A Systemic Safety Study of Pedestrians in Tribal Areas

January 2025

Publication No. FHWA-HRT-25-042

U.S. Department of Transportation
Federal Highway Administration

Research, Development, and Technology
Turner-Fairbank Highway Research Center
6300 Georgetown Pike McLean, VA 22101-2296

Turner-Fairbank
Highway Research Center

FOREWORD

Pedestrian safety in Tribal communities represents a critical and complex issue, influenced by unique geographic, administrative, and infrastructural challenges. Recognizing these challenges, the Federal Highway Administration (FHWA) undertook this comprehensive study to explore effective ways to enhance pedestrian safety in these communities. The study focuses on identifying risk factors for pedestrian crashes and developing tools and strategies to address these risks.

This study offers a suite of tools and resources designed to assist in identifying high-risk areas, selecting appropriate countermeasures, and prioritizing improvements to reduce pedestrian fatalities and serious injuries in Tribal areas.

The study emphasizes the value of Complete Streets principles and FHWA Proven Safety Countermeasures (PSCs), advocating for strategies like speed management, crosswalk enhancements, pedestrian refuge islands, and improved lighting to foster safer environments for all users. Importantly, the study's tools empower Tribal practitioners to proactively plan and demonstrate the need for targeted safety improvements, thereby bolstering grant applications and funding opportunities.

This work underscores FHWA's commitment to supporting equitable, safe, and connected transportation networks. By integrating the findings and tools from this study into local and regional planning efforts, Tribal agencies and their partners can make significant strides toward creating safer, more inclusive environments for pedestrians. The study serves as a critical resource for practitioners aiming to advance pedestrian safety in Tribal areas, offering actionable insights and evidence-based guidance to mitigate risks and save lives.

Erin Kenley
Director, Office of Tribal Transportation

Notice

This document is disseminated under the sponsorship of the U.S. Department of Transportation (USDOT) in the interest of information exchange. The U.S. Government assumes no liability for the use of the information contained in this document.

Non-Binding Contents

Except for the statutes and regulations cited, the contents of this document do not have the force and effect of law and are not meant to bind the States or the public in any way. This document is intended only to provide information regarding existing requirements under the law or agency policies.

Quality Assurance Statement

The Federal Highway Administration (FHWA) provides high-quality information to serve Government, industry, and the public in a manner that promotes public understanding. Standards and policies are used to ensure and maximize the quality, objectivity, utility, and integrity of its information. FHWA periodically reviews quality issues and adjusts its programs and processes to ensure continuous quality improvement.

Disclaimer for Product Names and Manufacturers

The U.S. Government does not endorse products or manufacturers. Trademarks or manufacturers' names appear in this document only because they are considered essential to the objective of the document. They are included for informational purposes only and are not intended to reflect a preference, approval, or endorsement of any one product or entity.

Recommended citation: Federal Highway Administration, *A Systemic Safety Study of Pedestrians in Tribal Areas* (Washington, DC: 2025) https://doi.org/10.21949/1521424

TECHNICAL REPORT DOCUMENTATION PAGE

<table>
<tr><td colspan="2">1. Report No.
FHWA-HRT-25-042</td><td>2. Government Accession No.</td><td colspan="2">3. Recipient’s Catalog No.</td></tr>
<tr><td colspan="3" rowspan="2">4. Title and Subtitle
A Systemic Safety Study of Pedestrians in Tribal Areas</td><td colspan="2">5. Report Date
January 2025</td></tr>
<tr><td colspan="2">6. Performing Organization Code:</td></tr>
<tr><td colspan="3">7. Author(s)
Brent Crowther and Eric Sweat</td><td colspan="2">8. Performing Organization Report No.</td></tr>
<tr><td colspan="3" rowspan="2">9. Performing Organization Name and Address
Texas A&M Transportation Institute
400 Harvey Mitchell Parkway South, Suite 300
College Station, TX 77845-4375

Kimley-Horn and Associates, Inc.
421 Fayetteville St., Suite 600
Raleigh, NC 27601-1777</td><td colspan="2">10. Work Unit No.</td></tr>
<tr><td colspan="2">11. Contract or Grant No.
693JJ322D000003 The Texas A&M Transportation Institute
Task Order Proposal Request # HFL230008PR</td></tr>
<tr><td colspan="3" rowspan="2">12. Sponsoring Agency Name and Address
Office of Research, Development, and Technology
Federal Highway Administration
6300 Georgetown Pike
McLean, VA 22101-2296</td><td colspan="2">13. Type of Report and Period Covered
Final Report; June 2023–December 2024</td></tr>
<tr><td colspan="2">14. Sponsoring Agency Code
HRT-1</td></tr>
<tr><td colspan="5">15. Supplementary Notes
The contracting officer’s representative was Doug Roberts (HFTT-PA)</td></tr>
<tr><td colspan="5">16. Abstract
Pedestrian safety in Tribal communities is a critical concern shaped by unique challenges. To help address challenges, the Federal Highway Administration conducted a comprehensive study to identify risk factors for pedestrian crashes occurring in Tribal areas and develop tools and strategies for improving pedestrian safety. The study provides resources to help Tribal and other practitioners identify high-risk areas, implement effective pedestrian safety countermeasures, and prioritize safety improvements or locations. This work supports equitable, connected transportation networks and empowers agencies to proactively plan and improve pedestrian safety in their communities.</td></tr>
<tr><td colspan="2">17. Key Words
Pedestrian safety in Tribal areas</td><td colspan="3">18. Distribution Statement
No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22161.
https://www.ntis.gov</td></tr>
<tr><td>19. Security Classif. (of this report)
Unclassified</td><td colspan="2">20. Security Classif. (of this page)
Unclassified</td><td>21. No. of Pages
164</td><td>22. Price
N/A</td></tr>
</table>

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized.

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
	NOTE: volumes greater than 1,000 L shall be shown in m^3			
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2,000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	$candela/m^2$	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2,000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	2.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

TABLE OF CONTENTS

CHAPTER 1. PROJECT BACKGROUND 1
Introduction 1
Safe System Approach 2
CHAPTER 2. ENGAGEMENT 5
Advisory Committee 5
Engagement 5
Interviews 5
CHAPTER 3. LITERATURE REVIEW 9
Previous Plans and Studies 9
Safety Strategies and Countermeasures 15
FHWA PSCs 15
FHWA PEDSAFE 17
NHTSA CTW 17
CHAPTER 4. DATA COLLECTION 19
Data Sources 19
Analysis Methodology 20
CHAPTER 5. CRASH ANALYSIS 23
Summary of Potential Risk Factors 23
Detailed Crash Types 25
CHAPTER 6. STRATEGIES AND COUNTERMEASURES 33
Identified Risk Factors 33
Countermeasure Selection Matrix 34
Pedestrian Safety Risk Evaluation Form 39
CHAPTER 7. PROJECT CASE STUDIES 41
CHAPTER 8. FUNDING OPPORTUNITIES 43
Federal Program Funding Types 43
Other Resources 43
Behavior-Related Funding 43
CHAPTER 9. NEXT STEPS 49
APPENDIX A. INTERVIEWS SUMMARY 51
Interview 1 51
Interview 2 53
Interview 3 54
Interview 4 56
Interview 5 57
Interview 6 59
Interview 7 60
Interview 8 61
Interview 9 62
Interview 10 63

Interview 11 ..... **64**
Interview 12 ..... **65**

APPENDIX B. LITERATURE REVIEW **67**
Tribal Development of Trails and Other Dedicated Pedestrian and Bicycle Infrastructure[9] **67**
Comparative Study of Communities with High Rates of Pedestrian Injuries[10] **70**
Low-Cost Pedestrian Safety Zones: Countermeasure Selection Resource[11] **71**
Pedestrian Crossings and Safety on Four Anishinaabe Reservations in Minnesota[12] **72**
Understanding Roadway Safety in American Indian Reservations: Perceptions and Management of Risk by Community, Tribal Governments, and Other Safety Leaders[13] **73**
Tribal Transportation Strategic Safety Plan[2] **75**
New Methods for Identifying Roadway Safety Priorities in American Indian Reservations[14] **78**
Manual for Selecting Safety Improvements on High Risk Rural Roads[15] **79**
Tribal School Zone Safety Video and Toolkit[16] **80**
Safe Transportation for Every Pedestrian (STEP)[17] **81**

APPENDIX C. SUMMARY OF COLLECTED DATA **83**
Data Collection **83**
Collected Data **83**

APPENDIX D. CRASH DATA ANALYSIS **85**
Roadway Characteristics **85**
Posted Speed Limit 85
Roadway Geometry 86
Roadway Surface 87
Functional Classification 88
Guardrail or Barrier Infrastructure 89
Median Type 91
Pedestrian Facilities 94
Paved Shoulder Width 96
Number of Lanes 97
Location **98**
Rural/Urban 98
Relation to Trafficway 99
Crash Location 100
Nearest Land Use 102
Environmental Conditions **106**
Weather Conditions 106
Lighting Conditions 107
Roadway Surface Conditions 108
Pedestrian Attributes **109**
Age 109
Pedestrian Gender 110
Behavior **111**
Driver Impairment 111

Pedestrian Impairment 113
Other Unique Circumstances 114
APPENDIX E. PEDESTRIAN COUNTERMEASURES SELECTION MATRIX 117
APPENDIX F. PEDESTRIAN SAFETY RISK EVALUATION FORM 129
APPENDIX G. PROJECT CASE STUDY SUMMARY SHEETS 133
Busby Pathway and Crossing Project in Busby, MT 133
Project Description 133
Project Identification 133
Solutions and Countermeasures 133
Lessons Learned 134
Poplar River Pedestrian and Bike Path Bridge Safety Improvement Project, Poplar, MT 135
Project Description 135
Project Identification 135
Solutions and Countermeasures 136
Lessons Learned 136
Hemish Path to Wellness, Jemez Pueblo, NM 137
Project Description 137
Project Identification 137
Solutions and Countermeasures 137
Lessons Learned 138
Pedestrian Safety Improvements on SR–447, Wadsworth, NV 140
Project Description 140
Project Identification 140
Solutions and Countermeasures 140
Lessons Learned 141
Red Cap Road Project, Orleans, CA 142
Project Description 142
Project Identification 142
Solutions and Countermeasures 143
Lessons Learned 143
Gordon Cooper Sidewalk Safety Project, Shawnee, OK 144
Project Description 144
Project Identification 144
Solutions and Countermeasures 144
Lessons Learned 145
ACKNOWLEDGMENTS 147
REFERENCES 149

LIST OF FIGURES

Figure 1. Illustration. Safe System Approach principles.[5] 3
Figure 2. Graph. PBCAT 3 Detailed Crash Types.[23] 26
Figure 3. Equation. Sample size calculation. 83
Figure 4. Bar graph. Posted speed limit. 86
Figure 5. Bar graph. Roadway geometry. 87
Figure 6. Pie chart. Roadway surface. 88
Figure 7. Bar graph. Functional classification. 89
Figure 8. Pie chart. Guardrail or barrier infrastructure. 90
Figure 9. Chart. Guardrail, barrier infrastructure, pedestrian facilities, and paved shoulder width. 90
Figure 10. Bar graph. Median type. 92
Figure 11. Charts. Median types breakdown of rural and urban crashes. 93
Figure 12. Bar graph. Pedestrian facilities. 95
Figure 13. Chart. Paved shoulder width on roadways with no other pedestrian facilities. 95
Figure 14. Bar graph. Paved shoulder width. 96
Figure 15. Bar graph. Paved shoulder width breakdown of crashes occurring with no adjacent pedestrian facilities. 97
Figure 16. Bar graph. Number of lanes. 98
Figure 17. Pie chart. Rural versus urban crashes. 99
Figure 18. Illustration. PBCAT 3 definition of trafficway and nontrafficway[58]. 100
Figure 19. Pie chart. Relation to trafficway. 100
Figure 20. Pie chart. Crash location. 101
Figure 21. Chart. Roadway segment crash location, no pedestrian facilities, and shoulder width. 102
Figure 22. Bar graph. Nearest land use. 104
Figure 23. Bar graph. Distance to nearest land use (miles). 104
Figure 24. Chart. Rural nearest land use. 105
Figure 25. Chart. Nearest land use within 1/4 mi. 106
Figure 26. Bar graph. Weather conditions. 107
Figure 27. Bar graph. Lighting conditions. 108
Figure 28. Bar graph. Roadway surface conditions. 109
Figure 29. Bar graph. Crash totals by age group. 110
Figure 30. Pie chart. Pedestrian gender. 111
Figure 31. Bar graph. Driver impairment. 112
Figure 32. Bar graph. Pedestrian impairment. 114
Figure 33. Map. Busby, MT, multiuse separated pedestrian and bicycle pathway. 133
Figure 34. Image. A pedestrian crossing with RRFB signs was installed on Highway 212 in the south Busby, MT, community. 134
Figure 35. Image. A separated multiuse pedestrian and bicycle pathway constructed adjacent to Highway 212 in Busby, MT. 134
Figure 36. Map. Pedestrian path to the tribal ceremonial Tribal Ceremonial grounds project. 135
Figure 37. Image. Proposed location of the new pedestrian bridge and path. 136
Figure 38. Image. Poplar River pedestrian and bike path bridge safety improvement project. 136
Figure 39. Map Hemish Path to Wellness project. 137

Figure 40. Image. View looking north along NM–4 Highway at Sandoval County bus stop. ... 138
Figure 41. Image. Before Construction: view looking north along NM–4 Highway at Arroyo System. ... 139
Figure 42. Image. RRFB Crossing located at the Intersection of Bear Head Canyon Road and NM–4. ... 139
Figure 43. Image. View looking north along NM–4 Highway at new pedestrian bridge crossing over arroyo. ... 139
Figure 44. Map. Project location. ... 140
Figure 45. Image. Pedestrian safety improvements at midblock crossing on SR-447. ... 141
Figure 46. Image. Before the transformation: midblock crossing on SR–447 before any improvements. ... 141
Figure 47. Image. Aerial view of completed paved shared-use path in Wadsworth, NV ... 141
Figure 48. Map. The Red Cap Road project area. ... 142
Figure 49. Image. A curved section of Red Cap Road. ... 143
Figure 50. Map. Gordon Cooper sidewalk safety project. ... 144
Figure 51. Map. Vicinity map of project location and surrounding areas ... 145
Figure 52. Image. Before sidewalk construction: a well-worn path alongside Gordon Cooper Drive leading to available pedestrian facilities on the Canadian River Bridge. ... 145
Figure 53. Image. Safety enhancement project: sidewalk installation south of the Canadian River Bridge in CPN, Shawnee, OK. ... 145

LIST OF TABLES

Table 1. Study interviewees. 6
Table 2. Previous plans and studies reviewed. 9
Table 3. Summary of literature review. 10
Table 4. Proven safety countermeasures.[18] 16
Table 5. Collected pedestrian crash data. 20
Table 6. Most common 10 PBCAT 3 crash type details.[23] 27
Table 7. Other PBCAT 3 detailed crash types.[23] 31
Table 8. Risk factors summary. 33
Table 9. Countermeasure toolbox summary. 35
Table 10. Project case studies. 41
Table 11. Funding opportunities. 44
Table 12. Components of sample size equation. 83
Table 13. Pedestrian countermeasures selection matrix. 118

CHAPTER 1. PROJECT BACKGROUND

INTRODUCTION

The Federal Highway Administration (FHWA) initiated this project to research ways to improve pedestrian safety in rural Tribal communities. The study identified risk factors for pedestrian crashes in rural Tribal settings and explored transportation planning practices and strategies to reduce the occurrence and severity of pedestrian fatalities and serious injuries in rural Tribal areas. This study identified resources available and created tools for Tribal agencies (planners, engineers, councils, etc.) and others who may be involved with pedestrian safety in Tribal communities to help determine high-risk areas within communities, identify potential safety improvements, and prioritize potential improvements or locations.

Previous analysis indicated the following:

- Comparisons of pedestrians by race showed that American Indian and Alaska Native (AIAN) people have by far the highest traffic fatality rates per miles walked compared to others. AIAN people are five times more likely to die walking than White people and more than twice as likely to die than Black people.[(1)]

- Pedestrian safety is one of seven priority topics that must be addressed to reduce transportation-related fatalities and serious injuries in Tribal areas.[(2)]

Recognizing the need to improve pedestrian safety in Tribal areas, researchers for the study A Systemic Safety Study of Pedestrians in Tribal Areas completed the following tasks:

- Prepared a comprehensive and representative dataset of reported pedestrian fatalities and serious injuries in Tribal communities.

- Obtained officer narratives and diagrams of a representative sample of crash reports.

- Supplemented crash data with enhanced contextual information, including information pertaining to land use, existing infrastructure, and pedestrian and motorist actions prior to a crash, among others.

- Conducted interviews of Tribal employees from sample communities impacted by pedestrian fatalities.

- Identified risk factors, or combinations thereof, that are frequently associated with pedestrian fatal crash locations in Tribal areas.

- Prepared recommendations for transportation, injury prevention, and education practitioners to apply to locations in rural Tribal communities to improve pedestrian safety.

This study did not focus on individuals identified as AIAN but rather on the geographic areas where Tribal governments have the most influence on infrastructure, public safety services, and public outreach.

Certain complexities surround road infrastructure in Tribal areas. These roads are owned by various entities, including Tribal, Federal, State, and local governments, and play a crucial role in providing access to and within these areas. While a comprehensive dataset on these roads is not readily available, roads in Tribal areas are often in a rudimentary condition. A lack of adequate basic infrastructure can create delays in improving the overall infrastructure and implementing effective policy-level strategies. Additionally, multiagency coordination, including the Bureau of Indian Affairs (BIA), U.S. Department of Transportation (USDOT), and Tribal Governments, introduces complexities. Understanding these challenges is essential to address the unique needs of rural Tribal communities and improve pedestrian safety and road infrastructure.

Agencies need additional capacity to implement safety programs, projects, and policies to address pedestrian safety needs. In addition, financial resources and support from law enforcement and policymakers may be needed. Additional information on programs and processes and how to address these concerns is available from the National Cooperative Highway Research Program (NCHRP) Synthesis 419.[3]

The findings and materials developed in this study should be used by practitioners to advance pedestrian safety in their communities. FHWA is focused on supporting agencies' efforts to plan, develop, and operate equitable streets and networks that prioritize safety, comfort, and connectivity for all users, consistent with Complete Streets principles.[4] The process of identifying areas in need of safety improvements based on risk factors, selecting countermeasures to address the risk, and prioritizing locations and improvements helps practitioners implement data-driven planning practices.

SAFE SYSTEM APPROACH

Recommendations to improve pedestrian safety in Tribal areas also build on the Safe System Approach.[5] The Safe System Approach is a guiding paradigm to address roadway safety and mitigate the risk inherent in complex transportation systems. The Safe System Approach, illustrated in figure 1, focuses on human mistakes and human vulnerability to design a safer transportation system.

Source: FHWA.

Figure 1. Illustration. Safe System Approach principles.[5]

A Safe System Approach incorporates the following principles:[5]

Death and Serious Injuries Are Unacceptable: A Safe System Approach prioritizes the elimination of crashes that result in death and serious injuries.

Humans Make Mistakes: People will inevitably make mistakes and decisions that can lead or contribute to crashes, but the transportation system can be designed and operated to mitigate the outcomes of human mistakes and avoid death and serious injuries when a crash occurs.

Humans Are Vulnerable: Human bodies have physical limits for tolerating crash forces before death or serious injury occurs; therefore, it is critical to design and operate a transportation system that is human-centric and recognizes physical human vulnerabilities.

Responsibility Is Shared: All stakeholders—including government at all levels, industry, nonprofit/advocacy, researchers, and the public—are vital to preventing fatalities and serious injuries on our roadways.

Safety Is Proactive: Proactive tools should be used to identify and address safety issues in the transportation system, rather than waiting for crashes to occur and reacting afterward.

Redundancy Is Crucial: Reducing risks requires that all parts of the transportation system be strengthened, so if one part fails, the other parts still protect people.

Safe System Approach elements, listed as follows, work with the Safe System principles toward the Safe System Approach's vision:[5]

Safe Road Users

- Encourage safe driving, walking, and cycling behavior by those who are using the roadway network and create conditions that prioritize their ability to reach their destination unharmed.

Safe Vehicles

- Promote the availability of vehicles with safety features to aid in crash prevention and minimize the impact when a crash occurs.

Safe Speeds

- Promote safe travel speed on all roadway environments by implementing context-appropriate roadway design, speed-limit setting, enforcement, and education.

Safe Roads

- Design roadway infrastructure to mitigate human mistakes, account for injury tolerances, encourage safe behavior, and facilitate safe travel by all.

Post-Crash Care

- Enhance survivability of crashes through fast access to emergency medical services, creating a safe work environment for first responders and preventing secondary crashes through traffic incident management practices.

All icons source: FHWA.

This research study highlighted the importance of Safe System Approach elements to improve pedestrian safety in Tribal areas: design roads with sidewalks or shared-use paths to accommodate pedestrians, manage speeds through Tribal communities, and encourage safe behavior by those driving and walking.[5]

CHAPTER 2. ENGAGEMENT

ADVISORY COMMITTEE

An advisory committee with membership from Tribal Government or agencies, Federal and State agencies, academia, consultants, and interest groups was established for this project. The advisory committee was integral throughout the study. The advisory committee provided input to the study team to develop data schema, reviewed analyses, participated in interviews, provided project case study information, and reviewed draft reports. The study team convened at key project milestones, meeting approximately every 3 or 4 mo.

ENGAGEMENT

To broaden community input to the study, the project team participated in other Tribal transportation-focused conferences and events, including the following:

- The National Transportation in Indian Country Conference (NTICC) in Anchorage, AK, in September 2023.[6]
- The Arizona Department of Transportation (ADOT) Tribal Transportation Safety & Injury Prevention Summit in Phoenix, AZ, in August 2023.[7]
- NTICC in Durant, OK, in August 2024.[8]

At these events, the project team participated in sessions and panels and staffed information booths to inform Tribal community members about the study, promote response to the crash data collection request, and report on study findings. The study team also held short discussions with available participants to listen to their perspectives and experiences with improving pedestrian safety. At the NTICC in August 2024, draft study results were shared, and an exercise was conducted with conference participants using the tools and findings from the study to evaluate and prioritize different potential project locations.[8] The pedestrian countermeasure selection matrix and pedestrian safety risk evaluation tool were introduced and tested with this group. Chapter 6 details the resources and tools developed as part of this study.

INTERVIEWS

The advisory committee helped the study team to identify members of the advisory committee or others with experience improving pedestrian safety in Tribal lands who were willing to be interviewed by the project team. Interview candidates were also identified through the engagement efforts noted in the Engagement section. Interviews were held with participants identified in table 1. Appendix A summarizes the interviews.

Table 1. Study interviewees.

Name	Sector	Tribe/Agency
Marty Allen	Tribal employee	Skokomish Indian Tribe
Connie Thompson	Tribal employee	Fort Peck Tribes, Tribal Transportation Program
Paul Azure	Tribal employee	Fort Peck Assiniboine and Sioux Tribes
Curtis Monteau	Tribal employee	Chippewa Cree Tribe
Joan Mitchell	Tribal employee	Chippewa Cree Tribe
Sheri Bozic	Tribal employee	Pueblo of Jemez
Vernon Lujan	Tribal employee	Taos Pueblo
Hillary Mead	Tribal employee	Cherokee Nation
Sherry Ely Mendes	Tribal employee	Pyramid Lake Paiute Tribe
Michael Petesch	State Government	Minnesota Department of Transportation (MnDOT)
Caroline Ketcham	State Government	MnDOT
Kathy Quick	Academia	University of Minnesota
Guillermo Narvaez	Consultant/other interest group	Proxemic Insights, LLC
Pamela Jurney	Consultant/other interest group	Cross Timbers Consulting
Chris Robideau	Consultant/other interest group	Red Plains Professional, Inc.
Cordell Ringel	Consultant/other interest group	Ringel Consulting Services, Inc.
Kelsey Moldenke	Consultant/other interest group	Red Plains Professional, Inc.
Matthew Riddell	Consultant/other interest group	Qk4, Inc.
Michia Casebier	Consultant/other interest group	M.G. Tech-Writing, LLC

The study team asked the interviewees the following four questions. Following is a summary of the findings:

- Question 1: What are the most prominent risk factors for pedestrian safety on Tribal lands?

    - An overwhelming majority of responses included the lack of pedestrian facilities or the inadequacy of current facilities. Some common specific facility inadequacies that were discussed were sidewalks and pathways, lighting, and shoulder widths.

    - Another common risk factor shared among many interviewees was the prevalence of walking in these areas. The lack of mobility options in these areas results in many people walking to and from destinations.

    - Other common risk factors included speeding, driver and pedestrian behaviors (e.g., distracted driving or walking and drugs and alcohol), and time of day.

    - Interview participants noted the difficulty of having many State and Federal roads, which are often high-speed roadways, bisecting their communities.

- Other risk factors discussed were the following:
  - Inadequate planning and design.
  - Communication issues (e.g., delay to medical services).

- Question 2: What are some successfully implemented pedestrian safety projects that you know of for facilities and infrastructure?
  - Many successfully implemented pedestrian safety projects were shared during interviews. Some projects shared by participants were part of the case studies detailed later in this report.
  - Most interviewees indicated their projects were funded in part by Federal grants and completed in collaboration with other State or Federal agencies.
  - Noninfrastructure projects, including education campaigns and temporary demonstration projects, were noted to be successful.

- Question 3: If you had unlimited resources, what are some goals or achievements you would pursue?
  - More robust and accurate data collection.
  - Better signage and lighting as a standard.
  - Enhanced education for all (i.e., drivers and pedestrians).
  - Training and guidance on the following:
    - Obtaining funding.
    - Partnering with Federal, State, and local agencies.
    - Using tools to help prioritize needs.
    - Navigating complex processes.

- Question 4: What are the most challenging aspects when it comes to implementing safety improvements?
  - Every interview participant noted funding is the biggest obstacle in completing pedestrian safety projects. Participants noted the following funding obstacles:
    - Difficulty in securing funding (sometimes a cumbersome and costly process).
    - Coordination with Federal or State agencies to secure funding.
    - Funding not available for certain improvements, specifically trails, sidewalks, and multimodal improvements.
    - Funding having specific requirements that may not align with the identified need.
    - Lack of funding for large-scale projects.

- The geographic location of Tribal communities was also noted as an obstacle.
- Participants expressed that receiving support for change from the community can be difficult.
- Limited Tribal staff makes it difficult to focus on projects and maintenance.

CHAPTER 3. LITERATURE REVIEW

This chapter reviews existing information pertinent to the study. This review encompasses prior plans and studies, strategies, and countermeasure sources related to pedestrian safety.

PREVIOUS PLANS AND STUDIES

To position study recommendations to build on previous efforts, the project team reviewed the previously completed plans, studies, and resources listed in table 2.

Table 2. Previous plans and studies reviewed.

Title	Year	Source
Tribal Development of Trails and Other Dedicated Pedestrian and Bicycle Infrastructure[9]	2023	FHWA
Comparative Study of Communities with High Rates of Pedestrian Injuries[10]	2023	National Highway Traffic Safety Administration (NHTSA)
Low-Cost Pedestrian Safety Zones: Countermeasure Selection Resource[11]	2023	NHTSA
Pedestrian Crossings and Safety on Four Anishinaabe Reservations in Minnesota[12]	2020	University of Minnesota and MnDOT
Understanding Roadway Safety in American Indian Reservations: Perceptions and Management of Risk by Community, Tribal Governments, and Other Safety Leaders[13]	2018	University of Minnesota
Tribal Transportation Strategic Safety Plan[2]	2017	FHWA
New Methods for Identifying Roadway Safety Priorities in American Indian Reservations[14]	2015	University of Minnesota
Manual for Selecting Safety Improvements on High Risk Rural Roads[15]	2014	FHWA
Tribal School Zone Safety Video and Toolkit[16]	2007	FHWA
Safe Transportation for Every Pedestrian (STEP)[17]	Various	FHWA

Appendix B summarizes each reviewed plan or study.

Table 3 provides a summary of the literature review, highlighting the importance of previous research to this effort.

Table 3. Summary of literature review.

Publication	Type	Description
Tribal Development of Trails and Other Dedicated Pedestrian and Bicycle Infrastructure[9]	Summary	This research provided information and resources for agencies regarding trail projects, including benefits, funding opportunities, partnerships, and planning resources.
	Relevant findings	A review of successful projects highlighted the following strategies as crucial to improving pedestrian and bicycle infrastructure: • Coordination. • Funding. • Jobs and training. • Community engagement. • Road safety audit. • Tribal history and culture. • Planning. • Health and active transportation. The benefits of trails include connecting communities, providing safe spaces for pedestrians and bicyclists, promoting health and physical activity, and bringing economic benefits.
	Applications to the current study	The best practices and strategies detailed in this study can help Tribes and Tribal agencies plan and construct trails in their communities.
Comparative Study of Communities with High Rates of Pedestrian Injuries[10]	Summary	This study reviewed 12 communities that have had success in decreasing pedestrian fatality rates and developed a guidebook of strategies to achieve successful pedestrian safety. Strategies were designated as common, uncommon, or rare. The guidebook also offers a self-assessment framework and tool for community and transportation leaders to assess capabilities and needs.
	Relevant findings	Categories identified to be contributing to declining pedestrian fatalities include the following. Each category has multiple specific strategies to advance pedestrian safety: • Community engagement. • Countermeasures. • Data analysis. • Organizational structure. • Project funding. • Project prioritization and support.

Publication	Type	Description
	Applications to the current study	Tribal transportation and community leaders can use the self-assessment framework and tools to help prioritize their safety programs and mobilize resources to align with strategies presented in the research.
Low-Cost Pedestrian Safety Zones: Countermeasure Selection Resource[11]	Summary	This report details different low-cost countermeasures (and combinations of countermeasures) that can be deployed in support of the pedestrian zone approach to small areas. The report includes descriptions, effectiveness, and implementation and operational considerations, such as cost, planning time, and build time.
	Relevant findings	The low-cost countermeasures include specific improvements from the following categories: • Engineering (e.g., traffic-calming measures, rectangular rapid flashing beacons (RRFBs), pedestrian hybrid beacons (PHBs), lighting, and striping or markings). • Enforcement (e.g., speed limit enforcement and yielding enforcement). • Education (e.g., safety campaigns and countermeasure-specific outreach).
	Applications to the current study	Community leaders may use the provided matrix to select behavior programs to accompany low-cost pedestrian-specific engineering countermeasures.
Pedestrian Crossings and Safety on Four Anishinaabe Reservations in Minnesota[12]	Summary	The University of Minnesota, MnDOT, and Tribal Governments partnered to investigate, document, plan, and implement pedestrian safety countermeasures (specifically for pedestrian crossings) across the State. Coordination on locations, monitoring plans, data-collection methodology, and identification of observed risks and potential countermeasures led to successful pedestrian safety improvements in four Tribal communities across the State.
	Relevant findings	Coordination was welcomed and enhanced findings and implementation of the identified issues and proposed countermeasures. Video data collection helped validate findings and proved useful in agency coordination and the ability to get identified improvements integrated into existing projects.
	Applications to the current study	Agency coordination and data collection were valuable in identifying risks and potential countermeasures and implementing solutions. In some cases, improvements were able to be completed within existing projects.

Publication	Type	Description
Understanding Roadway Safety in American Indian Reservations: Perceptions and Management of Risk by Community, Tribal Governments, and Other Safety Leaders[13]	Summary	Data collection from multiple sources concluded the following: • Pedestrian safety is a critical, distinctive (compared to general rural areas), and underrecognized priority in Tribal lands. • Road engineering and repair need sustained resources. • Impaired driving must not be assumed to be the only explanation. • Education and enforcement to increase seatbelt use are essential. • Tribes need better cooperation with local, State, and Federal agencies. • Further research is needed to improve reservation roadway safety. Various Tribal transportation safety leaders noted that pedestrians in their area deal with high speeds on rural roads. Pedestrians also deal with wanting to promote active transportation for health and lifestyle but not being able to provide adequate or safe facilities to do so.
	Relevant findings	Tribal leaders shared strategies they are working on to improve pedestrian safety, including the following: • Safe routes to school plans and investments in infrastructure. • Trail connections, connecting pedestrian destinations (e.g., schools and regional recreation centers). • Lighting along paths and sidewalks.
	Applications to the current study	The current study confirms the findings from this research and provides potential solutions to pedestrian infrastructure improvements and locations. Examples of successful strategies being implemented by Tribal leaders show the possibility of improving pedestrian safety in other Tribal communities.
Tribal Transportation Strategic Safety Plan[2]	Summary	The plan assesses safety needs and provides Tribal governments with strategies and resources to use in developing their own plans and working toward improving safety.
	Relevant findings	Seven topics of concern in Tribal areas include: 1. The decisionmaking process. 2. Crash data availability and limitations. 3. Roadway departure. 4. Occupant protection. 5. Impaired driving. 6. Pedestrian safety.

Publication	Type	Description
		7. Availability of public services. 8. Strategies, tools, and resources are provided to help plan for each topic and advance safety in that category.
	Applications to the current study	The plan encourages Tribal governments to develop a local road safety plan that reflects local data analysis and safety priorities. This study will aid in the development of these plans. The study also confirms previous findings and provides specific potential countermeasures to address identified topics of concern.
New Methods for Identifying Roadway Safety Priorities in American Indian Reservations[14]	Summary	The research describes new methods to identify roadway safety priorities in Tribal lands. Recommendations include which key stakeholders to interview, questions to ask, and methodologies in collecting information that have proved useful in generating new insights on key safety risks in Tribal lands.
	Relevant findings	The research also provided a list of safety risks gathered after completing this methodology, including the following: • Pedestrian safety and the complex situation of wanting to encourage physical activity for health and recreation but lacking infrastructure for people to do it safely. • Coordination issues among jurisdictions including Tribal Governments, State public safety or transportation agencies, BIA, etc. • Driver education. • Low use or improper use of safety restraint systems, including child seats. • Poverty and isolation impairing driver safety.
	Applications to the current study	The tools identified may be used by Tribal Governments and others to prepare Tribal safety plans, identify locations for road safety audits, and improve and implement transportation and safety policies by getting useful information from key stakeholders.
Manual for Selecting Safety Improvements on High Risk Rural Roads[15]	Summary	The manual provides information and criteria relating to treatments to improve safety on high-risk rural roads. The manual is intended to help agencies understand the effectiveness of various safety improvements and the treatment selection process. The manual presents information for safety improvements in the following categories: horizontal curves, intersections (both signalized and unsignalized), nonmotorized users, pavements and shoulders, markings, signing, vertical curves, etc.

Publication	Type	Description
	Relevant findings	The high-risk rural road Treatment Matrix sorts through treatment selections and deployment criteria to identify potential improvements for a specified location. Benefits and costs are provided for each safety treatment identified. The nonmotorized user treatments that may be applicable to pedestrian safety on Tribal lands include the following: • Providing crosswalks. • Installing pedestrian crossing signal heads at signalized intersections. • Installing RRFB crossings. • Building sidewalks. • Constructing adjacent shared-use paths. • Installing PHB signalized crossings.
	Applications to the current study	Agencies can use this manual to determine safety benefits, cost-effectiveness comparison of treatments, applicability of treatment deployment, maintenance cost, and the decisionmaking process for treatment selection.
Tribal School Zone Safety Video and Toolkit[16]	Summary	The Tribal School Zone Safety Video and Toolkit was prepared to raise awareness of pedestrian safety risk in Tribal areas and give Tribal communities and leaders tools to help increase the safety of pedestrians.
	Relevant findings	The toolkit includes safety videos, pedestrian safety materials for children and adults, promotional tips to increase awareness and safety, information on how to use the videos and information, and a resource sheet for additional information.
	Applications to the current study	This information may be used by Tribal Governments and leaders in education campaigns as well as for decisionmaking assistance on potential improvements.
Safe Transportation for Every Pedestrian (STEP)[17]	Summary	The initiative provides information relating to pedestrian safety countermeasures to reduce crashes at crossing locations. Agencies can use these countermeasures and associated resources to determine safety benefits, countermeasure features, applicability of treatments, and general implementation costs.
	Relevant findings	The STEP tech sheets sort through countermeasures and their associated criteria and benefits to identify potential improvements for a specified location. The countermeasures identified are applicable to pedestrian safety in Tribal areas.
	Applications to the current study	Agencies can use the STEP initiative tech sheets to help determine or confirm safety benefits, cost comparisons of countermeasures, and applicability of countermeasure deployment.

