

Pedestrian Crossings and Safety on Four Anishinaabe Reservations in Minnesota

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16. Abstract (Limit: 250 words) The Minnesota Department of Transportation (MnDOT) has identified Native American as one of six priority populations in the state that face disproportionate risks as pedestrians. This report summarizes results from observations of pedestrian crossing behaviors on four Anishinaabe reservations in northern Minnesota. The University of Minnesota Traffic Observatory (MTO) video-taped and classified pedestrian crossings at 10 intersections identified by Tribal transportation managers as high priority because of perceived risks. Across the intersections, pedestrian crossing volumes during daylight hours ranged from 3 per day to 136 per day. The percent of pedestrian crossings that involved interactions with vehicles ranged from 9% to 54%. Tribal transportation managers from the Bois Forte, Fond du Lac, Grand Portage, and Mille Lacs Bands, MnDOT, county engineers, and the investigators collaborated to identify countermeasures to address risks to pedestrians. Proposed countermeasures varied by intersection and included vegetation removal and line-of-sight improvements, new lighting, crosswalk improvements, Rectangular Rapid Flashing Beacons with advanced warning signs, ADA-compliant ramps, pedestrian education programs, realignment of intersections, and at one intersection a Pedestrian Hybrid Beacon. Prospects for implementation of countermeasures vary by intersection and reservation and are contingent on Tribal and transportation agency budgets, state and county plans for roadway improvements, and categorical grant programs such as Minnesota's Transportation Alternatives Program. Some countermeasures are being implemented, and MnDOT is extending the approach to additional reservations.			
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FINAL REPORT

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EXECUTIVE SUMMARY

Minnesota Walks (MnDOT & MDH 2016), Minnesota's policy framework for advancing safe, convenient walking, identifies Native American as one of six priority populations, with members that are more likely to walk in their everyday lives. Tribal transportation managers identify pedestrian safety as one of their top safety concerns on reservations. The Minnesota Department of Transportation (MnDOT) funded this research project with the University of Minnesota (UMN) to document pedestrian behavior on reservations and identify potential countermeasures to reduce risks to pedestrians. The Advocacy Council on Tribal Transportation (ACTT) served as the Technical Advisory Panel. Transportation managers from the Bois Forte Band of Chippewa; Fond du Lac Band of Lake Superior Chippewa; Grand Portage Band of Ojibwe; and Mille Lacs Band of Ojibwe identified sites where Tribal elders and members were concerned about pedestrian safety. UMN researchers conducted field studies and collaborated with MnDOT, Tribal transportation managers, and county engineers to identify potential countermeasures.

A Collaborative Approach

MnDOT's approach to the project was consultative and collaborative. MnDOT's Tribal liaison advised staff and researchers on project development and implementation. Following ACTT's agreement to participate in the project, MnDOT and the researchers:

- Consulted Tribal transportation managers who identified priority sites for monitoring
- Prepared monitoring plans and obtained approval from Tribes and agencies for monitoring
- Installed video equipment and analyzed videos
- Reviewed findings with Tribal representatives
- Identified potential countermeasures in consultation with Tribes and county engineers

Multiple representatives from each reservation and county engineers participated in meetings to identify potential countermeasures and review opportunities to integrate them into planned projects. MnDOT and researchers reviewed the literature and:

- Met with Tribal representatives to review results and brainstorm countermeasures
- Met with MnDOT safety and district engineers to refine possible countermeasures
- Met jointly with Tribal representatives, MnDOT district engineers, and county engineers to finalize short-lists of countermeasures and opportunities to integrate them into scheduled or planned projects

Monitoring Results

The research team monitored pedestrian traffic at 10 locations on four reservations for between 11 and 20 days between May and August 2017 (Table ES.1). The greatest number of pedestrian crossings observed was at an unmarked crossing on TH 169 in Mille Lacs. The mean daily volume for the days analyzed at this location was 136. More than half of these crossings (54%) involved some interaction

with vehicles, meaning that either the pedestrians or drivers sped-up, slowed, or stopped and waited. At the other nine locations, the mean number of crossings observed per day ranged from a low of 3 to 39. Across sites, the percent of pedestrians who interacted with vehicles ranged from 9% to 33%.

