

Developing a Methodology for Implementing Safety Improvements on Low-Volume Roads in Montana

Task IV Report: State of the Practice Survey Report

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TABLE OF CONTENTS

1. Introduction	1
2. Methodology.....	2
3. Results	3
3.1. Safety Improvement Programs for State-Owned Low-Volume Roads.....	3
3.2. Safety Improvement Programs for Non-state-owned Low Volume Roads	7
4. Summary and Key Findings	11
References.....	12
Appendix A: Survey Questionnaire	13
Appendix B: Different Site Identification Methods For State-Owned Local Roads Reported Under Others	19
Appendix C: Different Site identification Methods For Non-State-Owned Local Roads Reported Under Others	20

LIST OF FIGURES

Figure 1: Map showing the Survey Responding States	2
Figure 2: Percentage of Low-Volume Roads in State Highway Network.....	3
Figure 3: Frequency of Use of Different Site Identification Methods.....	4
Figure 4: Number of States Using Different Fund Allocation Methods.....	7
Figure 5: Frequency of Different Site Identification Methods for Non-State-Owned Local Roads.....	8
Figure 6: Frequency of Different Site Justification Methods for Non-State Local Roads	9
Figure 7: Safety Funds for Systemic Improvements for Non-State-Owned Local Roads.....	10

LIST OF TABLES

Table 1: Use of Cost Effectiveness in Safety Management on State-Owned LVRs	5
Table 2: Agencies' Level of Satisfaction with State-Owned LVR Methods.....	5
Table 3: Association of Level of Satisfaction with Site Identification Method Used	6
Table 4: Access to Different Data Types	6
Table 5: Entities Conducting Roadway and Traffic Data Collection for Non-State-Owned Local Roads	8

LIST OF ACRONYMS

AADT	Annual Average Daily Traffic
DOT	Department of Transportation
EB	Empirical Bayes
FHWA	Federal Highway Administration
HSIP	Highway Safety Improvement Program
HSM	Highway Safety Manual
LVR	Low-Volume Roads
SPF	Safety Performance Function

1. INTRODUCTION

This task report presents the results from Task IV of the “Developing a Methodology for Implementing Safety Improvements on Low-Volume Roads in Montana” project. Task IV aims at understanding the state of practice in the United States regarding identifying sites for safety improvements on low-volume roads. An online practice survey was developed in this task which was then finalized and sent to all state Departments of Transportation (DOTs) seeking information on different aspects of safety management programs on low-volume roads, with emphasis on identifying sites for safety improvement projects.

The task report begins with a summary of the methodology and a description of the survey tool. The remainder of the report discusses the results of the questionnaire. A summary of the findings is presented at the end of the report.

2. METHODOLOGY

The survey questionnaire consists of two major parts. The first part contains seven questions about identifying sites for low-volume roads that are owned and operated by the state's DOT. These questions address issues such as the use of specific network screening methods, use of cost effectiveness in the process, access to various types of data, and the level of agency's satisfaction with the site selection process. In this regard, "network screening is the process of identifying sites for further investigation and potential treatment" [1]. The second part of the questionnaire consists of ten questions and focuses on site identification for non-state-owned local roads. The questions in this section address issues such as the leadership of safety programs for non-state-owned low-volume roads (LVRs), local agency involvement and its level, safety fund allocation for non-state-owned local roads, site identification methods, and other relevant aspects.

The survey used for this study was created and managed using Qualtrics software. The survey was sent via email to safety personnel at state DOTs in all 50 states. Thirty-two (32) agencies responded to the survey resulting in a response rate of 64 percent. The responding states are shown in red (the darker shaded areas) on the map in Figure 1. One responding agency submitted the survey without completing the questionnaire, and as such, this response was excluded from further consideration and analysis. A copy of the questionnaire is provided at the end of the report in Appendix A.