SAFETY STRATEGIES AND COUNTERMEASURES

In addition to strategies and countermeasures found in the literature review, the study team conducted a review of the following pedestrian safety strategy and countermeasure sources:

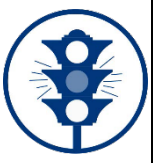
- FHWA Proven Safety Countermeasures (PSCs).[18]
- FHWA *Pedestrian Safety Guide and Countermeasure Selection System* (PEDSAFE).[19]
- National Highway Traffic Safety Administration (NHTSA) *Countermeasures That Work* (CTW).[20]

The study team reviewed each source and extracted relevant pedestrian-related safety countermeasures that may help address identified risk factors from this study's crash analysis (see chapter 6).

FHWA PSCs

The PSC initiative is a collection of 28 countermeasures effective in reducing roadway fatalities and serious injuries.[18] FHWA encourages agencies to consider implementation of the PSC initiative to accelerate the achievement of local, State, and national safety goals. The PSC initiative is designed for all road users on all kinds of roads—rural and urban roads, high-volume freeways, less-traveled two-lane State and county roads, and roads with signalized crossings and horizontal curves. Each countermeasure addresses at least one safety focus area—speed management, intersections, roadway departures, or pedestrians and bicyclists—while others are crosscutting strategies that address multiple safety focus areas. Table 4 lists the countermeasures.

Table 4. Proven safety countermeasures.[18]

Icon	Countermeasures
	Speed management: • Appropriate speed limits for all road users. • Speed safety cameras. • Variable speed limits.
	Intersections: • Backplates with retroreflective borders. • Corridor access management. • Yellow change intervals. • Dedicated left- and right-turn lanes at intersections. • Reduced left-turn conflict intersections. • Roundabouts. • Systemic application of multiple low-cost countermeasures at stop-controlled intersections.
	Roadway departures: • Enhanced delineation for horizontal curves. • Longitudinal rumble strips and stripes on two-lane roads. • Median barriers. • Roadside design improvements at curves. • SafetyEdge℠.[21] • Wider edge lines.
	Pedestrians and bicyclists: • Bicycle lanes. • Crosswalk visibility enhancements. • Leading pedestrian intervals. • Medians and pedestrian refuge islands in urban and suburban areas. • PHBs. • RRFBs. • Road diets (roadway configuration). • Walkways.
	Crosscutting: • Lighting. • Local road safety plans. • Pavement friction management. • Road safety audits.

All icons source: FHWA.

FHWA PEDSAFE

PEDSAFE provides users with information for improving the safety and mobility of those who walk.[19] The online tools provide the user with a list of possible engineering, education, or enforcement treatments to improve pedestrian safety and mobility based on user input about a specific location.

NHTSA CTW

CTW is intended to be a reference guide for State highway safety offices to help select effective, science-based traffic safety countermeasures to address highway safety problem areas in their States.[20] All countermeasures included in this guide aim to change human behavior in some way.

CHAPTER 4. DATA COLLECTION

The study team reviewed available and requested crash data from States and Tribal organizations. In addition to reviewing crash data available in the national Fatality Analysis Reporting System (FARS), the study team distributed a data request to State departments of transportation (DOTs) and Tribal agency representatives identified in collaboration with the project's advisory committee.[22]

DATA SOURCES

The FHWA Office of Tribal Transportation previously compiled limited data for pedestrian fatalities that occurred in Tribal areas from the FARS for 2015–2019.[22] The project team supplemented this dataset with FARS pedestrian crash data for 2020 and 2021.

The project team then analyzed the FARS dataset to identify pedestrian crashes that occurred in Tribal areas. In total, 297 of the 339 fatal crashes evaluated in this research study were in the FARS dataset.[22] Appendix C details why additional crashes were requested and added to the data for evaluation. Crashes were determined to occur in Tribal areas based on geographic location defined in appendix C of the *Tribal Transportation Strategic Safety Plan*:

> United States Geological Survey Protected Areas Database (USGS PAD) version 1.1 (all fatal crashes in Indian Reservations, Land owned by Tribes, Bureau of Indian Affairs Tribal Trust Land, and Alaska Native Village Corporation boundaries).[2]

Requests for police reports and narratives for the selected crashes were then submitted to State DOTs, Tribal police departments, and Tribal community leaders. Some States submitted data that included motor vehicle crashes on Tribal lands or pedestrian crashes that did not result in a fatality or serious injury. The project team filtered the data to isolate collisions with pedestrians. The study team was successful in collecting crash data and officer narratives for 392 pedestrian fatality and serious injury crashes from 20 different agencies in 18 States.

The crash data include fatalities and serious injuries that occurred in Tribal areas from 2013 to 2022. Oftentimes, roadway contributing factors that lead to fatal or serious injury crashes are indistinguishable. This study did not distinguish findings between fatal and serious injury crash severities and sought to reduce the frequency of all severity outcomes. The goal of the study was to collect a representative sample of fatal and serious injury crashes. Some agencies provided data on fatal crashes while others provided serious injury crash information only. The study identified factors that contribute to high-severity pedestrian-vehicle crashes.

Table 5 summarizes the received crash data collected by States and agencies or tribes. The 392 analyzed reports achieved a 95-percent confidence level for the dataset. See appendix C for a summary of collected data for this study.

The received data may exhibit statistical bias toward roadway types and regions of the country for which the crash data were received. For example, severe weather conditions, including snow and ice, may contribute more in some regions than in Arizona, from which a large portion of the data for this study were received. Furthermore, a comprehensive geospatial inventory of

roadways in Tribal areas would have enhanced the analysis and the identification of risk correlations and findings.

Table 5. Collected pedestrian crash data.

State	Agency or Tribe	Pedestrian Crash Reports	
		Fatal	Serious Injury
Arizona	ADOT	122	—
	Salt River Pima-Maricopa Indian Community	2	—
	Gila River Indian Community	2	—
California	California Highway Patrol	3	—
Florida	Florida DOT	7	—
Idaho	Idaho Transportation Department	2	2
Maine	Maine DOT	1	1
Michigan	Michigan DOT	5	—
Minnesota	MnDOT	11	14
Montana	Montana DOT	23	28
Nebraska	Nebraska DOT	2	—
Nevada	Nevada DOT	2	—
New Mexico	New Mexico Department of Transportation	72	1
New York	New York State DOT	1	—
Oregon	Oregon DOT	2	—
South Dakota	South Dakota Department of Public Safety	18	7
Utah	Utah DOT	5	—
Washington	Washington State DOT	48	—
Wisconsin	Wisconsin DOT	5	—
Wyoming	Wyoming DOT	6	—

—No data received.
Note: Total crash reports received were 339 fatal and 53 serious injury.

ANALYSIS METHODOLOGY

The Pedestrian and Bicycle Crash Analysis Tool (PBCAT 3) was used to determine the crash type and record data and information associated with each pedestrian crash analyzed.[(23)] The study team used PBCAT 3 in characterizing safety deficiencies and identifying strategies to prevent these crashes (see the section "Detailed Crash Types" in chapter 5).

PBCAT 3 is an open-access crash-typing application for safety practitioners and researchers to supplement data that already exist in crash databases.[23] High-quality crash-type descriptors are frequently missing in crash databases. By answering questions in the tool, PBCAT 3 users create new, objective information that can be added to the existing data to help characterize each crash. PBCAT 3 crash types and contextual factors help identify preventable crash scenarios.

The project team compiled crash data provided by the agencies, FARS, PBCAT 3 results, and information gathered from visual observation using Geographic Information Systems (GIS) and Google® Earth™ for each pedestrian crash in the analysis.[22–24]

CHAPTER 5. CRASH ANALYSIS

The study team analyzed crash reports and officer narratives for the 392 pedestrian fatal and serious injury crashes for which data were received. The team identified common contributing factors or characteristics in the crash data. Risk factors contributing to pedestrian fatality or serious injury crashes on Tribal lands were grouped into the following categories:

- Roadway characteristics.
- Location.
- Environmental conditions.
- Pedestrian attributes.
- Behavior: PBCAT 3 crash types.[23]

Appendix D provides detailed crash analysis findings for each category and characteristic evaluated.

Summary of Potential Risk Factors

The following is a summary of potential risk factors for each of these categories.

Roadway Characteristics

The study team evaluated roadway characteristics in the crash analysis and identified the following as potential risk factors:

- **Vehicle speed:** Fewer fatal and serious injury crashes (10 percent) occurred on roadways with a posted speed limit of 25 mph or less. Most crashes occurred on two-lane roadways with higher speed limits (50 mph or above). (See appendix D.)

- **Functional classification:** A high percentage (35 percent) of crashes occurred on principal arterials and major arterial roadways.

- **Roadway geometry:**

    - **Shoulder width:** The data show that approximately 26 percent of crashes occurred where paved shoulder widths are 4 ft or less.

    - **Surface:** Collected data show 3 percent of analyzed crashes occurred on unpaved roadway surfaces (dirt or gravel), which typically have lower speeds than paved roads.

    - **Medians:** A majority (52 percent) of fatal and serious injury pedestrian crashes occurred on undivided roadways with no median. While there were fewer fatalities and serious injury crashes on roadways with physical separation or medians (e.g., earth, barrier, or cable), it is unclear how strong this correlation is due to the lack of information on the mileage of two-lane undivided roadways compared to divided two-lane roadways. (See appendix D.)

- **Horizontal alignment:** Sixteen percent of the crashes analyzed occurred on horizontal curves; the strength of this correlation cannot be determined because the mileage of horizontal curves compared to straight segments is not available.

- **Barriers:** The analyzed crashes do not appear to show a high correlation between pedestrian fatalities and the presence of guardrails, bridge barriers or railings, or barriers on the roadway. (See appendix D.)

- **Presence of pedestrian facility:** The data show that most crashes occurred at locations without pedestrian facilities such as crosswalks, sidewalks, or shared-use paths. (See appendix D.)

Location

The study team evaluated location characteristics in the crash analysis. Potential risk factors relating to the location of the pedestrian crash may include the following:

- **Roadway segments:** Seventy-three percent of pedestrian fatal and serious injury crashes occurred on roadway segments and not at intersections.

- **Land use:** A majority (71 percent) of pedestrian fatal and serious injury crashes occurred within 1/4 mi of an identified land use or potential pedestrian attractor. Of those occurring within 1/4 mi, the most commonly identified land use was residential (64 percent), followed by commercial areas (14 percent), casinos (8 percent), and other community areas (e.g., government buildings, health centers, and Tribal buildings) (7 percent).

Environmental Conditions

The study team evaluated environmental conditions in the crash analysis. Potential risk factors relating to environmental conditions may include the following:

- **Lighting:** A high proportion of total crashes (51 percent) occurred in dark conditions without lighting. Of these crashes, most occurred where no other pedestrian facilities, such as sidewalks, were available for the pedestrian to use. (See appendix D.)

- **Surface conditions:** A low percentage (14 percent) of fatal and serious injury crashes occurred on roadways with unfavorable surface conditions (e.g., wet; sand, mud, dirt, or gravel; ice or frost; or slush or snow).

- **Weather:** A low percentage (8 percent) of fatal and serious injury crashes occurred in adverse weather conditions (e.g., rain; snow; severe crosswinds; or fog., smog, or smoke).

Pedestrian Attributes

The study team evaluated pedestrian attributes in the crash analysis. Potential risk factors relating to pedestrian attributes may include the following:

- **Age:** The highest frequency of crashes (50 percent) occurred among those aged 20–49.
- **Gender:** Male pedestrians represent a disproportionate percentage (64 percent) of fatal and serious injury crashes.

Behavior

The study team evaluated pedestrian and driver behaviors in the crash analysis and identified the following potential risk factors relating to pedestrian or driver behavior:

- **Pedestrian impairment:** Thirty-nine percent of the fatal or serious injury pedestrian crashes involved pedestrians who were intoxicated (alcohol and/or drugs); in 29 percent of crashes, impairment status was unknown or not reported .
- **Driver impairment:** Fourteen percent of drivers involved in a pedestrian fatal or serious injury crash were identified as intoxicated (alcohol and/or drugs); in 27 percent of crashes, impairment status was unknown or not reported.
- **Pedestrian apparent intent:** Thirty-four of the 392 crashes (9 percent) included information in the officer's narrative crash report that the pedestrian intentionally caused the crash.
- **Hit and run:** One hundred and three of the 392 crashes (26 percent) were reported as hit-and-run crashes.

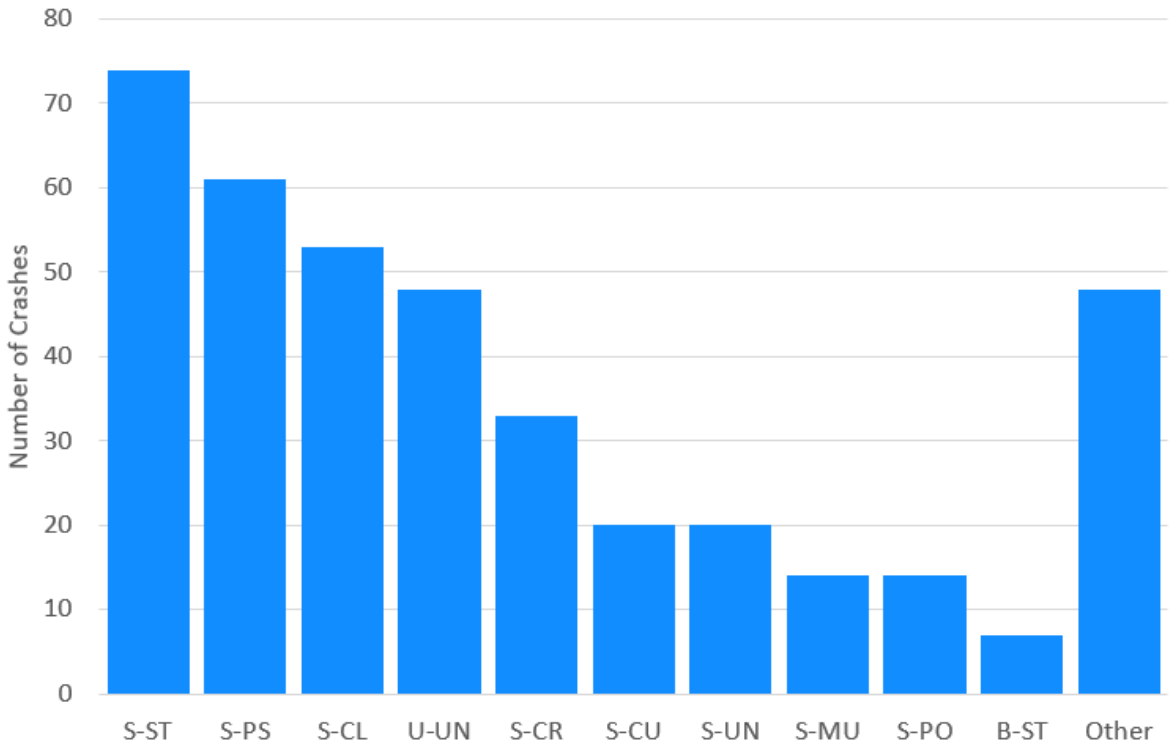
Detailed Crash Types

PBCAT 3 uses motorist and pedestrian movements to generate a detailed crash-type variable for a crash.[23] The resulting crash type and code indicate the motorist movement first and then the pedestrian movement.

Figure 2 and table 6 show the detailed crash types for the 10 most common crash types of the 392 crash reports analyzed for this study:

1. Going straight—stationary (S-ST).
2. Going straight—parallel path, same direction (S-PS).
3. Going straight—crossing path from motorist's left (S-CL).
4. Unknown maneuver—unknown (U-UN).
5. Going straight—crossing path from motorist's right (S-CR).
6. Going straight—crossing path, unknown direction (S-CU).
7. Going straight—unknown (S-UN).

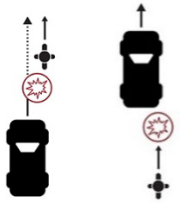
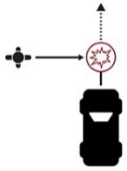
8. Going straight—moving in an unknown path or direction (S-MU).
9. Going straight—parallel path, opposite direction (S-PO).
10. Backing—stationary (B-ST).

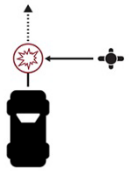
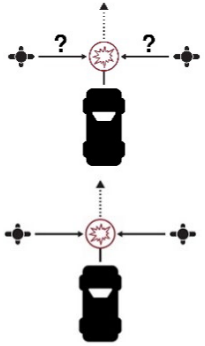


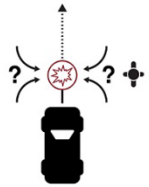
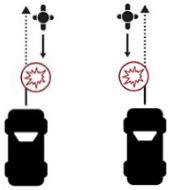
Source: FHWA.

Figure 2. Graph. PBCAT 3 Detailed Crash Types.[23]

Table 6. Most common 10 PBCAT 3 crash type details.[23]

Abbreviation	Detailed Crash Type (Category)	Description	Illustration	Number of Crashes	Percent of Total
S-ST	Going straight—stationary	Motorist: Going straight—The motorist's movement was essentially straight ahead, including negotiating a curve, overtaking or passing another road user, changing lanes, or slowing. Pedestrian: Stationary—The nonmotorist was not moving (e.g., was standing, sitting, or lying).		74	19
S-PS	Going straight—parallel path, same direction	Motorist: Going straight—The motorist's movement was essentially straight ahead, including negotiating a curve, overtaking or passing another road user, changing lanes, or slowing. Pedestrian: Parallel path, same direction—The nonmotorist was traveling on a parallel path in the same direction as the motorist *before* any turns.		61	16
S-CL	Going straight—crossing path from motorist's left	Motorist: Going straight—The motorist's movement was essentially straight ahead, including negotiating a curve, overtaking or passing another road user, changing lanes, or slowing. Pedestrian: Crossing path from motorist's left—The nonmotorist was traveling on a crossing path approaching from the motorist's left *before* any turns.		53	14

Abbreviation	Detailed Crash Type (Category)	Description	Illustration	Number of Crashes	Percent of Total
U-UN	Unknown maneuver—unknown	Motorist: Unknown maneuver—The motorist's maneuver is unknown or cannot be determined. Pedestrian: Unknown—The nonmotorist's movement or actions are unknown or cannot be determined.	–	48	12
S-CR	Going straight—crossing path from motorist's right	Motorist: Going straight—The motorist's movement was essentially straight ahead, including negotiating a curve, overtaking or passing another road user, changing lanes, or slowing. Pedestrian: Crossing path from motorist's right—The nonmotorist was traveling on a crossing path approaching from the motorist's right *before* any turns.		33	8
S-CU	Going straight—crossing path, unknown direction	Motorist: Going straight—The motorist's movement was essentially straight ahead, including negotiating a curve, overtaking or passing another road user, changing lanes, or slowing. Pedestrian: Crossing path, unknown direction—The nonmotorist was crossing a trafficway or other facility at an angle to the motorist *before* any turns, but it could not be determined whether the nonmotorist was approaching from the motorist's right or left.		20	5

Abbreviation	Detailed Crash Type (Category)	Description	Illustration	Number of Crashes	Percent of Total
S-UN	Going straight—unknown	Motorist: Going straight—The motorist's movement was essentially straight ahead, including negotiating a curve, overtaking or passing another road user, changing lanes, or slowing. Pedestrian: Unknown—The nonmotorist's movement or actions are unknown or cannot be determined.	–	20	5
S-MU	Going straight—moving in an unknown path or direction	Motorist: Going straight—The motorist's movement was essentially straight ahead, including negotiating a curve, overtaking or passing another road user, changing lanes, or slowing. Pedestrian: Moving in an unknown path or direction—The nonmotorist was moving in a direction that could not be determined.		14	4
S-PO	Going straight—parallel path, opposite direction	Motorist: Going straight—The motorist's movement was essentially straight ahead, including negotiating a curve, overtaking or passing another road user, changing lanes, or slowing. Pedestrian: Parallel path, opposite direction—The nonmotorist was traveling on a more or less parallel path in an opposing direction to the motorist *before* any turns.		14	4

Abbreviation	Detailed Crash Type (Category)	Description	Illustration	Number of Crashes	Percent of Total
B-ST	Backing—stationary	Motorist: Backing—The motorist was backing. Pedestrian: Stationary—The nonmotorist was not moving (e.g., was standing, sitting, or lying).		7	2

All images source: FHWA.
—No illustration available.

Supporting findings are as follows:

- Of the 392 crashes, 106 (27 percent) included the motorist going straight and the pedestrian crossing (either from the left, right, or an unknown direction).

- Of the 74 crashes involving the motorist going straight and the pedestrian being stationary (S-ST), 31 (42 percent) included the pedestrian being intoxicated (alcohol and/or drugs). 12 of the 74 crashes (16 percent) included the driver being intoxicated (alcohol and/or drugs).

- Of the 74 crashes involving the motorist going straight and the pedestrian being stationary (S-ST), 54 (73 percent) occurred on a roadway or at an intersection with no pedestrian facilities.

- Of the 61 crashes involving the motorist going straight and the pedestrian traveling in a parallel path and same direction (S-PS), 55 (90 percent) occurred on a roadway or at an intersection with no pedestrian facilities.

- Of the 53 crashes involving the motorist going straight and the pedestrian traveling on a crossing path approaching from the motorist's left (S-CL), 37 (70 percent) occurred on a roadway or at an intersection with no pedestrian facilities.

- Of the 392 crashes, 84 (24 percent) included the pedestrian walking along the roadway in a parallel path to the vehicle.

The "other" category in figure 2 represents other detailed crash types with five or fewer crashes each. Table 7 describes the other crash types and the number of crashes of each type.

Table 7. Other PBCAT 3 detailed crash types.[23]

Detailed Crash Type	Motorist Action—Pedestrian Action	Number of Crashes
L-CU	Turning left—crossing path, unknown direction	5
U-CU	Unknown maneuver—crossing path, unknown direction	5
U-PS	Unknown maneuver—parallel path, same direction	4
U-ST	Unknown maneuver—stationary	4
L-ST	Turning left—stationary	3
O-ST	Other maneuver—stationary	3
B-CU	Backing—crossing path, unknown direction	2
B-UN	Backing—unknown	2
R-CU	Turning right—crossing path, unknown direction	2
R-PS	Turning right—parallel path, same direction	2
S-OU	Going straight—other or unusual	2
S-PU	Going straight—parallel path, unknown direction	2
B-CL	Backing—crossing from motorist's left	1
B-MU	Backing—moving in unknown path or direction	1

Detailed Crash Type	Motorist Action—Pedestrian Action	Number of Crashes
B-OU	Backing—other or unusual	1
L-CR	Turning left—crossing path from motorist's right	1
L-OU	Turning left—other or unusual	1
NA	No crash type returned	1
O-OU	Other maneuver—other or unusual	1
O-PS	Other maneuver—parallel path, same direction	1
O-UN	Other maneuver—unknown	1
P-OU	Parked—other or unusual	1
U-MU	Unknown maneuver—moving in an unknown path or direction	1
U-OU	Unknown maneuver—other or unusual	1

CHAPTER 6. STRATEGIES AND COUNTERMEASURES

IDENTIFIED RISK FACTORS

Building on the crash analysis results presented in chapter 5 and appendix D, the study team identified risk factors associated with pedestrian safety in Tribal lands. Table 8 summarizes factors that were identified as contributing to pedestrian fatality or serious injury crashes.

Table 8. Risk factors summary.

Risk Factor	Description
Proximity to land uses or pedestrian attractors	A majority (71 percent) of pedestrian fatal and serious injury crashes occurred within 1/4 mi of an identified land use or potential pedestrian attractor—the most common identified land use was residential (64 percent), followed by commercial areas (14 percent), casinos (8 percent), and other community areas (e.g., government buildings, health centers, and Tribal buildings) (7 percent).
Presence of pedestrian facilities	Most crashes occurred at locations without pedestrian facilities, such as crosswalks, sidewalks, or shared-use paths.
Location (roadway versus intersection)	Seventy-three percent of pedestrian fatal and serious injury crashes occurred on roadway segments and not at intersections.
Posted speed limit	Fewer fatal and serious injury crashes (10 percent) occurred on roadways with a posted speed limit of 25 mph or less.
Paved shoulder width	Collected data show 31 percent of analyzed crashes occurred where paved shoulder widths were 4 ft or less.
Center medians	A majority (52 percent) of fatal and serious injury pedestrian crashes occurred on undivided roadways with no median.
Lighting conditions	• A high proportion of total crashes (51 percent) occurred in dark conditions without lighting. • Most of these crashes occurred where no other pedestrian facilities, such as sidewalks, were available for the pedestrian to use.
Driver/pedestrian intoxication	• Thirty-nine percent of the fatal or serious injury pedestrian crashes involved pedestrians who were intoxicated (alcohol and/or drugs); in 29 percent of these crashes, impairment was unknown or not reported. • Fourteen percent of drivers involved in a pedestrian fatal or serious injury crash were identified as intoxicated (alcohol and/or drugs); in 27 percent of these crashes, impairment was unknown or not reported.
Pedestrian action	• Pedestrian stationary in roadway. • Pedestrian walking parallel with vehicle traffic. • Pedestrian crossing.

COUNTERMEASURE SELECTION MATRIX

The study team developed a toolbox of pedestrian safety countermeasures to summarize potential safety improvements applicable to Tribal areas that help address the identified risk factors. The toolbox's pedestrian safety countermeasures were identified from the literature review, primarily from the following sources:

- FHWA PSC.[18]
- FHWA PEDSAFE.[19]
- NHTSA CTW.[20]
- FHWA *Small Town and Rural Multimodal Networks*.[25]

The potential countermeasures were grouped into the following categories based on the identified need:

- **Roadway infrastructure (to address walking along the roadway):** Physical improvement to enhance safety for pedestrians walking along the roadway.
- **Roadway infrastructure (to address crossing the roadway):** Physical improvements to enhance safety for pedestrians crossing the roadway.
- **Intersection improvements:** Physical improvements to enhance safety at intersections.
- **Policies**: Policies and programs to improve pedestrian safety.
- **Education and enforcement**: Measures to inform the public and enforce traffic laws to increase safety.
- **Planning:** Development of planning documents to provide a framework for identifying and implementing safety improvements.

Each of these countermeasure categories corresponds with a Safe System Approach category, detailed in table 9.[5] The table also summarizes countermeasures applicable to pedestrians in Tribal areas that may be implemented for a location based on the location's characteristics.

Table 9. Countermeasure toolbox summary.

Category	Safe System Approach Category[5]	Countermeasure	Countermeasure Description
Roadway infrastructure (to address walking along the roadway)	Safer roads	Walkways (sidewalks and shared-use paths)	Defines space or pathways within the public right-of-way that is separated from roadway vehicles.
		Shared-use path	Shared-use path or other trail in an independent right-of-way, not in a roadway right-of-way.
		Paved shoulders	Minimum 6-ft paved shoulder to provide a place for pedestrians to walk.
		Lighting	Lighting to increase visibility when dark.
		Median barriers	Longitudinal barriers (e.g., cable, metal beam, and concrete) to separate opposing traffic.
		Rumble strips	Milled or raised edge-line or center-line rumble strips along the roadway.
		Road diets (roadway reconfiguration)	Reduction in widths or the number of vehicle travel lanes and reallocation of that space for other uses (e.g., pedestrian crossing island, bicycle lanes, or on-street parking).
		Edge-lane roads	Area on the edge of the roadway that offers prioritized space for nonmotorized users. Treatment includes pavement striping and signage.
		Traffic calming	Combination of physical design and other measures to reduce negative effects of motorized vehicle use, alter driver behavior, and improve conditions for nonmotorized users; some traffic calming includes chokers, speed tables, chicanes, gateways, roadway narrowing, etc.
		Enhanced delineation for horizontal curves	Enhanced delineation at horizontal curves includes a variety of potential strategies that can be implemented in advance of or within curves, in combination or individually, including pavement parking, delineators, chevron signage, dynamic signs, etc.

Category	Safe System Approach Category[5]	Countermeasure	Countermeasure Description
		Roadside design improvements at curves	Roadside design improvements at curves are a strategy encompassing several treatments that target the high-risk roadside environment along the outside of horizontal curves. These treatments give vehicles the opportunity to recover safely and reduce crash severity. Roadside design improvements can be implemented alone or in combination. Treatments may include clear zones, slope flattening, adding or widening shoulders, barriers or guardrails, etc.
Roadway infrastructure (to address crossing the roadway)	Safer roads	RRFBs	Enhancement to improve visibility of pedestrians and increase driver awareness at uncontrolled, marked crosswalks.
		PHBs	Traffic control device at unsignalized crossings on higher speed roadways.
		Pedestrian overpass or underpass	Allows uninterrupted flow of nonmotorized users separate from vehicle traffic.
		Medians and pedestrian refuge islands in urban and suburban areas	Raised median with a refuge area intended to help pedestrians who are crossing a road.
		Curb extensions	Extension of the sidewalk or curbline to increase turning radius and to reduce pedestrian crossing distance.
		Crosswalk visibility enhancements	Enhancements at marked crosswalks to increase visibility to drivers, including high-visibility crosswalks, lighting, and signing and pavement markings.

Category	Safe System Approach Category[5]	Countermeasure	Countermeasure Description
Intersection improvements	Safer roads	Traffic signal	Creates gaps for pedestrians to adequately cross at locations where pedestrians would otherwise experience high delays, difficulties crossing the street, or safety issues.
		Roundabout	Install roundabouts at intersections. Roundabouts help improve pedestrian safety by separating movements with a refuge island, often shortening crossing distance, and reducing approaching vehicle speeds.
		Driveway improvements	Improvement of pedestrian safety and comfort at driveways; potential improvements may include driveway consolidations, narrowing driveways, tightening turning radii, or enhanced delineations.
		Leading pedestrian interval	Gives pedestrians the opportunity to enter the crosswalk at a signalized intersection before allowing vehicles to enter the intersection.
		Enhanced stop-controlled intersection	Enhanced signing and pavement markings to increase driver awareness and recognition of the intersection and potential conflicts.
Policies	Safer speeds	Appropriate speed limits	Sets appropriate speed limits; may include self-enforcing roadways, traffic calming, etc.
		Corridor access management	Implementation of access management strategies (e.g., driveway closure, consolidation, or relocation; intersection spacing; raised median; or turn lanes) to enhance safety for all modes.

Category	Safe System Approach Category[5]	Countermeasure	Countermeasure Description
Education and enforcement	Safer people and post-crash care	Police enforcement	Increased driver awareness to share the roadway and reduce pedestrian-related collisions.
		Pedestrian and driver education	Informs pedestrians and motorists of relevant traffic laws and provides information to help motivate change in behaviors to reduce the risk of pedestrian collisions.
		Radar speed feedback signs	Speed-monitoring trailers can enhance enforcement efforts through public education and awareness. The trailers are not substitutes for permanent actions, such as traffic-calming treatments, to address neighborhood speeding issues.
		Emergency dispatch training	Provide emergency services training to increase the effectiveness of dispatching to rural areas.
		First-aid training	Provide first-aid training to help with post-crash care.
Planning	Safer roads	Local road safety plan	Provide a framework for identifying, analyzing, and prioritizing roadway safety improvements.
		Road safety audit	A formal evaluation of a roadway segment by an independent, multidisciplinary team to identify potential specific safety improvements; identified risks are prioritized and addressed with both low- and high-cost recommendations.

Appendix E contains the complete pedestrian safety countermeasure selection matrix. The countermeasure selection matrix details applicable countermeasures, generalized cost, a typical roadway typology or characteristic that a countermeasure may be applied to, and the identified risk factors from this study's crash analysis that the applicable countermeasure addresses. Specifically, the matrix includes the following information:

- Category.
- Countermeasure (and source of countermeasure).
- Description.
- Crash modification factor (CMF).
- CMF source.

- Cost:
  - Low (simple).
  - Medium (moderately complex).
  - High (complex).
- Roadway typology (e.g., rural two-lane road or urban five-lane road).
- Risk factors addressed.

PEDESTRIAN SAFETY RISK EVALUATION FORM

The study team developed a pedestrian safety risk evaluation form (appendix F) as a resource for Tribal communities to evaluate the relative safety risk experienced by a pedestrian at a project location. The pedestrian safety risk evaluation asks the practitioner to consider 13 factors, derived from the study's crash analysis and risk identification. The factors are as follows:

1. Location and environmental factors:

   - Proximity to land uses or pedestrian attractors.
   - Operating environment.
   - Pedestrian crossing distance.
   - Lighting condition at vehicle–pedestrian conflict areas.
   - Vehicle speed (posted speed limit).
   - Pedestrian exposure to vehicles and vehicle traffic on the roadway (average daily traffic).
   - Pedestrian activity.

2. Infrastructure factors:

   - Presence of pedestrian facilities.
   - Paved shoulder width.
   - Median type.

3. Other:

   - Prior vehicle-to-pedestrian crashes (or near misses) within the last 5 yr.
   - Availability of public safety services.
   - Project scale and complexity.

A resulting pedestrian risk score for each factor is associated with the practitioner's response based on the presented scoring criteria (appendix F). For example, for the paved shoulder width risk factor, the available options for a practitioner to answer are 0–1 ft (equal to four points), 1–4 ft (equal to three points), 5–9 ft (equal to two points), or 10 ft or greater, curb/gutter, or a

sidewalk/pathway present (equal to one point). If a user indicates 1–4 ft as the shoulder width in the proposed location, the score for that individual risk factor would be three points (out of four points total). The scores are based on findings from the crash analysis and risk identification and put emphasis on areas where a strong correlation between pedestrian fatality or serious injury crash was associated with a roadway characteristic. For example, the proximity to land uses or pedestrian attractors has a higher potential individual risk score compared to other identified risks. A total Pedestrian Safety Risk Score is calculated based on a summation of the subcategory scores.

By completing these risk assessments, Tribal communities may gain insight regarding risks that can be addressed to improve pedestrian safety. The evaluation may help to prioritize pedestrian safety improvements or locations for improvements in a community. In addition, when seeking resources to construct infrastructure improvements, a Tribal community may be able to use the completed risk evaluation to demonstrate the level of risk to pedestrians. Because pedestrian crashes are rare events and crash data is unavailable in many Tribal areas, the completed risk evaluations may help a Tribe proactively demonstrate the need for pedestrian safety improvements based on the national crash-data analysis performed in this report.

The study team anticipates that these evaluations could provide the justification most State and Federal transportation safety programs require. An agency may also consider the pedestrian risk evaluation when implementing or prioritizing projects in the community, specifically during Complete Streets planning.[4]

CHAPTER 7. PROJECT CASE STUDIES

Advisory committee members and interviewees identified completed safety improvement projects as examples of what has been done to improve pedestrian safety in Tribal areas. The scope of completed projects varied but included pathways, sidewalks, bridges, shoulder widening, and crossing improvements. Table 10 summarizes the projects; appendix G provides full project summaries.

Table 10. Project case studies.

Project Name	Location	Project Type	Project Description
Hemish Path to Wellness	Jemez Pueblo, New Mexico	Pathway and crossing improvements	A 1.7-mi paved shared-use path adjacent to the NM 4 highway, connecting users and key destinations. The project included new pedestrian crossings at two locations (RRFBs), bridge drainage improvements, lighting, and signage.
State Route (SR) 447 Pedestrian Safety Improvements	Pyramid Lake Paiute Tribe, Nevada	Pathway and crossing improvements	A 1,200-ft shared-use path adjacent to SR–447, connecting schools, community buildings, and residential areas. The project included three enhanced crossing locations (RRFBs), lighting, signage, striping, and pavement markings.
Gordon Cooper Road Sidewalk Safety Project	Citizen Potawatomi Nation, Oklahoma	Sidewalk	A 0.7-mi concrete sidewalk next to Gordon Cooper Road, separated from the roadway and shoulder, connecting residents and visitors to the Tribal complex area.
Poplar River Pedestrian/Bike Bridge Safety Improvement Project	Fort Peck Tribes, Montana	Pathway and bridge	A 0.6-mi paved shared-use path adjacent to Poplar River Road connects the community to Tribal ceremonial grounds. The project included a pedestrian and bicycle bridge over the Poplar River, a below-grade crossing under a roadway, and lighting improvements.
Pedestrian Pathway and Crossing Project	Northern Cheyenne Tribe, Montana	Pathway and crossing project	A 1-mi separated multiuse pedestrian and bicycle pathway adjacent to US 212 connecting the community to Tribal facilities, schools, and commercial areas. The project included lighting enhancements on the pathway and an RRFB crossing.
Red Cap Road Shoulder Improvement Project	Karuk Tribe, California	Shoulder improvements	The project included widening shoulders, adding striping, adding signage, and installing bicycle lanes within the existing right-of-way, connecting residential, schools, and community service areas. The project also added traffic-calming elements.

CHAPTER 8. FUNDING OPPORTUNITIES

Multiple funding sources are available to help Tribal communities plan, design, and implement pedestrian safety infrastructure. Table 11 lists potential funding sources.

FEDERAL PROGRAM FUNDING TYPES

The two most common funding types are competitive (discretionary) and formula:

- **Competitive (discretionary)** grants are awarded through an application process, where applicants need to plan a project, write a proposal, and submit a grant application. Applications are reviewed and evaluated by a team of reviewers. When applying for a competitive grant, applicants need to have a good understanding of the proposed project and grant evaluation criteria.