Table ES.1 Pedestrian Crossings on Four Reservations

Reservation	Crossing Locations	Days of Data	Pedestrians	Mean Pedestrians / Day	Maximum Pedestrians / Day	Percent Crossings with Interactions
Bois Forte	CSAH 104 (Gruben Rd) / T-3256 (Farm Rd)	14	548	39.1	70	9.3%
	CSAH 104 (Gruben Rd) / Gold Mine Spur Rd	12	313	26.1	46	16.0%
Fond du Lac	CSAH 7 (Big Lake Rd) / CR 115 (Pinewood Dr)	20	578	28.9	61	28.7%
	CSAH 7 (Big Lake Rd) / CR 114 Trettel Lane)	11	339	30.8	56	29.2%
	CSAH 7 (Big Lake Rd) / CSAH 5 (Brevator Road)	11	33	3.0	8	9.1%
	TH 210 / CSAH 25 (Mission Road)	17	206	12.1	23	33.0%
Grand Portage	TH 61 / Blazes Pit Road (north of Marina Rd)	16	218	13.6	38	21.1%
	TH 61 / Stevens Rd	13	147	11.3	23	19.0%
Mille Lacs Band of Ojibwe	TH 169 / Casino Road	16	63	3.9	11	65.1%*
	TH 169 / north of Casino Road	20	2,728	136.4	210	--
	TH 169 / north of Casino Road	3	375	125.0	155	54.4%

*Estimate includes pedestrians observed waiting at traffic signal at formal crossing.

Potential Countermeasures

MnDOT personnel, Tribal transportation managers, county engineers, and the research team reviewed monitoring results, discussed safety implications, and identified potential countermeasures to reduce risk to pedestrians (Table ES.2). These countermeasures ranged from sight-line improvements to new signs to installation of a Pedestrian Hybrid Beacon.

Lessons Learned

Lessons learned during the project included:

1. *Plans and policies matter.* MnDOT's commitments to priority populations, pedestrian safety, and equity that have been institutionalized in Minnesota Walks and other policies and programs provided a rationale for this project and increased the likelihood of future implementation.
2. *Evidence is essential.* Rural and Tribal transportation managers often lack data about pedestrian activity. Evidence such as simple user counts can inform decision-making. Collaborative efforts can produce evidence that matters.
3. *Risks are relative but real.* Rural pedestrian crossing volumes are low relative to urban volumes, but the risks pedestrians face are real; drivers may not expect to see pedestrians on remote rural roadways. Low volumes are not a reason for no action to reduce risks.
4. *Equity, as well as efficiency, is important.* If efficiency (i.e., numbers of pedestrians) were the sole basis for investments, agencies would rarely fund countermeasures on reservations. Investments on reservations are needed to redress historical marginalization of Tribes and existing disparities in traffic safety.
5. *Engage collaborators early on.* Tribes are sovereign governments with participatory decision-making processes. Pedestrian safety issues on reservations often are addressed in cooperation with county and state highway departments. Meetings to plan research, share and review findings, and discuss implications can increase likelihood of project funding and implementation.

Table ES.2 Potential Countermeasures to Increase Pedestrian Safety on Reservations

Reservation / Roadways /	Potential Countermeasures											Scheduled
	Crosswalk; Signs	Re-alignment	Pedestrian Crossing Signs	Pedestrian Education	Improved Lighting	RRFB & Signs	Access Ramps	Line of Sight Improvements	Access Management	Trails	Other*	
Boise Forte												
CSAH 104-Farm Rd	X	X	X	X							A, B	NA
CSAH 104-Gold Mine Spur Rd	X	X	X		X							NA
Fond du Lac												
Big Lake Rd-Pinewood Dr	X		X			X						NA
Big Lake Rd-Trettel Ln								X				NA
Big Lake Rd-Brevator						X	X		X	X		NA
TH 210 and Mission Rd			X		X					X	C	2019, 2021
Grand Portage												
TH 61-Blazes Pit Rd	X		X	X	X	X	X				D, E	2021
TH 61-Stevens Rd	X		X		X	X					E	2021
Mille Lacs												
TH 169-Casino Dr	<i>None required: crossing controlled with traffic signal.</i>											
TH 169-Ataage Dr	X		X								F	2019-2020
*A=speed warning signs. B=in-street bollards. C=pedestrian landing. D=center turn lane. E=guardrails. F=Pedestrian Hybrid Beacon												