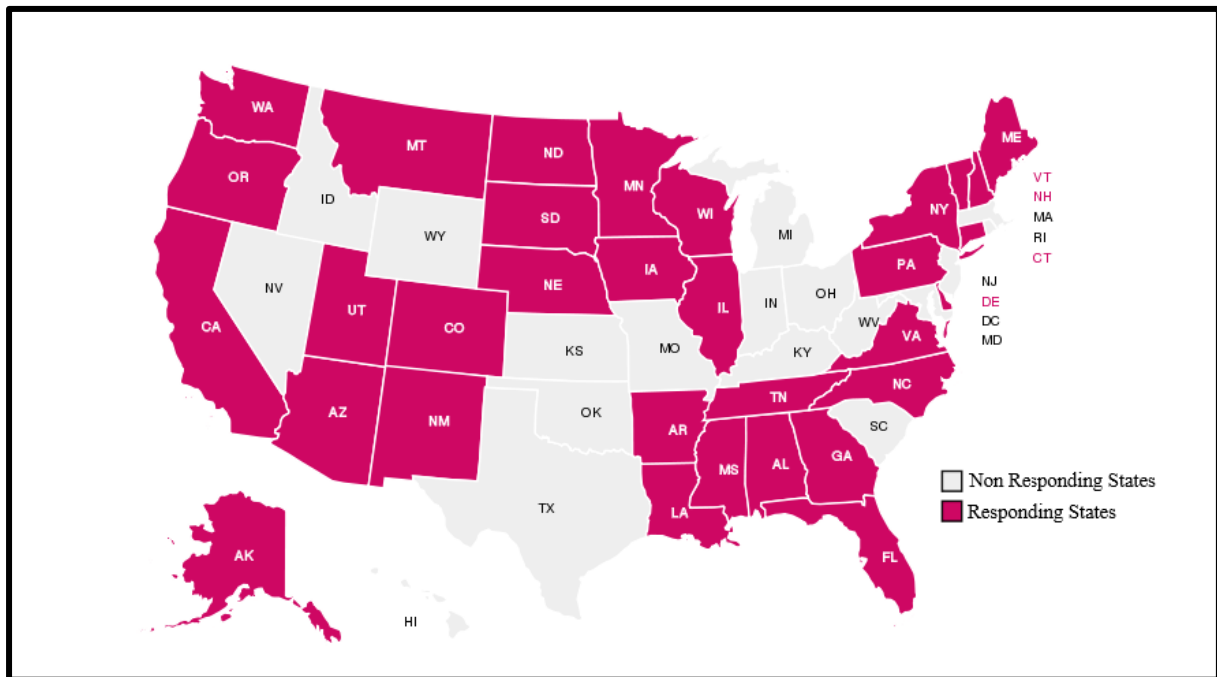


Figure 1: Map showing the Survey Responding States

3. RESULTS

3.1. Safety Improvement Programs for State-Owned Low-Volume Roads

As discussed earlier, the survey was divided into two parts. The first part consisted of questions that focused specifically on state-owned local roads. The results from the analysis of these responses are discussed in the following paragraphs.

The purpose of this survey was to understand how safety projects on low-volume roads are addressed by the different states. Before inquiring about the different methods of how safety concerns on low-volume roads are addressed, a question about the percentage of low-volume roads in each state was asked. The question asked about the percentage of roadways in the state that have a volume of less than 1000 vehicles per day (vpd). The responses to this question are illustrated in Figure 2.

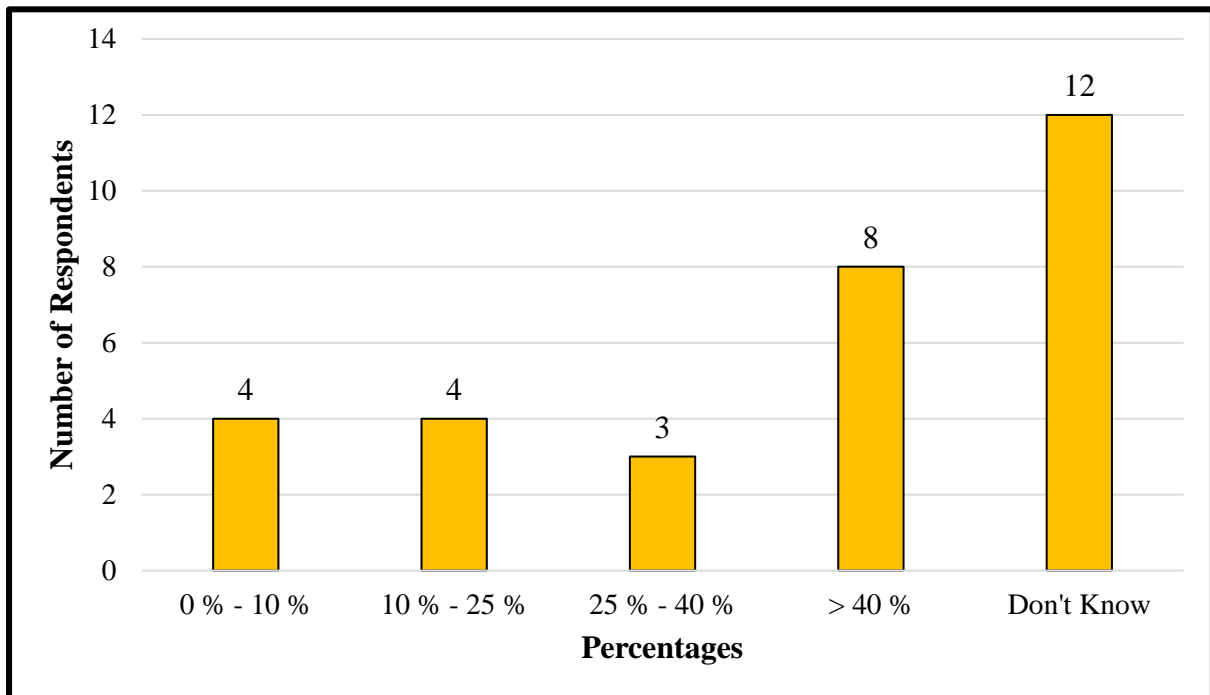


Figure 2: Percentage of Low-Volume Roads in State Highway Network

Eight out of 31 states (around 25 percent) reported that more than 40 percent of their roads are low-volume roads, i.e. have annual average daily traffic (AADT) of less than 1000 vehicles per day. Four out of 31 (about 13 percent) respondents reported a percentage between 10 and 25, and a similar number of states reported a percentage less than 10. Only three out of 31 states (less than 10%) reported a percentage between 25 and 40. It is important to note that 12 out of 31 respondents (around 38 percent) did not report a percentage due to lack of information. This might be because most states do not classify their roads based on daily volumes. Another possible reason is that many of the low-volume roads are in remote rural areas and therefore traffic counts on these roads may not be readily available.

Moving on to understand how states manage safety projects for LVRs, the survey inquired whether the agency has a different method for selecting safety improvement sites on LVRs than that used for other state-owned roads. This information is important because traditional methods for site identification on higher-volume roads (non LVRs) may not work well on low-volume roads.

More than 80 percent of the respondents (25 out of 31) reported having a different method for their local roads, while only about 19 percent of the respondents (6 out of 31) reported using the same method/process. This shows that most of the responding agencies use separate and different methods for LVRs.