- **Formula** grants are awards to a predetermined list of recipients. The allocation amounts are determined by a mathematical formula. Typically, formula grant funds are granted to State or larger agencies that then determine which local projects will be funded.

OTHER RESOURCES

Grants.gov℠ provides information for Federal funding opportunities. The website provides information on grant-related topics such as eligibility, program, and reporting.(26)

FHWA updated the *Transportation Funding Opportunities for Tribal Nations* document in June 2023.(27) The purpose of the document is to provide information to Tribes on new and existing highway and bridge transportation funding programs for which Tribes are eligible.

The Rural Health Information Hub is funded by the Federal Office of Rural Health Policy as a clearinghouse on rural health issues.(28) This site provides information on rural funding opportunities from Federal and State agencies.

BEHAVIOR-RELATED FUNDING

Funding opportunities for behavioral- or educational-related projects may be available at the following agencies:

- Department of Health and Human Services.
- NHTSA.
- Occupational Safety and Health Administration.
- Substance Abuse and Mental Health Services Administration.

Table 11. Funding opportunities.

Agency	Name	Program Type	Purpose/Description	Website
FHWA	Tribal Transportation Program (TTP)	Formula	Tribes with a TTP agreement with FHWA receive funds for projects that provide safe and adequate transportation and public road access within Tribal land. Eligible activities include transportation planning, design, construction, and road and bridge maintenance.	https://highways.dot.gov/federal-lands/tribal[29]
	Tribal High Priority Project Program	Competitive	Provides additional funding where the annual TTP allocation is insufficient to complete the highest priority projects or disaster and emergency recovery to an eligible National Tribal Transportation Facility Inventory transportation facility.	https://highways.dot.gov/federal-lands/tribal/tribal-hpp-program[30]
	Tribal Transportation Program Safety Fund	Competitive	Projects dedicated to preventing and reducing transportation-related injuries and fatalities in Tribal areas. Eligible projects include the following: • Development and updating of transportation safety plans. • Safety data assessment, improvement, and analysis. • Systemic roadway departure countermeasures. • Infrastructure improvements and other eligible activities listed in 23 U.S.C. 148(a)(4).[31]	https://highways.dot.gov/federal-lands/tribal/safety/funds[32]
	Accelerated Innovation Deployment Demonstration	Competitive	Funding to accelerate the deployment and adoption of proven innovative practices and technologies in highway transportation projects.	https://www.fhwa.dot.gov/innovation/grants/[34]

Agency	Name	Program Type	Purpose/Description	Website
	Active Transportation Infrastructure Investment Program	Competitive	Funds projects that will help improve the safety, efficiency, and reliability of active transportation networks and communities.	https://www.transportation.gov/rural/grant-toolkit/active-transportation-infrastructure-investment-program-atiip[34]
	Rural Surface Transportation Grant Program	Competitive	Improves and expands surface transportation infrastructure to increase connectivity, improve safety and reliability of the movement of people and freight, generate regional economic growth, and improve quality of life.	https://www.transportation.gov/grants/rural-surface-transportation-grant-program[35]
	Reconnecting Communities Pilot Grant Program	Competitive	Projects that restore community connectivity by removing, retrofitting, or mitigating transportation facilities that create barriers to community connectivity. There are two types of grants: • Capital construction: Projects focused on reducing environmental harm and improving access in disadvantaged communities. • Community planning: Planning activities to support future construction projects or address localized transportation challenges.	https://www.transportation.gov/reconnecting[36]

Agency	Name	Program Type	Purpose/Description	Website
USDOT	Safe Streets and Roads for All (SS4A) Program	Competitive	Projects prevent roadway deaths and serious injuries. SS4A provides funding for two types of grants: • Planning and demonstration: Develop, complete, or supplement an action plan. • Implementation: Implement projects and strategies identified in an action plan to address a roadway safety problem.	https://www.transportation.gov/grants/SS4A[37]
	Strengthening Mobility and Revolutionizing Transportation (SMART)	Competitive	Conducts demonstration projects focused on advanced smart community technologies and systems to improve transportation efficiency and safety. SMART projects demonstrate at least one of the eight technology areas: connected vehicles, delivery and logistics, sensors, system integration, coordinated automation, innovative aviation, smart grid, or traffic signals.	https://www.transportation.gov/grants/SMART[38]
	Thriving Communities Program	Competitive	Helps disadvantaged communities with technical tools and organizational capacity to compete for Federal aid and deliver quality infrastructure projects.	https://www.transportation.gov/grants/thriving-communities[39]
BIA	Indian Highway Safety Program	Competitive	Funding program that manages grants that assist Indian tribes in implementing activities in support of national goals to reduce traffic injuries and deaths within Indian communities. The purpose of the grant varies during the year.	https://www.bia.gov/bia/ojs/dhs[40]

Agency	Name	Program Type	Purpose/Description	Website
NHTSA	GO Teams: Traffic Records Technical Assistance	—	Tribes may fill out an application to receive technical assistance from GO Teams, which consists of a contractor paid by NHTSA. GO Teams collaborates with applicants to improve traffic safety data collection and analysis.	https://www.tribalsafety.org/data-collection[41]
	National Priority Safety Program Grants	Competitive	Multiple grants to fund programs that address national priorities for reducing highway deaths and injuries. Some of these grants include the following: • Occupant Protection Grants. • State Traffic Safety Information System. • Impaired Driving Countermeasures. • Distracted Driving Grants. • Motorcyclist Safety.	https://www.nhtsa.gov/highway-safety-grants-program/resources-guide[42]
State-Managed Federal Funding	Highway Safety Improvement Program	Formula	Eligible projects and activities with the goal of significantly reducing traffic fatalities and serious injuries on all public roads.	https://highways.dot.gov/safety/hsip[43]
	Transportation Alternatives	Competitive	Funding for a variety of smaller scale transportation projects, such as pedestrian and bicycle facilities, safe routes to school projects, vulnerable road user safety assessments, etc.	https://www.fhwa.dot.gov/environment/transportation_alternatives/[44]

—No specific program type identified.

CHAPTER 9. NEXT STEPS

The findings, resources, and tools documented in this study help advance pedestrian safety in Tribal areas by providing guidance on how to plan, design, and implement safety improvement projects.

This study highlights transportation system risk factors derived from evaluating fatal and serious injury vehicle-to-pedestrian crashes across multiple States and Tribal lands. Tribal Governments and agencies can identify these risk factors to be proactive in preventing pedestrian-involved crashes.

Tribal practitioners can use the findings, resources, and tools developed for this study to understand risks associated with pedestrian safety in their community, either systemically or at specific locations.

The tools developed for the study may help practitioners select appropriate pedestrian safety improvements and countermeasures based on the identified risk and prioritize improvements or locations for improvements within a community. Pedestrian safety improvements should build upon Complete Streets best practices.[4] Complete Streets best practices, such as improving connectivity for people walking and riding a bicycle, separating pedestrians from high-speed vehicle traffic, and reducing vehicle speeds, are effective in reducing pedestrian fatalities and serious injuries.

Pedestrian safety improvements should also build on FHWA PSCs, a collection of 28 countermeasures and strategies effective in reducing roadway fatalities and serious injuries on streets and highways.[18] Many of the PSCs published by FHWA are specific to improving pedestrian safety on less-traveled roadways in rural environments, such as the following:[45]

- Speed management: Appropriate speed limits for all users.
- Pedestrian and bicyclist improvements:
  - Crosswalk visibility enhancements.
  - Medians and pedestrian refuge islands.
  - Road diets.
  - Walkways.
  - Rectangular Rapid Flashing Beacon (RRFB).
  - Crosscutting: Lighting.

Additionally, the pedestrian risk evaluation tool may enable Tribal practitioners to proactively demonstrate the need for pedestrian safety improvements based on the information presented in this study.

The study team hopes that State and Federal agencies consider these risk-based approaches and findings in their planning and awarding processes for grant and project applications. Because pedestrian fatalities are rare events and crash data is often unavailable, particularly in Tribal areas, risk-based evaluations and identification of potential safety improvements should be considered. State and Federal agencies may consider implementing risk-based analysis or evaluations into the required applications for grants and project awards.

APPENDIX A. INTERVIEWS SUMMARY

INTERVIEW 1

Attendees:

- Joan Mitchell, Chippewa Cree Tribe.
- Curtis Monteau, Jr., Chippewa Cree Tribe.

Question 1: What are the most prominent risk factors for pedestrian safety on Tribal lands?

Responses: The group members said they aim to prioritize their control and responsibilities by focusing on law enforcement and Tribal road management. The group mentioned that the time of day can be a risk factor, primarily during the early morning and nighttime hours; some pedestrians wear all black. The group suggested that this risk factor could probably be assigned to law enforcement and increased education. A group member stated that people sometimes step out onto the road and try to flag down others for a ride. This person was worried about everyone's safety, from the pedestrian to the driver.

The group members brought up a recent road strategic planning meeting where they discussed the management of lighting for the shared-use path. The staff expressed their desire for the lighting to be in line with the natural aesthetics of Rocky Boy's, rather than resembling a busy city. They suggested using a solar-powered, motion-activated lighting system to provide illumination for the path. While they acknowledged concerns about vandalism, they believed that it would not be a major issue.

A group member mentioned a current collaboration with the State of Montana to develop a proposal called Safe Streets for All along Route 6. This area has raised concerns among residents regarding both the speed limit and traffic conditions. Route 6 is divided into three different speed zones, each with their own posted speed limits. One suggestion that has been raised is to explore the possibility of implementing speed tracking or installing speed feedback signs in this area.

The group expressed concerns about the lack of separate access on busy corridors. The group recommended that a flashing caution light be installed in areas where people frequently walk, particularly in the corridor between water resources and the college. Additionally, having a designated walking path between the school and the first set of villages would greatly enhance safety for everyone involved.

Question 2: What are some successfully implemented pedestrian safety projects that you know of for facilities or infrastructure?

Responses: The Tribe received a $41,000 grant from the BIA Rocky Mountain region for Tribal tourism. The group's plan is to create turnout lanes for scenic views, install signage, and develop a cartoon map for public engagement. The group was excited because these improvements will not only enhance scenic viewpoints but also serve as trailheads, pull-off areas for distracted drivers, and safe spots for hitchhikers with added lighting.

The group members discussed a shared-use path that connects Box Elder villages to Box Elder, MT. They have initiated the construction of a second path, which will run from the college to the health center. The group members expressed optimism about the progress of this project and their commitment to completing all the necessary work. One member of the group later pointed out that a section of this path is currently unpaved and primarily used as a footpath. This member emphasized the need for further improvements, such as continued paving, installation of lighting, and regular maintenance.

Question 3: If you had unlimited resources, what are some goals or achievements you would pursue?

Responses: The group would like to conduct a foot traffic count on a narrow road or divide. The group members are interested in installing a motion light for the footpath while preserving the scenic landscape and avoiding artificial light that could disrupt the ambiance. Drug use (or nefarious activity) is prevalent in the area, and lighting may make it safer.

If the group members were to have unlimited resources for a 3-yr period, they would allocate personnel to conduct site visits and analyze various situations to identify trouble spots. As the weather warms up, foot traffic has increased. However, even in cold temperatures, some individuals still venture out. One team member shared a story about a snow road operator who noticed a person walking very early in the morning in a remote rural area. Concerned for the pedestrian's well-being, the operator requested a welfare check on the pedestrian. With the necessary resources, the operator was able to ensure the safety of the individual, who may have been walking to keep warm or possibly experiencing delusions.

The group members also mentioned they would like to know where people are speeding. A group member wished others would follow the rules and speeds since they are in place for a reason.

The group's current focus is on finalizing and submitting its Safe Streets and Roads for All application. One group member said they are working with the State to implement traffic calming.

A group member also expressed the importance of signage and flashing yellow lights to caution pedestrians and drivers. So many vulnerable users use the shared paths, and they should be protected.

The group is actively working toward collaborating with the Community Safety group. Their goal is to come together and determine each other's roles in addressing pedestrian safety.

Question 4: What is the most challenging aspect when it comes to implementing safety improvements, considering the top three obstacles?

Responses: Funding was stated as being the most challenging aspect when it comes to implementing safety improvements.

The group members also emphasized the importance of collaborating within the Tribe. They suggested working with the Indian Housing Authority to advocate for walkways in the villages.

The group said seeing funding consistently allocated toward new homes, while sidewalks and other pedestrian facilities are neglected in the housing areas is disheartening. The group proposed that the DOT or State safety departments allocate additional funding specifically for pedestrian facilities in these housing areas, where existing funding cannot be repurposed. This allocation would prioritize pedestrian safety in this community.

INTERVIEW 2

Attendees:

- Paul Azure, Fort Peck Assiniboine and Sioux Tribes.
- Connie Thompson, Fort Peck Tribes, Tribal Transportation Program.
- Cordell Ringel, Ringel Consulting Services, Inc.

Question 1: What are the most prominent risk factors for pedestrian safety on Tribal lands?

Responses: The group members have identified a current issue with the width of shoulders, which they believe is not sufficient. They proposed conducting a safety study to assess this concern. Due to the lack of accessible pedestrian facilities, people are forced to walk on the highway.

A major concern raised by the group was the presence of a discount store on Highway 2, which is a State road. Pedestrians are frequently seen walking to and from this store. The group was deeply concerned about the safety of these pedestrians and strongly believed that no fatalities should occur on this corridor simply because the store is located outside of town.

Weather and lighting were also identified as major issues. A consistent conflict exists between drivers and pedestrians when they use the road, particularly during snowy conditions when the roads are the only infrastructure that can be plowed.

Alcohol and drugs have been identified as risk factors for alcohol-related crashes, primarily involving motorists but sometimes pedestrians as well. The group also mentioned that distracted drivers and pedestrians pose a risk when they are preoccupied with cell phones or other electronic devices.

Connectivity for pedestrians in and out of communities remains a persistent issue. Additionally, maintenance has been identified as a challenge since there is a lack of trained individuals to maintain sidewalks, curbs, and gutters. Unfortunately, no assistance is currently available.

The group also mentioned that certain areas have side slopes of 2 ft to 1 ft and no shoulder. This further emphasizes the need for work to be done in these areas.

Question 2: What are some successfully implemented pedestrian safety projects that you know of for facilities and infrastructure?

Responses: The group mentioned that the Tribal Safety Fund in Poplar, MT, was used to build a multiuse path to cross the river and to connect the community to ceremonial grounds. This path eliminated interference with traffic and pedestrians.

The group members also discussed their Tribal safety program, which aimed to involve the public in promoting community safety. They mentioned that they collaborated with the Safe On All Roads program (managed by the State) to provide education opportunities to ensure the safety of all road users.

Question 3: If you had unlimited resources, what are some goals or achievements you would pursue?

Responses: The group emphasized the importance of coordination at all levels, including Tribal housing developments, cities, and law enforcement. The group highlighted that a lack of coordination can lead to several issues. The group expressed frustration when Tribal entities fail to coordinate with others and pursue their own initiatives.

The group suggested that implementing educational safety programs could help create awareness for all individuals involved in school zones, pedestrian areas, and crossing Highway 2.

Question 4: What is the most challenging aspect when it comes to implementing safety improvements, considering the top three obstacles?

Responses: The group members stated that they would like to have an overall assessment of their Tribal community. A road safety audit (RSA) for a whole community and not a specific site would help identify issues and prioritize them.

One identified issue is the lack of understanding regarding the right-of-way (ROW) and the lack of action taken to address it. An example of this is the absence of infrastructure facilities at railroad crossings, specifically pedestrian facilities. Private train companies own a significant span of area, and the lack of accommodations for pedestrians in these areas has resulted in several reports of fatalities. The group said the frustrating part is not knowing which agency is responsible for addressing this issue.

INTERVIEW 3

Attendees: Marty Allen, Skokomish Indian Tribe.

Question 1: What are the most prominent risk factors for pedestrian safety on Tribal lands?

Responses: The interviewee expressed concern regarding pedestrian involvement in crashes. The interviewee believed that inadequate facilities and lighting are contributing factors to these incidents. Additionally, the interviewee highlighted that these crashes are not limited to urban areas but also occur in low-populated rural communities.

The interviewee also stated the design and maintenance of roadways pose a risk factor for drivers. Examples of these risk factors include intersections that may be poorly designed, allowing for cars to park along the road, and overgrown vegetation that obstructs the visibility of pedestrians approaching a crosswalk. The interviewee discussed the poor judgment on the part of the road design since it did not consider pedestrians.

The interviewee has identified certain risky pedestrian behaviors, specifically the lack of attentiveness and failure to look around.

Question 2: What are some successfully implemented pedestrian safety projects that you know of for facilities and infrastructure?

Responses: A sidewalk extension has been implemented at the intersection of Reservation Road and State Route (SR) 101. This project includes upgrades, such as the installation of light-emitting diode lights specifically designed for pedestrian use.

Another sidewalk extension starts at the connection point between the new sidewalk and existing sidewalks, located at SR–106. The sidewalk extension continues past the community school, where children frequently use these sidewalks. This project was completed last year and was funded through the FHWA Safe Routes to School program.

The interviewee reported that prior to the completion of the project, many people were forced to walk in ditches or on the road instead of using the sidewalk. However, people can now use the connection to walk on Reservation Road and Tribal Center Road. Additionally, people have been complimenting the roads and their lighting, specifically the LED lights at the intersection of Reservation Road and SR–106.

The interviewee also discussed the Tribe's bicycle rodeo, which was a noninfrastructure project to teach children pedestrian safety when riding their bikes. The interviewee recalled this event happening 10 yr ago.

Question 3: If you had unlimited resources, what are some goals or achievements you would pursue?

Responses: The interviewee admitted to having a weak knowledge of the planning process and how to create plans to improve facilities. The interviewee has ideas to address issues on the State route, such as speeding and reducing crashes within Tribal area boundaries. However, the interviewee is unsure of how to proceed with implementing these ideas. The interviewee believed that documenting the proposals on paper would help others visualize the plans. One specific improvement the interviewee would like to see is the installation of a roundabout at the intersections of SR–101 and SR–106, accompanied by sidewalks on both sides to promote pedestrian access to shops and to support cardiovascular health.

The interviewee agrees with the moderator's suggestion that conducting an RSA would be beneficial in this case. The interviewee expressed a desire to pursue this option. It was mentioned that initially, the Washington State DOT (WSDOT) did not want an RSA. However, the interviewee believed that once the audit is initiated, the results will indicate the need for slower traffic, ultimately making the area safer.

Question 4: What is the most challenging aspect when it comes to implementing safety improvements, considering the top three obstacles?

Responses: The interviewee expressed that obtaining funding and getting approval through WSDOT can be challenging, especially regarding road inventory projects that involve roads

running through Tribal areas. The interviewee believed that more training is needed on how to secure funding for these projects and on the specifications required by WSDOT. The interviewee also mentioned the importance of having the necessary resources and guidance to successfully complete these projects, including training in project management and familiarity with WSDOT specifications.

Question 5: Any closing thoughts?

Responses: Improving pedestrian safety is of utmost importance and requires careful attention. Many communities are recognizing the significance of this issue. While some improvements have been made, continuing to strive for further enhancements in pedestrian safety is crucial.

The interviewee mentioned that the transportation plan states whenever a roadway project is undertaken, sidewalks are also included. Additionally, a specific pedestrian safety plan is addressed within the transportation plan.

INTERVIEW 4

Attendees: Sheri Bozic, Pueblo of Jemez.

Question 1: What are the most prominent risk factors for pedestrian safety on Tribal lands?

Responses: In response to the question, the interviewee identified various risk factors including speeding, frustrations with infrastructure drainage, inadequate pedestrian facilities, the preservation of cultural practices and way of life through unpaved roads, poor pavement curves, improper driving, the geography of the lands, and the challenge of changing people's attitudes toward accepting infrastructure improvements. The interviewee mentioned the transformation of five- and six-way intersections from walking paths to nonpaved roads, expressing the need for creativity to foster pedestrian safety within the community.

Question 2: What are some successfully implemented pedestrian safety projects that you know of for facilities and infrastructure?

Responses: The interviewee believed that the Hemish (Jemez) Path to Wellness project, which has a related summary in appendix G, is expected to be high profile and serve as a role model. The interviewee considered it to be an excellent project to highlight.

The interviewee is working toward implementing a noninfrastructure safety campaign and has already called for community engagement by opening slogan and mascot submittals. The interviewee reported having an overwhelming community response to this call to action.

Other noninfrastructure projects the interviewee mentioned include a National Walk and Roll to School event that was recently completed.

Question 3: If you had unlimited resources, what are some goals or achievements you would pursue?

Responses: The interviewee believed that more noninfrastructure safety projects and programs are needed; 65 percent of the issues are attributed to driver inattention and driver behavior, while 20 percent are related to speeding. The interviewee emphasized the need to prioritize safety campaigning in addition to improving infrastructure. The interviewee believed that driver safety training and courses would greatly benefit the Pueblo community. Concern was expressed that Tribal members may not be able to afford private firms offering driver education since high schools have removed this program. The interviewee also highlighted the connection between improper driving and the frequency of crashes, noting that a significant number of individuals lack insurance coverage.

Question 4: What is the most challenging aspect when it comes to implementing safety improvements, considering the top three obstacles?

Responses: The interviewee identified several challenges to implementing safety improvements. First, gathering funding has proven to be difficult. Additionally, the geographic layout of the Tribal community presents challenges, particularly in terms of drainage issues, especially during monsoon season. Another challenge is harnessing the support of the community. People tend to resist change, especially when it involves their landscape and land.

Question 5: Any closing thoughts?

Responses: When asked about the planning process and the Hemish Path to Wellness project, the interviewee shared the following insights. The interviewee conducted community meetings and patiently addressed complaints over the phone. In 2018, the interviewee updated the transportation safety plan, ensuring that the project remained a priority, as voiced by community members. The completion of the trails and bikeways master plan in 2020 was highly anticipated and appreciated by the community.

From this experience, the interviewee learned the importance of effective communication, including involving the Tribal leadership and council, as well as supporting the tight-knit community. The interviewee also acknowledged the mistake of using rumble strips near homes since it resulted in numerous noise complaints at the Tribal and State levels. Consequently, the rumble strips were removed, and costly striping replacements were made. However, despite this setback, the interviewee expressed happiness in seeing many children riding their bikes and enjoying the path with their dogs.

INTERVIEW 5

Attendees: Hillary Mead, Cherokee Nation.

Question 1: What are the most prominent risk factors for pedestrian safety on Tribal lands?

Responses: The interviewee emphasized the need for sidewalk repairs; the lack of infrastructure; concerns over speeding near communities located along highways; the need for safe crossings, particularly on railroad crossings; the absence of shoulders on roads; and the challenges related to funding and staffing. The interviewee also commented on the common practice of walking as a great alternative within the community.

Question 2: What are some successfully implemented pedestrian safety projects that you know of for facilities and infrastructure?

Responses: The interviewee shared several pedestrian safety infrastructure projects that have been undertaken in the community. The interviewee mentioned that funding has been successfully secured for a sidewalk from downtown to the schools, and the interviewee is hoping to receive funding for connecting the schools to the parks. Speed bumps and signage have also been implemented around the schools in collaboration with the city.

Furthermore, the interviewee shared a specific project that involved assessing an area near a local school and presenting the data to the city. As a result, the city designated the area as a school zone and installed a sidewalk, crosswalk, and signage. This project was initiated by the high school administration, who saw an opportunity to add infrastructure in collaboration with the school, Cherokee Nation, and city. Although the project took place on city-owned property, it was within the Cherokee Nation Tribal area, which showcases the importance of collaboration on all levels.

One of the infrastructure projects the interviewee mentioned is the development of a trail and sidewalk system to provide easy access from the downtown area to the park. Another project focuses on creating a sidewalk with a safe railroad crossing. The interviewee also highlighted the importance of addressing drainage issues in the community.

Additional successes shared by the interviewee include converting a two-way street into a one-way street, changing a one-way stop into a four-way stop, and implementing measures to slow down traffic for safer drop-off zones. The interviewee shared the importance of these changes because of the numerous reports of children getting struck while going to school. A noninfrastructure program listed by the interviewee was the Walk to School Days program, which gave school children the opportunity to learn about pedestrian safety while using sidewalks to walk to school.

Question 3: If you had unlimited resources, what are some goals or achievements you would pursue?

Responses: The interviewee expressed that having continued access to a low-budget assessor would be a great benefit. The interviewee mentioned a previous experience where an assessor provided strategies for the community, such as using paint for bike lanes and crosswalks, which proved to be useful and effective. The interviewee also highlighted the need for evaluation activities, such as walkability assessments and the placement of speed radars, which would be beneficial. The interviewee stated that when these activities are conducted, the outcomes are well received, and successful changes are made.

Question 4: What is the most challenging aspect when it comes to implementing safety improvements, considering the top three obstacles?

Responses: The interviewee identified a couple of challenging aspects when it comes to implementing safety improvements. The first challenge is gathering enough funding to support large-scale projects and small-scale projects. The interviewee said that usually not enough funding is set aside for sidewalks and trails. The second challenge is that the community does not

have a road department, so there are not enough staff members to focus on opportunities stemming from these departments.

INTERVIEW 6

Attendees: Pamela Jurney, Cross Timbers Consulting.

Question 1: What are the most prominent risk factors for pedestrian safety on Tribal lands?

Responses: The interviewee mentioned the most common risk factor to pedestrian safety is the presence of pedestrians on inadequate facilities. The interviewee further explained that in rural settings, connectivity is a problem due to the challenging landscape and topography. The interviewee acknowledged that constructing walkways in such areas can be difficult at times.

Question 2: What are some successfully implemented pedestrian safety projects that you know of for facilities and infrastructure?

Responses: The interviewee highlighted the successful identification and implementation of a pedestrian bridge over a large ditch. Children from the Tribal housing area often took a shortcut by climbing down a large ditch, crossing the State highway, and climbing up a hill to reach school. The bridge project was funded by the Muscogee Nation, and the State added a crosswalk across the State highway.

Additionally, the interviewee shared another noteworthy project involving the development of a sidewalk network on Potawatomi Nation land. This project was significant since it was the first-ever initiative aimed at improving connectivity.

Question 3: If you had unlimited resources, what are some goals or achievements you would pursue?

Responses: The interviewee mentioned capitalizing on the opportunity to implement the Safe Routes to School program and is currently working toward this.

The interviewee also expressed a desire for easier methods to conduct pedestrian assessments. A simple approach would enable Tribes to easily conduct pedestrian counts. These assessments would provide both quantitative and qualitative data, allowing for a comprehensive understanding of pedestrian presence. In particular, the interviewee highlighted the importance of identifying social trails and gathering evidence of trail usage. By analyzing trends and identifying areas with high pedestrian activity, the assessments would help determine the demand for pedestrian infrastructure.

Question 4: What is the most challenging aspect when it comes to implementing safety improvements, considering the top three obstacles?

Responses: The interviewee emphasized that limited funding poses a challenge but also noted an improvement in accessing funding over time. Another challenge highlighted by the interviewee is the difficulty in achieving cooperation. The interviewee further explained the obstacles faced in getting a Tribe to recognize opportunities and garner unanimous support. An example of this

challenge is the ongoing collaboration between the City of Norman and the Shawnee Tribe to effectively implement pedestrian infrastructure safety measures.

INTERVIEW 7

Attendees:

- Chris Robideau, Red Plains Professional, Inc.
- Kelsey Moldenke, Red Plains Professional, Inc.

Question 1: What are the most prominent risk factors for pedestrian safety on Tribal lands?

Responses: The group identified two risk factors. The first is inadequate planning and design of infrastructure. The second is the lack of comprehensive infrastructure due to insufficient funding sources. This second risk factor implies that the available funds may not be enough to cover all aspects and components of the infrastructure project, resulting in a more limited scope or functionality.

Question 2: What are some successfully implemented pedestrian safety projects that you know of for facilities and infrastructure?

Responses: The group presented several noteworthy projects, including the following:

- A completed RSA for the Pueblo of Zuni. This audit identified various issues and proposed solutions, with a particular emphasis on pedestrian safety. Although the safety audit was conducted in collaboration with the New Mexico DOT (NMDOT), it was funded through the safety fund program.

- A combination of different designs for pedestrian and bicycle facilities on SR–164 for the Muckleshoot Tribe.

- The Mentasta safety plan, which highlighted the necessity for a separate pedestrian facility.

Question 3: If you had unlimited resources, what are some goals or achievements you would pursue?

Responses: The group members shared several planning tools and resources. They mentioned the need for a tool to help Tribes identify, apply for, and secure these grants for their initiatives. Additionally, the group emphasized the importance of gathering data, such as GIS data, crash reports, and narratives, to aid their grant writers. Another resource mentioned is the need for teaching Complete Streets concepts to Tribes through training and conferences.[4] Lastly, the group expressed a desire for consistency across States in providing the same data.

Question 4: What is the most challenging aspect when it comes to implementing safety improvements, considering the top three obstacles?

Responses: The group identified two significant challenges. The first challenge was the need for an adequately funded program. The second challenge was the desire to enforce the Complete Streets concepts for candidates of Tribal Transportation Program (TTP) projects.

Question 5: Any closing thoughts?

Responses: The group also had the following additional comments:

- Multijurisdictional facilities vary along corridors, with longer highways entering rural communities, which may be a higher risk for conflicts between high-speed vehicles and pedestrians using facilities. Even when pedestrian facilities are present, pedestrians may still choose to cross in certain areas due to their habits. Additionally, overgrown conditions may force pedestrians to walk on roadways instead of using designated facilities.

- Multimodal planning is, unfortunately, a second thought. In or around large or small communities, the lack of funding is obvious as multimodal planning has taken a back seat.

- Long-range transportation plans (LRTPs) should include guidance on the importance of including these facilities and not overlooking them in the planning process. An LRTP toolkit is expected to be released soon, which will provide resources to help create comprehensive and effective LRTPs.

- People will often choose the shortest and most convenient route, even if it means deviating from designated pedestrian facilities. This practice presents a significant concern for pedestrian safety, and capturing this behavior in planning efforts can be challenging since it is rooted in social aspects.

INTERVIEW 8

Attendees: Matthew Riddell, Qk4, Inc.

Question 1: What are the most prominent risk factors for pedestrian safety on Tribal lands?

Responses: The interviewee identified several prominent risk factors, including pedestrians who choose to be in areas where they are not supposed to be. The interviewee said this is particularly concerning due to the lack of alternative mobility options available. The interviewee also highlighted alcohol consumption as a risk factor affecting both pedestrians and drivers. Additionally, the interviewee emphasized the need to address distracted driving and pedestrians since their lack of attention can contribute to accidents and injuries.

Question 2: What are some successfully implemented pedestrian safety projects that you know of for facilities and infrastructure?

Responses: The interviewee noted that residential roads typically have sidewalks due to an increased focus on pedestrian facilities in the design phase of projects. The interviewee also highlighted the Catawba Nation's successful lower speed residential project in Rockville, SC.

This project widened shoulders for pedestrians, added rumble-strip separation, and used Transportation Safety Funds to create a shoulder and bike lane combination.

Question 3: If you had unlimited resources, what are some goals or achievements you would pursue?

Responses: The interviewee emphasized the value of understanding crash data and expressed the desire from Tribes to further enhance their understanding of crash data. The interviewee also expressed a goal of modeling vehicles and pedestrians, as well as conducting pedestrian counts. Overall, the Tribes are seeking to identify problem areas and implement effective countermeasures. In an ideal scenario with unlimited resources, the Tribes would benefit from a developed tool to individually evaluate and rate sections of road in their inventory. This would enable them to prioritize pedestrian accommodations effectively.

Question 4: What is the most challenging aspect when it comes to implementing safety improvements, considering the top three obstacles?

Responses: One challenge highlighted by the interviewee is the issue of inadequate funding. Despite the willingness of Tribes to initiate improvements, funding constraints hinder their progress. Another challenge mentioned is the need for effective prioritization. Often, project scopes become overly large, resulting in an overwhelming workload.

INTERVIEW 9

Attendees:

- Michia Casebier, M.G. Tech-Writing, LLC.
- Vernon Lujan, Taos Pueblo.

Question 1: What are the most prominent risk factors for pedestrian safety on Tribal lands?

Responses: The first risk factor identified by the group is the presence of high-speed state routes that divide communities. Another risk identified is the lack of infrastructure, such as crossings and trails. The group also mentioned the absence of adequate lighting for pedestrian use since highway-scale lighting is insufficient. Additionally, the group highlighted the risks faced by younger pedestrians and cyclists, aged approximately 12–17 yr, who may not have received proper training on road safety and often do not wear helmets or visible colored clothing.

Question 2: What are some successfully implemented pedestrian safety projects that you know of for facilities and infrastructure?

Responses: A group member shared about a 2.5-mi asphalt path in Alaska, where this paved path serves as a connection between a local school and a city. The current project has received support to extend it further by 14.7 mi to the city of Klawock. Another group member also mentioned the Taos Pueblo Veterans Highway Bridge. This bridge was completed in 2018 and features added infrastructure to support and connect pedestrians, cyclists, and horseback riders.

Question 3: If you had unlimited resources, what are some goals or achievements you would pursue?

Responses: The group emphasized the importance of Tribes needing Safe Routes to School programs.

Question 4: What is the most challenging aspect when it comes to implementing safety improvements, considering the top three obstacles?

Responses: The group observed that the development of roadway networks often lacks proper engineering and planning, which poses challenges. These networks typically start as footpaths and progress to horse trails before finally becoming a network for vehicles. The process of flattening curves and controlling vegetation growth alongside the road—while preserving native vegetation—has proven to be difficult. The group also noted that road improvements sometimes inadvertently lead to higher speeds. Furthermore, pedestrians often neglect to use designated sidewalks or paths constructed for their safety. Lastly, the group mentioned the difficulty in obtaining crash data from law enforcement. The group has encountered challenges in engaging with enforcement regularly for safety planning and believes that education is necessary to help law enforcement understand the importance of sharing pedestrian safety data.

INTERVIEW 10

Attendees: Sherry Ely-Mendes, Pyramid Lake Paiute Tribe.

Question 1: What are the most prominent risk factors for pedestrian safety on Tribal lands?

Responses: The interviewee believed the most prevalent problem is the lack of pedestrian facilities. The interviewee stated that paved roads and State highways go through Tribal communities, but no sidewalks are available. The Pyramid Lake Tribal area has only two sidewalks between three communities. Wadsworth, NV, has more kids going to school but has insufficient pedestrian facilities to support safe walking. The interviewee shared that SR–447 is among the deadliest highways out there, with no shoulders visible and reports of run-off-the-road crashes and speeding along this route. The interviewee also mentioned the recreation and event traffic, specifically from the increased traffic and issues that the Burning Man event brings to the community.

Question 2: What are some successfully implemented pedestrian safety projects that you know of for facilities and infrastructure?

Responses: The interviewee provided details about the newly opened paved shared-use path on SR–447 in 2022. The Nevada DOT (NDOT) collaborated closely with the project, matching funds and demonstrating great teamwork. The community considers the project a success since it was well designed, and the Tribe has taken over full maintenance responsibilities. Another project in the works is a walking path in Nixon, NV, which will connect Basin Road to Pyramid Lake High School. This path will be conveniently located near key destinations such as the store, clinic, and museum. Due to the presence of Burning Man and regular speeding traffic, a Safe Systems Approach evaluation was conducted in this area.[5]

Question 3: If you had unlimited resources, what are some goals or achievements you would pursue?

Responses: The interviewee believed that Tribes would benefit from educating themselves on navigating different policies and processes. The interviewee suggested the creation of a written manual, providing guidance on obtaining Tribal ROW, securing BIA ROW, partnering with agencies such as State or county organizations, and knowing how to request an RSA. This manual would serve as a valuable resource for Tribes, offering a step-by-step approach to navigating these complex processes.

Question 4: What is the most challenging aspect when it comes to implementing safety improvements, considering the top three obstacles?

Responses: The interviewee identified lack of funding as the primary obstacle faced by Tribal agencies and others looking to implement safety improvements. The interviewee also expressed agreement with the concerns voiced by Tribes, emphasizing the significant amount of planning required before being eligible to apply for funding. Another obstacle identified was the cumbersome and costly approval process. The interviewee highlighted the numerous steps involved in obtaining a walkway on Tribal inventory and securing funding approval from organizations. Additionally, the interviewee noted that Tribes often lack a master development plan, resulting in ROW issues, particularly in navigating between BIA and Tribe ROW. Lastly, the cost of ownership and maintenance was identified as another significant obstacle.

INTERVIEW 11

Attendees:

- Kathy Quick, University of Minnesota.
- Guillermo Narváez, Proxemic Insights, LLC.

Question 1: What are the most prominent risk factors for pedestrian safety on Tribal lands?