CHAPTER 1: INTRODUCTION

The Minnesota Department of Transportation (MnDOT) has adopted policies, plans, and programs to encourage walking and increase pedestrian safety, including Minnesota GO, the agency's 50-year vision plan; Complete Streets; and Toward Zero Deaths. Minnesota Walks is MnDOT's framework for creating safe, walkable communities for all Minnesotans (MnDOT & MDH 2016). Among other objectives, Minnesota Walks identifies the need to work with priority populations that face disproportionate risks when walking. These populations include rural Minnesotans and Minnesota's 11 Native American populations, the majority of who live on seven Anishinaabe (Chippewa, Ojibwe) reservations and in four Dakota (Sioux) communities. In 2016, MnDOT funded a research and implementation project, *Understanding Pedestrian Travel Behavior and Safety in Rural Settings*, to increase understanding of pedestrian travel behavior and safety on reservations in rural settings. The project was undertaken in collaboration with the Advocacy Council for Tribal Transportation (ACTT), a Minnesota organization concerned with roadway issues on or near Indian reservations and committed to collaborative partnerships to assess common Tribal issues. ACTT develops policy and legislation, educates and creates awareness about Tribal transportation issues, and identifies successful management practices. This report summarizes the results of this project.

Chapter 2 is a brief literature review that describes issues related to pedestrian safety in rural areas and on Tribal reservations, including strategies and countermeasures to reduce risk. Chapter 3 summarizes background information for the project, the process MnDOT followed to initiate collaboration with the Tribes and select sites for study, and the methods used to observe and describe pedestrian crossings, interpret results, and identify potential countermeasures. Chapter 3 also provides a brief over the 10 sites on four reservations included in the study. The Anishinaabe Bands who participated in the study were the Bois Forte Band of Chippewa; Fond du Lac Band of Lake Superior Chippewa; Grand Portage Band of Ojibwe; and Mille Lacs Band of Ojibwe. Chapter 4 presents results in four sections, with each section designed as a standalone summary of investigations at one of the four reservations. These summaries include additional details about monitoring, images of each monitoring location, summaries of pedestrian counts and interactions with vehicles, and lists of countermeasures that potentially could be implemented to address risks identified at each project site. Chapter 4 also describes some outcomes of the study, including the planned implementation of a pedestrian hybrid beacon (PHB) on Trunk Highway 169 site on the Mille Lacs Reservation. Chapter 5 presents conclusions and discusses their implications for pedestrian safety in rural Minnesota.

This project also included development and delivery of case study materials for MnDOT to use when presenting project findings. These materials included a two-page project summary, a draft manuscript suitable for publication in a peer-reviewed journal, and a PowerPoint slide deck. The two-page project summary is included as Appendix A of this report. The draft manuscript is available from the authors. Copies of PowerPoint slides also are available from the authors.

Because this project led to implementation of countermeasures and additional Tribal governments expressed interest in participation in similar investigations, MnDOT funded a follow-up study titled, Understanding Pedestrian Travel Behavior and Safety in Rural Settings, Phase 2. At the time this Phase 1 report was completed (2020), the Phase 2 project, which will include evaluation of the pedestrian hybrid beacon on the Mille Lacs Reservation and other Phase 1 countermeasures that may be implemented, was scheduled to be completed in 2023.

CHAPTER 2: PEDESTRIAN SAFETY IN RURAL AREAS

The Minnesota Department of Public Safety (MnDPS), Office of Traffic Safety annually reports traffic-related crashes, deaths, and injuries in Minnesota. In 2018, 1,017 crashes involving pedestrians and vehicles were reported in Minnesota (MnDPS 2019). These crashes killed and injured 45 and 987 pedestrians, respectively. Eighty (7.9%) of these crashes occurred in rural areas with populations less than 5,000. Although these rural crashes accounted for just 6.5% of all pedestrian injuries, they accounted for 13 (29%) of all pedestrian fatalities. Pedestrians in rural areas in Minnesota are more likely to die than pedestrians in urban areas if they are involved in a crash with a motor vehicle. MnDOT and local governments, including counties, municipalities, and sovereign tribal governments have adopted many policies, implemented many programs, and invested millions of dollars to reduce traffic-related crashes, deaths, and injuries, including the disproportionate risk of death faced by pedestrian in rural areas.