The next question in the survey asked agencies about the different safety improvement site identification methods. Figure 3 shows the number of times different methods were reported being used for site identification on state-owned local roads. Results show that crash severity is the most often reported method (21 times), followed by the Federal Highway Administration (FHWA) systemic approach (15 times), and the combination of the crash frequencies and crash rates (15 times). The FHWA systemic approach to safety involves widely implemented improvements based on high-risk roadway features correlated with specific severe crash types [2]. Crash rate method alone is the least used method (8 times). Eleven states reported using different methods and their responses are summarized in Appendix B at the end of this report. As shown in this appendix, around seven responses are related to the use of predictive methods outlined in the Highway Safety Manual (HSM).

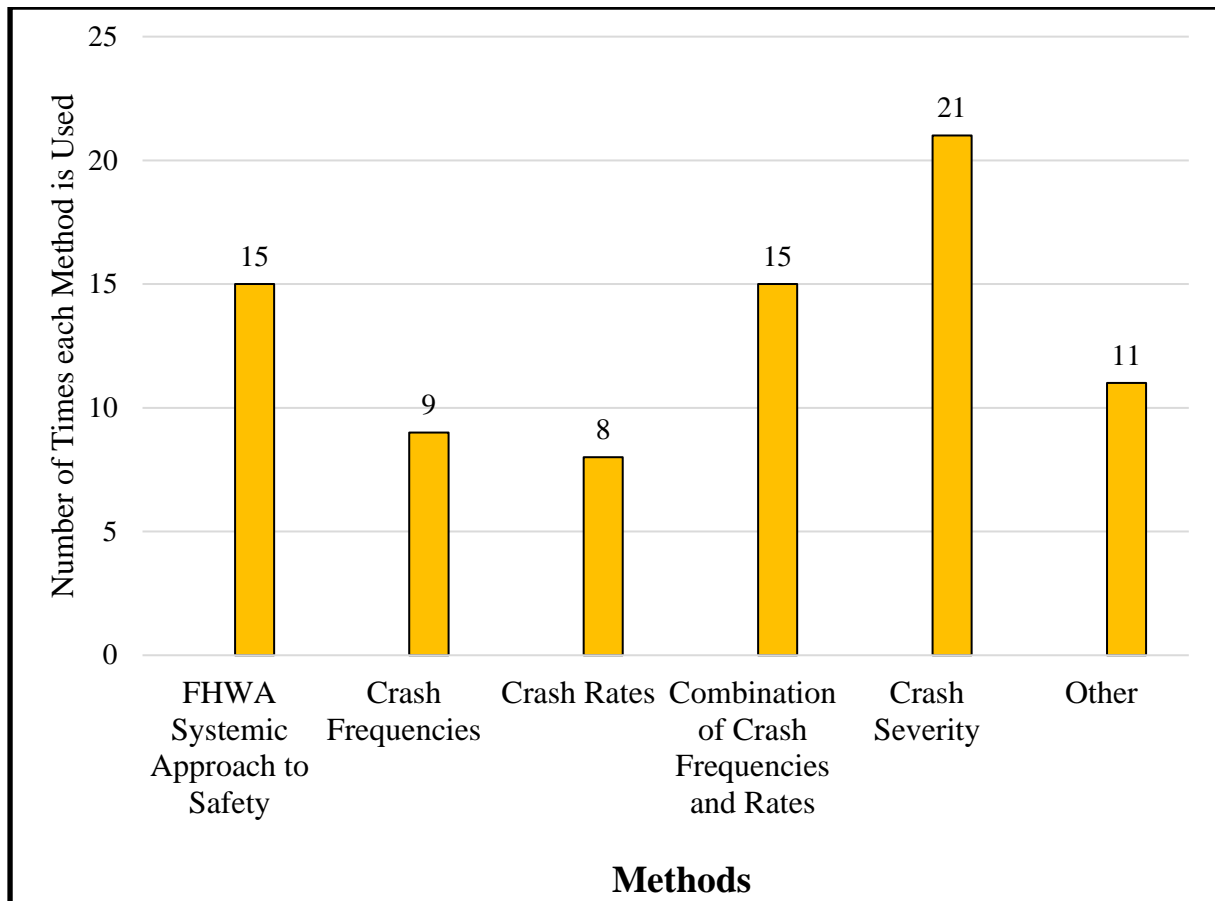


Figure 3: Frequency of Use of Different Site Identification Methods

Many of the respondents reported using the traditional network screening methods along with the FHWA systemic approach for site identification on state-owned local roads. Specifically, 15 out of 31 responding agencies (48 percent) reported using the FHWA systemic approach in combination with one or more of other network screening methods.

The next question in the survey asked agencies about how cost effectiveness is used for safety improvement site identification. Table 1 summarizes the responses to this question.

Seventeen out of 31 responding agencies (55 percent) reported using cost effectiveness for both ranking sites at the network level as well as for comparing different site-specific safety improvement alternatives. Only 7 agencies (22 percent) use cost effectiveness for site-specific comparative analyses and another 6 agencies (19 percent) use it for ranking sites at the network level (network screening).

Table 1: Use of Cost Effectiveness in Safety Management on State-Owned LVRs

How Cost Effectiveness is Used	Number of Responses
Rank safety improvement sites at the network level	6
Compare alternative safety countermeasures at specific sites	7
Both ranking sites and comparing alternatives	17
Not used	1

To indirectly gather information on the level of challenges (or difficulties) in managing safety on low-volume roads, agencies were asked about their level of satisfaction with the methods they reported using on state-owned LVRs. The question used a scale of 1 to 10, with 1 being “not satisfied” and 10 being “extremely satisfied.” The responses to this question are summarized in Table 2 and vary in a range from 4 to 10. Eighteen out of 31 agencies (about 58 percent) reported a satisfaction level of 8 or higher, indicating a high level of satisfaction with their LVRs methods. Five out of 31 agencies (around 16 percent) reported a score of 7, indicating agencies are somewhat satisfied with the methods used. The remaining eight agencies (around 26 percent) scored 6 or less on the scale, which reflects a lower level of satisfaction with the methods used. The responses reveal that most of the responding agencies (around 74 percent) are satisfied with their methods of identifying safety improvement sites on LVRs.