Responses: The group identified the following key safety issues that cannot be overlooked: high rates of poverty and disenfranchisement, which result in a significant portion of the population lacking access to cars (being unable to afford them) or facing difficulties in obtaining licenses and insurance.

Question 2: What is the most challenging aspect when it comes to implementing safety improvements, considering the top three obstacles?

Responses: The group highlighted the following top challenges:

- Lack of reporting.

- Pedestrian safety concerns: People in these areas frequently walk long distances on roads that are not pedestrian friendly.

- Communication issues: A significant delay exists between the occurrence of a crash and the time it takes to report it to 911, primarily due to limited cell phone coverage.
- Reluctance to involve law enforcement agencies in incidents.
- High-risk footpaths leading directly to four-lane U.S. highways.
- Other nonrelated challenges include long travel distances in winter conditions, poor nighttime visibility due to lack of lighting, and the presence of dogs.

Question 3: Any closing thoughts?

Responses: The group shared the fact that many of the "busy highways" cutting through Tribal lands were intentionally constructed because, in 1921, Federal Highways Act funding was 100 percent across these Tribal lands.[46]

A group member also provided contact information for an urban planner who focuses on active transportation. He has worked with Minnesota Tribes and the Minnesota DOT (MnDOT) on implementing recent improvements to pedestrian facilities on Tribal lands.

The group also provided several forms of literature:

- *Understanding Roadway Safety in American Indian Reservations*.[13]
- Pedestrian Safety: A Critical, Distinctive, and Under-recognized Priority for Reducing Roadway Injuries in Reservations.[47]
- *New Methods for Identifying Roadway Safety Priorities in American Indian Reservations*.[14]

INTERVIEW 12

Attendees:

- Michael Petesch, MnDOT.
- Caroline Ketcham, MnDOT.

Question 1: What are some successfully implemented pedestrian safety projects that you know of for facilities and infrastructure?

Responses: The group shared several projects, including a crossing project on Highway 61, which involved a 0.5-mi stretch of road between two intersections. The intersections were commonly used as crossings, and video data were collected during the day. Both qualitative and quantitative data were captured for analysis.

Another project focused on Highway 169, where a high-intensity activated crosswalk (HAWK) system was implemented. Initially, the crosswalk at an intersection did not meet the needs of the community. The Tribal Nation applied for funding using video recording data to support its case

for installing the HAWK system. The Tribal Nation collaborated with the MnDOT district throughout the process.

In addition, the group members shared that they deployed video cameras at 20 locations to record data for 7–20 d. These specific locations were determined by Tribes or their transportation managers. The interviewees also mentioned that their overall project aimed to collect pedestrian and bike volumes in rural areas. They identified multiple areas to collect these data and provided them to Tribes to support their applications for Federal funding.

Question 2: What is the most challenging aspect when it comes to implementing safety improvements, considering the top three obstacles?

Responses: The primary challenge identified by the group was a lack of funding. Additionally, the group members mentioned that Tribes are aware of the safety concerns on their lands but face resource constraints such as insufficient staff and limited knowledge of the necessary processes to address these concerns.

Question 3: Any closing thoughts?

Responses: The group members mentioned that their phase 1 document includes a section on lessons learned from previous projects. They also mentioned that they will be releasing a phase 2 document in the next month. Additionally, they shared that MnDOT has recently hired a Tribal liaison to provide support to Tribes in their grant application process. Interviewees also shared that they worked with 7 out of the 11 Tribes in the State to facilitate communication between the Tribes' engineers and the county or local engineers. They also stated that MnDOT's Statewide Pedestrian System Plan identified natives as part of the six priority populations (who walk or bike more than the general public).[49]

APPENDIX B. LITERATURE REVIEW

TRIBAL DEVELOPMENT OF TRAILS AND OTHER DEDICATED PEDESTRIAN AND BICYCLE INFRASTRUCTURE[9]

FHWA, November 2023

This research provides information and resources for Tribes, Tribal trails and active transportation advocates, and agencies that may partner with Tribes on trail projects, including Federal and State agencies, metropolitan planning organizations, county and local governments, and community organizations.[9] This research includes information on the health and economic benefits of trails, funding opportunities, partnership opportunities, and resources for trail planning.

The successful projects reviewed in this research highlight best practices and strategies across the following categories to improve pedestrian and bicycle infrastructure:

- Coordination.
- Funding.
- Jobs and training.
- Community engagement.
- RSA.
- Tribal history and culture.
- Planning.
- Health and active transportation.

Tribes successfully used the following practices to support the planning and development of trails and dedicated bicycle and pedestrian infrastructure:

- Coordination:
    - The coordination process and the protection of Tribal sovereignty can be made and kept through project agreements with other government entities.
    - Tribal transportation departments can work with other Tribal departments (e.g., housing, social services, and health) in the planning process to gather data and other information to ensure the trail design meets community needs.
    - Coordination is an excellent way to get all departments to collaborate with one another and hold one another accountable. Many interviewees mentioned the lack of collaboration between Tribal departments.
- Funding:
    - Agreements made with the Federal Government enable Tribes to use Federal-aid funding under the TTP process.

    - TTP and TTP Safety Funds can provide additional funding for Tribes' trail planning activities and projects, supplementing TTP formula funding and offering local matching funds over multiple years.

    - Tribes are eligible for Transportation Alternatives Set-Aside funding, which is Federal-aid funding administered by State DOTs, to implement trail projects.

- Jobs and training: Trail projects create jobs and provide job training opportunities to Tribal members through Tribal training and employment centers. For example, the Seneca Nation Training and Employment Resource Center provided workforce development assistance to Seneca members (youth and adults) for work related to the Pennsy Trail. This assistance provided members with opportunities to learn how to build and install swings and benches along the trail.

- Community engagement:

    - The successful completion of a trail project has the potential to generate support for future trail planning and initiatives in a community.

    - Trail committees consisting of community members (with diverse backgrounds) can provide for successful training and network development.

- RSA: RSAs can specify roadway safety issues that trails or sidewalks may help to address. RSAs can also gather data and necessary information to be used to justify funding requests for trails and dedicated bicycle and pedestrian infrastructure.

- Tribal history and culture: Trails can be creatively designed and named to honor and showcase the rich history and culture of surrounding Tribe(s).

- Planning: Building trail segments in phases makes it easier to design and fund future trail networks.

- Health and active transportation: Trails promote safe and active transportation, providing Tribes an opportunity to address common health issues like obesity and diabetes.

The following are other benefits of trails as noted in the study:

- Benefits of trails:

    - Tribal communities lack active transportation infrastructure, leading to pedestrians and bicyclists making unsafe maneuvers (e.g., forcing travelers to use highway shoulders or walkways that are not separated from travel lanes):

        - Studies have indicated that complex transportation infrastructure poses risks for bicyclists, while off-road bike paths offer the lowest risks.

        - Separated pathways provide options away from vehicular traffic to help reduce conflicts and prevent crashes involving pedestrians on road shoulders; overall, these pathways aid in creating a comfortable environment for all users.

    - Researchers found that trails and dedicated infrastructure for walking, bicycling, and rolling improve safety for all users, reducing injuries, promoting user comfort, and ensuring personal security. Dedicated pedestrian and bicycle infrastructure networks provide safety benefits and promote safe and livable communities:

        - Several studies show that crime rates are lower on trails.

        - Limited pedestrian facilities on Tribal Lands have been identified in the literature as a social determinant or risk factor contributing to the prevalence of human trafficking and missing and murdered Indigenous women and girls.

- Health and physical activity:

    - Sources and peer-reviewed articles state that physical activity (e.g., hiking and biking) are proven to help lower blood pressure, maintain a healthy body weight, reduce the amount of insulin a Type 1 diabetic may need, and promote mental wellness by reducing stress and releasing endorphins.[49,50]

      A study showed a significant correlation between how close someone lives to pedestrian and bicycle infrastructure and the amount of weekly exercise they get. Researchers found that residents who live within a mile of new trails got 45 min more exercise per week on average.[51]

    - A study highlighted the use of a proactive framework introduced by FHWA to assist in prioritizing pedestrian and bicycle infrastructure.[52] The main objective of this framework would be to emphasize the positive health benefits associated with such infrastructure:

        - Define transportation problems and public health issues.
        - Identify transportation and health needs, resources, and priorities.
        - Develop goals and objectives that promote health in the community.
        - Establish evaluation criteria that include public health.
        - Develop and evaluate recommendations and their health impacts.

- Economic development: The literature indicates that trails and other pedestrian and bicycle infrastructure can provide a variety of economic benefits to communities:

    - Trails can stimulate increased spending at local businesses.

    - Studies show that the presence of trails can increase tax revenues because of direct economic activity brought in by trail infrastructure.

- Constructing and maintaining trails and dedicated pedestrian bicycle infrastructure not only provide transportation opportunities but also generate employment opportunities.

COMPARATIVE STUDY OF COMMUNITIES WITH HIGH RATES OF PEDESTRIAN INJURIES[10]

NHTSA, July 2023

This research developed a guidebook documenting strategies that communities are actively implementing to achieve successful pedestrian safety outcomes. The study reviewed 12 communities with successful track records of declining pedestrian fatality rates.

The researchers identified strategies and best practices that may be contributing to the declining rates of pedestrian deaths and injuries. Strategies are classified into common, uncommon, and rare categories. The successful communities were more likely to use the identified strategies, indicating they could be effective at improving pedestrian safety.

The guidebook also offers a self-assessment framework, providing a tool for community and transportation leaders to assess their current capabilities and needs, enabling them to prioritize how best to reorient their safety programs and mobilize resources to align with these strategies.

Categories and strategies include the following:

- Community engagement:
  - Strategy 1: Connect with community members using social media or other online tools, if available.
  - Strategy 2: Coordinate pedestrian safety messaging through a communications group.
  - Strategy 3: Engage law enforcement for community engagement.
- Countermeasures:
  - Strategy 1: Deploy context-appropriate pedestrian and bicycle facilities.
  - Strategy 2: Develop adequate buffers and circulation networks for pedestrians and bicyclists.
  - Strategy 3: Develop regular sidewalk, street maintenance, and upgrade programs.
  - Strategy 4: Engage law enforcement for speed control and education.
  - Strategy 5: Facilitate behavioral change through positive reinforcement.
  - Strategy 6: Reduce interaction between motorists and pedestrians.
- Data analysis:
  - Strategy 1: Develop staff capacity to identify, analyze, and respond to safety issues.

    - Strategy 2: Engage law enforcement for data collection efforts.
    - Strategy 3: Use data-driven methods for targeting safety improvements.

- Organizational structure:
    - Strategy 1: Coordinate between city departments to capitalize on projects with safety components.
    - Strategy 2: Convene citizen and staff committees focused on pedestrian and bicyclist safety.
    - Strategy 3: Devote staff to safety projects or establish safety roles and teams.

- Project funding:
    - Strategy 1: Apply for grants and other available funding opportunities.
    - Strategy 2: Establish or identify a dedicated funding source for pedestrian-focused projects.

- Project prioritization and support:
    - Strategy 1: Prioritize children, elders, and other vulnerable populations.
    - Strategy 2: Prioritize opportunities to improve nonmotorized travel conditions.

LOW-COST PEDESTRIAN SAFETY ZONES: COUNTERMEASURE SELECTION RESOURCE[(11)]

NHTSA, July 2023

This report presents details about different low-cost countermeasure combinations that can be deployed in support of the pedestrian zone approach to small areas. Each countermeasure reviewed includes a description; the effectiveness; and implementation and operational considerations, including cost, planning time, and build time.

The low-cost countermeasures detailed in the report include the following:

- Engineering:
    - High-visibility crosswalk marking.
    - Parking restrictions.
    - Stop bar adjustment at intersections.
    - Speed humps and speed tables.
    - Curb extensions.
    - Median islands.
    - Traffic calming.
    - Right turn on red restrictions.
    - Permissive left turn restrictions.
    - Turning Vehicles Yield to Pedestrians (R-10-15) sign.
    - Leading pedestrian interval (LPI).
    - Walking speed decreased or time added to pedestrian phase.
    - Hot-button actuation implemented.

    - Progression speed managed with signal timing.
    - Stop or yield line advanced.
    - In-road Yield to Pedestrian Sign (R1-6/R1-6a).
    - Gateway arrangement of in-road Yield to Pedestrian Sign (R1-6/R1-6a).
    - RRFB.
    - Pedestrian hybrid beacon (PHB).
    - Lighting.

- Enforcement:
    - Targeted yielding enforcement operation.
    - Lower speed limits.
    - Speed enforcement.
    - Automated speed enforcement.

- Education:
    - Countermeasure-specific outreach.
    - Safety campaigns and messaging.
    - Pedestrian safety skills training for children.
    - Dynamic speed feedback signs.
    - Automated speed warnings.
    - High-visibility enforcement through media and progressive ticketing.
    - Media framing.
    - Social norming community feedback signs.

The study shows how engineering and infrastructure countermeasures coordinate with behavioral (enforcement and educational) countermeasures to promote pedestrian safety.

The study details how a community may isolate a high-pedestrian area, select appropriate applicable engineering countermeasures, and see resulting behavioral countermeasures (enforcement and education) that pair well with the selected engineering countermeasures. A table is included in the document that will assist a user in selecting behavioral countermeasures that pair well with various engineering countermeasures.

PEDESTRIAN CROSSINGS AND SAFETY ON FOUR ANISHINAABE RESERVATIONS IN MINNESOTA[12]

MnDOT, November 2020

Tribal transportation managers identify pedestrian safety as one of their top safety concerns in Tribal areas. MnDOT funded this research project to document pedestrian behavior in Tribal areas and identify potential countermeasures to reduce risks to pedestrians.

Tribal transportation managers, MnDOT employees, county engineers, and the University of Minnesota collaborated to prepare and review findings and identify potential countermeasures for the chosen locations. A key aspect was collecting usable data via video data collection and counting the number of pedestrians crossing roads. The research team collected pedestrian traffic

at 10 locations on four Tribal lands for between 11 and 20 d in 2017.[13] The data proved valuable in showing all stakeholders the necessity of pedestrian safety infrastructure.

Various sites on Tribal lands were observed to collect pedestrian crossing information. Using the collected data, the research team reviewed results, discussed safety, and identified potential countermeasures to reduce risk to pedestrians. Countermeasures varied and included, but were not limited to, sight-line improvements, new signs, installation of PHBs or RRFBs, lighting improvements, pedestrian education, access management, and trails. Countermeasures were planned and integrated into existing MnDOT-planned projects where possible.

This project led to the implementation of countermeasures, and additional Tribal Governments expressed interest in participating in future investigations. MnDOT funded a followup study to evaluate the PHB installed and other Phase 1 countermeasures.

UNDERSTANDING ROADWAY SAFETY IN AMERICAN INDIAN RESERVATIONS: PERCEPTIONS AND MANAGEMENT OF RISK BY COMMUNITY, TRIBAL GOVERNMENTS, AND OTHER SAFETY LEADERS[13]

University of Minnesota, October 2018

The focus of this study was roadway safety in American Indian reservations, and the research provides new sources of data and policy-relevant findings to address the unusually high rates of roadway fatalities among American Indians.

Researchers conducted ethnographic research with four Tribal Governments in Minnesota. Findings triangulated with data from FHWA's 2016 nationwide survey of Tribes and States include the following:

- Pedestrian safety is a critical yet underrecognized issue on reservations, which is unequivocal across all data sources and differentiates reservations from rural areas in general.
- Reservation road engineering and repair are very high priorities according to both Tribal and State Governments.
- Reckless driving is a multifaceted concern, including not only impaired driving but also cell phone distraction and speeding.
- Education and enforcement to increase seatbelt and car seat use are named as high priorities in the national survey.
- Tribes need better cooperation with local, State, and Federal agencies. Priorities include addressing data quality and sharing issues for better interjurisdictional cooperation for infrastructure and enforcement.

The following are key concerns and recommendations from the data and research:

- Pedestrian safety is a critical, distinctive, and underrecognized priority on reservations:

    - A difference between nonreservation and reservation areas is the number of people walking.
    - Pedestrian safety is stated as being the "single most distinctive feature of reservations."[13]
    - One hundred and fifty Tribal Government respondents chose pedestrian safety from among a dozen options as the most frequently named concern. Inadequate pedestrian facilities were fourth.
- Road engineering and repair need sustained resources.
- Impaired driving must not be assumed to be the only explanation.
- Education and enforcement to increase seatbelt use are essential.
- Tribes need better cooperation with local, State, and Federal agencies. Tribes have the following needs:
    - Addressing mismatched perceptions of ground conditions through improved data quality and sharing and an expansion of knowledge sources.
    - Improving coordination for resource sharing, planning, and implementation, especially for infrastructure and enforcement.
- Positive models working to improve pedestrian safety mentioned by the four participating Tribal Governments include the following:
    - Development of safe routes to school plans and investments in infrastructure.
    - The Leech Lake Tribal Government recently collaborated with the school district, the State, and local government agencies to extend a regional recreation trail to include an additional 0.4 mi so that students could use it to bike or walk to their middle school and high school campuses.
    - Red Lake received a grant for a lighted pedestrian path for students to access the elementary school.
    - Fond du Lac is lengthening one of its pedestrian trails.
    - Mille Lacs is actively seeking grant funds for pedestrian improvements.
- Further research is needed to improve reservation roadway safety, specifically the following:
    - Evaluate roadway safety implementation in Tribal lands.
    - Advance qualitative methods and expand qualitative data sources.
    - Assess emergency response quality.

- Tribal Governments' highest concerns include the following:

    - Road infrastructure (i.e., curves, ditches, surface condition, and lighting).
    - Speeding or reckless driving.
    - Road maintenance.
    - Vulnerable roadway users (i.e., pedestrians, cyclists, and children).

TRIBAL TRANSPORTATION STRATEGIC SAFETY PLAN[2]

FHWA, August 2017

The *Tribal Transportation Strategic Safety Plan,* published by FHWA in 2017, assesses transportation safety needs in Tribal areas and provides Tribal Governments with strategies and resources that can be used in the pursuit of saving lives.[2] The plan was developed by the Tribal Transportation Safety Management System Steering Committee.

The plan identifies and details the following seven topics of concern in Tribal areas:

- Decisionmaking process:
    - This topic encourages Tribes to develop strategic safety plans and to use those plans to manage a safety program.

    - Successful transportation safety programs follow a cyclical, strategic process, which includes the engagement of stakeholders from various sectors such as leadership, enforcement, engineering, education, and even emergency medical services. Planning involves assessing needs, analyzing data, and developing a transportation safety plan, which identifies risk factors and countermeasures. Ongoing evaluations and updates are essential to monitor progress and adjust to new data or developments, ensuring the effectiveness of the active transportation safety program.

    - This information provides a structured approach to addressing transportation safety issues and highlights the importance of collaboration, planning, implementation, and continuous evaluation in achieving positive outcomes.

- Crash data availability and limitations:
    - Accurate reporting of crash data is crucial for effective transportation strategic safety plans, particularly in Tribal areas where data quality and availability often need improvement. Quality crash data help prioritize projects and programs, interpret crash patterns, and identify opportunities for infrastructure-oriented safety treatments, along with acquiring State and Federal grants.

    - The quality and types of crash data collected need improvement in many Tribal areas.

    - One strategy includes standardized crash data collection by Tribal and BIA law enforcement.

- Roadway departure:
  - Errant drivers leaving a lane or roadway represent a large portion of fatal crashes in Tribal areas.

  - Roadway departure poses significant issues in Tribal areas. Data from 2010 to 2014 reveal that roadway departure was a contributing factor in crashes, responsible for 63 percent of all reported motor vehicle fatalities within Tribal areas. This topic addresses strategies to mitigate roadway departure crashes, which occur when a vehicle leaves the traveled way and collides with a guardrail or fixed objects or runs off the roadway. Strategies for roadway departure are as follows:

    - Keep vehicles on the roadway:
      - Address behavioral actions that can lead to road departure.

      - Ensure the use of appropriate warning signs and incorporate enhanced warning signs (applied to locations of frequent crashes or systemically to address high-risk factors).

      - Use road surface friction treatments.

      - Provide a shoulder, edge, and shoulder rumble strips or stripes.

      - Install and maintain pavement markings.

      - Install post-mounted delineators.

      - Maintain the roadway surface for the designed speed.

      - Ensure visibility of signs at night.

    - Provide for safe recovery:
      - Provide clear zones free of hazardous roadside objects.
      - Flatten roadside slopes.
      - Use Safety Edge on paving projects.[21]

    - Minimize crash severity:
      - Install barriers, breakaway poles, and crashworthy devices for immovable hazards.

      - Update guardrails to meet a crashworthiness standards like the *Recommended Procedures for the Safety Performance of Evaluation of Highway Features* or NCHRP Report 350.[54]

- Occupant protection: Child passenger seats.
- Impaired driving.
- Pedestrian safety:

- Between 2010 and 2014, Tribal areas saw an average of 69 pedestrian fatalities per year, representing 11 percent of all fatal crashes.[2] Many safety plans in these areas prioritize pedestrian infrastructure improvements, with a significant amount of funding requests aimed at enhancing pedestrian safety. These efforts are important, especially considering most pedestrian fatalities occur in rural areas, outside of intersections or crosswalks, and are disproportionately high among AIAN populations.

- Strategies include the following:

  - Ensure alternatives to driving and walking are available for those leaving bars and other locations where alcohol is served.

  - Provide separated pathways or sidewalks in areas frequently used by pedestrians.

  - Provide pathways between origins and destinations independent of the road network that decrease pedestrian activity along roadways.

  - Provide roadway lighting (along a roadway where pedestrian activity occurs).

  - Mitigate obstacles such as bridges, culverts, steep embankments, snow storage, and utility apparatuses that may force pedestrians into the roadway.

  - Shorten crossing distances with bulb-out extensions of the curb and midcrossing refuge islands to eliminate the need for pedestrians to cross multiple lanes.

  - Provide time for the pedestrian walk indication before conflicting signals turn green.

  - Remove sight distance obstacles that can hide pedestrians from a driver's view.

- Education strategies:
  - Walk on a sidewalk or path when one is available.

  - Walk on the shoulder, facing traffic, if there is no sidewalk or path. Stay alert.

  - Avoid distractions that take eyes and ears off the surroundings.

  - Be cautious. Never assume a driver sees you. Make eye contact with a driver before entering the travel lane.

  - Be predictable. When possible, cross streets at crosswalks or intersections, where drivers expect and can see pedestrians.

  - Be seen. Wear bright clothing during the day and wear reflective materials or use a flashlight at night.

  - Avoid alcohol and drugs when walking.

    - Look for pedestrians everywhere.
    - Never pass vehicles stopped at a crosswalk. They may be stopped to allow pedestrians to cross the street.
    - Never drive under the influence of alcohol or drugs.
    - Follow the speed limit, and slow down around pedestrians.
    - Stay focused and slow down where children are likely to be present, like school zones and neighborhoods.

- Availability of public safety services: The severity of an injury often relates directly to the speed at which proper medical attention can be provided. The elapsed time from notification of emergency medical services to a crash victim's arrival at a treatment facility is often greater than an hour in Tribal areas. Based on available data, the elapsed time is greater than an hour in 44 percent of crashes in Tribal areas, compared with 23 percent for the United States overall.

The safety plan encourages each Tribal Government to develop a local road safety plan that reflects local data analysis and safety priorities. Numerous additional safety resources are available from FHWA to aid planners, engineers, and employees in advancing safety in their region.[55] Additional resources include the development of transportation safety plans, examples of other strategic highway safety plans, State plans, etc.

NEW METHODS FOR IDENTIFYING ROADWAY SAFETY PRIORITIES IN AMERICAN INDIAN RESERVATIONS[14]

University of Minnesota, August 2015

Researchers describe new methods developed to identify roadway safety priorities in American Indian reservations. The tools identified may be used by Tribal Governments and others to prepare Tribal safety plans, to identify focal areas for RSAs, and to improve transportation and safety policies and implementation of policies.

The document includes recommended key stakeholders to interview, questions to ask, and conversations initiated by examining maps with expert drivers and interested residents. These methods proved useful in generating new insights on key safety risks in Tribal lands, specifically for pedestrian and bicyclist safety, policy design and implementation, and interagency collaboration. The document lists safety risks revealed through the stated methods:

- Pedestrian safety, specifically wanting to encourage activity for health and recreation, but lacking infrastructure for people to do it safely.
- Coordination problems among jurisdictions including Tribal Governments, State public safety and transportation agencies, BIA, etc.
- Driver education and behavior concerns for residents and nonresidents.

- Low, improper use, or low use of safety restraint systems, including child seats and seatbelts.

- Poverty and isolation impairing driver safety.

MANUAL FOR SELECTING SAFETY IMPROVEMENTS ON HIGH RISK RURAL ROADS[15]

FHWA, August 2014

The *Manual for Selecting Safety Improvement on High Risk Roads* provides information and criteria associated with treatments to improve safety on high-risk rural roads (HRRRs).[15] Agencies can use this manual to determine safety benefits, a cost-effectiveness comparison of treatments, the applicability of treatment deployment, maintenance cost, and the decisionmaking process for treatment selection. The manual is intended to assist an agency in understanding the effectiveness of safety improvements on HRRRs to aid in the treatment selection process.

The manual presents safety treatment for the following categories:

- Horizontal curves.
- Intersections (signalized).
- Intersections (unsignalized).
- Nonmotorized users.
- Pavement and shoulder resurfacing.
- Pavement markings.
- Roadsides.
- Signing.
- Vertical curves.
- Other treatments.

The HRRR Treatment Matrix sorts through treatment selections and deployment criteria to identify potential improvements for a location. Each treatment category section has a treatment matrix that provides an overview of the benefits and costs associated with each safety treatment in the section.

Nonmotorized user treatments, specifically to improve pedestrian safety, include the following:

- Providing crosswalks.
- Installing pedestrian crossing signal heads at signalized intersections.
- Installing RRFB crossings.
- Building sidewalks.
- Constructing adjacent shared-use paths.
- Installing PHB signalized crossings.

Many of the nonmotorized user treatments are directly applicable to Tribal land settings.

TRIBAL SCHOOL ZONE SAFETY VIDEO AND TOOLKIT[16]

FHWA, March 2007

The Tribal School Zone Safety Video and Toolkit is meant to raise awareness of the high rates of pedestrian injury and death among American Indians in the United States and give Tribal communities tools to help increase the safety of pedestrians[16]. The toolkit includes the following:

- Safety videos: A video for children (for use in school or other community events) and a video targeting adults, elders, and a more general audience.

- A series of pedestrian safety materials designed to help educate children and adults on safe walking behaviors:

    - 7 Quick Tips for Children for Walking Safely to School.
    - Tips for Walking Safely to School.
    - Pedestrian Safety Tips for Parents and Other Caregivers.
    - Walkability Checklist—How Walkable Is Your Community?
    - Activities for Children.

- Promotional tips to increase pedestrian safety awareness and promote pedestrian safety:

    - Videos to create awareness within schools, the local media, and throughout other community organizations.

    - Template letters and news articles to submit to newspapers or schools.

- Information on how to use the video elements: Providing additional information for others to create their own videos.

- A resource sheet for additional information.

Engineering methods and potential improvements detailed in the safety videos include the following:

- Traffic calming, including raising the visibility of crosswalks and intersections.
- Projects to consider:

    - Build new medians, speed humps, and curb extensions.

    - Undertake cost-effective projects including separated gravel or asphalt pathways, signage, retiming of traffic lights, and repainting of crosswalks and bike lanes.

    - Retrofit existing intersections (e.g., roundabouts).

- Institute a system to report any hazardous areas to the Tribal council or other authorities.

- Use education programs to promote safety, health, and wellness.

SAFE TRANSPORTATION FOR EVERY PEDESTRIAN (STEP)[17]

FHWA, June 2021

The Safe Transportation for Every Pedestrian (STEP) initiative provides information and recommendations associated with improving pedestrian safety.[17] The STEP program promotes countermeasures to improve pedestrian crossing locations and reduce crashes. Agencies can use these countermeasures and associated resources to determine safety benefits, countermeasure features, applicability of treatments, and implementation cost. The initiative is intended to assist an agency by providing countermeasures and their associated benefits to improve pedestrian crossing locations and reduce crashes. Benefits noted include improved safety, targeted investment, and enhanced quality of life.

The initiative presents guidance and tech sheets for the following countermeasures:

- Crosswalk visibility enhancements.
- LPI.
- PHB.
- Pedestrian refuge island.
- Raised crosswalk.
- Road diet.
- RRFB.

The STEP initiative provides additional resources and guidance for planners, engineers, agencies, and anyone wanting to advance pedestrian safety.[17] STEP provides webinars, videos, and campaign materials to promote and identify potential countermeasures for locations. Related case studies are also included to showcase the effectiveness of the selected STEP countermeasures and highlight actual implementation. Case studies showcase a variety of countermeasures, including RRFBs, Complete Streets, road diets, LPIs, PHBs, raised crosswalks, medians, etc.[4] Each case study provides the context of the project, data, public engagement findings, etc., and can be a great resource to agencies and others.

APPENDIX C. SUMMARY OF COLLECTED DATA

DATA COLLECTION

The project team established a target goal to gather police reports and narratives for up to 500 fatal pedestrian crashes that occurred in Tribal areas. A target of 500 reports recognizes that not all reports collected will be complete but will provide enough complete reports and information to achieve a 95-percent confidence level. The sample size required to achieve this level of confidence was calculated to be 356. The calculation is illustrated in table 12 and figure 3.

Table 12. Components of sample size equation.

Parameters	**Value**
Z-Score	1.96
e (margin of error)	0.05
N (population size)	5016
p (standard deviation)	0.5
Calculation	**Value**
Numerator	384.16
Denominator	1.07659
Sample size	356

$$\text{Sample size} = \frac{\frac{z^2 \times p\,(1-p)}{e^2}}{1 + \left(\frac{z^2 \times p\,(1-p)}{e^2 N}\right)}$$

Figure 3. Equation. Sample size calculation.

COLLECTED DATA

The study team successfully collected crash data and officer narratives for 392 pedestrian fatality and serious injury crashes from 20 different agencies in 18 States. The crash data include fatalities and serious injuries that occurred in Tribal areas from 2013 to 2022.

Table 1 summarizes the received crash data collected by States, agencies, and Tribes. The 392 analyzed reports achieved a 95-percent confidence level for the dataset.

APPENDIX D. CRASH DATA ANALYSIS

ROADWAY CHARACTERISTICS

Additional information about crashes associated with each risk factor category is included in the following sections.

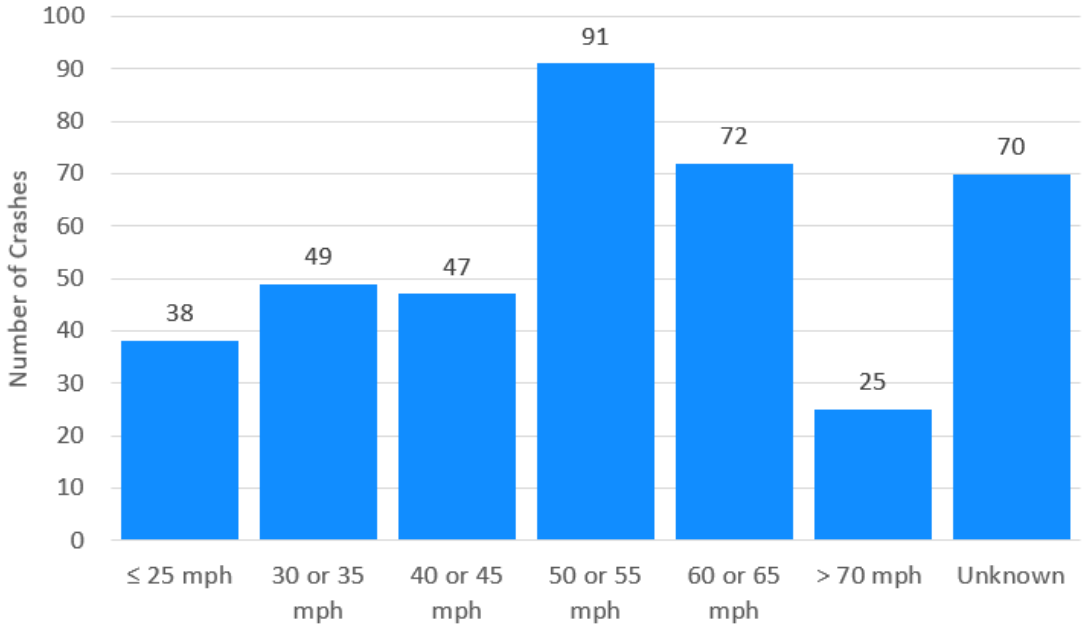
Posted Speed Limit

The posted speed limit at crash locations was recorded from State- or agency-provided crash data and supplemented with visual observation using online mapping tools. While operating speed and posted speed limit may differ, only posted speed limit data was available for the crashes evaluated in this study. Operating speed is not specified for each crash with the data available.

Risk factor observation: Fewer fatal and serious injury crashes occurred on roadways with a posted speed of 25 mph or less. The correlation between vehicle speed and pedestrian injury severity or survival is well documented.[56] A pedestrian is at a 90-percent risk of death when struck by a vehicle traveling at 58 mph.

Supporting findings are as follows:

- Thirty-eight of the 392 crashes (10 percent) occurred on roadways with a posted speed limit of 25 mph or less (figure 4).
- The findings by urban and rural area crashes are as follows:
    - **Urban:** Seventy-seven out of 126 urban-area crashes (61 percent) occurred on roadways with a posted speed limit of 45 mph or less.
    - **Rural:** One hundred and fifty-nine out of 266 rural-area crashes (60 percent) occurred on roadways with a posted speed limit of 50 mph or higher.



Source: FHWA.

Figure 4. Bar graph. Posted speed limit.

Roadway Geometry

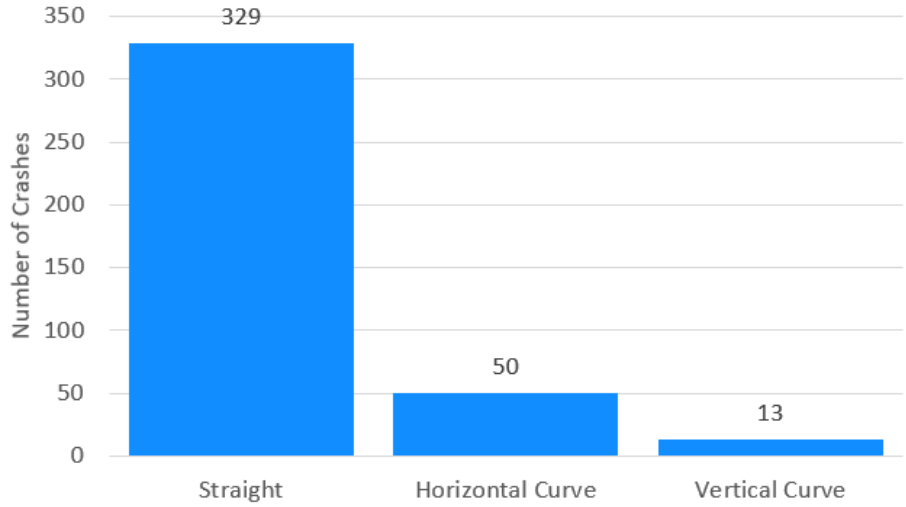
Basic roadway geometry was recorded from visual observation, using online mapping tools, for each crash location.

Risk factor observation: The data show that 16 percent of crashes occurred on horizontal curves. However, data regarding the percentage of the roadway network on horizontal curves are not available.

Supporting findings for figure 5 are as follows:

- Sixty-three of the 392 crashes (16 percent) occurred on curves (horizontal or vertical) on the roadway. Nationally, more than 25 percent of fatal crashes are associated with a horizontal curve, and most of these types of crashes are single-vehicle roadway departures.[(57)]

- Most crashes occurred on straight segments of roadway (329 of the 392 crashes, 84 percent).



Source: FHWA.

Figure 5. Bar graph. Roadway geometry.

Roadway Surface

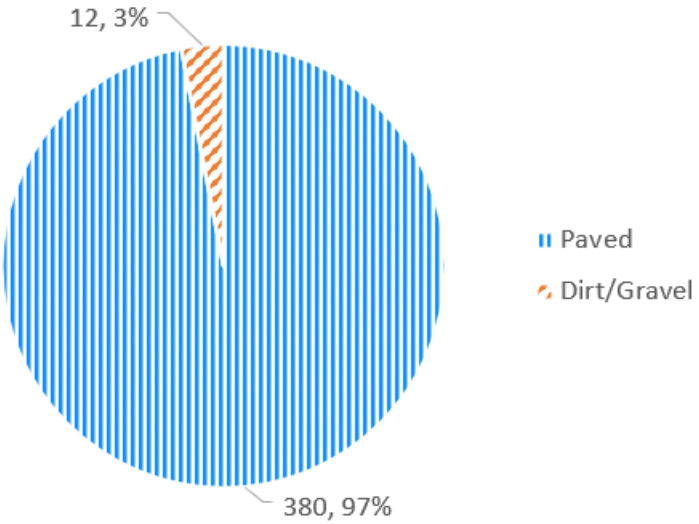
The roadway surface type was recorded from visual observation, using online mapping tools, for each crash location.

