based on the results of this assessment, a systemic analysis could be conducted to identify locations with similar configurations and safety risk. As in this case, enhanced signage could be considered for implementation at selected locations throughout the community.

The Manual on Uniform Traffic Control Devices (MUTCD) should be consulted for guidance and requirements related to sign size, placement, and retroreflectivity (http://mutcd.fhwa.dot.gov/). Figure 10 below is an *incomplete excerpt*[2] of Figure 2C2 from the 2009 MUTCD, illustrating the recommended curve delineation sign layout for a horizontal curve. The MUTCD provides detailed information used to customize this layout to the specifics of the curve.

[2] Notes and advisory speed signage information are not included in the figure in order to focus on curve delineation.

Figure 10. MUTCD Excerpt on Chevron Sign Spacing



Source: FHWA.

For example, Table 7 from the MUTCD illustrates the spacing of chevron signs based on the radius of the curve being delineated. In this scenario, the curve has a radius of 228 feet which results in a chevron sign (W1 8L) spacing of 80 feet along the outside of the curve.

Table 7. MUTCD Chevron Sign Spacing Based on Advisory Speed and Curve Radius

Advisory Speed	Curve Radius	Sign Spacing
15 miles per hour or less	Less than 200 feet	40 feet
20 to 30 miles per hour	200 to 400 feet	80 feet
35 to 45 miles per hour	401 to 700 feet	120 feet
50 to 60 miles per hour	701 to 1,250 feet	160 feet
More than 60 miles per hour	More than 1,250 feet	200 feet

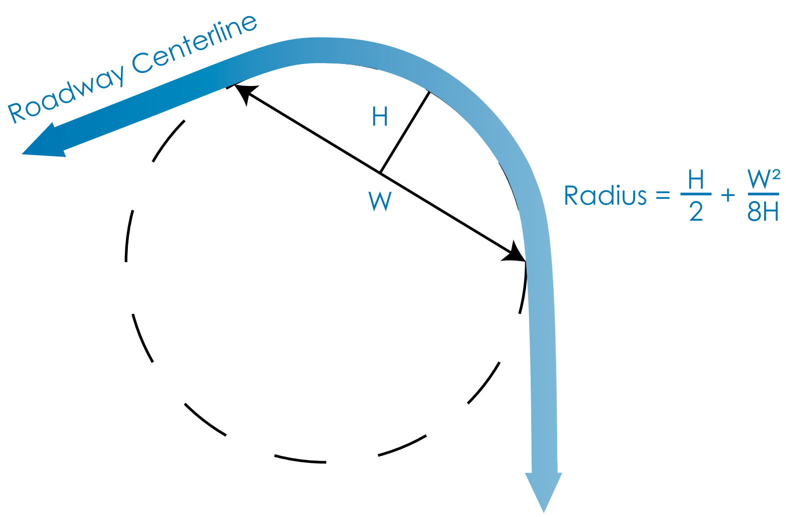
Source: MUTCD.

Note: The relationship between the curve radius and the advisory speed shown in this table should not be used to determine the advisory speed.

Alternatively, if the curve radius is not known, it can be calculated using the information in Figure 11.

Figure 11. Curve Radius Calculation

Step 6



Finally, if other aspects of the project have been documented, it would be useful to add the results of this step to the project documentation as well. At this stage, the project documentation outline could be:

Introduction

- Description of concerns at the site; and
- Description of approach to analyzing conditions.

Data Collection and Evaluation

- Description of the data that was collected and summary of the data:
  - Crash data tables; and
  - Roadway characteristics summary or sketches.

Diagnosis Results

- Summary of the evaluation of the existing crash and roadway characteristics data; and
- Summary of identified contributing factors and treatment types selected for potentially addressing the issues.

Countermeasure Prioritization

- Summary of prioritization process, evaluation criteria, and results.

Recommendations

- Brief summary of the memorandum explaining fundamental conclusions of the analysis and the recommended action.

Final Comments

- Potential for applying the treatment elsewhere in the community; and
- Lessons learned for future application.