Traffic safety problems on American Indian Reservations are particularly severe. A growing number of studies have documented the disproportionate rates of fatalities and injuries suffered by American Indians relative to other races and ethnicities (Quick et al. 2019; Iragavarapu et al. 2015; West and Naumann 2011; Mickleson and Corbett 2007; Hilton 2006; Subramanian 2005; Grossman et al 1997). Complex sets of factors, including cultural considerations, must be addressed to reduce crashes, fatalities and injuries. Tribal transportation managers, who often are responsible for substantial miles of low-volume roadways that serve dispersed populations, cite road quality engineering and repair; reckless driving; seatbelt/car seat use; and pedestrian safety as their top safety-related concerns (Quick et al. 2019). Traffic safety experts assert that coordination, cooperation, and communication among sovereign Tribal governments and county and state departments of transportation is necessary to address the disparities in fatality and injury rates (Martinez et al. 2009; Kozak and White 2003). Recent studies also have described the potential for systematic approaches to address these concerns. Researchers working in collaboration with Tribal transportation leaders and other safety stakeholders have shown that these systematic approaches can help overcome the “limited resources, lack of coordination across jurisdictions, rural nature of many of the roadways, and lack of crash data” that have complicated efforts by tribes to implement effective risk reduction programs (Shinstine and Ksaibati 2013, p. 80; Shinstine and Ksaibati 2015; Shinstine, et al. 2015; Nazneen, et al. 2018; Terrill & Ksaibati 2018; Wempel and Colling 2014). Fewer studies, however, have documented specific strategies or countermeasures to be implemented at specific, high-priority locations identified by Tribal governments and partners. In 2008, the Minnesota Tribal Road Safety Summit described ongoing efforts to increase traffic safety on reservations and identified the need to assess implementation of measures to increase safety (Cambridge Systematics 2008).

The cultural, governance, and administrative contexts for implementation of countermeasures on reservations are different than in other rural communities in Minnesota but, from a transportation or public works perspective, the factors that contribute to crashes and the types of engineering interventions or countermeasures to reduce crashes are relevant both on and off reservations. For example, Minnesota Trunk Highways cross and connect reservations and other rural communities.

Depending on traffic volumes, roadway geometry, speed limits, and other site-specific factors, crashes may be more or less likely, and countermeasures such as Pedestrian Hybrid Beacons with marked crosswalks may more or less appropriate for implementation.

County safety plans in Minnesota identify factors associated with crashes in rural areas. Most crashes occur at sites not considered high-crash locations, and in Greater Minnesota, 86% of severe crashes occur on rural roads (CH2M Hill 2016). On rural two-lane roads, most crashes are segment-related and not intersection-related, and of these, most crashes involve lane departure. At intersections, most rural crashes involve right angle collisions. Other factors associated with crashes at rural intersections include the proximity of roadway curves, the presence of adjacent development, whether the previous stop was greater than five miles distance, and the crossing volumes. With respect to pedestrian crashes in 2018, the MnDPS (2019, p. 81) reported that, among all contributing factors included in police reports, 59% were attributed to motor vehicle drivers and 41% were attributed to pedestrians. For motor vehicle drivers, failure to yield right of way was the most frequently cited factor (20%) while for pedestrians, the most frequently cited contributing factor was darting/dashing into the roadway (20%). Approximately 53% and 61% of pedestrians killed and injured, respectively, were walking across traffic in the roadway.

The Federal Highway Administration (FHWA), national transportation associations, MnDOT, and many other state transportation agencies have published general guides for addressing rural and Tribal transportation safety problems and the types of factors associated with crashes that kill and injure pedestrians (e.g., https://safety.fhwa.dot.gov/local_rural/training/fhwasa14072/isrltrst.pdf; accessed 12/20/2019; MnDOT 2019; MnDOT 2013).