Risk factor observation: Very few (3 percent) fatal or serious injury pedestrian crashes of those analyzed occurred on unpaved roads. Dirt and gravel roads typically have lower speeds than paved roads.

Supporting findings include the following:

- Most observed crashes occurred on paved roadways (380 of 392 crashes, 97 percent) (figure 6). Tribal areas typically include unpaved roadways. However, of the crash data provided and analyzed for this research, findings show fatal and serious injury crashes occurring mostly on paved roadways.

- Twelve of the 392 crashes (3 percent) occurred on a dirt or gravel road surface (figure 6).



Source: FHWA.

Figure 6. Pie chart. Roadway surface.

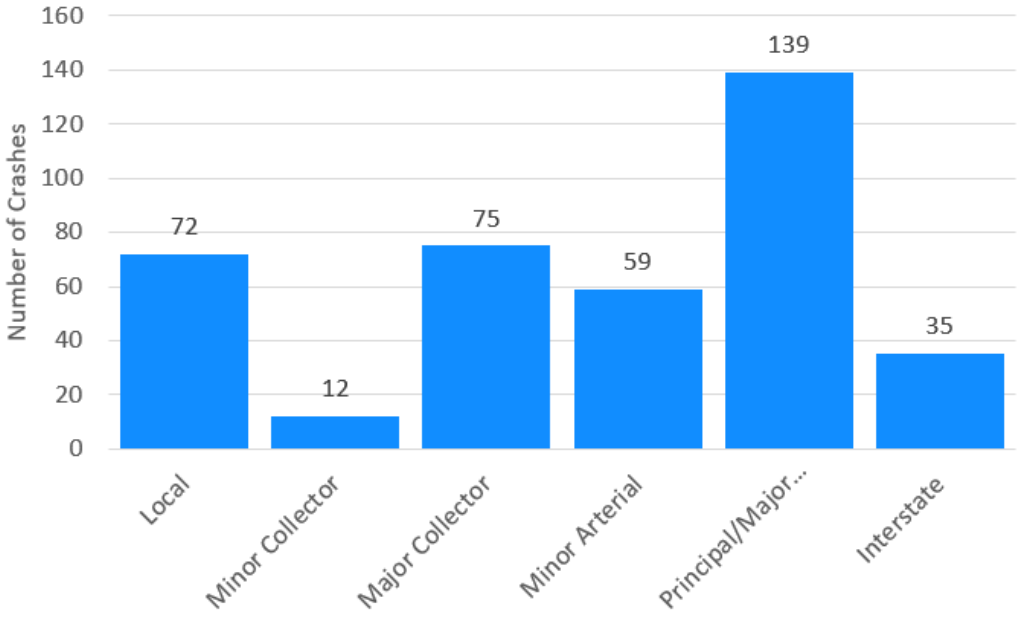
Functional Classification

The functional classification of roadways was recorded from State or agency-provided crash data.

Risk factor observation: A high percentage (35 percent) of crashes occurred on principal arterials or major arterial roadways. These facilities are typically higher speed/higher volume roadways.

Supporting findings for figure 7 are as follows:

- Seventy-two of the 392 crashes (18 percent) occurred on local roadways.
- Thirty-five of the 392 crashes (9 percent) occurred on interstate roadways.



Source: FHWA.

Figure 7. Bar graph. Functional classification.

Guardrail or Barrier Infrastructure

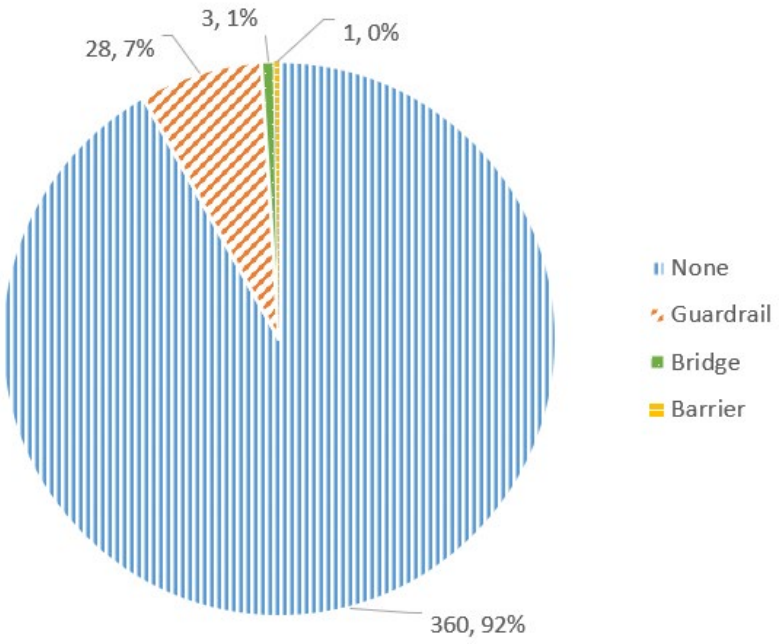
The presence and type of shoulder infrastructure were recorded from visual observation, using online mapping tools, for each crash. From 2010 to 2014, roadway departure represented 63 percent of all reported motor vehicle fatalities in Tribal areas.[2]

Risk factor observation: From the crashes observed, there does not appear to be a high correlation between pedestrian fatalities and the presence of guardrails, bridge barriers or railings, or barriers on the roadway at those locations.

Supporting findings are as follows:

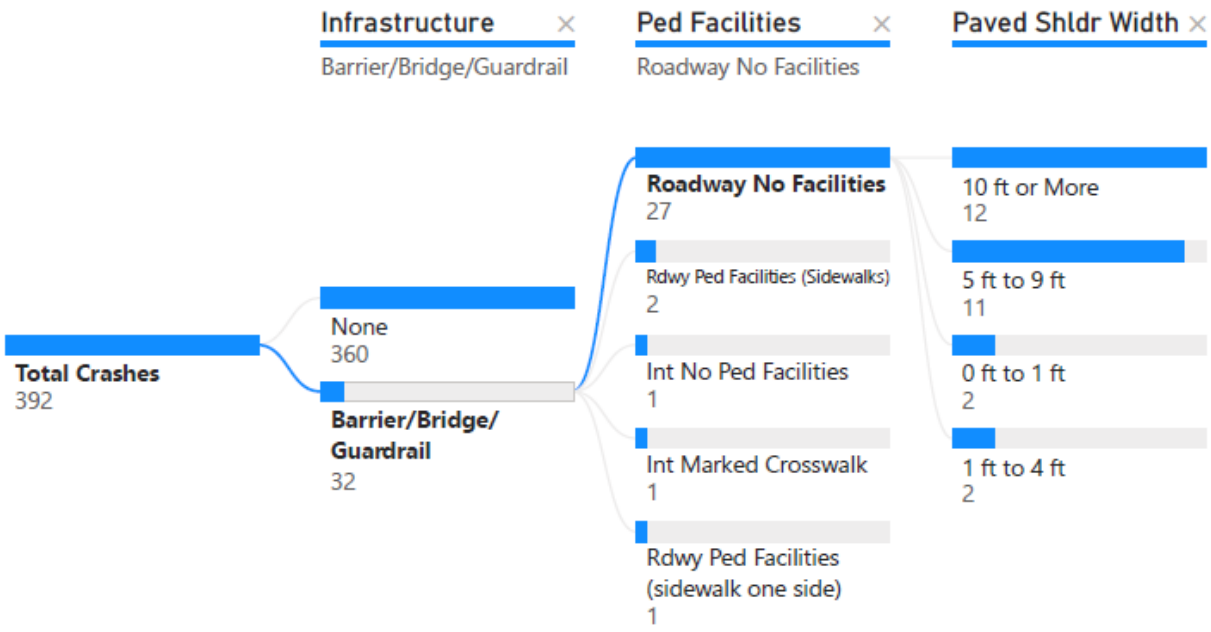
- Thirty-two of the 392 crashes (8 percent) occurred when the pedestrian was adjacent to a guardrail or barrier shoulder infrastructure (figure 8).
- Twenty-seven of the 32 crashes (84 percent) occurred on a roadway where there were no other facilities for pedestrians to use (i.e., no sidewalk or path.) at that crash location (figure 9). Of those 27 crashes on facilities with no other pedestrian infrastructure, the findings were as follows:
    - Twelve crashes (44 percent) occurred where paved shoulders were 10-ft wide or wider.
    - Eleven crashes (41 percent) occurred where paved shoulders were 5–9-ft wide.
    - Two crashes (7 percent) occurred where paved shoulders were 1–4-ft wide.

- Two crashes (7 percent) occurred where paved shoulders were less than 1-ft wide or not present.



Source: FHWA.

Figure 8. Pie chart. Guardrail or barrier infrastructure.



Source: FHWA.
Int = intersection; Ped = pedestrian; Rdwy = roadway; Shldr = shoulder.

Figure 9. Chart. Guardrail, barrier infrastructure, pedestrian facilities, and paved shoulder width.

Median Type

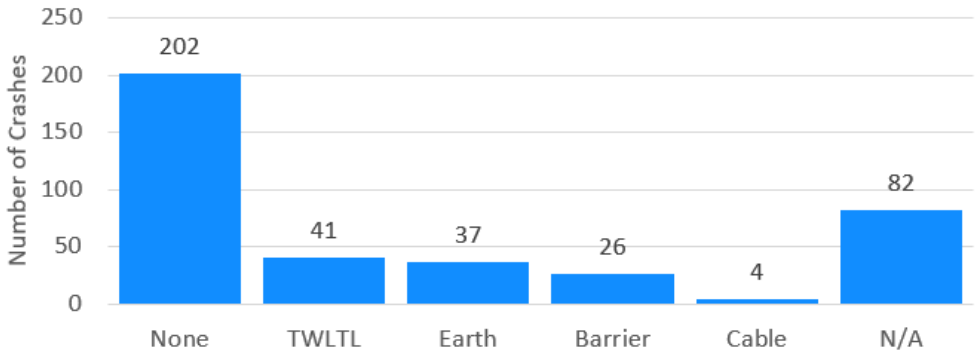
The presence and type of center medians were recorded from visual observation, using online mapping tools, for each crash location.

Risk factor observation: A majority (52 percent) of fatal and serious injury pedestrian crashes occurred on undivided roadways with no median. Fewer fatalities and serious injury crashes occurred where physical separation or medians (e.g., earth, barrier, or cable) were present on the roadway for the dataset analyzed. The proportion of divided roadways in the dataset was unknown.

Supporting findings are as follows:

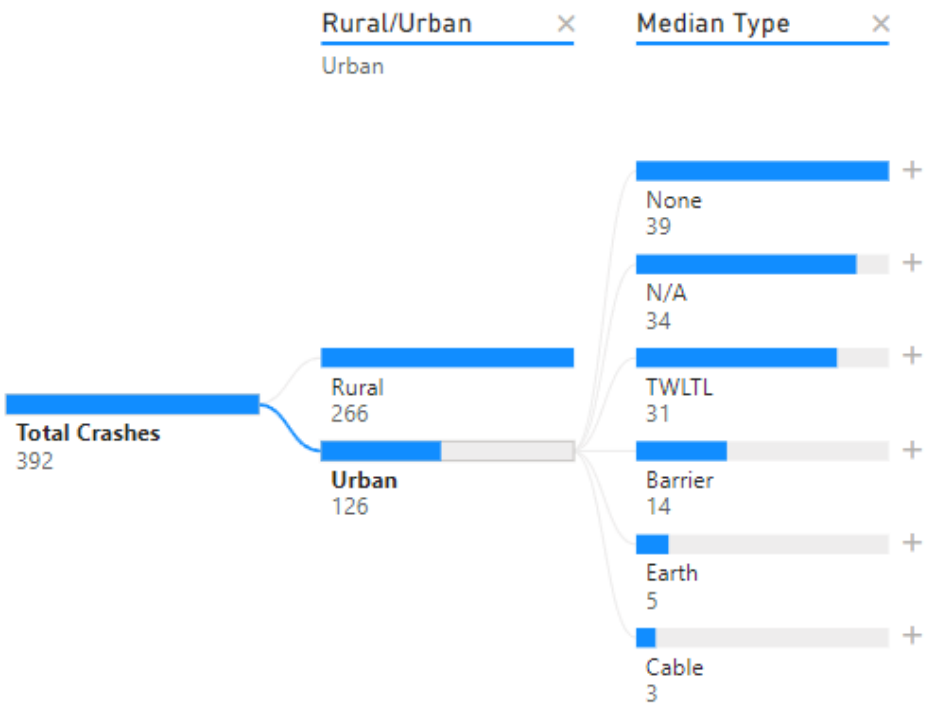
- A total of 202 of the 392 crashes (52 percent) occurred on undivided roadways with no center median (figure 10).
- A total of 108 of the 392 crashes (28 percent) occurred on some type of median-divided roadway (figure 10):
    - Forty-one of the 392 crashes (11 percent) occurred where a two-way left-turn lane (TWLTL) was present.
    - Thirty-seven of the 392 crashes (9 percent) occurred where an earth median was present.
    - Twenty-six of the 392 crashes (7 percent) occurred where a median barrier was present.
    - Four of the 392 crashes (1 percent) occurred where a cable median barrier was present.
    - The N/A category represents crashes that occurred at intersections or areas where median infrastructure is not applicable (e.g., parking lots, access driveways, or construction areas).
- The following was found in urban areas (figure 11-A):
    - Fifty-three of 126 urban crashes (42 percent) occurred on median-divided roadways (including TWLTLs, barrier, earth, or cable).
    - Thirty-one of the 126 urban crashes (25 percent) occurred on a median-divided roadway where a TWLTL was present.

- The following was found in rural areas (figure 11-B):
    - Fifty-five of 266 rural crashes (21 percent) occurred on median-divided roadways (including TWLTLs, barrier, earth, or cable).
    - Thirty-two of the 55 rural crashes (58 percent) occurred on median-divided roadways where an earth barrier was present.



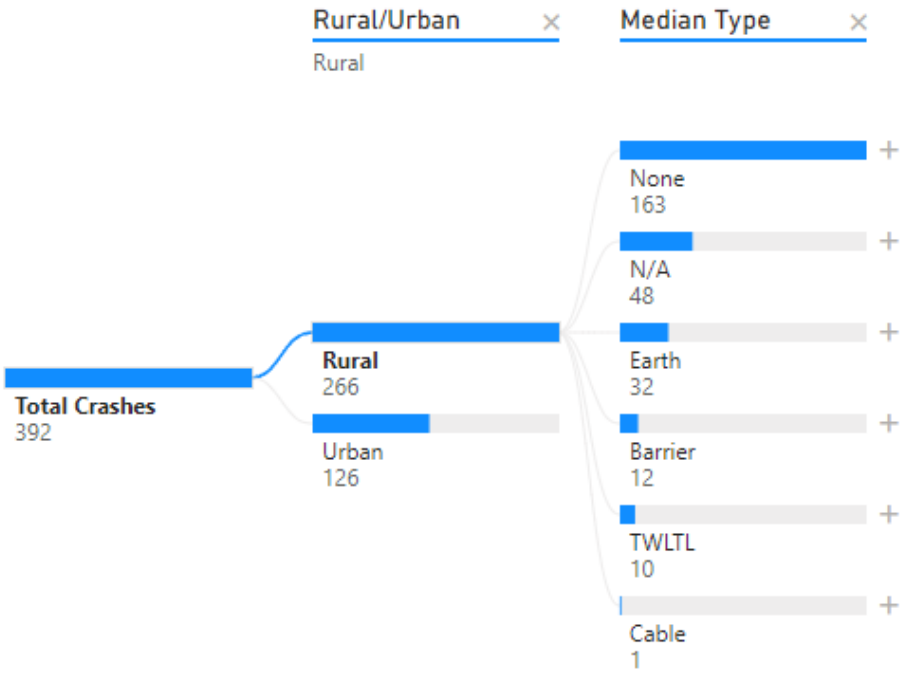
Source: FHWA.
N/A = not applicable.

Figure 10. Bar graph. Median type.



Source: FHWA.

A. Urban crashes.



Source: FHWA.

B. Rural crashes.

Figure 11. Charts. Median types breakdown of rural and urban crashes.

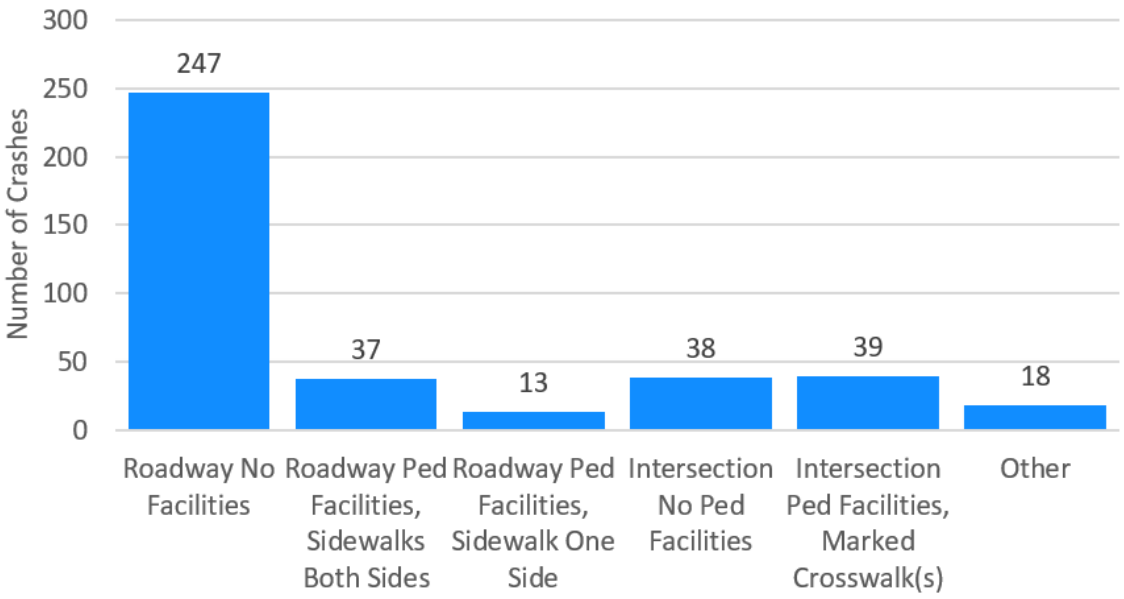
Pedestrian Facilities

The presence and type of pedestrian facilities were recorded from visual observation, using online mapping tools, for each crash location. Pedestrian facilities were categorized first by location (e.g., intersection or roadway segment) and then by pedestrian infrastructure type (e.g., sidewalks or crosswalks).

Risk factor observation: The data overwhelmingly show that most crashes occurred at locations without any pedestrian facilities (e.g., crosswalk, sidewalk, and shared-use path). Of the 392 crashes, 89 crashes (23 percent) occurred where pedestrian facilities were present.

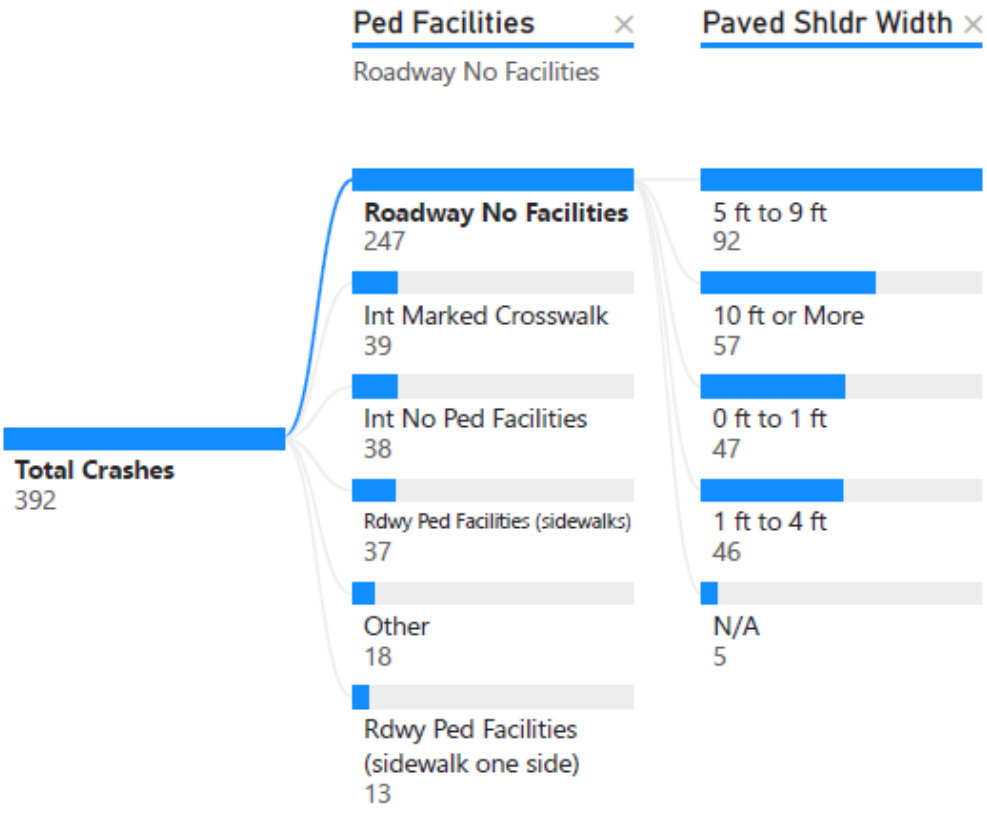
Supporting findings are as follows:

- A total of 285 of the 392 crashes (73 percent) occurred on a roadway segment or intersection with no pedestrian facilities (figure 12):
    - The most common posted speed limit at crash locations with no pedestrian facilities was 50 or 55 mph (82 of 285, 29 percent).
    - The second most common posted speed limit at crash locations with no pedestrian facilities was 60 or 65 mph (70 of 285, 25 percent).
    - A total of 247 of the 392 crashes (63 percent) occurred on a roadway segment with no pedestrian facilities:
        - Forty-seven of the 247 crashes (19 percent) on roadway segments with no pedestrian facilities occurred on roadways with no shoulder or a paved shoulder of 1 ft or less (figure 13).
        - Ninety-two of the 247 crashes (37 percent) occurred where the paved shoulder width was 5–9 ft (figure 13).
- The “other” category represents crashes that occurred at locations where pedestrian facilities are not applicable (e.g., parking lots, private access driveways, and construction areas).
- Number of Crashes vs. Pedestrian Facilities, Roadway No Facilities is 247, Roadway Ped Facilities, Sidewalks Both Sides is 37, Roadway Ped Facilities, Sidewalk One Side is 13, Intersection No Ped Facilities is 38, Intersection Ped Facilities, Marked Crosswalk(s) is 39, and Other is 18.



Source: FHWA.

Figure 12. Bar graph. Pedestrian facilities.



Source: FHWA.

Figure 13. Chart. Paved shoulder width on roadways with no other pedestrian facilities.

Paved Shoulder Width

Paved shoulder widths were extracted from State- or agency-provided crash data and supplemented with visual observation, using online mapping tools, when needed.

Risk factor observation: The data show that approximately 31 percent of crashes occurred where paved shoulder widths are 4 ft or less. However, data regarding the percentage of the roadway network with shoulders 4 ft or less are not available.

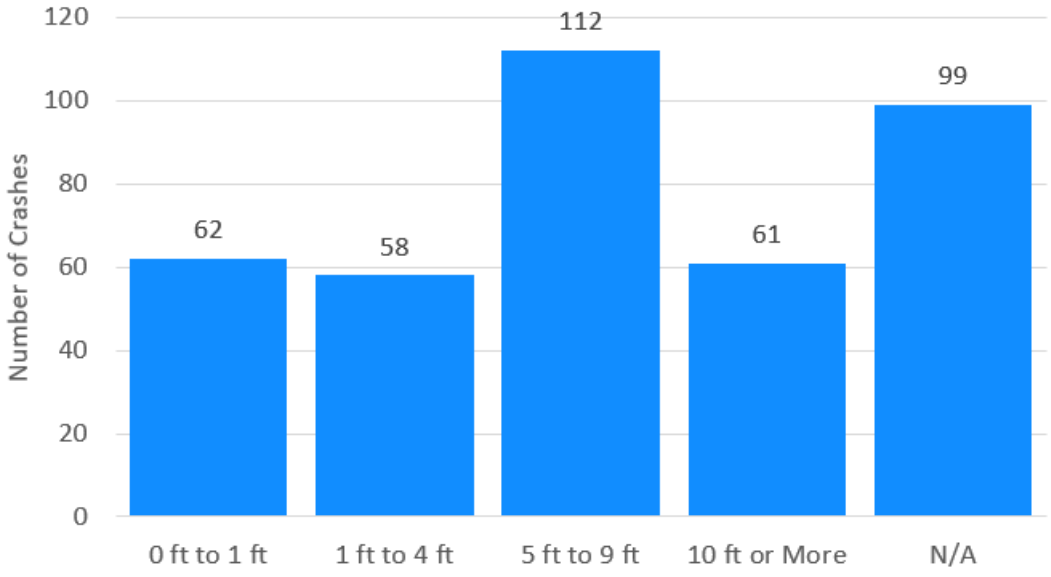
Supporting findings are as follows:

- Sixty-two of the 392 crashes (16 percent) occurred on roadways with either no shoulder or a shoulder of 1 ft wide or less (figure 14).

- The N/A category represents crashes that occurred at intersections or areas where paved shoulder widths are not applicable (e.g., unpaved roads, parking lots, access driveways, and construction areas). Twelve crashes occurred on unpaved roads (with unpaved shoulders). For this analysis, the shoulder widths specified are paved shoulder widths.

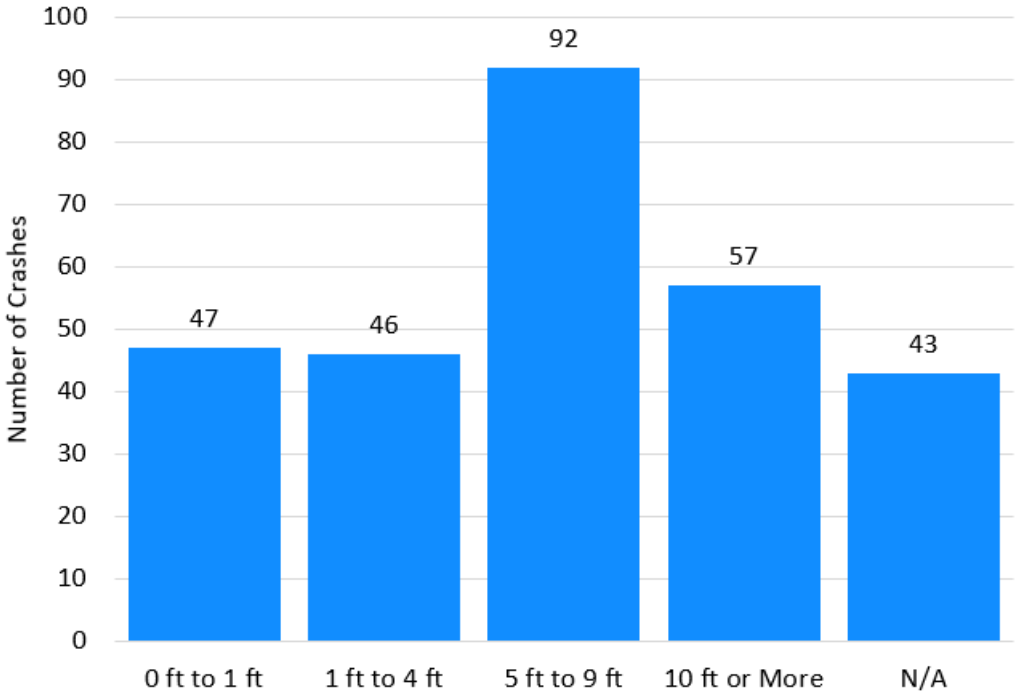
- Other analysis shows that crashes associated with a road lane departure (22 crashes) were distributed across paved shoulder widths: 6 crashes occurred where there was no paved shoulder or a shoulder less than 1-ft wide, 1 crash occurred where shoulders were 1–4-ft wide, 4 crashes occurred where shoulders were 5–9-ft wide, and 4 crashes occurred where shoulders were 10-ft wide or more.

Figure 15 shows a breakdown of paved shoulder widths at crash locations with no adjacent pedestrian facilities.



Source: FHWA.

Figure 14. Bar graph. Paved shoulder width.



Source: FHWA.

Figure 15. Bar graph. Paved shoulder width breakdown of crashes occurring with no adjacent pedestrian facilities.

Number of Lanes

The number of lanes (two-way total) on the roadway was extracted from State or agency-provided crash data and supplemented with visual observation (via online mapping tools) when needed.

Risk factor observation: Most crashes (47 percent) occurred on two-lane roadways. While a comprehensive inventory of roadway miles by number of lanes is not available, intuitively, most roads on Tribal lands consist of one lane in each direction.

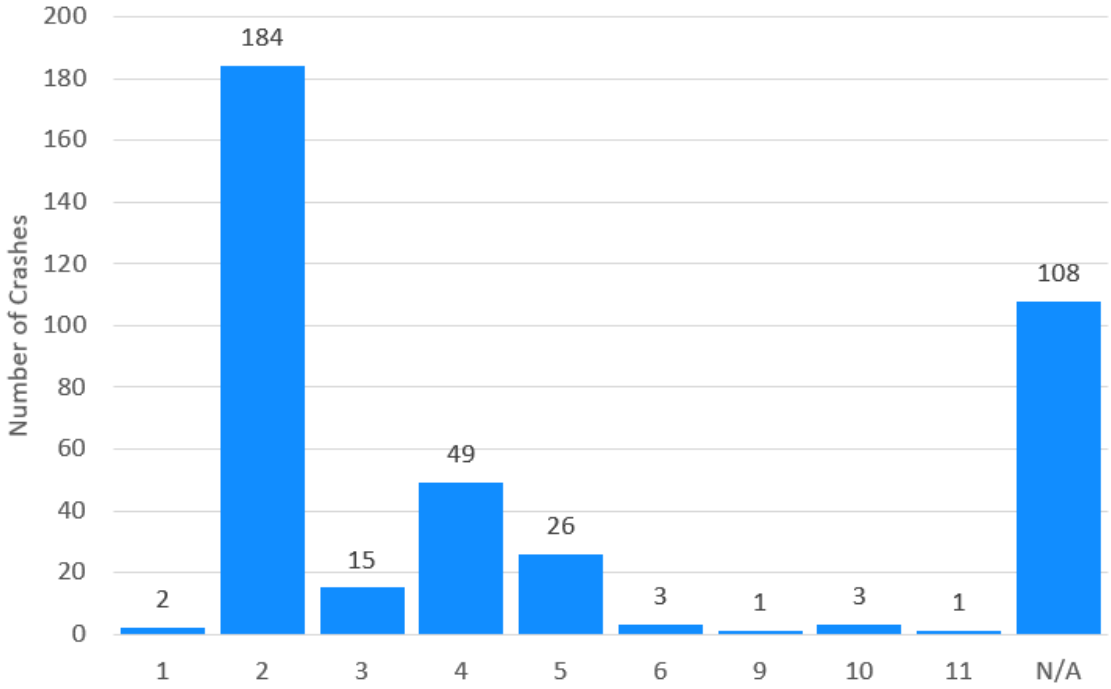
Supporting findings are as follows:

- A total of 184 of the 392 crashes (47 percent) occurred on two-lane roadways (figure 16):
    - One hundred and two of the 184 crashes (55 percent) occurred on roadways with a posted speed limit of 50 mph or higher.
    - Additional analysis shows that 167 of the 184 crashes (91 percent) occurred at a location without pedestrian facilities. Of the 167 crashes, 101 (60 percent) occurred where the posted speed limit was 50 mph or higher.

- The N/A category represents crashes that occurred at intersections or areas where the number of lanes of the roadway would not be applicable (e.g., parking lots and access driveways).

- Thirty-eight of the 126 urban area crashes (30 percent) occurred on a three-, four-, or five-lane roadway.

- A total of 155 of the 266 rural-area crashes (58 percent) occurred on a two-lane roadway. Ninety-eight of the 155 rural-area crashes (63 percent) on a two-lane roadway occurred where the posted speed limit was 50 mph or greater.



Source: FHWA.

Figure 16. Bar graph. Number of lanes.

LOCATION

Rural/Urban

The general crash location was extracted from State- or agency-provided crash data and FARS data supplemented with visual observation (via online mapping tools) when needed.[22] From visual observation, "urban" was selected if the crash occurred in the direct vicinity of a commercial activity area.

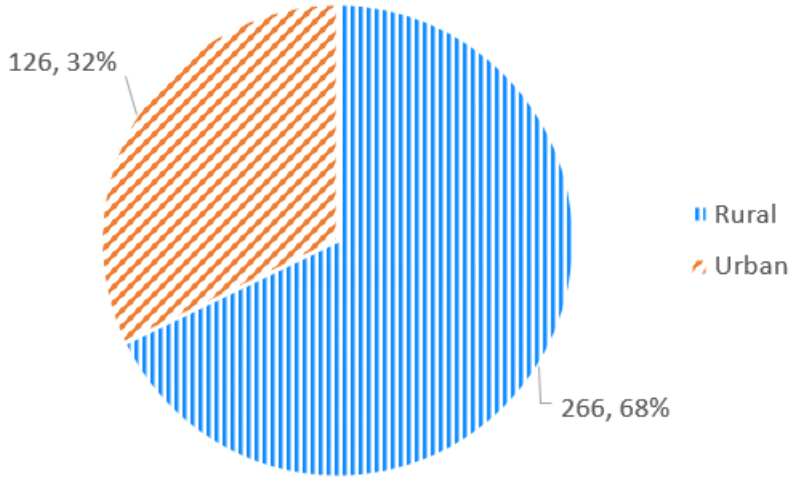
The designation of areas as rural or urban was determined through a two-step process. First, relevant data were extracted from the FARS database.[22] Second, surroundings adjacent to the crash location were determined by visual observation. Residential areas include (but are not limited to) private residences, single-family housing, and multifamily residences. Commercial

areas include (but are not limited to) office complexes, shopping malls, service stations, and commercial buildings.

Risk factor observation: Most pedestrian fatal or severe injury crashes occurred in areas considered to be rural, located outside urban-developed areas.

Supporting findings for figure 17 are as follows:

- A total of 126 of the 392 crashes (32 percent) occurred in urban locations.
- A total of 266 of the 392 crashes (68 percent) occurred in rural locations.



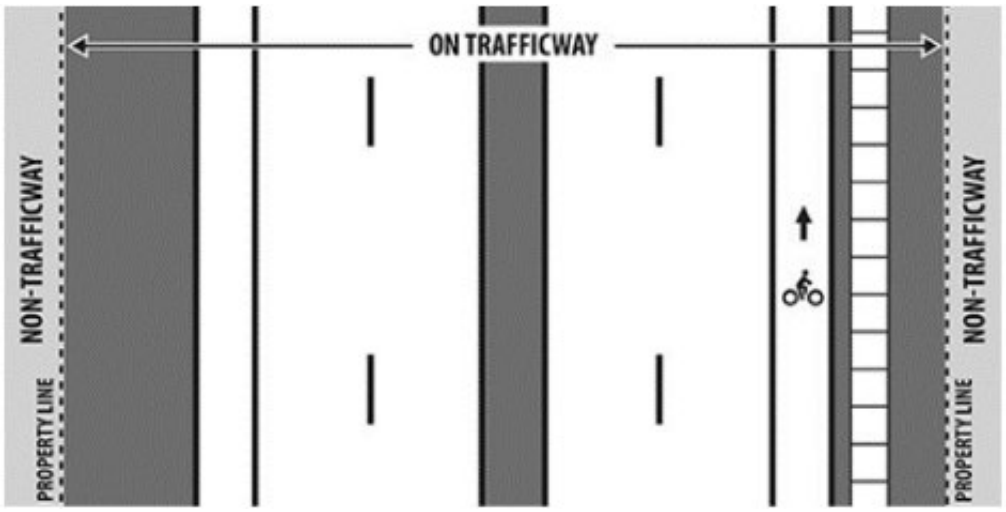
Source: FHWA.

Figure 17. Pie chart. Rural versus urban crashes.

Relation to Trafficway

The crash's location relative to the trafficway is recorded as part of the PBCAT 3 analysis.[23] PBCAT 3 defines a trafficway as any part of the roadway, shoulder, or roadside and all facilities within the public ROW, as outlined in figure 18.

Risk factor observation: Based on the available data, a significant majority (more than 90 percent) of crashes involving pedestrians occurred while the pedestrian was in the trafficway.