Table 2: Agencies’ Level of Satisfaction with State-Owned LVR Methods

Level of Satisfaction	Number of responding agencies
1	0
2	0
3	0
4	1
5	2
6	5
7	5
8	14
9	3
10	1

To examine any possible association between the level of satisfaction of agencies and the methods used by agencies in identifying safety improvement sites, the number of states with a level of satisfaction of 7 or greater were found for three different identification method categories: using network screening, using FHWA systemic approach and network screening,

and using HSM-related methods (i.e. prediction models using safety performance functions (SPFs) or empirical Bayes (EB)). The results of this analysis are summarized in Table 3. The level of satisfaction is the lowest for states using only network screening methods. The use of FHWA systemic approach in conjunction with network screening methods is shown to improve the level of satisfaction. Finally, all states that reported using HSM-related methods have a level of satisfaction of 7 or greater.

Table 3: Association of Level of Satisfaction with Site Identification Method Used

	Number of States	With Level of Satisfaction > 7	Percent
Number of States using only Network Screening Methods	16	10	63%
Number of States using FHWA Systemic Approach with Network Screening Approach	15	13	87%
Number of States using HSM-Related Methods	7	7	100%

To effectively manage safety on LVRs, access to crash, traffic, roadway, and roadside data is critical. Therefore, a question about the type of data that is readily available to safety personnel at the network level was included in the survey. The responses are summarized in Table 4.

Seven out of 31 agencies (around 22 percent) reported having access to all data, i.e. crash, traffic, roadway, and roadside data (e.g. side slope, fixed objects, driveway density, etc.). Fourteen agencies (around 45 percent) reported having access to all data except roadside features. The remaining nine agencies don't have access to roadway or roadside data: seven agencies have access to crash and traffic data and two agencies have access to crash data only. These numbers show that around two thirds of the responding agencies have access to most of the data needed to analyze safety at the network level.

Table 4: Access to Different Data Types

Combination of Different Data Types	Number of States with Data Access
Detailed Crash Data	2
Crash & Traffic	7
Crash, Traffic & Roadway	14
All	7
Crash, Roadway & Roadside	1

3.2. Safety Improvement Programs for Non-state-owned Low Volume Roads

The second part of the survey focused on safety programs and practices for non-state-owned local roads. The findings from the responses to this part of the questionnaire are discussed in the following section.

To understand how safety on non-state-owned local roads are managed by agencies, the survey asked agencies whether the Highway Safety Improvement Program (HSIP) leader for non-state-owned roadways is different from the individual leading the program for state-owned roadways. Around 90 percent (28 out of 31) of responding agencies do not have a separate HSIP leader for non-state-owned local roads. The remaining 10 percent (3 agencies) confirmed that different leaders are assigned to safety programs for state-owned and non-state-owned local roads.

For more effective safety improvement programs on low-volume roads, input from local agencies is important. To understand the extent of involvement of local agencies, a question about involvement was included in the survey. Approximately 90 percent of the respondents (28 out of 31) reported involving local agencies in the site identification process, while only about 10 percent of respondents (3 out of 31) reported no involvement of local agencies in the process. These numbers suggest that most programs rely on input from local agencies in identifying safety improvement sites on local roads.

To gain a better understanding of how agencies manage safety on non-state-owned local roads, agencies were asked about the way agencies allocate funds for safety improvements on these roads. Specifically, a question regarding the process for determining how much funding is allocated to safety projects on non-state-owned local roads was included in the survey. Most of the responses were descriptive responses and the results are codified and summarized in Figure 4.