Table 2.1 identifies countermeasures from these guides that potentially could be implemented to reduce risk to pedestrians, the type of risk or safety problem the countermeasure addresses, and factors to be considered in implementation. The general categories of countermeasures include pedestrian actuated controls, roadway markings, signs, roadway or lane narrowing, improved lighting, and education. The relevance and appropriateness of each measure depends on site-specific factors such as posted traffic speeds, roadway geometry, and other factors. Most of these countermeasures are non-structural, do not involve roadway reconstruction, and therefore are relatively low-cost. Some countermeasures have been approved and are included in the FHWA's Manual of Uniform Traffic Control Devices (MUTCD), while others (e.g., zig-zag lane markings) are considered experimental and would require FHWA approval. Many of these countermeasures potentially are relevant to the locations monitored in this study.

Table 2.1 Examples of Countermeasures to Increase Rural Pedestrian Safety

Countermeasure	Safety Issue(s) Addressed		Considerations
Pedestrian Actuated Controls			
Rectangular Rapid Flashing Beacon	<ul style="list-style-type: none"> • Conflicts at crossing locations • Drivers not yielding to pedestrians in crosswalks 		<ul style="list-style-type: none"> • Enables pedestrians to warn motorists of crossing • Some pedestrians may not actuate if inconvenient or perceived lack of need
Roadway Markings			
Zig-Zag Lane Markings	<ul style="list-style-type: none"> • Excessive vehicular speed • Unexpected presence of pedestrians 		<ul style="list-style-type: none"> • Placement along approach to intersections may increase motorist awareness • Motorists may not understand purpose • Is experimental practice; requires evaluation
Transverse Lane Markings	<ul style="list-style-type: none"> • Excessive vehicular speed • Unexpected presence of pedestrians 		<ul style="list-style-type: none"> • Transverse bars or chevrons spaced on roadway to give drivers the perception they are speeding up • Placement along approach to intersections may increase motorist awareness • Motorists may not understand purpose • May require evaluation
Pavement Word, Symbol, and Arrow Markings: PED XING	<ul style="list-style-type: none"> • Conflicts at crossing locations • Excessive vehicle speed • Unexpected presence of pedestrians 		<ul style="list-style-type: none"> • Alerts motorists to potential presence of pedestrians crossing • Suitability may depend on roadway speed limit • Can be used in tandem with signs
Crosswalk Visibility Enhancements (e.g., new or more visible markings)	<ul style="list-style-type: none"> • Conflicts at crossing locations • Excessive vehicle speed • Unexpected presence of pedestrians 		<ul style="list-style-type: none"> • Alerts motorists to potential presence of pedestrians • Could provide pedestrians false sense of security • May require “formalizing” existing, informal midblock crossings

Table 2.1 Continued. Examples of Countermeasures for Rural Pedestrian Traffic Safety.

Countermeasure	Safety Issue(s) Addressed	Considerations
Signs		
Intersection Warning Signs and Plaques	<ul style="list-style-type: none"> • Conflicts at crossing locations • Unexpected presence of pedestrians 	<ul style="list-style-type: none"> • MN MUTCD recommends use of supplemental plaques with the legend AHEAD or XX FEET to inform motorists they are approaching a point where crossing activity might occur
Pedestrian Warning Signs and Plaques	<ul style="list-style-type: none"> • Conflicts at crossing locations • Unexpected presence of pedestrians 	<ul style="list-style-type: none"> • MUTCD recommends use of educational plaques with the legend AHEAD or XX FEET to inform motorists they are approaching a point where crossing activity might occur
Share the Road Warning Signs and Plaques	<ul style="list-style-type: none"> • Unexpected presence of pedestrians or bicyclists 	<ul style="list-style-type: none"> • The MUTCD notes a combined Bicycle/Pedestrian sign may be used where both bicyclists and pedestrians might be crossing the roadway
Speed feedback signs	<ul style="list-style-type: none"> • Excessive vehicular speed 	<ul style="list-style-type: none"> • Requires power source
Walk on Left Facing Traffic Signs	<ul style="list-style-type: none"> • Unexpected presence of pedestrians 	<ul style="list-style-type: none"> • Increases pedestrian visibility to motorists and pedestrian awareness of vehicles
Bicycle Wrong Way Sign and Ride with Traffic Plaque	<ul style="list-style-type: none"> • Bicyclists riding wrong-way on roadways • No safety issues addressed directly 	<ul style="list-style-type: none"> • May be mounted on back of other signs
Dakota and Ojibwe Language Signing Program (boundaries and geographical features)	<ul style="list-style-type: none"> • MN MUTCD generally does not provide for the display of alternative or supplemental languages on warning or regulatory signs 	<ul style="list-style-type: none"> • May increase motorist awareness that roadway is on a reservation
Roadway or Lane Narrowing		
Curb extension (bulbout, bumpout)	<ul style="list-style-type: none"> • Conflicts at crossing locations • Excessive vehicle speed 	<ul style="list-style-type: none"> • Installation depends on roadway type and speed limits • Can be implemented temporarily with permit and temporary devices (e.g., bollards, cones)
Lane narrowing with lane striping or bollards or cones (temporary)	<ul style="list-style-type: none"> • Excessive speed 	<ul style="list-style-type: none"> • Can be implemented temporarily with permit and temporary devices (e.g., bollards, cones)