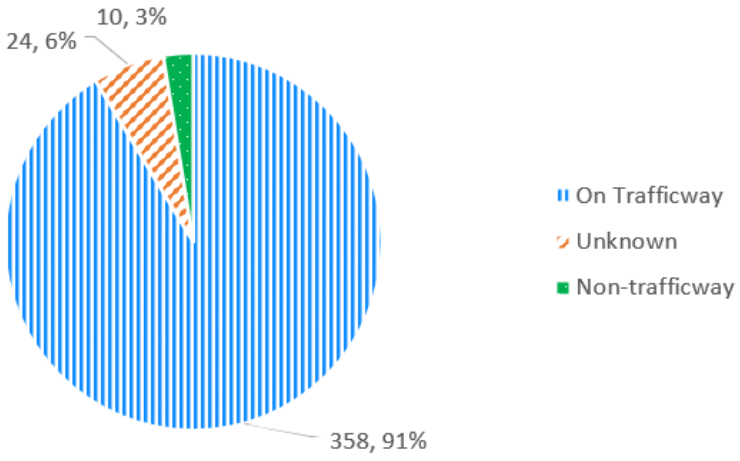


Source: FHWA.

Figure 18. Illustration. PBCAT 3 definition of trafficway and nontrafficway[58].

Supporting findings for figure 19 are as follows:

- A total of 358 of the 392 crashes (91 percent) occurred on (or within) the defined trafficway.
- Ten of the 392 crashes (3 percent) occurred outside the trafficway (or nontrafficway occurring).



Source: FHWA.

Figure 19. Pie chart. Relation to trafficway.

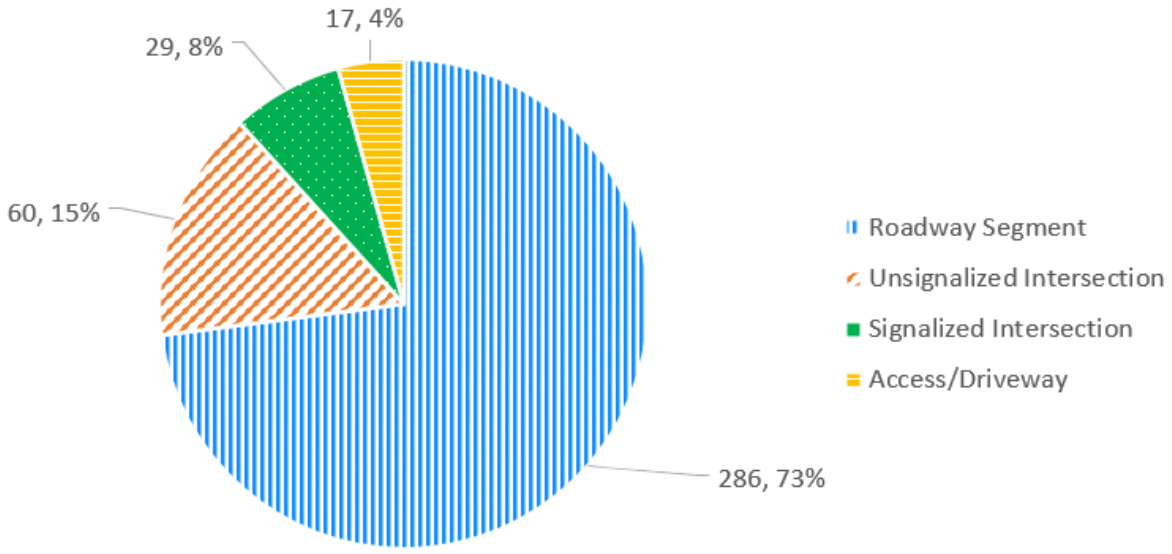
Crash Location

Crash locations were recorded from visual observation (via online mapping tools) for each crash. Crash locations were categorized as being located on a roadway segment, at a signalized intersection, at an unsignalized intersection, or at an access or driveway.

Risk factor observation: Seventy-three percent of pedestrian fatal and serious injury crashes occurred on roadway segments (not at intersections). Intuitively, rural areas include fewer intersections.

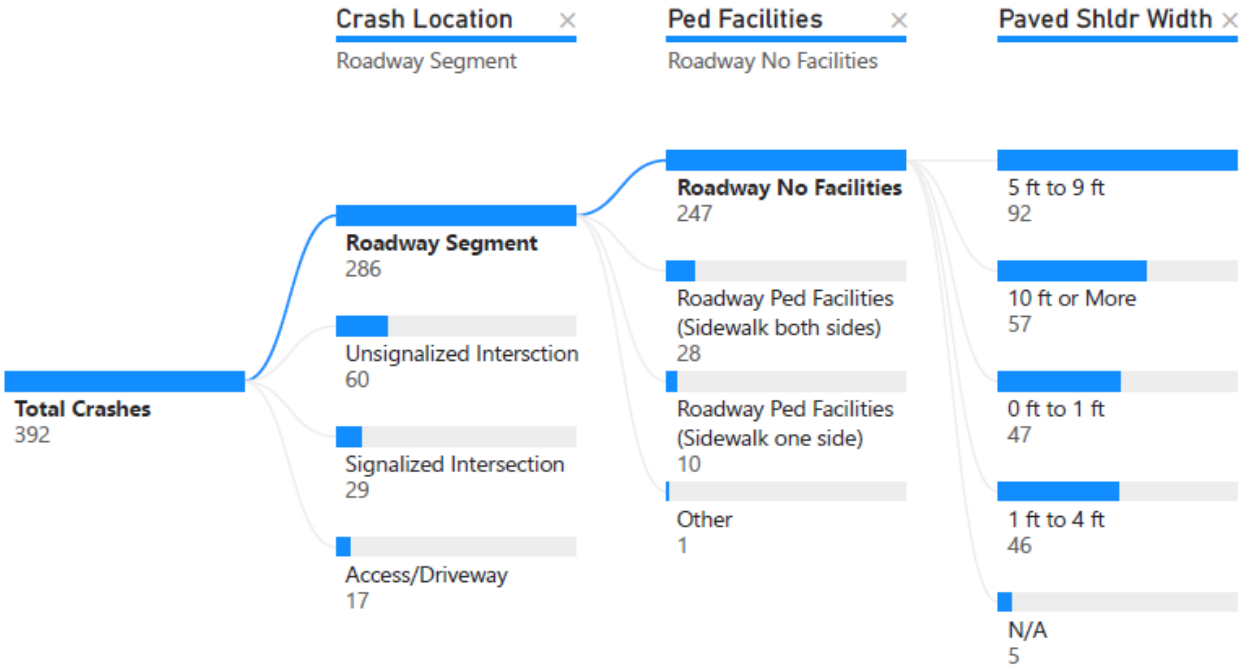
Supporting findings are as follows:

- A total of 286 of the 392 crashes (73 percent) occurred on a roadway segment (not at an intersection or driveway) (figure 20). The following are findings from these roadway crashes:
    - National data from 2021 show 73 percent of pedestrian fatalities occurred at nonintersection locations.[21]
    - Two hundred forty-seven of the 286 roadway segment crashes (86 percent) occurred where no pedestrian facilities were present (figure 21).
- Sixty of the 392 crashes (15 percent) occurred at unsignalized intersections.
- Twenty-nine of the 392 crashes (7 percent) occurred at signalized intersections.
- Seventeen of the 392 crashes (4 percent) occurred at an access or driveway.



Source: FHWA.

Figure 20. Pie chart. Crash location.



Source: FHWA.

Figure 21. Chart. Roadway segment crash location, no pedestrian facilities, and shoulder width.

Nearest Land Use

Nearest land uses and potential pedestrian attractors for each crash location were recorded from visual observation using online mapping tools. Land uses included residential, commercial, casino, convenience store, community area, and school. The distance to the nearest land use was also recorded from visual observation.

Risk factor observation: A majority (71 percent) of pedestrian fatal and serious injury crashes reviewed occurred within 1/4 mi of an identified land use or potential pedestrian attractor, with residential use being the most common followed by commercial areas, casinos, and other community areas (e.g., government buildings, health centers, and Tribal buildings). Pedestrian facilities should be constructed in the immediate vicinity of pedestrian attractors and common land uses.

Supporting findings are as follows:

- The most common nearest land use to a crash was residential use (243 of the 392 crashes (62 percent)) (figure 22).
- One hundred forty-three of the 392 crashes (36 percent) were in commercial (e.g., casino, commercial shopping, or convenience store) or community areas (figure 22).
- A total of 280 of the 392 crashes (71 percent) occurred within 1/4 mi of a land use or potential pedestrian attractor (e.g., residential, commercial area, or casino) (figure 23).

- Figure 24 shows the nearest land uses for crashes occurring in more rural areas.

- The following is a breakdown of the land uses within 1/4 mi of the crash location (figure 25):

    - Residential: 178 of the 280 crashes (64 percent).
    - Commercial area: 40 of the 280 crashes (14 percent).
    - Casino: 21 of the 280 crashes (8 percent).
    - Community area: 19 of the 280 crashes (7 percent).
    - Convenience store: 18 of the 280 crashes (6 percent).
    - School: 4 of the 280 crashes (1 percent).

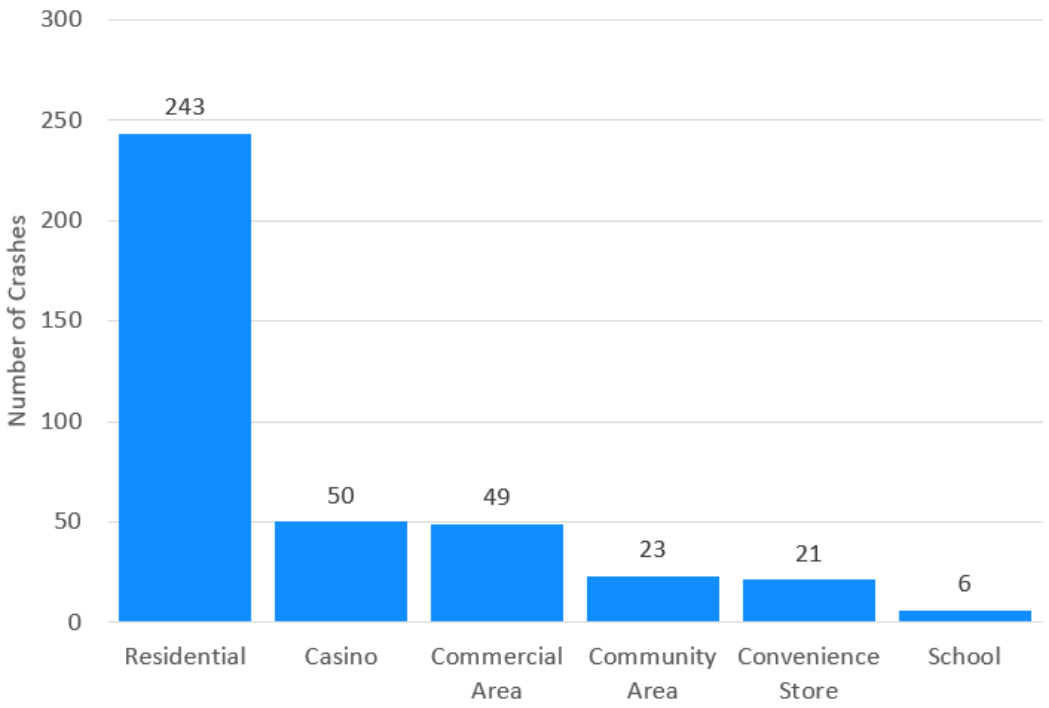
- One hundred eight-six of the 280 crashes (66 percent) within 1/4 mi of a land use or potential pedestrian attractor occurred at a roadway segment or intersection with no pedestrian facilities.

- A total of 339 of the 392 crashes (87 percent) occurred within 1/2 mi of a land use or potential pedestrian attractor (figure 23).

- Thirty-seven of the 392 crashes (9 percent) occurred within 1/2 mi of a casino. Of those crashes, the following was found:

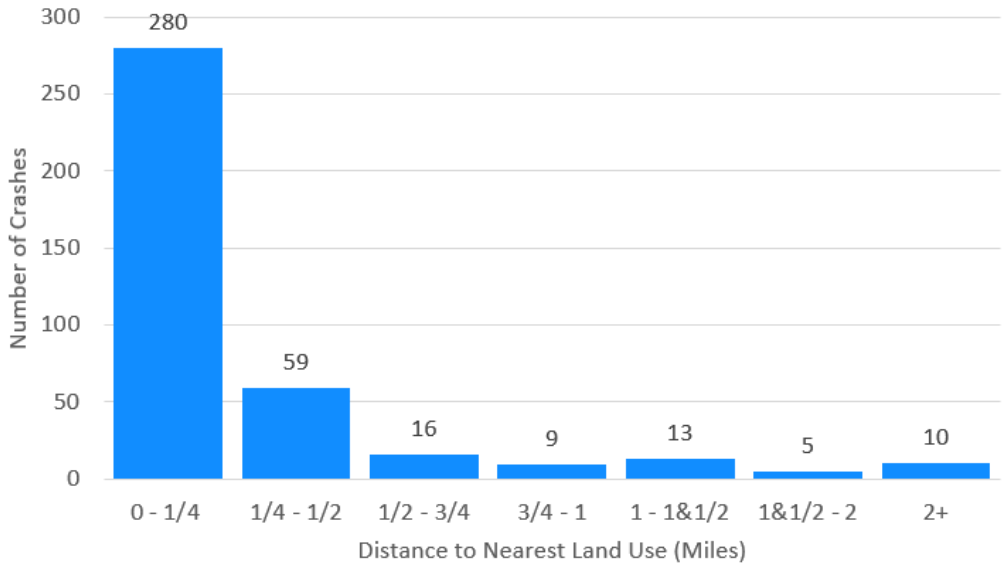
    - Eleven of the 37 crashes (30 percent) that occurred within 1/2 mi of a casino involved an intoxicated pedestrian.

    - Four of the 39 crashes (10 percent) that occurred within 1/2 mi of a casino involved an intoxicated driver.



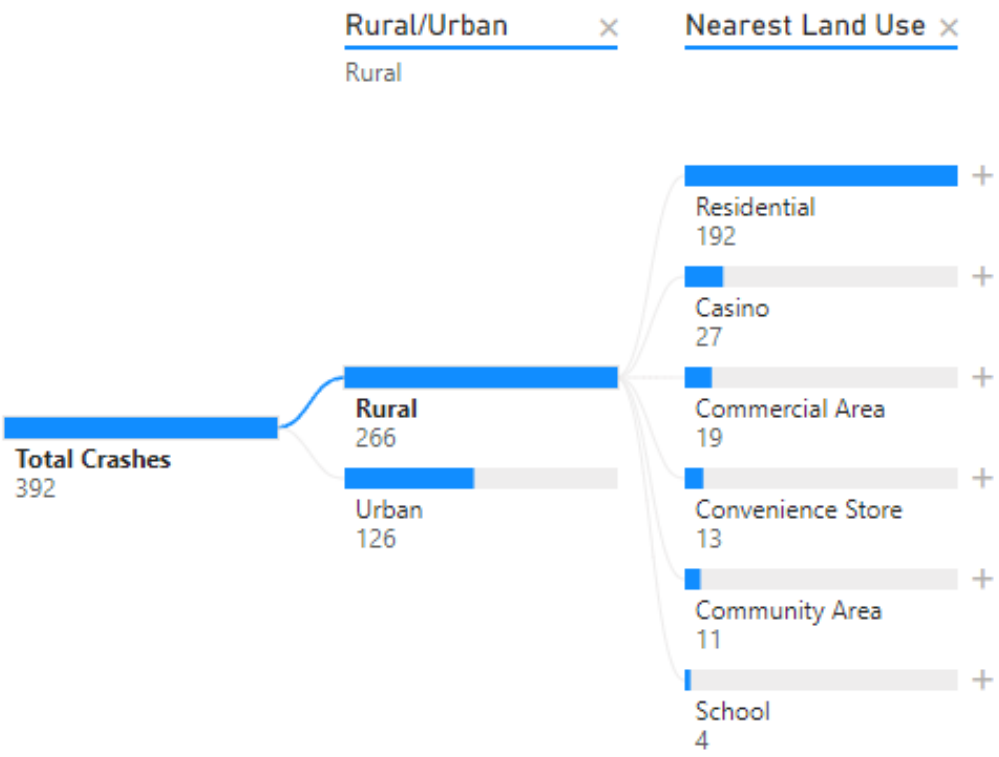
Source: FHWA.

Figure 22. Bar graph. Nearest land use.



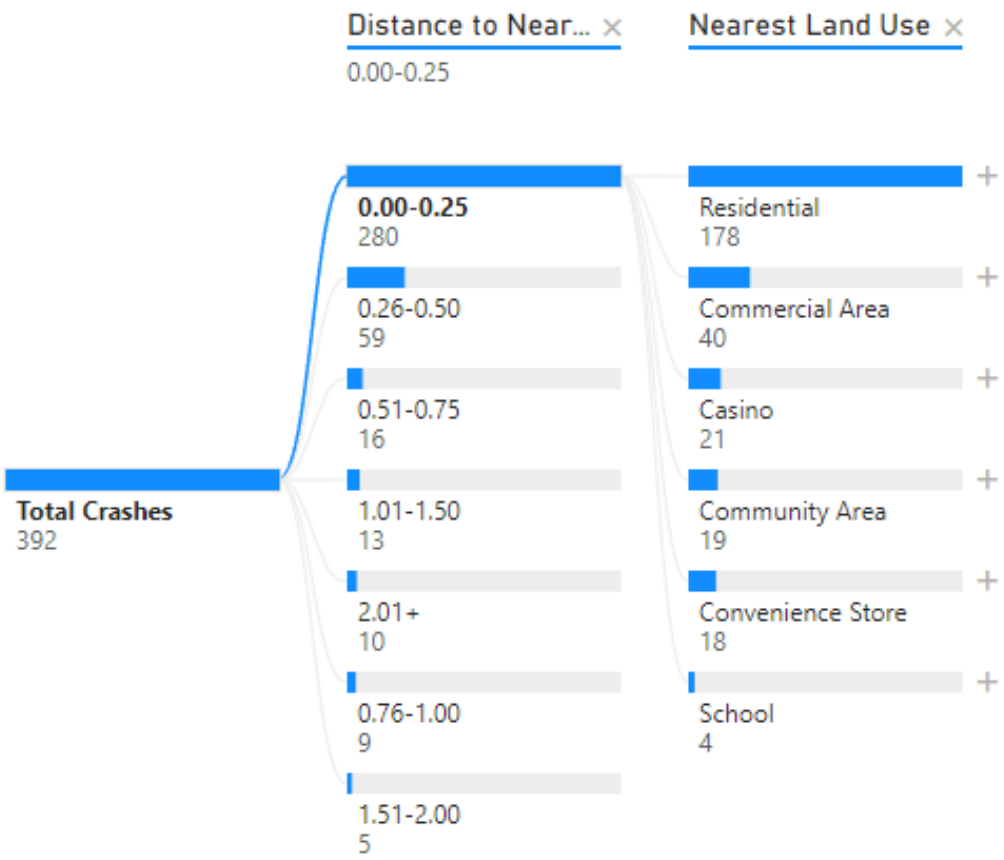
Source: FHWA.

Figure 23. Bar graph. Distance to nearest land use (miles).



Source: FHWA.

Figure 24. Chart. Rural nearest land use.



Source: FHWA.

Figure 25. Chart. Nearest land use within 1/4 mi.

ENVIRONMENTAL CONDITIONS

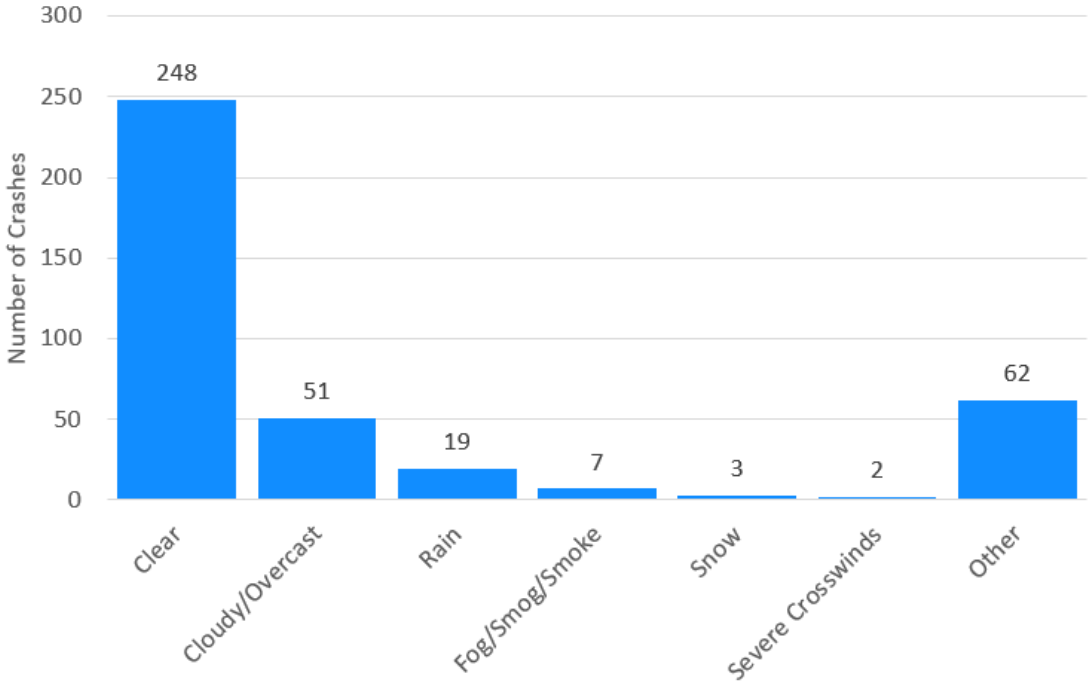
Weather Conditions

Weather condition information for each crash was extracted from State- or agency-provided crash data and supplemented with provided officer narratives and crash diagrams.

Risk factor observation: A low percentage (8 percent) of fatal and serious injury crashes occurred during adverse weather conditions (e.g., rain; snow; severe crosswinds; or fog, smog, or smoke), which may be expected because pedestrians are less likely to be on or near roadways in adverse weather.

Supporting findings are as follows:

- Thirty-one of the 392 crashes (8 percent) occurred in adverse weather conditions (i.e., rain; snow; severe crosswinds; or fog, smog, or smoke) (figure 26).
- The “other” category consists of weather conditions not being reported or unknown for the crash location.



Source: FHWA.

Figure 26. Bar graph. Weather conditions.

Lighting Conditions

Lighting condition information for each crash was extracted from State- or agency-provided crash data and supplemented with provided officer narratives and crash diagrams when needed.

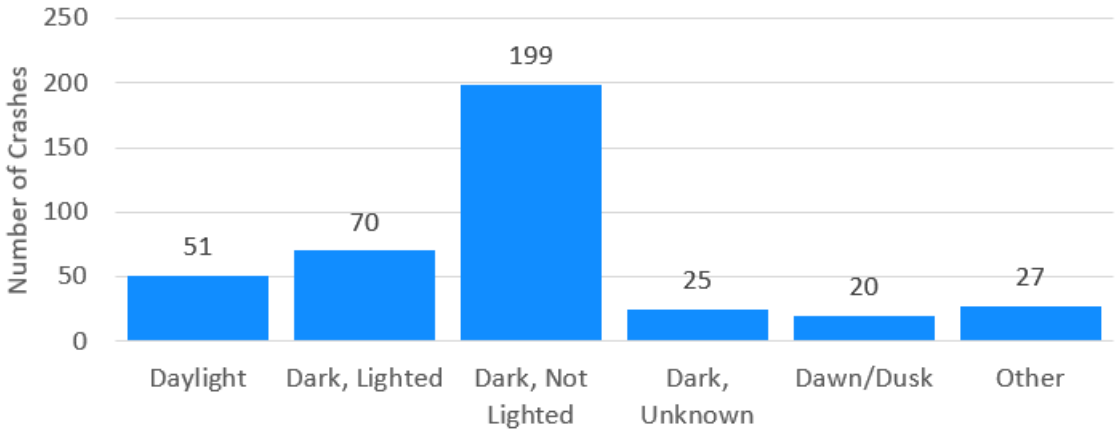
Risk factor observation: A high proportion of total crashes (51 percent) occurred in dark conditions without lighting. Most of these crashes occurred where no other pedestrian facilities, such as sidewalks, were available for the pedestrian to use. Contributing risk factors are dark, unlighted conditions, absence of pedestrian facilities, and speed.

Supporting findings are as follows:

- A total of 294 of the 392 crashes (where lighting condition was reported) occurred in dark conditions (75 percent) (figure 27). National data from 2021 show that 76 percent of collisions that killed pedestrians occurred when it was dark.[(20)]
- The "other" category consists of lighting conditions being reported as unknown.
- Seventy of the 392 crashes (17 percent) occurred in dark (lighted) conditions (figure 27).
- A total of 224 of the 392 crashes (57 percent) occurred in dark (not lighted) or dark (unknown) conditions (figure 27):

- One hundred seventy-eight of the 224 crashes (79 percent) that occurred in dark (not lighted) or dark (unknown) conditions happened on a roadway with no pedestrian facilities.
- Seventeen of the 224 crashes (8 percent) that occurred in dark (not lighted) or dark (unknown) conditions happened at an intersection with no pedestrian facilities.

- A total of 176 of the 266 rural crashes (66 percent) occurred in dark (not lighted) or dark (unknown) conditions.
- Forty-two of the 126 urban crashes (33 percent) occurred in dark, lighted conditions.
- A total of 140 of the 188 crashes (74 percent) that occurred on roadways with a posted speed limit of 50 mph or greater happened in dark (not lighted) conditions.



Source: FHWA.

Figure 27. Bar graph. Lighting conditions.

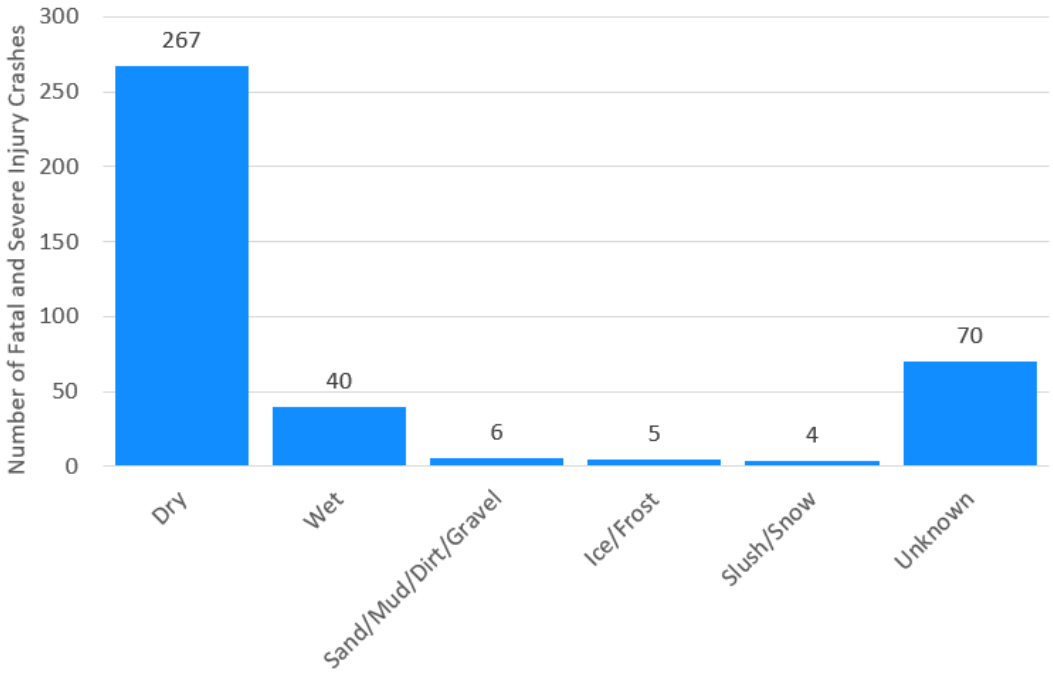
Roadway Surface Conditions

Roadway surface conditions information for each crash was extracted from State- or agency-provided crash data and supplemented with provided officer narratives and crash diagrams when needed.

Risk factor observation: A low percentage (14 percent) of fatal and serious injury crashes occurred on roadways with unfavorable surface conditions (e.g., wet; sand, mud, dirt, or gravel; ice or frost, or slush or snow), which may be expected because pedestrians are less likely to be on or near roadways in conditions when a roadway surface would be poor (e.g., rain or snow).

Supporting findings are as follows:

- Fifty-five of the 392 crashes (14 percent) occurred in unfavorable roadway conditions (e.g., wet; sand, mud, dirt, or gravel; ice or frost; or slush or snow) (figure 28).
- "Unknown" indicates roadway surface conditions at the time of the crash were unknown or unreported.



Source: FHWA.

Figure 28. Bar graph. Roadway surface conditions.

PEDESTRIAN ATTRIBUTES

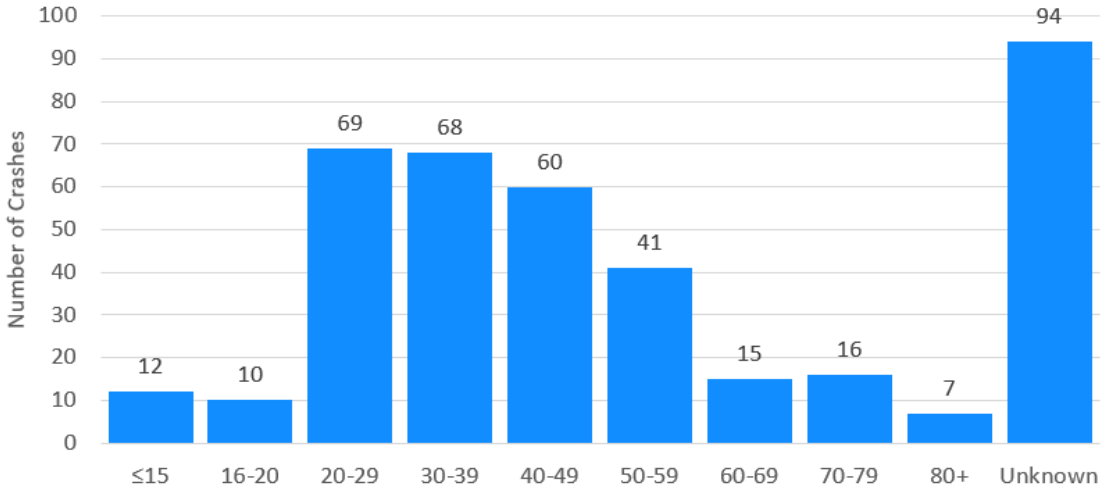
Age

The age of the pedestrian involved in the crash was extracted from State- or agency-provided crash data and supplemented with provided officer narratives and crash diagrams when available. Unknowns in figure 29 are a result of either the State or agency not allowing for the disclosure of personally identifiable information (PII) or failure to provide such information in the crash report narratives or data.

Risk factor observation: The highest frequency of crashes (50 percent) occurred among those aged 20–49.

Supporting findings are as follows:

- A total of 197 of the 392 crashes (50 percent) involved a pedestrian between the ages of 20 and 49 (figure 29):
    - National data from 2021 show the age groups 60–64 and 65–70 have the largest percentage of pedestrian fatalities (23 percent). The average age of pedestrians killed remained similar over the previous 10 yr, ranging from 45 to 48.[(20)]
    - The data analyzed showed a higher proportion of younger-aged pedestrians were involved in fatal crashes versus national data.
- The "unknown" category indicates either age was not reported, or the information was redacted from provided reports to protect PII.
- Twenty-two of the 392 crashes (6 percent) included a pedestrian 20 yr old or younger (figure 29).
- Thirty-eight of the 392 crashes (10 percent) included a pedestrian 60 yr old or older (figure 29).



Source: FHWA.

Figure 29. Bar graph. Crash totals by age group.

Pedestrian Gender

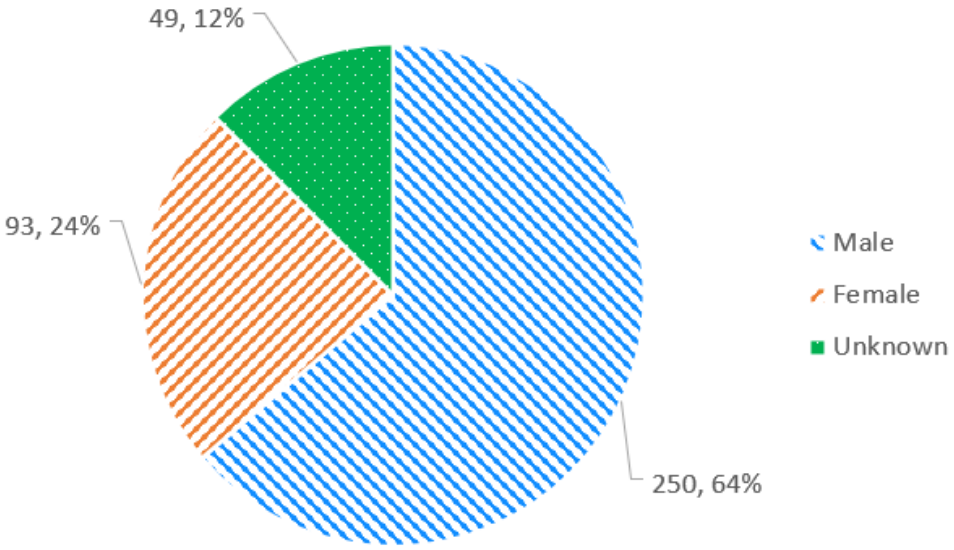
Pedestrian gender for each crash was recorded from State- or agency-provided crash data and supplemented with provided officer narratives and crash diagrams when needed.

Risk factor observation: Male pedestrians represent a disproportionate percentage (64 percent) of fatal and serious injury crashes.

Supporting findings are as follows:

- A total of 250 of the 392 crashes (64 percent) involved a male pedestrian (figure 30). National data from 2021 show 70 percent of pedestrian fatalities involved males.[21]

- The "unknown" category indicates either gender was not reported, or the information was redacted from provided reports to protect PII.



Source: FHWA.

Figure 30. Pie chart. Pedestrian gender.

BEHAVIOR

Driver Impairment

Driver impairment information for each crash was extracted from State- or agency-provided crash data and supplemented with provided officer narratives and crash diagrams when needed. The following observations were noted in the most recent data published by NHTSA regarding drugs and impairment.[59] It should be noted that people involved in a crash in Tribal areas may not always report to trauma registries. Future research could consider the extent to which trauma registry data is recorded. Also, the impairment findings from this crash analysis cannot be directly compared due to not including the same statistical imputation model used by NHTSA when reporting statistics:

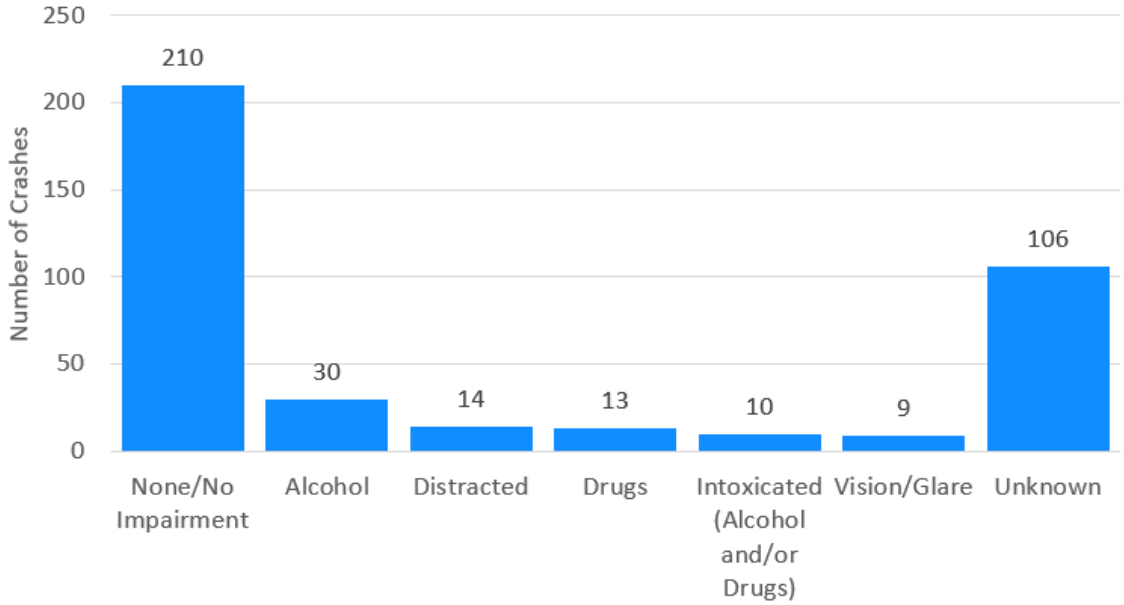
- Of driver roadway users presenting to trauma centers, 54.4 percent tested positive for one or more drugs (i.e., alcohol, medications, and all other drugs included on this study's toxicology panel).