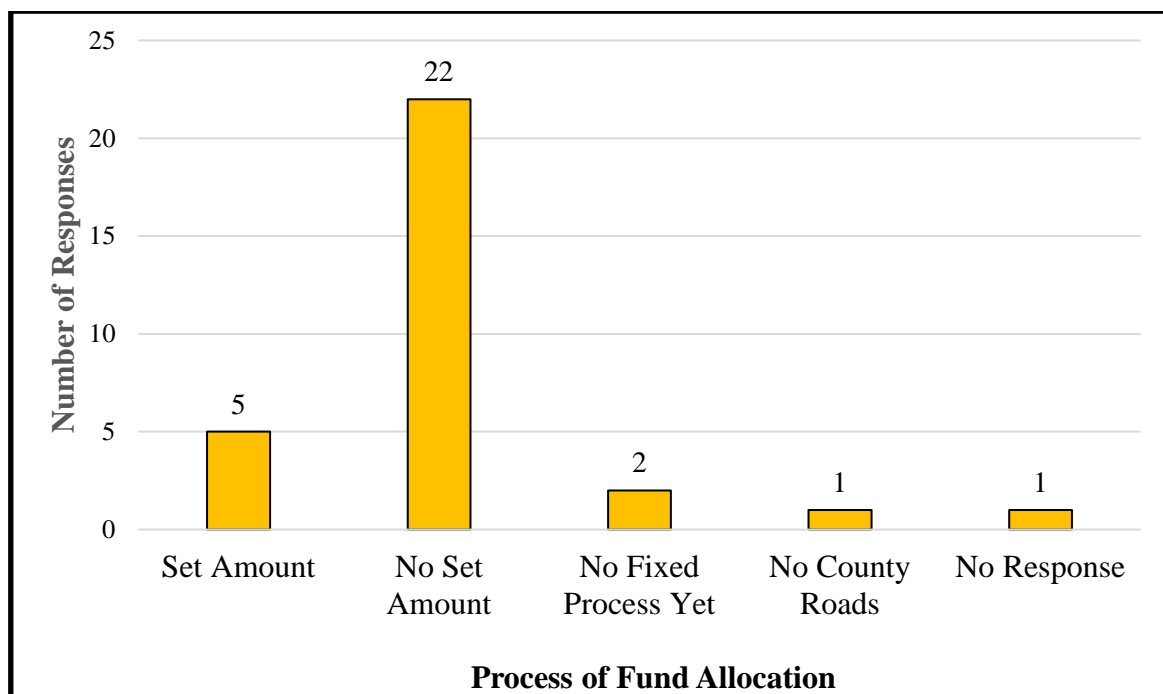


Figure 4: Number of States Using Different Fund Allocation Methods

Figure 4 clearly shows that only five states (around 16 percent) have a process where they set aside a specific amount of safety funds for these roads. Most respondents (24 out of 31) indicated that they don't use a set amount of funds or don't have an established process for

allocating funds to non-state-owned local roads. The state of North Carolina reported not having any significant number of non-state-owned local roads, and therefore, does not have a separate fund allocation for them.

One of the most important aspects of any safety program is site identification. Therefore, a question about how safety improvement sites are identified on non-state-owned local roads was included in the survey. The frequency of using different identification methods is illustrated in Figure 5. In answering this question, respondents could choose more than one method in their answers. Fifteen agencies reported that they include non-state-owned local roads in their statewide hotspot network screening. Another 13 agencies indicated they perform network screening within local jurisdictions. Further, crash experience at sporadic specific sites, and perception of risk at individual sites by law enforcement or the public were reported in 21, 17, and 8 responses respectively. About 8 of the responding states reported using methods other than those included in this question. Those different methods as reported by the agencies are provided in Appendix C of this report.

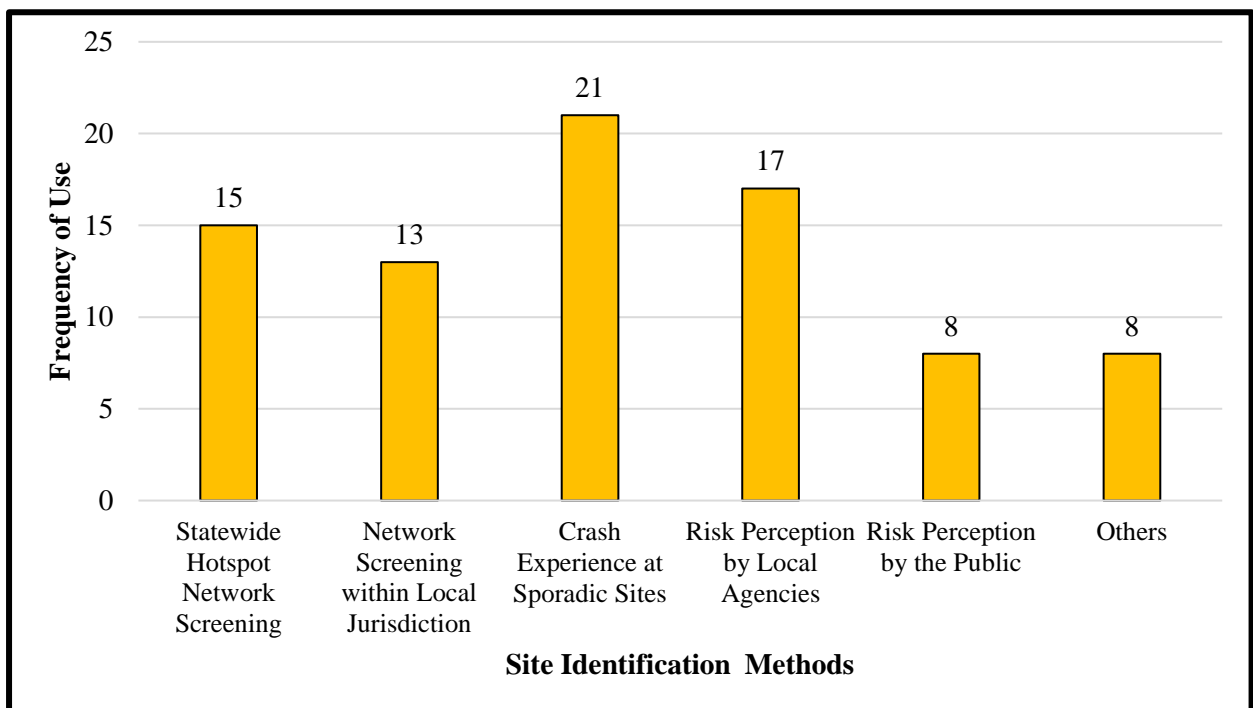


Figure 5: Frequency of Different Site Identification Methods for Non-State-Owned Local Roads

For any data-driven safety analysis, access to crash, roadway, and traffic data is critical. To understand how different agencies handle non-state-owned local roads, a question about which entity conducts traffic and roadway data collection for non-state-owned local roads was included. The summary of the responses is provided in Table 5.

Table 5: Entities Conducting Roadway and Traffic Data Collection for Non-State-Owned Local Roads

State DOT	3
Local Agency	9
Both	16
Others	3

As shown in Table 5, around half of the responding agencies reported that both the state DOT and the local agencies conduct the traffic and roadway data collection needed for safety improvement sites. Nine responding agencies indicated that local agencies are responsible for collecting traffic and roadway data, while only three agencies indicated that data collection is undertaken by the state DOT.