Table 2.1 Continued. Examples of Countermeasures for Rural Pedestrian Traffic Safety.

Countermeasure	Safety Issue(s) Addressed	Considerations
Improved night-time lighting		
<ul style="list-style-type: none"> • Upgrade existing or install new lighting 	<ul style="list-style-type: none"> • Conflicts at crossing locations 	<ul style="list-style-type: none"> • Increases visibility of pedestrians • May require “formalizing” informal crossing locations
Education		
<ul style="list-style-type: none"> • Design and conduct program for motorists, cyclists, and pedestrians 	<ul style="list-style-type: none"> • Conflicts at crossing locations • Excessive vehicle speed • Unsafe cycling behavior • Unsafe pedestrian behavior 	<ul style="list-style-type: none"> • Often undertaken in conjunction with implementation of new countermeasures or enforcement
Enforcement		
<ul style="list-style-type: none"> • Coordinate speed limit enforcement with local authorities 	<ul style="list-style-type: none"> • Excessive vehicle speed 	<ul style="list-style-type: none"> • Often undertaken in conjunction with implementation of new countermeasures or enforcement

CHAPTER 3: BACKGROUND, APPROACH, AND METHODS

3.1 BACKGROUND AND APPROACH

Minnesota Walks is Minnesota’s “statewide framework for creating safe, desirable and convenient places to walk and roll” (<http://www.dot.state.mn.us/peds/documents/planning-research/minnesota-walks-2017-final.pdf>, p. 8). MnDOT and the Minnesota Department of Health (MDH) created the framework “to guide planning, decision-making and collaboration for government agencies, organizations, policymakers, and public and private entities across the state” (IBID, p. 8). The framework identifies six sub-populations who are more likely to walk in their daily lives and therefore are “priority populations” for improved pedestrian infrastructure (IBID, p. 16). These priority populations are residents of “small rural communities, children and youth, Native American populations, people with low-income living in urban communities, older adults, and people with disabilities” (IBID, p. 16). MnDOT initiated this research project in 2016 to increase understanding of pedestrian behavior among Native American populations and factors that affect risks and safety of walking on reservations.

MnDOT staff from the Office of Transit and Active Transportation initially presented the project at an April, 2016 meeting of ACTT and invited participation from the Tribes. Representatives from four Anishinaabe Bands expressed interest in collaboration. Figure 3.1 is a map that shows the locations of the reservations of the four Bands who collaborated in the project:

- Bois Forte Band of Chippewa;
- Fond du Lac Band of Lake Superior Chippewa;
- Grand Portage Band of Ojibwe; and
- Mille Lacs Band of Ojibwe.

The ACTT agreed to serve as the Technical Advisory Panel (TAP) for the project. A MnDOT staff member served as liaison to ACTT and as Technical Liaison for the project. Field research was conducted by researchers with the Minnesota Traffic Observatory (MTO) at the University of Minnesota (UMN). Key substantive project tasks included:

- Consultation with Tribal representatives about pedestrian safety and selection of monitoring sites;
- Preparation of monitoring plans and monitoring of pedestrian behavior through video observation;
- Video reduction and data analysis; and
- Identification of potential countermeasures to address observed risks.