- Of driver roadway users presenting to a medical examiner's office, 68.8 percent tested positive for one or more drugs.

Risk factor observation: Fourteen percent of drivers involved in a pedestrian fatal or serious injury crash were identified as intoxicated (alcohol and/or drugs); 27 percent were unknown.

Supporting findings are as follows:

- Fifty-three of the 392 crashes (14 percent) included an intoxicated driver (alcohol and/or drugs) (figure 31), compared to 2022 data from NHTSA showing 18 percent of pedestrian fatal crashes involved an alcohol-impaired driver:[(60)]
    - The pedestrian was also intoxicated in 26 of the 53 driver-intoxicated crashes (49 percent).
    - Sixteen of the 53 driver-intoxicated crashes (30 percent) occurred within 1/2 mi of a convenience store or liquor store.
- Seventy-six of the 392 crashes (19 percent) included an impaired driver (e.g., intoxication, distraction, or vision or glare) (figure 31).



Source: FHWA.

Figure 31. Bar graph. Driver impairment.

Pedestrian Impairment

Pedestrian impairment information for each crash was extracted from State- or agency-provided crash data and supplemented with provided officer narratives and crash diagrams when needed.

The following observations were noted in the most recent data published by NHTSA[59] regarding drugs and impairment:

- Of pedestrian roadway users presenting to trauma centers, 54.6 percent tested positive for one or more drugs (i.e., alcohol, medications, and all other drugs included on this study's toxicology panel).

- Of pedestrian roadway users presenting to a medical examiner's office, 68.6 percent tested positive for one or more drugs.

Risk factor observation: Thirty-nine percent of the fatal or serious injury pedestrian crashes involved pedestrians who were intoxicated (alcohol and/or drugs); 29 percent were unknown.

Supporting findings are as follows: 151 of the 392 crashes (39 percent) included an intoxicated pedestrian (alcohol and/or drugs) (figure 32), compared to 2022 data from NHTSA showing 30 percent of pedestrians killed in traffic crashes were alcohol impaired.[60] Of these intoxicated pedestrian crashes, the findings show the following:

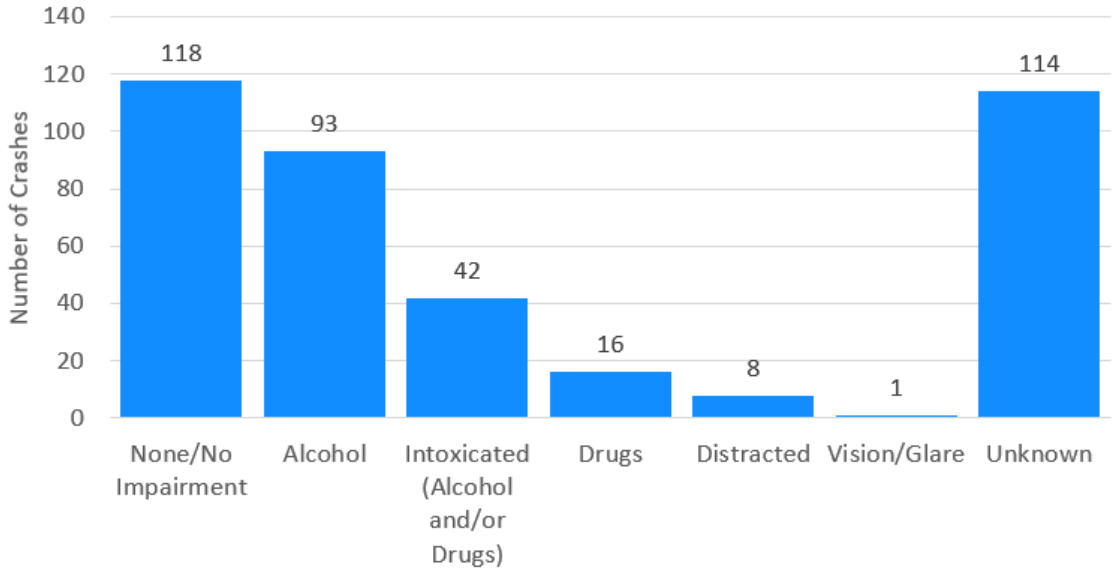
- The driver was also intoxicated in 26 of the 151 pedestrian-intoxicated crashes (17 percent).

- The driver was also impaired (e.g., intoxication, distraction, or vision or glare) in 31 of the 151 pedestrian-intoxicated crashes (21 percent).

- Fourteen of the 151 pedestrian-intoxicated crashes (9 percent) occurred within 1/2 mi of a casino.

- Thirty-nine of the 151 pedestrian-intoxicated crashes (26 percent) occurred within 1/2 mi of a convenience store.

- Ninety-seven of the 151 pedestrian-intoxicated crashes (64 percent) involved a male pedestrian.



Source: FHWA.

Figure 32. Bar graph. Pedestrian impairment.

Other Unique Circumstances

Nonmotorist Intentionally Caused

PBCAT 3 types a crash as a nonmotorist intentionally caused crash by answering yes to the following question: "Did the nonmotorist intentionally strike the motor vehicle or intentionally cause the crash?"[24] Crash information and narratives were reviewed in each crash in which the answer to this question could be yes. The question was answered yes if it was clearly documented in the narrative that the pedestrian intentionally struck a vehicle (e.g., ran toward a vehicle, dashed or darted in front of a vehicle, or was documented or confirmed to have suicidal intentions). Supporting information that resulted in a yes to this question may have been provided as follows:

- The action of the pedestrian was confirmed by witnesses to the crash as reported in the officer crash narrative.
- The action of the pedestrian was confirmed by family, relatives, or next of kin of the pedestrian as reported in the officer crash narrative.
- The action of the pedestrian was confirmed in the law enforcement narrative and documented by scene reconstruction.

Supporting findings are that 34 of the 392 crashes (9 percent) included information in the officer's narrative crash report that the pedestrian intentionally caused the crash; 23 of the 34 intentionally caused crashes (68 percent) involved an intoxicated pedestrian.

Hit and Run

PBCAT 3 types a crash as a hit-and-run crash by answering yes to the following question: "Did the motorist leave the scene without stopping to render aid or report the crash (hit and run)?"[23]

Supporting findings are as follows:

- One hundred and three of the 392 crashes (26 percent) were reported as hit-and-run crashes.
- National data (from 2021) show 23 percent of pedestrian fatalities involved hit-and-run drivers.[20]

Dash

PBCAT 3 types a crash as a dash-related crash by answering yes to the following question: "Did the nonmotorist run into the roadway and get struck by a vehicle whose view of the nonmotorist was not obstructed (dash)?"[20]

Supporting findings are that 62 of the 392 crashes (16 percent) were reported as dash related.

Dart Out

PBCAT 3 types a crash as a dart-out-related crash by answering yes to the following question: "Did the nonmotorist walk or run into the roadway and get struck by a motorist whose view of the nonmotorist was blocked until an instant before impact (dart out)?"[20]

Supporting findings are that 22 of the 392 crashes (6 percent) were reported as dart-out related.

Dispute Related

PBCAT 3 types a crash as a dispute-related crash by answering yes to the following question: "Did the motorist strike the nonmotorist during a domestic altercation or other dispute?"[20]

Supporting findings are that 10 of the 392 crashes (3 percent) were reported as dispute related.

Working in the Roadway

PBCAT 3 types a crash as a working-in-the-roadway crash by answering yes to the following question: "Was the nonmotorist working in the roadway prior to the crash?"[20]

Supporting findings are that 7 of the 392 crashes (2 percent) included the pedestrian working in the roadway.

Playing in the Roadway

PBCAT 3 types a crash as a playing-in-the-roadway crash by answering yes to the following question: "Was the nonmotorist playing in the roadway prior to the crash?"[20]

Supporting findings are that 4 of the 392 crashes (1 percent) included the pedestrian playing in the roadway. All four pedestrians were less than 16 yr old.

Standing in the Roadway

PBCAT 3 types a crash as a standing-in-the-roadway crash by answering yes to the following question: "Was the nonmotorist standing in the roadway prior to the crash?"[20]

Supporting findings are that 87 of the 392 crashes (22 percent) included the pedestrian standing in the roadway.

Lying or Sitting in the Roadway

PBCAT 3 types a crash as a lying or sitting-in-the-roadway crash by answering yes to the following question: "Was the nonmotorist lying or sitting in the roadway prior to the crash?"[20]

Supporting findings are that 38 of the 392 crashes (10 percent) included the pedestrian lying or sitting in the roadway.

Vehicle Type

Vehicles with higher, more vertical front ends pose a greater risk to pedestrians according to research from the Insurance Institute for Highway Safety.[61] Pickup trucks, sport utility vehicles, and vans with a hood height greater than 40 inches are about 45 percent more likely to cause fatalities in crashes with pedestrians than cars and other vehicles with a hood height of less than 30 inches.[62]

Vehicle descriptions for the crashes analyzed as part of this study were not provided in all crash narratives or data. The vehicle types are also unknown for the hit-and-run crashes.

APPENDIX E. PEDESTRIAN COUNTERMEASURES SELECTION MATRIX

Table 13 is a toolbox of pedestrian safety countermeasures summarized by the study team to show potential safety improvements and applicability to roadway types and Tribal areas. The countermeasures were grouped into categories based on the identified need. Each countermeasure indicates which identified risk factors from this study it may help address.

Table 13. Pedestrian countermeasures selection matrix.

Countermeasure Information						Roadway Typology							Risk Factors Addressed
Category	Countermeasure	Description	CMF	CMF Source	Cost/ Complexity	Rural 2-Lane	Rural 3-Lane	Rural 4-Lane	Urban 2-Lane	Urban 3-Lane	Urban 4-Lane	Urban 5-Lane	
Roadway infrastructure (to address walking along the roadway)	Walkways (sidewalk, shared-use path)[18,19]	Install sidewalk or a paved shared-use path. Define a space or pathway within the public ROW that is separated from roadway vehicles.	0.71–3.09	CMF Clearinghouse[63]	Medium–high	✓	✓	✓	✓	✓	✓	✓	• Proximity to land uses. • Presence of pedestrian facilities. • Vehicle speed. • Driver/pedestrian intoxication. • Pedestrian action (stationary in roadway or intersection). • Pedestrian action (walking parallel with vehicle traffic).
	Shared-use path (outside of ROW)[25]	Shared-use path or other trail in independent ROW, not in a roadway ROW.	N/A	—	Medium–high	✓	✓	✓	✓	✓	✓	✓	• Proximity to land uses. • Presence of pedestrian facilities. • Vehicle speed. • Driver/pedestrian intoxication. • Pedestrian action (stationary in roadway or intersection). • Pedestrian action (walking parallel with vehicle traffic).
	Paved shoulders[19,20]	Minimum 6-ft paved shoulder to provide a place for pedestrians to walk.	0.11–0.34	CMF Clearinghouse[63]	Medium–high	✓	✓	✓	✓	✓	✓	✓	• Proximity to land uses. • Vehicle speed. • Paved shoulder width. • Driver/pedestrian intoxication. • Pedestrian action (walking parallel with vehicle traffic).

Countermeasure Information						Roadway Typology							Risk Factors Addressed
Category	Countermeasure	Description	CMF	CMF Source	Cost/ Complexity	Rural 2-Lane	Rural 3-Lane	Rural 4-Lane	Urban 2-Lane	Urban 3-Lane	Urban 4-Lane	Urban 5-Lane	
	Lighting[18–20]	Provide lighting to increase visibility when dark, specifically at vehicle-to-pedestrian conflict points (crossings, intersections, etc.). Consider the direction provided in FHWA's Pedestrian Lighting Primer.[64]	0.58–0.62	FHWA PSC[18]	Varies	✓	✓	✓	✓	✓	✓	✓	• Proximity to land uses. • Lighting conditions. • Driver/pedestrian intoxication. • Pedestrian action (stationary in roadway or intersection). • Pedestrian action (crossing).
	Median barriers[18]	Longitudinal barriers (cable, metal beam, concrete) to separate opposing traffic.	0.03	FHWA PSC[18]	Medium–high	—	—	✓	✓	—	✓	—	• Vehicle speed. • Driver/pedestrian intoxication.
	Rumble strips[18]	Milled or raised edge-line or center-line rumble strips along the roadway.	0.36–0.56	FHWA PSC[18]	Low	✓	✓	✓	—	—	—	—	• Vehicle speed. • Paved shoulder width. • Driver/pedestrian intoxication. • Pedestrian action (walking parallel with vehicle traffic).
	Road diets (roadway reconfiguration)[17, 18]	Reduce widths or number of vehicle travel lanes and reallocate that space for other use (pedestrian crossing island, bicycle lanes, on-street parking, etc.).	0.53–0.892	FHWA PSC[18]	Medium–high	—	✓	✓	—	✓	✓	✓	• Proximity to land uses. • Presence of pedestrian facilities. • Vehicle speed. • Paved shoulder width. • Pedestrian action (walking parallel with vehicle traffic). • Pedestrian action (crossing).

Countermeasure Information						Roadway Typology							Risk Factors Addressed
Category	Countermeasure	Description	CMF	CMF Source	Cost/ Complexity	Rural 2-Lane	Rural 3-Lane	Rural 4-Lane	Urban 2-Lane	Urban 3-Lane	Urban 4-Lane	Urban 5-Lane	
	Edge-lane roads[25]	Area on the edge of roadway that offers prioritized space for nonmotorized users. Edge-lane roads require approval by FHWA as an MUTCD experiment. Treatment includes pavement striping and signage.[65]	0.56	CMF Clearinghouse[63]	Low	✓	—	—	✓	—	—	—	• Proximity to land uses. • Presence of pedestrian facilities. • Vehicle speed. • Paved shoulder width. • Pedestrian action (walking parallel with vehicle traffic).
	Traffic calming[66]	Combination of physical design and other measures to alter driver behavior and improve conditions for nonmotorized users. Traffic calming examples include chokers, speed tables, chicanes, gateways, roadway narrowing, etc. Some traffic-calming elements may not be appropriate for high speed limit roadways.	0.32	CMF Clearinghouse[63]	Medium–high	✓	✓	✓	✓	✓	✓	✓	• Proximity to land uses. • Presence of pedestrian facilities. • Vehicle speed. • Paved shoulder width. • Center medians. • Pedestrian action (walking parallel with vehicle traffic). • Pedestrian action (crossing).

Countermeasure Information						Roadway Typology							Risk Factors Addressed
Category	Countermeasure	Description	CMF	CMF Source	Cost/ Complexity	Rural 2-Lane	Rural 3-Lane	Rural 4-Lane	Urban 2-Lane	Urban 3-Lane	Urban 4-Lane	Urban 5-Lane	
	Enhanced delineation for horizontal curves[18]	Enhanced delineation at horizontal curves includes a variety of potential strategies that can be implemented in advance of or within curves, in combination or individually, including pavement parking, delineators, chevron signage, dynamic signs, etc.	0.4–0.852 (varies)	CMF Clearinghouse[63]	Low	✓	✓	—	✓	✓	—	—	• Vehicle speed. • Paved shoulder width. • Driver/pedestrian intoxication. • Pedestrian action (stationary in roadway or intersection). • Pedestrian action (walking parallel with vehicle traffic).
	Roadside design improvements at curves[18]	Roadside design improvements at curves is encompasses several treatments that target the high-risk roadside environment along the outside of horizontal curves. These treatments let vehicles recover safely and reduce crash severity. Roadside design improvements can be implemented alone or in combination. Treatments may include clear zones, slope flattening, adding or widening shoulders, barriers or guardrails, etc.	0.56–0.92	CMF Clearinghouse[63]	High	✓	✓	—	✓	✓	—	—	• Vehicle speed. • Paved shoulder width. • Driver/pedestrian intoxication. • Pedestrian action (stationary in roadway or intersection). • Pedestrian action (walking parallel with vehicle traffic).

Countermeasure Information						Roadway Typology							Risk Factors Addressed
Category	Countermeasure	Description	CMF	CMF Source	Cost/ Complexity	Rural 2-Lane	Rural 3-Lane	Rural 4-Lane	Urban 2-Lane	Urban 3-Lane	Urban 4-Lane	Urban 5-Lane	
Roadway infrastructure (to address crossing the roadway)	RRFBs[17–20]	Enhancement to improve the visibility of pedestrians and increase driver awareness at uncontrolled, marked crosswalks.	0.526	FHWA PSC[18]	Medium	✓	✓	—	✓	✓	—	—	• Proximity to land uses. • Presence of pedestrian facilities. • Vehicle speed. • Driver/pedestrian intoxication. • Pedestrian action (crossing).
	PHBs[17–20]	Traffic control device at unsignalized crossing on higher speed roadways.	0.453	FHWA PSC[18]	Medium	—	✓	—	✓	✓	✓	✓	• Proximity to land uses. • Presence of pedestrian facilities. • Vehicle speed. • Pedestrian action (crossing).
	Pedestrian overpass or underpass[19]	Allows uninterrupted flow of nonmotorized users separate from vehicle traffic.	0.87	CMF Clearinghouse[63]	High	—	—	—	✓	✓	✓	✓	• Proximity to land uses. • Presence of pedestrian facilities. • Vehicle speed. • Driver/pedestrian intoxication. • Pedestrian action (stationary in roadway or intersection). • Pedestrian action (crossing).
	Raised pedestrian crossing[17,19]	Reduces vehicle speeds, reduces the need for curb ramps, and enhances the pedestrian crossing environment.	0.55–0.7	CMF Clearinghouse[63]	Low–medium	✓	✓	—	✓	✓	—	—	• Proximity to land uses. • Presence of pedestrian facilities. • Vehicle speed. • Pedestrian action (crossing).

Countermeasure Information						Roadway Typology							Risk Factors Addressed
Category	Countermeasure	Description	CMF	CMF Source	Cost/ Complexity	Rural 2-Lane	Rural 3-Lane	Rural 4-Lane	Urban 2-Lane	Urban 3-Lane	Urban 4-Lane	Urban 5-Lane	
Roadway infrastructure (to address crossing the roadway) *continued*	Medians and pedestrian refuge islands in urban and suburban areas[17–19]	Raised median with refuge area intended to help pedestrians who are crossing a road. Road diets can also make space for these treatments.	0.54	FHWA PSC[18]	Low–medium	—	—	—	✓	✓	✓	✓	• Proximity to land uses. • Presence of pedestrian facilities. • Vehicle speed. • Center medians. • Driver/pedestrian intoxication. • Pedestrian action (stationary in roadway or intersection). • Pedestrian action (crossing).
	Curb extensions[17,19,20]	Extend the sidewalk or curbline to increase turning radius and to reduce pedestrian crossing distance.	N/A	—	Low–medium	—	—	—	✓	✓	✓	✓	• Proximity to land uses. • Presence of pedestrian facilities. • Vehicle speed. • Driver/pedestrian intoxication. • Pedestrian action (crossing).
	Crosswalk visibility enhancements[17–20]	Enhancements at marked crosswalks to increase users' visibility to drivers. These enhancements include high-visibility crosswalks, lighting, signing, and pavement markings.	0.6–0.75	FHWA PSC[18]	Low	✓	✓	✓	✓	✓	✓	✓	• Proximity to land uses. • Presence of pedestrian facilities. • Vehicle speed. • Driver/pedestrian intoxication. • Pedestrian action (crossing).

Countermeasure Information						Roadway Typology							Risk Factors Addressed
Category	Countermeasure	Description	CMF	CMF Source	Cost/ Complexity	Rural 2-Lane	Rural 3-Lane	Rural 4-Lane	Urban 2-Lane	Urban 3-Lane	Urban 4-Lane	Urban 5-Lane	
Intersection improvements	Traffic signal[19]	Creates gaps for pedestrians to adequately cross at locations where pedestrians would otherwise experience long delays, difficulties crossing the street, or safety issues.	0.23–1.58	CMF Clearinghouse[63]	Medium	—	✓	—	✓	✓	✓	✓	• Proximity to land uses. • Presence of pedestrian facilities. • Vehicle speed. • Lighting conditions. • Pedestrian action (crossing).
	Roundabout[18]	Install roundabout at intersection. Roundabouts help improve pedestrian safety by separating movements with a refuge island, often shortening crossing distance and reducing approaching vehicle speeds.	0.528–1.288	CMF Clearinghouse[63]	High	✓	✓	✓	✓	✓	✓	✓	• Proximity to land uses. • Presence of pedestrian facilities. • Vehicle speed. • Pedestrian action (crossing).
	Driveway improvements[19,20]	Improve pedestrian safety and comfort at driveways. Potential improvements may include driveway consolidations, narrowing driveways, tightening turning radii, or enhanced delineations.	0.129–6.248	CMF Clearinghouse[63]	Medium–high	—	✓	—	✓	✓	✓	✓	• Proximity to land uses. • Vehicle speed. • Lighting conditions. • Pedestrian action (walking parallel with vehicle traffic).
	Leading Pedestrian Interval[18,19]	Pedestrians can enter the crosswalk at a signalized intersection before vehicles enter the intersection.	0.87	CMF Clearinghouse[63]	Low	—	✓	—	✓	✓	✓	✓	• Proximity to land uses. • Pedestrian action (crossing).

Countermeasure Information						Roadway Typology							Risk Factors Addressed
Category	Countermeasure	Description	CMF	CMF Source	Cost/ Complexity	Rural 2-Lane	Rural 3-Lane	Rural 4-Lane	Urban 2-Lane	Urban 3-Lane	Urban 4-Lane	Urban 5-Lane	
	Enhanced stop-controlled intersection[18,20]	Enhanced signing and pavement markings to increase driver awareness and recognition of the intersection and potential conflicts.	0.73–0.9	FHWA PSC [18]	Low	✓	✓		✓	✓			• Proximity to land uses. • Presence of pedestrian facilities. • Vehicle speed. • Pedestrian action (crossing).
Policies	Appropriate speed limits[18,20]	Set appropriate speed limits. May include self-enforcing roadways, traffic calming, etc.	0.78–1.095	CMF Clearinghouse[63]	Medium	✓	✓	✓	✓	✓	✓	✓	• Proximity to land uses. • Presence of pedestrian facilities. • Vehicle speed.
	Corridor access management[18]	Implement access management strategies (driveway closure, consolidation, and relocation; intersection spacing; raised median; turn lanes; etc.) to enhance safety for all modes.	0.69–0.75	FHWA PSC[18]	Medium–high	—	✓	—	✓	✓	✓	✓	• Proximity to land uses. • Presence of pedestrian facilities. • Pedestrian action (crossing).
Education and enforcement[21]	Police enforcement[19,20]	Increase drivers' awareness to share the roadway and reduce pedestrian-related collisions. Note, the NHTSA CTW specifies "High-Visibility Enforcement at Pedestrian Crossings" as the countermeasure.	N/A	—	Low	✓	✓	✓	✓	✓	✓	✓	• Vehicle speed. • Driver/pedestrian intoxication. • Pedestrian action (stationary in roadway or intersection).

Countermeasure Information						Roadway Typology							Risk Factors Addressed
Category	Countermeasure	Description	CMF	CMF Source	Cost/ Complexity	Rural 2-Lane	Rural 3-Lane	Rural 4-Lane	Urban 2-Lane	Urban 3-Lane	Urban 4-Lane	Urban 5-Lane	
	Pedestrian and driver education[19,20]	Inform pedestrians and motorists of relevant traffic laws and provide information to help motivate change in behaviors to reduce risk of pedestrian collisions. Note, NHTSA indicates that "driver training" and "pedestrian gap acceptance training" are approaches that need further evaluation.[20]	N/A	—	Low	✓	✓	✓	✓	✓	✓	✓	• Vehicle speed. • Driver/pedestrian intoxication. • Pedestrian action (stationary in roadway or intersection). • Pedestrian action (walking parallel with vehicle traffic). • Pedestrian action (crossing).
	Radar speed feedback signs[19]	Speed-monitoring trailers can enhance enforcement efforts through public education and awareness. They are not substitutes for permanent actions, such as traffic-calming treatments, to address neighborhood speeding issues.	0.78–0.95	CMF Clearinghouse[63]	Low	✓	✓	—	✓	✓	—	—	• Proximity to land uses. • Vehicle speed.
	Provide emergency dispatch training	Provide emergency services training to increase effectiveness of dispatching to rural areas.	N/A	—	Low	✓	✓	✓	✓	✓	✓	✓	• Proximity to land uses. • Pedestrian action (stationary in roadway or intersection). • Pedestrian action (walking parallel with vehicle traffic). • Pedestrian action (crossing).

Countermeasure Information						Roadway Typology							Risk Factors Addressed
Category	Countermeasure	Description	CMF	CMF Source	Cost/ Complexity	Rural 2-Lane	Rural 3-Lane	Rural 4-Lane	Urban 2-Lane	Urban 3-Lane	Urban 4-Lane	Urban 5-Lane	
	Provide first-aid training[20]	Provide first-aid training to help with postcrash care.	N/A	—	Low	✓	✓	✓	✓	✓	✓	✓	• Proximity to land uses. • Driver/pedestrian intoxication. • Pedestrian action (stationary in roadway or intersection). • Pedestrian action (walking parallel with vehicle traffic). • Pedestrian action (crossing).
Planning	Local Road Safety Plan[18]	Provide a framework for identifying, analyzing, and prioritizing roadway safety improvements.	N/A	—	Medium–high	✓	✓	✓	✓	✓	✓	✓	• Proximity to land uses. • Presence of pedestrian facilities. • Vehicle speed. • Paved shoulder width. • Center medians. • Lighting conditions. • Driver/pedestrian intoxication.
	RSA[18]	A formal evaluation of a roadway segment by an independent, multidisciplinary team to identify potential specific safety improvements. Identified risks are prioritized and addressed with both low- and high-cost recommendations.	N/A	—	Medium–high	✓	✓	✓	✓	✓	✓	✓	• Proximity to land uses. • Presence of pedestrian facilities. • Vehicle speed. • Paved shoulder width. • Center medians. • Lighting conditions. • Driver/pedestrian intoxication.

—No data.

APPENDIX F. PEDESTRIAN SAFETY RISK EVALUATION FORM

This pedestrian safety risk evaluation form is a resource that Tribes can use to evaluate the relative safety risk experienced by a pedestrian at a location. The pedestrian safety risk evaluation considers 13 factors. A resulting pedestrian risk score for each factor is associated with the practitioner's response. The scores are based on findings from the crash analysis and risk identification and emphasize areas where a strong correlation between pedestrian fatality or serious injury crash was associated with a roadway characteristic. A total pedestrian safety risk score is calculated based on a summation of the subcategory scores.

By completing these risk assessments, Tribal communities may gain insight regarding risks that can be addressed to improve pedestrian safety. The evaluation may help to prioritize pedestrian safety improvements or locations for improvements in a community. In addition, when seeking resources to construct infrastructure improvements, a Tribal community may be able to use the completed risk evaluation to demonstrate the level of risk to pedestrians. Because pedestrian crashes are rare events and crash data are unavailable in many Tribal areas, the completed risk evaluations may help a Tribe proactively demonstrate the need for pedestrian safety improvements based on the national crash-data analysis performed in this report. These evaluations could provide the justification most State and Federal transportation safety programs require.

An interactive, electronic version of the pedestrian safety risk evaluation is available at https://www.tribalsafety.org/ped-study.[67]

Pedestrian Safety Risk Evaluation

Location:

Proposed improvements:

How does the project enhance community connectivity?

What land uses are adjacent to the project site?

Risk Factor Summary

Instructions:
Select the appropriate attribute for the location of interest; all risk scoring information is provided on pages 2 and 3. Including maps or photos of the project location may help others better understand this risk evaluation. The risk may change through a project area. Conducting a risk assessment every 1/4 mi or when the roadway cross section changes may be necessary to accurately reflect and prioritize different segments. Develop a risk evaluation of the location for both the existing and future conditions to demonstrate reduced risk scores.

Location and Environmental Factors

Proximity to Land Uses or Pedestrian Attractors:

Operating Environment:

Pedestrian Crossing Distance[1]:

Lighting Condition at Vehicle-Pedestrian Conflict Areas:

Posted Speed Limit:

Pedestrian Exposure to Vehicles/Vehicle Traffic on the Roadway (Average Daily Traffic):

Pedestrian Activity:

Infrastructure Factors

Presence of Pedestrian Facilities: Paved

Shoulder Width:

Median Type:

Other Factors

Prior Vehicle-to-Pedestrian Crashes (or Near Misses) Within the Last 5 Yrs[2]:

Availability of Public Safety Services[3]:

Project Scale and Complexity:

Pedestrian Safety Risk Score / 62

1: For a crossing-related project.
2: Please attach crash reports or summaries, if available. If no formal reports are available, please attach a description of events.
3: Average time elapsed from crash to arrival at treatment facility.

Definitions

Risk Criteria	Measurement	Score	Location Score
Location and Environmental Factors			
Proximity to Land Uses or Pedestrian Attractors	<¼ mi to residential or commercial land uses	8	
	¼ to ½ mi to residential or commercial land uses	2	
	½ to 1 mi to residential or commercial land uses	1	
	>1 mi to residential or commercial land uses	0	
Operating Environment	6 or more lanes	4	
	4- or 5-lane undivided roadway	3	
	2- or 3-lane undivided roadway	2	
	4-lane divided roadway	1	
Pedestrian Crossing Distance[1]	>73 ft	4	
	51–72 ft	3	
	34–50 ft	2	
	<34 ft	1	
Lighting Condition[2]	No lighting	2	
	Inadequate lighting	1	
	Adequate lighting	0	
Posted Speed Limit	>50 mph	8	
	40 or 45 mph	4	
	30 or 35 mph	1	
	<25 mph	0	
Pedestrian Exposure to Vehicles/Traffic on the Roadway	>25,000 average daily traffic	4	
	5,001–25,000 average daily traffic	3	
	1,001–5,000 average daily traffic	2	
	<1,000 average daily traffic	1	
Pedestrian Activity[3]	High	4	
	Low	2	
	None	0	

Continues on the next page

1: For a pedestrian-crossing project.

2: Lighting condition at vehicle-pedestrian conflict areas.

3: Pedestrian activity, as defined in the FHWA *Pedestrian Lighting Primer* (April 2022):[64]

High or medium: More than 10 pedestrians in a peak hour (examples may include downtown retail or office areas, theaters, libraries, community buildings, concert halls, stadiums, and transit stops/stations).

Low: 10 or fewer pedestrians in a peak hour (examples may include low-density residential areas, semirural or suburban areas, etc.).

Please note any unique circumstances that may have an influx of pedestrians (festivals, events, etc.).

Definitions (continued)

Risk Criteria	Measurement	Score	Location Score
Infrastructure Factors			
Presence of Pedestrian Facilities[1]	No facilities	8	
	Some facilities	4	
	Adequate facilities	1	
	Enhanced facilities	0	
Paved Shoulder Width	0–1 ft	4	
	1–4 ft	3	
	5–9 ft	2	
	>10 ft, curb/gutter, or sidewalk/pathway present	1	
Median Type	None	4	
	Two-way left-turn lane	3	
	Earth median (divided roadway)	2	
	Barrier/cable or pedestrian refuge island	1	
Other Factors			
Prior Vehicle-to-Pedestrian Crashes (or Near Misses) within the Last 5 Yrs[2]	5 or more crashes	4	
	3–4 crashes	3	
	1–2 crashes	2	
	No crashes (or a history of near misses)	1	
Availability of Public Safety Services[3]	>1 h	4	
	16–60 min	2	
	<15 min	0	
Project Scale and Complexity	Low cost (<$200,000), simple countermeasures	4	
	Medium cost ($200,000 - $1,000,000), moderate countermeasures	2	
	High cost (>$1,000,000), complex countermeasures	1	

Please note any other relevant information for this project location:

1: Examples of pedestrian facilities include:
Some facilities: Fragmented sidewalk, sidewalk on only one side of roadway, signage only for crossings.
Adequate facilities: Sidewalks on both sides of roadway, separated sidewalk or paved path on one or both sides of roadway, marked (painted) crosswalk and static signage.
Enhanced facilities: Bulb-outs/curb extensions, median refuge island(s), pedestrian signal (PHB, RRFB).
2: Please attach crash reports or summaries, if available. If no formal reports are available, please attach a description of events.
3: Average time elapsed from crash to arrival at treatment facility.

APPENDIX G. PROJECT CASE STUDY SUMMARY SHEETS

BUSBY PATHWAY AND CROSSING PROJECT IN BUSBY, MT

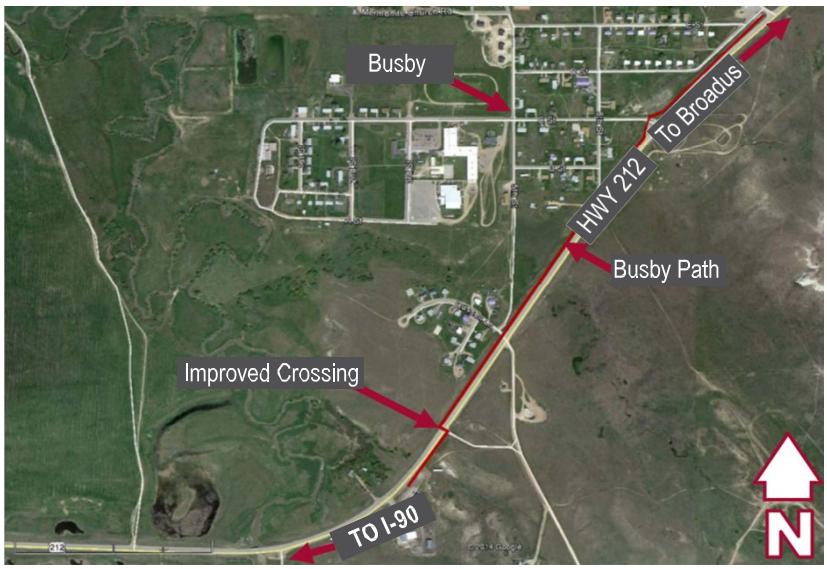
Tribal Community	Northern Cheyenne Reservation
Location	Busby, MT
Project Type	Crossing and pathway
Partner Agency	Montana Department of Transportation (MDT)
Date of Completion	November 2018
Cost	$498,026
Funding Type(s)	TTP and Tribal Transportation Program Safety Fund (TTPSF)
Other Notes	N/A

Project Description

The design and construction of a separated multiuse pedestrian and bicycle pathway (with lighting) approximately 1-mi in length has been completed. This pathway connected one end of the community of the Northern Cheyenne Reservation of Busby, MT, to the other end of the community. The path ran adjacent to U.S. Highway 212 and contained one rapid flashing beacon crossing.

Project Identification

The lack of infrastructure in Busby posed a significant risk to pedestrians and bicyclists traveling along U.S. Highway 212, especially those heading to key destinations such as core Tribal facilities in Lame Deer, housing, school, grocery store, and more. This absence of separated nonmotorized connections increased the likelihood of transportation-related crashes on the Northern Cheyenne Reservation. To address this issue, a fully separated multiuse path was urgently needed in Busby. This path would prioritize the safety of nonmotorized travelers and effectively reduce the risk of crashes with motorized traffic.



Original photo: © 2024 Google® Earth™. Modifications by the research team. (See Acknowledgments section.)

Figure 33. Map. Busby, MT, multiuse separated pedestrian and bicycle pathway.

Solutions and Countermeasures

The project includes the construction of the following safety improvements for the study area:

- A 1-mi multiuse pedestrian and bicycle pathway.
- Lighting enhancement along the pathway.
- Enhanced crossing with RRFB signs.

Lessons Learned

This project was conducted in conjunction with the MDT, with the Tribe completing all the planning, design, and environmental clearances. Construction was advertised and completed by MDT. One of the lessons learned was that while MDT standards were used for design, the project was not necessarily completed using MDT's format for survey and design files, which caused some issues during the transition to MDT completing the project. Overall, the project was a great opportunity for the Tribe and the State to work together to complete a needed improvement.