To understand the selection process of safety improvement sites on non-state-owned local roads, a question about the criteria used for justifying the selection of safety improvement sites was included in the survey. Figure 6 shows the frequency of the different criteria used in agency responses. In answering this question, agencies can select more than one criterion from the list of criteria provided. Consistent with expectations, cost effectiveness is the criterion most frequently used in selecting safety improvement sites (reported by 24 agencies). Crash severity was reported in 12 responses while the combination of crash frequency and rate was reported in 10 responses. Crash frequency and crash rate alone were reported in 8 and 5 responses, respectively.

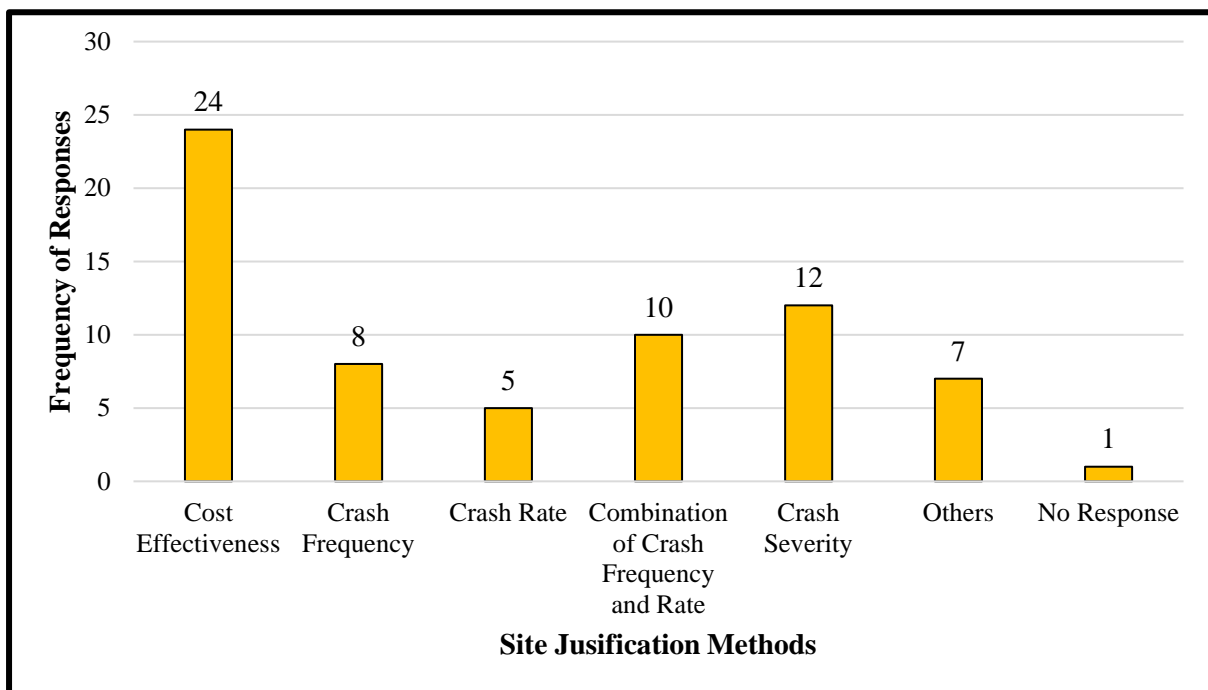


Figure 6: Frequency of Different Site Jusification Methods for Non-State Local Roads

Another question in the survey asked agencies whether the selection of safety improvement sites on non-state-owned local roads is performed separately from that of state-owned roadways. About 55 percent (17 out of 31) of the responding agencies select safety improvement sites on non-state-owned local roads together with state-owned local roads, while the remaining 45 percent (14 out of 31) of the responding agencies select them separately.

The FHWA systemic approach to safety evaluates risk across an entire roadway system and implements low-cost safety countermeasures throughout the roadway network. Given the lower crash densities on local and low-volume roads and the associated difficulty in using crash data alone for identifying safety improvement sites, systemic safety improvements become even more important in managing safety on low-volume roads. To understand the extent of its application on non-state-owned local roads, highway agencies were asked about the percentage of safety improvement funds allocated to systemic improvements. The responses are shown in Figure 7 below.