Step 7. Evaluate Effectiveness of Implemented Countermeasures

Background

If possible, it is useful to conduct a quantitative analysis to see if the crash frequency or severity has changed after implementing the treatments. Two to three years after implementing the treatment, agency staff should routinely conduct additional analyses to evaluate treatment effectiveness.

This Scenario

In this scenario, assuming traffic volume does not change dramatically, crash records for the three-year period after implementing the treatment should be collected, summarized, and compared to the crash data summarized for this analysis. Table 8 shows an example of a tabular comparison of the before-and-after period crash data. As shown in the table, the run-off-road crashes decreased after implementing enhanced signage. However, because of statistical issues associated with crash data (explained in the Toolkit) it should not be concluded that there was an 88 percent reduction in run-off-road crashes ((19-2)/19 = 89.5%). It can be concluded that run-off-road departure crashes have decreased, but this analysis is not statistically rigorous enough to quantify the change in crash frequency.

Note that the crash frequency for fixed-object and other crashes increased in the after-period. It is not possible to know if this is due to the treatment installed or a random fluctuation in crashes.

Table 8. Example of Comparison of Before-and-After Period Crash Data

Crash Type	Before (2009-2011)	After (2013-2015)
Run Off The Road	19	2
Fixed Object	12	8
Head-on	2	2
Other	4	6
Total	**37**	**18**

Step 7

It also is important to note that if traffic volume changes substantially after implementing the treatment at the site, this type of simple before-and-after crash analysis will be less valid because the change in traffic volume may be influencing the change in crash frequency or severity. For example, a significant decrease in crash frequency recorded in Table 8 may be due partially to the decrease in study area traffic volume.

Documenting the results of the effectiveness analysis in a memo, or for presentation to governing board would be useful. This could demonstrate the value of the project in the specific jurisdiction and serve as a resource if similar projects are considered in the future.

4.0 Options for Additional Activities

Looking forward from implementing the particular treatment at one site, there are a number of additional actions the agency could take. Staff could:

- Arrange for maintenance staff to review curves throughout the community (including night reviews) as part of other activities (e.g., vegetation control, pavement management). For those curves that have comparable conditions to the site studied in this scenario, staff could develop a list for enhanced signage and plan funding to implement the signs, when possible. Step 2 of the Toolkit has resources for this activity.
- Collect and summarize crash data for all horizontal curves in the community and begin a more quantitative process for identifying curves with potential safety treatment needs where the countermeasures outlined in this study could be applicable as well. The Toolkit provides a description of the systemic analysis.
- Contact the stakeholders that were so concerned about the treatment and gauge their interest in developing and participating in a community traffic safety committee. This committee could study traffic safety in the community, and identify potential solutions and activities to encourage safer travel in the community.
- Collaborate with police enforcement in the community to enhance speed enforcement in the vicinity of horizontal curves as a strategy for managing speeds and driver behavior in the community.

Regression to the Mean

On an annual basis, the number of crashes at a site will fluctuate up and down. Over time, if nothing changed at the site (e.g., traffic volume, surrounding land use, weather, driver demographics), the frequency of crashes at the site would converge on an average crash frequency. This is called regression to the mean. Regression to the mean is the tendency for a site to experience a period with a comparatively high crash frequency followed by a period with comparatively low crash frequency.

5.0 Conclusions

This User Guide (User Guide #1) focuses on studying safety conditions at one site. The site could be identified in any variety of ways such as public concern, local official input, or staff familiarity of site conditions. To study safety at one site, the practitioner can use a portion of the roadway safety analysis process presented in Figure 1. The steps to study safety conditions at one site are:

- Step 1 – Compile Data;
- Step 4 – Diagnose Site Conditions and Identify Countermeasures;
- Step 5 – Prioritize Countermeasures for Implementation;
- Step 6 – Implement Countermeasures; and
- Step 7 – Evaluate Effectiveness of Implemented Countermeasures.

At the conclusion of these activities, the practitioner also should evaluate whether there are other additional safety-related activities that can be conducted as part of ongoing work in the agency.

The solutions presented in this User Guide are provided in step-by-step form so that practitioners can apply the methods to comparable situations in any community. The scenarios outlined in the User Guide are examples to show intended use of the tools and provide examples of how some of the tools for each step are applied.

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