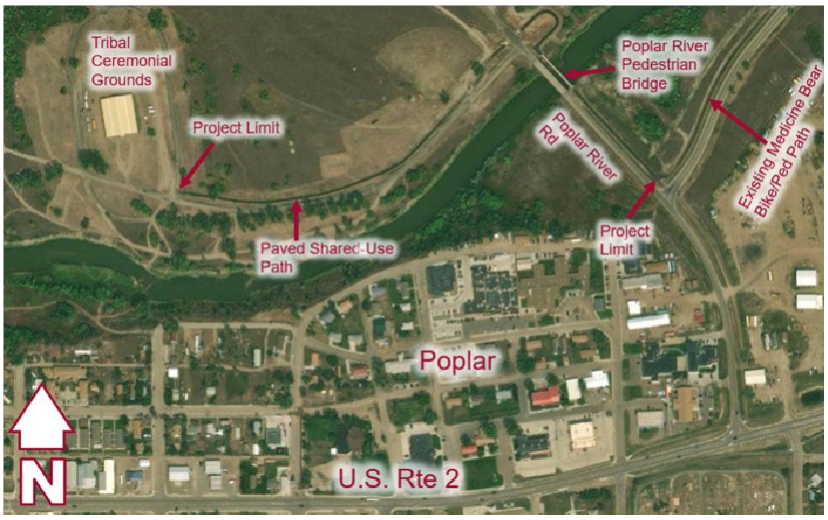
Figure 34. Image. A pedestrian crossing with RRFB signs was installed on Highway 212 in the south Busby, MT, community.

Figure 35. Image. A separated multiuse pedestrian and bicycle pathway constructed adjacent to Highway 212 in Busby, MT.

POPLAR RIVER PEDESTRIAN AND BIKE PATH BRIDGE SAFETY IMPROVEMENT PROJECT, POPLAR, MT

Tribal Community	Assiniboine and Sioux Tribes
Location	Fort Peck Indian Reservation, Poplar, MT
Project Type	Paved shared-use path and pedestrian bridge
Partner Agency	FHWA, TTPSF, TTP, carry-over State Community Transportation Enhancement Program funds, Roosevelt County
Date of Completion	2024
Cost	$2,000,000
Funding Type(s)	Project funded with $1,000,000 TTPSF. The Fort Peck Tribes matched the TTPSF funds with $712,000 of Tribal TTP funds, $238,000 of carry-over state Community Transportation Enhancement Program funds, and a $50,000 borrow contribution from Roosevelt County. The project was built with $1,000,000 TTPSF and $1,000,000 of matching Tribal and local funds.
Other Notes	An RSA was completed for the project area. Crash data was captured, and an Accident Report GIS database was created for Fort Peck Reservation. The project was completed by the Fort Peck Tribes Transportation Department.

Project Description



Original photo: © 2024 Google® Earth™. Modifications by the research team. (See Acknowledgments section.)

Figure 36. Map. Pedestrian path to the Tribal Ceremonial Grounds project.

This project is a 0.6-mi paved shared-use path adjacent to Poplar River Road, stretching southwest to the Tribal Ceremonial Grounds in Poplar, MT. The project also includes an enhanced pedestrian bridge spanning the Poplar River. This project was contracted to be completed within two years of the TTPSF award and meets the improvement requirements for safety projects.

Project Identification

Poplar River Road is a two-lane roadway with minimal paved shoulders (<1 ft), no adjacent facilities (sidewalks, curb and gutter, bicycle lanes), and a posted speed limit of 35 mph in the area. The project aimed to address concerns related to pedestrian safety in and around the grounds, since it was only accessible via a 26-ft wide, 180-ft-long highway bridge over the Poplar River. This bridge, located on North Park Road, served as the sole means of vehicle and pedestrian access from the northern part of the reservation to the City of Poplar, U.S. Highway 2, other east-west highways, and the Tribal Ceremonial Grounds.

During Tribal ceremonial activities, a continuous conflict existed between two-way vehicular traffic and other modes of transportation sharing the bridge. This conflict posed a significant risk for vehicle and pedestrian collisions, especially considering that ceremonial activities often extended into the evening hours.

Solutions and Countermeasures

The project includes the construction of the following safety improvements for the study area:

- A 0.6-mi paved shared-use path, separated (from earth shoulder) from the roadway and roadway shoulder.
- A below-grade crossing under North Park Road.
- Lighting enhancements along the entire length of paved path.

Lessons Learned

- Gathering relevant data, such as RSAs, crash data, and an accident GIS database, proved essential in successfully applying for and securing funding.
- Cultivating government-to-government relationships is essential for the successful implementation of projects and achieving long-lasting results.
- Recognizing the importance of contributions from community members and other entities within the Tribe, and valuing their input and insights, is crucial because they can offer valuable perspectives and knowledge.

Figure 37. Image. Proposed location of the new pedestrian bridge and path.

Figure 38. Image. Poplar River pedestrian and bike path bridge safety improvement project.

HEMISH PATH TO WELLNESS, JEMEZ PUEBLO, NM

Tribal Community	Pueblo of Jemez
Location	Jemez Pueblo, NM
Project Type	Multiuse pedestrian trail
Partner Agency	NMDOT
Date of Completion	2024
Cost	$7,500,000
Funding Type(s)	NMDOT Congestion Mitigation Air Quality Improvement Program, Recreation Trails Program, Transportation Alternatives Program grants, State Transportation funds, New Mexico Economic Development Department-Outdoor Recreation Division Trails+ grant, FHWA TTP funds
Other Notes	Project completed by the Jemez Department of Transportation

Project Description

The Hemish Path to Wellness is a 1.7-mi paved shared-use path adjacent to the NM–4 highway, stretching from Bear Head Canyon Road in the North to the Pueblo Place Housing Subdivision in the south. The trail is located on both the east and west sides of NM–4 and includes wide asphalt surfacing throughout its length. The project also included new pedestrian crossings at two locations, bridge and structure work, and signage. The shared-use path connects critical users and key destinations throughout the Pueblo of Jemez.

Project Identification

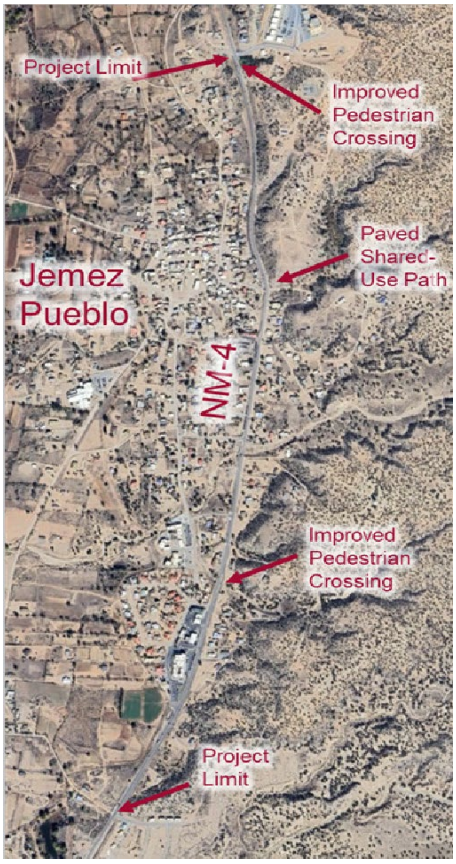
The construction of the NM–4 highway through the Pueblo of Jemez lands has had a generational impact on the safety of Tribal members. NM–4 is a two-lane roadway with minimal paved shoulders (<1 ft), no adjacent facilities (sidewalks, curb and gutter, and bicycle lanes), and a posted speed limit of 30 mph in the project area.

The primary objective of the project was to provide safety and support for different active transportation user types that already use this route. The path and enhanced pedestrian crossings offer continued access to key destinations, such as government buildings, health centers, regional transit stops, residencies, schools, and a fitness center.

Solutions and Countermeasures

The project includes the construction of the following safety improvements for the study area:

- A 1.7-mi paved shared-use path, separated (either by gravel shoulder or curbing) from the roadway and roadway shoulder.



Original photo: © 2024 Google® Earth™. Modifications by the research team. (See Acknowledgments section.)

Figure 39. Map Hemish Path to Wellness project.

- Two midblock pedestrian crossings equipped with pedestrian-activated RRFB signs on each side of NM–4.
- Two premanufactured pedestrian bridges spanning existing arroyo crossings.
- Drainage improvements.
- Lighting enhancements.
- Driver speed feedback signs on NM–4

Lessons Learned

- The Pueblo, by securing funds from multiple sources, saw the positive impacts the project would provide in enhancing safety, promoting physical activity, and creating community wellness and connectivity.
- This project serves as a beacon of hope for those facing similar challenges with pedestrian safety, highways traversing their lands, and a lack of pedestrian facilities along these highways.

The Hemish Path to Wellness project can serve as a model for addressing pedestrian safety challenges on Tribal lands by demonstrating the importance of collaboration among Tribes, government agencies, and other stakeholders. Collaboration is essential when creating long-lasting solutions to complex issues.

Figure 40. Image. View looking north along NM–4 Highway at Sandoval County bus stop.

© 2024 Pueblo of Jemez.

Figure 41. Image. Before Construction: view looking north along NM–4 Highway at Arroyo System.

© 2024 Pueblo of Jemez.

Figure 43. Image. View looking north along NM–4 Highway at new pedestrian bridge crossing over arroyo.

Source: FHWA.

Figure 42. Image. RRFB Crossing located at the Intersection of Bear Head Canyon Road and NM–4.

PEDESTRIAN SAFETY IMPROVEMENTS ON SR–447, WADSWORTH, NV

Tribal Community	Pyramid Lake Paiute Tribe
Location	Wadsworth, NV
Project Type	Paved shared-use path adjacent to a State highway and improved crossings
Partner Agency	NDOT
Date of Completion	2022
Cost	$500,000
Funding Type(s)	NDOT match (dollar to dollar), Highway Safety Improvement Funds, FHWA grant
Other Notes	RSA completed, collisional diagram and historical crash data available

Project Description

The Pyramid Lake Paiute Reservation, in conjunction with NDOT and the community of Wadsworth, completed a pedestrian and road safety improvement project on State Route SR–447. The project helped fulfill their Complete Streets Project goals.[4]

Project Identification

Residents and NDOT identified a need to enhance traffic safety on SR–447. SR–447 experiences vehicle traffic and high speeds and bisects the community of Wadsworth, passing the Natchez Elementary School, residential areas, and the Wadsworth Community Building. SR–447 is a two-lane roadway with a minimal paved shoulder (<1 ft), no adjacent facilities (sidewalks, curb and gutter, or bicycle lanes), and a posted speed limit of 25 mph. SR–447 also experiences high traffic and speeds as a connection from I–80 to recreation areas north of Wadsworth (Pyramid Lake) and major events such as Burning Man.

Original photo: © 2024 Google® Earth™. Modifications by the research team. (See Acknowledgments section.)

Figure 44. Map. Project location.

Solutions and Countermeasures

NDOT conducted an RSA on SR–447 in the area, completed with collisional diagrams and available historical crash data. The RSA determined that SR–447 in the area needed countermeasures to help prevent approximately three serious and fatal crashes involving pedestrians and bicyclists annually. The SR–447 project scope included the construction of the following safety improvements for the corridor:

- Three crossing location enhancements on SR–447 at Pyramid Street, North of 6th Street, connecting the path to Natchez Elementary School, and just north of 5th Street.
- Crossing enhancements included pedestrian-activated RRFB signs on each side of SR–447 and new or upgraded intersection and crosswalk overhead lighting.
- Speed feedback signs approaching the school zone.

- A 1,200-ft of shared-use asphalt path with Americans with Disabilities Act-compliant ramps on the west side of the corridor.[68]
- New or upgraded signage (to meet current MUTCD standards).[65]
- New or upgraded striping and pavement markings (to meet current MUTCD standards).[65]

Figure 45. Image. Pedestrian safety improvements at midblock crossing on SR-447.

Lessons Learned

- Gathering relevant data, such as RSAs, crash data, and collisional diagrams, proved essential in successfully applying for and securing funding.
- Cultivating government-to-government relationships is essential for the successful implementation of projects and achieving long-lasting results.
- Recognizing the importance of contributions from community members and other entities within the Tribe is important. They can offer valuable perspectives and knowledge.

Figure 46. Image. Before the transformation: midblock crossing on SR–447 before any improvements.

Figure 47. Image. Aerial view of completed paved shared-use path in Wadsworth, NV

RED CAP ROAD PROJECT, ORLEANS, CA

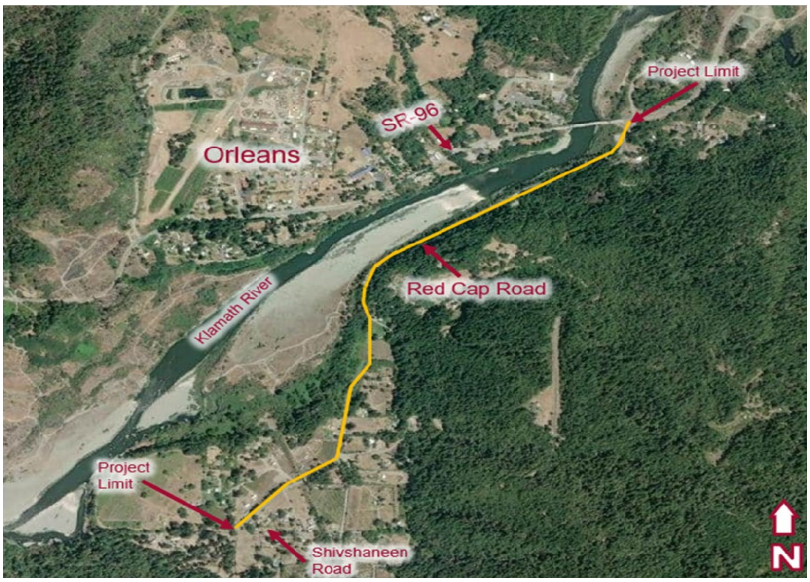
Tribal Community	Karuk Tribe
Location	Orleans, California
Project Type	Shoulder widening and traffic calming
Partner Agency	Humboldt County
Date of Completion	November 30, 2019
Cost	$872,000
Funding Type(s)	TTPSF
Other Notes	Red Cap Road ranked high in a project prioritization rating process and was listed in many transportation and bicycle plans in and around the county and region.

Project Description

Red Cap Road is a primary access road between residential areas, including tribal housing, jobs, schools, and services in the community of Orleans and beyond. The road safety improvement project, including widened shoulders and adding striping, signage, and bicycle lanes, was completed to address issues identified at the local and county level. The project was constructed within the existing ROW of the roadway and used the existing alignment.

Project Identification

Red Cap Road was a narrow two-lane roadway with little to no shoulder, no adjacent facilities (sidewalks, curb and gutter, or bicycle lanes), poor line of sight, severe pavement edge drop off, and a posted speed limit of 45 mph. Since Red Cap Road is considered a major access route, the corridor was subject to pedestrians, bicycles, and other nonmotorized transportation. In the past, the narrowness of Red Cap Road posed hazards for active transportation, as there was a lack of safe space for travel, which forced users to either walk on the roadway itself or on unimproved shoulders.



Original photo: © 2024 Google® Earth™. Modifications by the research team. (See Acknowledgments section.)

Figure 48. Map. The Red Cap Road project area.

The Karuk Tribe completed a Tribal Safety Transportation Plan with the help of a grant. As part of this plan, Red Cap Road was identified as a priority project area needing improvement. Before the development of the safety plan, residents, Tribal officials, and local county officials had already recognized the inadequacy of the corridor. With the safety plan in place, the Tribe was able to apply for a Safety Fund grant, which it successfully received. This funding allowed the Tribe to achieve its goal of creating a safe, active transportation route on both sides of Red Cap Road.

Solutions and Countermeasures

The Red Cap Road project scope included the following safety improvements and processes for the corridor:

- Widened shoulders of Red Cap Road.
- Constructed 1.56-mi of 5-ft-wide paved Class II Bikeway/Pedestrianway on each side.
- Added traffic calming elements: striping and signage.

Lessons Learned

- A Tribal Safety Transportation Plan proved vital in identifying an already known problem area, and with this supportive documentation, the Tribe was able to apply for and successfully obtain funds to meet its safety goals.
- Contributions from community members and other entities within the Tribe are important and should be recognized. Value their input and insights; they can offer valuable perspectives and knowledge.
- This project served as a prime example of improving safety for both individuals and the community while supporting the Walking and Biking in Indian Country Safe Routes to School Campaign that aimed to promote safety and healthy habits for students commuting to school.

Figure 49. Image. A curved section of Red Cap Road.

GORDON COOPER SIDEWALK SAFETY PROJECT, SHAWNEE, OK

Tribal Community	Citizen Potawatomi Nation
Location	Shawnee, OK
Project Type	Sidewalk
Partner Agency	Cross Timbers Consulting, LLC
Date of Completion	2017
Cost	$144,500
Funding Type(s)	TTPSF
Other Notes	N/A

Project Description

The Gordon Cooper Sidewalk Safety project is a 0.7-mi concrete sidewalk next to Gordon Cooper Road, extending from Hardesty Road to the Canadian River Bridge. The trail was constructed with a 10-ft-wide aggregate base 6 inches deep, and an 8-ft-wide concrete surface 4 inches deep. This project aimed to improve pedestrian access and promote recreational activities for Tribal members and visitors to the Citizen Potawatomi Nation (CPN) Tribal complex area.

Project Identification

Establishing walkable Tribal communities to prioritize safety, health, and cultural preservation was a pressing need. The lack of a sidewalk along Gordon Cooper Road showcased a significant safety hazard in this area. Gordon Cooper Road is a four-lane roadway with a 1-ft shoulder, no adjacent facilities (sidewalks, curb and gutter, or bicycle lanes), and a posted speed limit of 45 mph in the area.

The primary objective of the project was to continue providing safety and support for the route's users. This area of Gordon Cooper Road to the CPN Tribal complex and between the town of Shawnee was known to have heavy pedestrian traffic. Therefore, a decision was made to construct a sidewalk connecting the Tribal complex to the Canadian River Bridge leading into the City of Shawnee. This sidewalk created a beneficial connection for pedestrian traffic and further enhanced pedestrians' convenience and safety.

Solutions and Countermeasures

The project included the construction of a 0.7-mi concrete sidewalk separated (either with earth shoulder or curbing) from the roadway and roadway shoulder.

Original photo: © 2024 Google® Earth™. Modifications by the research team. (See Acknowledgments section.)

Figure 50. Map. Gordon Cooper sidewalk safety project.

Lessons Learned

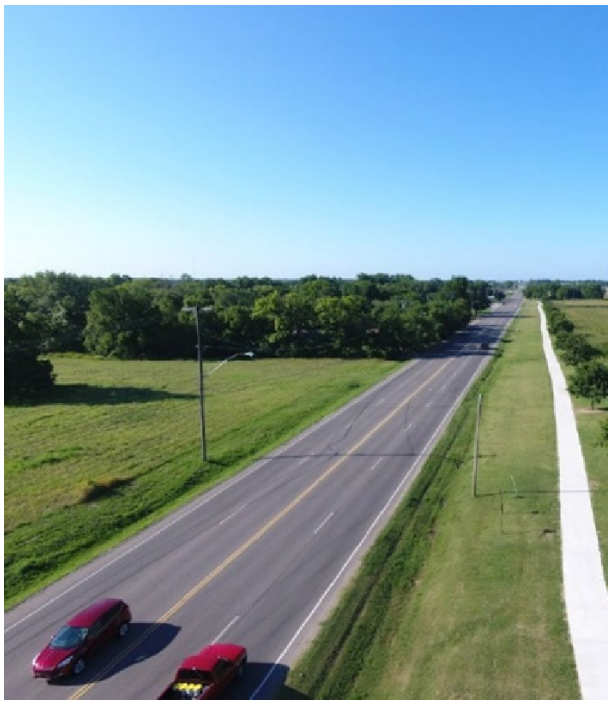
- Gaining community approval is vital in all stages of pedestrian safety projects.
- Working with organizations of all types, even outside of Tribal and State DOTs, can lead to a higher level of collaboration.

Original photo: © 2024 Google® Earth™. Modifications by the research team. (See Acknowledgments section.)

Figure 51. Map. Vicinity map of project location and surrounding areas

© 2024 Cross Timbers Consulting, LLC.

Figure 52. Image. Before sidewalk construction: a well-worn path alongside Gordon Cooper Drive leading to available pedestrian facilities on the Canadian River Bridge.



© 2024 Cross Timbers Consulting, LLC

Figure 53. Image. Safety enhancement project: sidewalk installation south of the Canadian River Bridge in CPN, Shawnee, OK.

ACKNOWLEDGMENTS

The original maps in figure 36, figure 40, figure 45, figure 48, figure 51, and figure 52 are the copyright property of Google Earth and can be accessed from https://www.google.com/earth.[24] The map labels and arrows were added to show the locations of the projects and the surrounding areas.

REFERENCES

1. Glassbrenner, D., G. Herbert, L. Reish, C. Webb, and T. Lindsey. 2022. *Evaluating Disparities in Traffic Fatalities by Race, Ethnicity, and Income.* Report No. DOT HS 813 188. Washington, DC: National Highway Traffic Safety Administration. https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813188, last accessed November 26, 2024.

2. FHWA Tribal Transportation Safety Management System Steering Committee. 2017. *Tribal Transportation Strategic Safety Plan.* Washington, DC: Federal Highway Administration. https://irp-cdn.multiscreensite.com/7e0c8ed5/files/uploaded/TRIBAL-TRANSPORTATION-SAFETY-PLAN-web.pdf, last accessed November 26, 2024.

3. National Academies of Sciences, Engineering, and Medicine. 2011. *Transportation Improvement Program Revision Process.* NCHRP Synthesis 419. Washington, DC: The National Academies Press. https://nap.nationalacademies.org/catalog/14557/transportation-improvement-program-revision-process, last accessed November 26, 2024.

4. FHWA. n.d. "Complete Streets in FHWA" (web page). https://highways.dot.gov/complete-streets, last accessed November 27, 2024.

5. FHWA. 2024. "Zero Deaths and Safe System" (web page). https://highways.dot.gov/safety/zero-deaths, last accessed November 27, 2024.

6. United South and Eastern Tribes, Inc. 2023. "National Transportation in Indian Country Conference" (web page). https://www.usetinc.org/event/national-transportation-in-indian-country-conference/#:~:text=September%2024%2C%202023%20%2D%20September%2028%2C%202023&text=%E2%80%8BNTICC%20provides%20information%20and,Native%20and%20Native%20American%20lands, last accessed November 27, 2024.

7. ADOT. 2023. *2023 Arizona Tribal Transportation Safety & Injury Prevention Summit*. Phoenix, AZ: Arizona Department of Transportation. https://aztribaltransportation.org/sites/default/files/2024-06/2023-Arizona-Tribal-Transportation-Safety-and-Injury-Prevention-Summit.pdf, last accessed November 27, 2024.

8. United South and Eastern Tribes, Inc. 2024. "NTICC" (web page). https://www.nticc.org/2024-presentations, last accessed November 27, 2024.

9. Fijalkowski, J., J. Sydoriak, and H. Tran. 2023. *Tribal Development of Trails and Other Dedicated Pedestrian and Bicycle Infrastructure.* Report No. FHWA-HEP-24-006. Washington, DC: Federal Highway Administration. https://www.fhwa.dot.gov/environment/recreational_trails/publications/tribal-dev-trails-ped-bicycle-infra.pdf, last accessed November 29, 2024.

10. Okyere, D., J. Murdoch, D. Gelinne, M. Davis, K. Harmon, W. Kumfer, and C. Ma. 2023. *Comparative Study of Communities With High Rates of Pedestrian Injuries.* Report No. DOT

HS 813 463. Washington, DC: National Highway Traffic Safety Administration. https://rosap.ntl.bts.gov/view/dot/68224, last accessed November 29, 2024.

11. Dunlop Associates, Inc. 2023. *Low-Cost Pedestrian Safety Zones: Countermeasure Selection Resource.* Report No. DOT HS 813 479. Washington, DC: National Highway Traffic Safety Administration.

12. Lindsey, G., J. Hourdos, P. Dirks, M. Duhn, Y. Qi, L. Singer-Berk, and M. Petesch. 2020. *Pedestrian Crossings and Safety on Four Anishinaabe Reservations in Minnesota.* Report No. MnDOT 2020-29. St. Paul, MN: Minnesota Department of Transportation.

13. Quick, K. S., and G. E. Narváez. 2018. *Understanding Roadway Safety in American Indian Reservations: Perceptions and Management of Risk by Community, Tribal Governments, and Other Safety Leaders.* Report No. CTS 18-20. Minneapolis, MN: University of Minnesota.

14. Quick, K., and G. Narváez. 2016. "New Methods for Identifying Roadway Safety Priorities in American Indian Reservations." Presented at the *95th Annual Meeting of the Transportation Research Board*. Washington, DC: Transportation Research Board.

15. Atkinson, J. E., B. E. Chandler, V. Betkey, K. Weiss, K. Dixon, A. Biragosian, K. Donoughe, and C. O'Donnell. 2014. *Manual for Selecting Safety Improvements on High Risk Rural Roads.* Report No. FHWA-SA-14-075. Washington, DC: Federal Highway Administration.

16. FHWA. 2007. *Tribal School Zone Safety Video and Toolkit.* Report No. FHWA-FLH-07-002. Washington, DC: Federal Highway Administration. https://irp-cdn.multiscreensite.com/7e0c8ed5/files/uploaded/Tribal_School_Zone_Safety_Video_Toolkit_r.pdf, last accessed November 29, 2024.

17. FHWA. 2021. "Safe Transportation for Every Pedestrian (STEP)" (web page). https://highways.dot.gov/safety/pedestrian-bicyclist/step, last accessed November 29, 2024.

18. FHWA. n.d. "Proven Safety Countermeasures" (web page). https://highways.dot.gov/safety/proven-safety-countermeasures, last accessed November 29, 2024.

19. FHWA. n.d. *PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System*. Washington, DC: Federal Highway Administration. https://pedbikesafe.org/PEDSAFE/, last accessed November 29, 2024.

20. NHTSA. 2023. *Countermeasures That Work*, 11th edition. Washington, DC: National Highway Transportation Safety Administration. https://www.nhtsa.gov/book/countermeasures/countermeasures-that-work, last accessed November 29, 2024.

21. FHWA. *SafetyEdge*℠. Publication No. FHWA-SA-21-038. Washington, DC: Federal Highway Administration. https://safety.fhwa.dot.gov/provencountermeasures/pdf/10_SafetyEdge_508.pdf, last accessed November 29, 2024.

22. NHTSA. n.d. “Fatality Analysis Reporting System (FARS)” (web page). https://www.nhtsa.gov/research-data/fatality-analysis-reporting-system-fars, last accessed November 29, 2024.

23. FHWA. 2023. “Pedestrian Bicycle Crash Analysis Tool” (web page). https://highways.dot.gov/research/pbcat/overview, last accessed November 29, 2024.

24. Google. 2024. Google Earth, Mountain View, CA. https://www.google.com/earth, last accessed November 29, 2024.

25. Dickman, D., N. Falbo, S. Durrant, J. Gilpin, G. Gastaldi, C. Chesston, P. Morrill, et al. 2016. *Small Town and Rural Multimodal Networks*. Report No. FHWA-HEP-17-024. Washington, DC: Federal Highway Administration. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/small_towns/, last accessed November 29, 2024.

26. Grants.gov. n.d. “Grants.gov” (web page). https://grants.gov, last accessed December 2, 2024.

27. FHWA. 2023. *Transportation Funding Opportunities for Tribal Nations.* Washington, DC: Federal Highway Administration. https://highways.dot.gov/federal-lands/tribal/transportation-funding-opportunities-tribal-nations, last accessed December 2, 2024.

28. Rural Information Hub. 2022–2024. “RHI Hub” (web page). https://www.ruralhealthinfo.org/funding, last accessed December 2, 2024.

29. FHWA. n.d. “Office of Tribal Transportation” (web page). https://highways.dot.gov/federal-lands/tribal, last accessed December 2, 2024.

30. FHWA. 2024. “Tribal HPP Program” (web page). https://highways.dot.gov/federal-lands/tribal/tribal-hpp-program, last accessed December 2, 2024.

31. Highway Safety Improvement Program. 2023. U.S. Code 23 § 148. https://www.govinfo.gov/app/details/USCODE-2023-title23/USCODE-2023-title23-chap1-sec148, last accessed December 2, 2024.

32. FHWA. 2024. “Tribal Transportation Program Safety Fund” (web page). https://highways.dot.gov/federal-lands/tribal/safety/funds, last accessed December 2, 2024.

33. FHWA. 2024. “AID Demo: Accelerated Innovation Deployment” (web page). https://www.fhwa.dot.gov/innovation/grants/, last accessed December 2, 2024.

34. USDOT. 2024. “Active Transportation Infrastructure Investment Program (ATIIP)” (web page). https://www.transportation.gov/rural/grant-toolkit/active-transportation-infrastructure-investment-program-atiip, last accessed December 2, 2024.

35. USDOT. 2024. “The Rural Surface Transportation Grant Program” (web page). https://www.transportation.gov/grants/rural-surface-transportation-grant-program, last accessed December 2, 2024.

36. USDOT. n.d. “Reconnecting Communities Pilot Grant Program” (web page). https://www.transportation.gov/reconnecting, last accessed December 2, 2024.

37. USDOT. 2024. “Safe Streets and Roads for All (SS4A) Grant Program” (web page). https://www.transportation.gov/grants/SS4A, last accessed December 2, 2024.

38. USDOT. 2024. “SMART Grants Program” (web page). https://www.transportation.gov/grants/SMART, last accessed December 2, 2024.

39. USDOT. 2024. “Thriving Communities Program” (web page). https://www.transportation.gov/grants/thriving-communities, last accessed December 2, 2024.

40. U.S. Department of the Interior. n.d. “Indian Highway Safety Program” (web page). https://www.bia.gov/bia/ojs/dhs, last accessed December 2, 2024.

41. Transportation Safety for Tribes. n.d. “Data Collection” (web page). https://www.tribalsafety.org/data-collection, last accessed December 2, 2024.

42. NHTSA. n.d. “Resources Guide” (web page). https://www.nhtsa.gov/highway-safety-grants-program/resources-guide, last accessed December 2, 2024.

43. FHWA. 2024. “Highway Safety Improvement Program (HSIP)” (web page). https://highways.dot.gov/safety/hsip, last accessed December 2, 2024.

44. FHWA. 2024. “Transportation Alternatives” (web page). https://www.fhwa.dot.gov/environment/transportation_alternatives/, last accessed December 2, 2024.

45. FHWA. 2024. *Proven Safety Countermeasures in Rural Communities*. Publication No. FHWA-SA-24-005. Washington, DC: Federal Highway Administration. https://highways.dot.gov/sites/fhwa.dot.gov/files/2024-01/FHWA_PSCs_in_Rural_Communities_508.pdf, last accessed December 2, 2024.

46. U.S. Congress. 1921. “Public Law 67-87 An Act To amend the Act entitled ‘An Act to provide that the United States shall aid the States in the construction of rural post roads, and for other purposes.’” U.S. Government Publishing Office. https://www.govinfo.gov/app/details/STATUTE-42/STATUTE-42-Pg212, last accessed December 4, 2024.

47. Narváez, G. E., and K. S. Quick. Forthcoming. “Pedestrian Safety: A Critical, Distinctive, and Under-Recognized Priority for Reducing Roadway Injuries in Reservations.” *IHS Primary Care Provider* 44, no. 11.

48. MnDOT. 2024. “MnDOT Statewide Pedestrian System Plan” (web page). https://minnesotago.org/stay-updated/featured-content/mndot-statewide-pedestrian-system-plan, last accessed December 5, 2024.

49. Sharma, A., V. Madaan, and F. D. Petty. 2006. “Exercise for Mental Health.” *Primary Care Companion Journal of Clinical Psychiatry* 8, no. 2: 106. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1470658/, last accessed December 5, 2024.

50. Harvard Health Publishing. 2021. “Exercise Is an All-Natural Treatment to Fight Depression.” *Harvard Health Publishing*. February 2, 2021. https://www.health.harvard.edu/mind-and-mood/exercise-is-an-all-natural-treatment-to-fight-depression, last accessed December 5, 2024.

51. Goodman, A., S. Sahlqvist, and D. Ogilvie on behalf of iConnect Consortium. 2014. “New Walking and Cycling Routes and Increased Physical Activity: One- and 2-Year Finding From the UK iConnect Study.” *American Journal of Public Health* 104: e38–e46. https://doi.org/10.2105/AJPH.2014.302059, last accessed December 5, 2024.

52. FHWA. 2021. “Health in Transportation: Framework for Better Integrating Health into Transportation Corridor Planning” (web page). https://www.fhwa.dot.gov/planning/health_in_transportation/planning_framework/, last accessed December 5, 2024.

53. Vision Zero Network. 2024. “Vision Zero Highlights” (web page). https://visionzeronetwork.org/, last accessed December 5, 2024.

54. Ross, H. E., Jr., D. L. Sicking, R. A. Zimmer, and J. D. Miche. 1993. *Recommended Procedures for the Safety Performance Evaluation of Highway Features.* NCHRP Report No. 350. Washington, DC: National Academy Press. https://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_350-a.pdf, last accessed December 5, 2024.

55. FHWA. 2024. “Additional Safety Resources” (web page). https://highways.dot.gov/federal-lands/tribal/safety/additional-safety-resources, last accessed December 5, 2024.

56. Tefft, B. C. 2011. *Impact Speed and a Pedestrian’s Risk of Severe Injury or Death.* Washington, DC: AAA Foundation for Traffic Safety. https://aaafoundation.org/impact-speed-pedestrians-risk-severe-injury-death/#:~:text=The%20average%20risk%20of%20death,Risks%20vary%20significantly%20by%20age, last accessed December 5, 2024.

57. FHWA. 2016. “Horizontal Curve Safety” (web page). https://safety.fhwa.dot.gov/roadway_dept/horicurves/#:~:text=More%20than%2025%20percent%20of,these%20crashes%20are%20roadway%20departures, last accessed December 5, 2024.

58. FHWA. 2022. *PBCAT Pedestrian and Bicycle Crash Analysis Tool Version 3.0 User Guide*. Publication No. FHWA-HRT-22-071. Washington, DC: Federal Highway Administration.

https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/FHWA-HRT-22-071.pdf, last accessed December 5, 2024.

59. Thomas, F. D., J. Darrah, L. Graham, A. Berning, R. Blomberg, K. Finstad, C. Griggs, M. Crandall, et al. 2022. *Alcohol and Drug Prevalence Among Seriously or Fatally Injured Road Users*. Report No. DOT HS 813 399. Washington, DC: National Highway Traffic Safety Administration. https://www.nhtsa.gov/sites/nhtsa.gov/files/2022-12/Alcohol-Drug-Prevalence-Among-Road-Users-Report_112922-tag.pdf, last accessed December 5, 2024.

60. NHTSA. 2022. *Traffic Safety Facts: 2022 Data.* Publication No. DOT HS 813 590. Washington, DC: National Highway Traffic Safety Administration. https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813590, last accessed December 5, 2024.

61. Insurance Institute for Highway Safety. 2023. "Vehicles With Higher, More Vertical Front Ends Pose Greater Risk to Pedestrians" (web page). https://www.iihs.org/news/detail/vehicles-with-higher-more-vertical-front-ends-pose-greater-risk-to-pedestrians, last accessed December 5, 2024.

62. Monfort, S. S., W. Hu, and B. C. Mueller. 2024. "Vehicle Front-End Geometry and In-Depth Pedestrian Injury Outcomes." *Traffic Injury Prevention (TIP)*, April 2024. https://www.iihs.org/topics/bibliography/ref/2293, last accessed December 5, 2024.

63. FHWA. 2024. "Crash Modification Factors Clearinghouse" (web page). https://cmfclearinghouse.fhwa.dot.gov/, last accessed December 6, 2024.

64. Vanasse Hagen Brustlin, Inc., Virginia Tech Transportation Institute, and FHWA. 2022. *Pedestrian Lighting Primer.* Report No. FHWA-SA-21-087. Washington, DC: Federal Highway Administration. https://safety.fhwa.dot.gov/roadway_dept/night_visib/docs/Pedestrian_Lighting_Primer_Final.pdf, last accessed December 6, 2024.

65. FHWA. 2023. *Manual on Uniform Traffic Control Devices for Streets and Highways*, 11th Edition. Washington, DC: Federal Highway Administration. https://mutcd.fhwa.dot.gov/pdfs/11th_Edition/mutcd11thedition.pdf, last accessed August 2, 2024.

66. FHWA. n.d. "Traffic Calming ePrimer" (web page). https://highways.dot.gov/safety/speed-management/traffic-calming-eprimer, last accessed December 6, 2024.

67. FHWA. n.d. "Research: Pedestrian Safety in Tribal Areas" (web page). https://www.tribalsafety.org/ped-study, last accessed December 20, 2024.

68. Office of the Federal Register, National Archives and Records Administration. 1990. "Americans With Disabilities Act of 1990. Public Law 101-336." Washington, DC: U.S. Government Publishing Office. https://www.govinfo.gov/content/pkg/STATUTE-104/pdf/STATUTE-104-Pg327.pdf, last accessed January 22, 2024.

Recycled
Recyclable

Recommended citation: Federal Highway Administration,
A Systemic Safety Study of Pedestrians in Tribal Areas
(Washington, DC: 2025) https://doi.org/10.21949/1521424

HRT-1/01-25(WEB)E