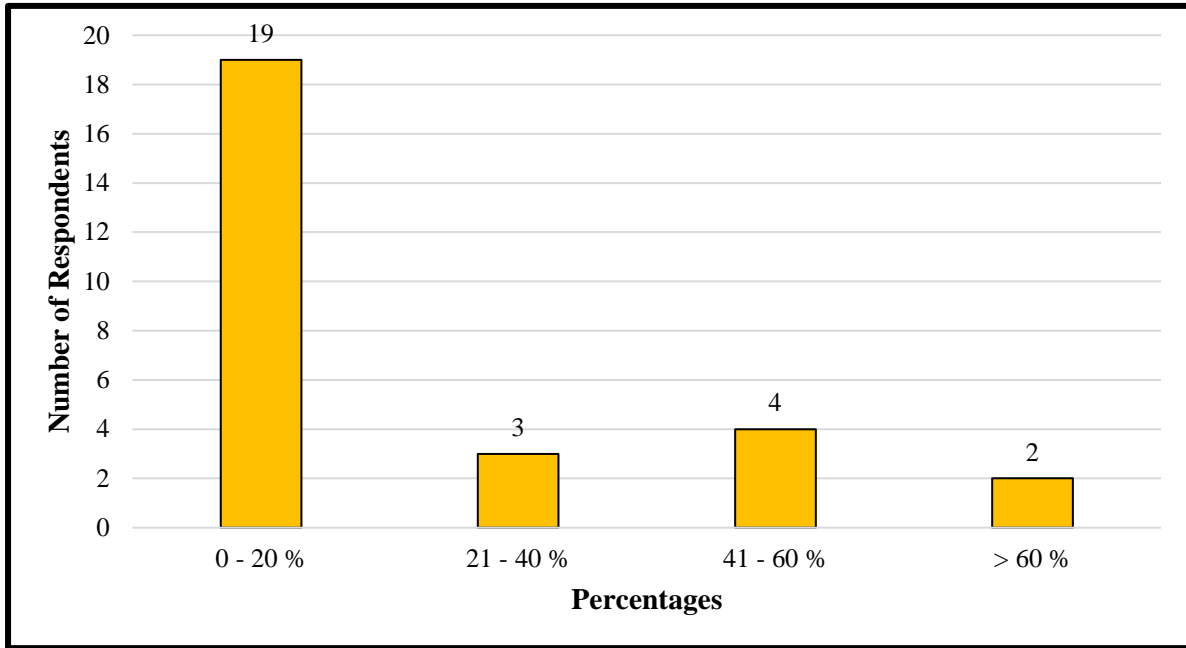


Figure 7: Safety Funds for Systemic Improvements for Non-State-Owned Local Roads

More than two thirds of the responding agencies (19 out of 28) reported allocating less than 20 percent of the funds for systemic improvements, while only about 7 percent (2 out of 28) of the responding agencies reported allocating more than 60 percent. The remaining seven agencies (25 percent) reported allocating 20 to 60 percent of total safety improvement funds to systemic improvements. Three agencies did not answer this question.

Many of the non-state-owned low-volume local roads in Montana are unpaved, and therefore, a question was included in the survey on whether agencies include unpaved roads in their safety improvement programs. About 61 percent (19 out of 31) of the responding agencies do not include non-state-owned unpaved roads in their programs while the remaining 39 percent (12 out of 31) of the agencies include them.

4. SUMMARY AND KEY FINDINGS

A state of practice survey was conducted in order to learn about state agency practices in managing safety on low-volume local roads. The survey was sent to safety personnel in all 50 states and 32 of the states responded to the survey. This report presented and discussed the results obtained from the survey. The major findings of the survey are:

- About 80 percent of the responding agencies have a separate method for selecting sites on low-volume roads from the method used for conventional roads.
- Crash severity is the most frequently used criterion for identification of potential safety improvement sites on LVRs.
- Around 48 percent of the responding agencies reported using the FHWA systemic approach in combination with one or more of other network screening criteria.
- More than half of the responding agencies (55 percent) reported using cost effectiveness both in ranking sites at the network level as well as in comparing specific safety improvements at individual sites.
- Around 90 percent of the responding agencies have the same personnel leading the safety improvement program for state-owned and non-state-owned local roads.
- Around two thirds of the responding agencies reported having access to crash, traffic, and roadway data for state-owned low-volume roads. However, only one third of those agencies (7 states) reported having access to roadside data as well.
- Around 90 percent of the responding agencies involve local agencies (counties, townships, etc.) in identifying safety improvement sites on non-state-owned local roads.
- Most of the responding agencies (70 percent) reported not allocating a set amount of funds for safety projects on non-state-owned local roads.
- Crash experience at sporadic sites was the most frequently reported method for identifying safety improvement sites on non-state-owned local roads.
- Roadway and traffic data for non-state-owned local roads are collected by both the state and the local agency, as reported by 52 percent of the responding agencies.
- Cost effectiveness was the most frequently reported criterion in justifying safety improvement projects on non-state-owned local roads.
- More than half of the responding agencies (55 percent) reported using one process for identifying safety improvement sites on state-owned and non-state-owned local roads.
- More than two thirds of the responding agencies allocate less than 20 percent of total safety funds to systemic improvements on non-state-owned local roads.
- Unpaved roads are not involved in safety improvement programs on non-state-owned local roads for 61 percent of the responding agencies.

REFERENCES

1. Srinivasan, R., Gross, F., Lan, B., and Bahar, G. (2016) "Reliability of Safety Management Methods: Network Screening," Federal Highway Administration, Report #FHWA-SA-16-037, <https://safety.fhwa.dot.gov/rsdp/downloads/fhwas16037.pdf>, Accessed on 12/11/2019.
2. Federal Highway Administration. "A Systemic Approach to Safety – Using Risk to Drive Action," FHWA, Office of Safety, <https://safety.fhwa.dot.gov/systemic/index.cfm>, Accessed on 12/11/2019.

APPENDIX A: SURVEY QUESTIONNAIRE

Identification of Sites for Safety Improvement on Low-Volume Roads in Montana

The purpose of this survey is to understand the state of practice in selecting highway safety improvement sites on rural low-volume roads (LVRs). Low-volume roads may be owned and operated by state DOTs or by local agencies such as counties, cities, and townships. For local agencies non-state-owned local roads will be used to refer to low-volume roads under local jurisdictions.

The survey is divided in two parts. Part A is concerned with the agency practice in identifying sites for safety improvement projects on state-owned and operated low-volume roads. Part B includes questions about safety improvement projects on non-state-owned local roads, i.e. roads that fall under local jurisdictions (primarily counties, townships and cities).

This survey should be completed by those in your agency who are involved in the safety improvement programs. Participation is voluntary, you can choose not to answer any question that you do not want to answer, and you can stop at any time. The survey has 17 questions in total and is expected to take approximately 15-20 minutes to complete. Thank you in advance for your participation.

Please enter your contact information: (We may wish to contact you if we need clarification or desire more information regarding a response)

NAME:

TITLE:

AGENCY:

PHONE:

EMAIL:

PART A - Identifying Sites for Safety Improvements – State-Owned LVRs

QA1. Defining low-volume roads (LVRs) as roads with AADT less than 1000 vehicles per day, how much do LVRs constitute of your highway network by length?

- 0% - 10%
- 10% - 25%
- 25% - 40%
- > 40%
- Don't know

QA2. Is your agency's method / process for selecting sites for safety improvements on state-owned LVRs different from that used on other state-owned roadways?

- Yes
- No

QA3. What is the method / process used for identifying safety improvement sites on state-owned LVRs? (check all that apply)

- FHWA systemic approach to safety
- Network screening using:
 - Crash frequencies
 - Crash rates
 - Combination of crash frequencies and crash rates
 - Crash severity (check if severity is accounted for by the method)
 - Other, please specify

QA4. In identifying sites for safety improvement on state-owned LVRs, cost-effectiveness (e.g. benefit-to-cost ratio) is used by the agency to (check all that apply):

- Rank safety improvement sites at the network level
- Comparing alternative safety countermeasures at specific sites
- Cost effectiveness is not used

QA5. On a scale of 1 to 10, how satisfied is your agency using this method / process on state-owned LVRs? (1 = not satisfied, 10 = extremely satisfied)

- 1 2 3 4 5 6 7 8 9 10

Q A6. Do safety personnel in your agency have ready access to the following low-volume road data at the network level? (check all that apply)

- Detailed crash data
- Traffic data (i.e. counts, vehicle class)
- Roadway geometry
- Roadside features

QA7. Please add any other information related to how your agency select sites for safety improvements on state-owned low-volume roads.

PART B - Identifying Sites for Safety Improvements – Non-State-Owned Local Roads

QB1. Is the HSIP program leader for non-state owned roadways (counties, townships, etc.) different from the staff member leading the program for state-owned roadways?

- Yes No

QB2. Are local agencies (counties, townships, etc.) involved in the identification of safety improvement project sites on local roads under their jurisdiction?

- Yes No

QB3. What is the process for determining how much funding is allocated to local (non-state owned and operated) safety projects?

- Past crash experience (e.g. proportion of crashes on non-state owned roads)
- Size of network by length (e.g. proportion of network consisting of non-state owned roads)
- Estimated vehicle miles of travel (e.g. proportion of travel on non-state owned roads)
- Other, please specify

QB4. From past experience, safety improvement sites on local roads (counties, townships, and cities) are identified based on (check all that apply):

- Statewide hotspot network screening
- Network screening within local jurisdiction
- Crash experience at sporadic (individual) sites
- Risk perception by local agency staff or law enforcement
- Risk perception by the public
- Other, please specify

QB5. For sites on non-state owned local roads proposed by local agencies, traffic and roadway data collection is usually undertaken by:

- State DOT
- Respective local agency (county, township, etc.)
- Both (i.e. for some sites, local agencies provide data, and for others state DOT does)
- Other, please explain:

QB6. How is the selection of safety improvement sites (and their ranking) justified on non-state owned local roads?

- Cost effectiveness (e.g. benefit-to-cost ratio)
- Crash frequency
- Crash rate
- Combination of crash frequency and rate
- Crash severity (if severity is accounted for in the process)
- Other, please explain:

QB7. Is the selection of safety improvement sites on non-state owned local roads performed separately from state-owned roadways, (i.e. the list of sites, rankings, etc. is done exclusively for non-state owned roadways)?

- Yes No

QA8. For non-state owned local roads, what is the percentage of safety improvement funds allocated to systemic safety improvements? (i.e. using the FHWA systemic approach to safety)

- 0% - 20%
- 21% - 40%
- 41% - 60%
- > 60%
- Don't know

QA9. Do safety improvement project sites involve unpaved non-state owned local roads?

- Yes
- No

QB10. Please provide any additional information on selecting sites for safety improvements on non-state owned local roadways that are not covered in the previous questions.

APPENDIX B: DIFFERENT SITE IDENTIFICATION METHODS FOR STATE-OWNED LOCAL ROADS REPORTED UNDER OTHERS

SPI (Safety Priority Index)
Roadway characteristics (usRAP). Any proposed project is evaluated for BCR (Benefit-Cost Ratio) in three manners: 1) 3 year crash history, 2) Predictive methods of the HSM, 3) usRAP evaluation for crash risk.
VA (Virginia) -SPFs
Safety Analyst expected/predicted crashes
HSM network screening by Excess method with EB adjustment
observed site conditions
Level of Service of Safety
Risk analysis on fatal and serious injury crashes
Excess Crash Costs with Empirical Bayes Adjustment
Levels of Service of Safety
Use HSM methodology to develop SPF for local routes

APPENDIX C: DIFFERENT SITE IDENTIFICATION METHODS FOR NON-STATE-OWNED LOCAL ROADS REPORTED UNDER OTHERS

Statewide network screening (roadway departure, intersection and bike/ped
Local Road Safety Plans. We have developed plans for approximately 60 percent of counties in our state.
We don't have a lot of local roadway information. So the best we can do is develop local road clusters by street name only.
NYSDOT is implementing a new safety management system that will provide the ability to perform network screening on local roads.
Some consultants have started working with local agencies to assist them with city-wide network screening.
Systemic risk analysis based on fatal and serious injury crashes
A few horizontal curve signing projects used a systemic network screening method to identify locations for engineering study and/or signing.