The principal objectives were to identify risks faced by pedestrians on each reservation and provide evidence for further action to address risks. Because the project was designed and funded as a research project, it did not include funds for design or implementation of countermeasures. The number of sites for monitoring on each reservation was limited by the funds available for the project.

Anishinaabe Reservations Collaborating in Study

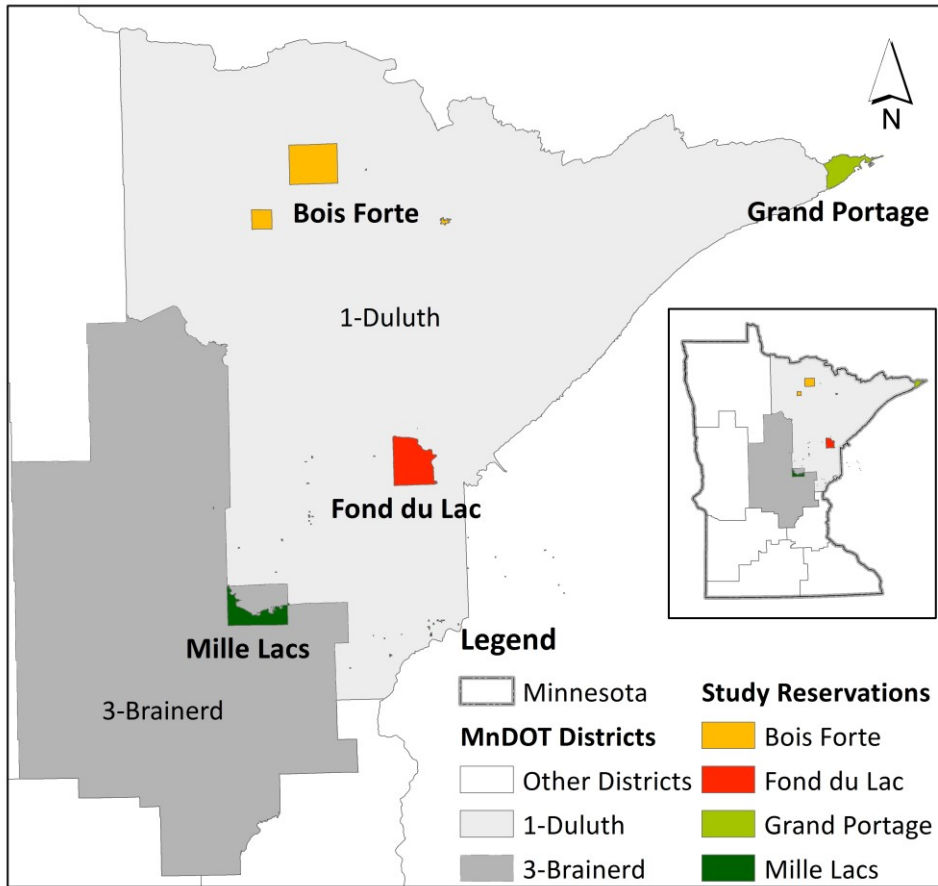


Figure 3.1 Anishinaabe Reservations Collaborating in Study

3.2 CONSULTATION WITH TRIBES, SITE SELECTION, AND OVERVIEW OF SITES

MnDOT convened meetings with Tribal representatives from each of the four reservations, and MnDOT staff and members of the research team traveled to the reservations for preliminary field investigations. Tribal representatives described pedestrian activity and specific places where people had expressed concerns about risks. Participants in meetings then visited sites to assess strategies for monitoring. Although the roadway context and safety-related issues varied across the four reservations, each of the sites of concern involved pedestrians crossing state or county highways, mainly at unmarked crossings near destinations for employment, shopping, or other services such as casinos, trading posts, grocery stores, schools, or Tribal centers. Following the initial site visits, the research team determined it could monitor two to four locations on each of the four reservations.

Table 3.1 lists the 10 sites selected for study, including characteristics associated with pedestrian crossings and safety at each site. Two sites were monitored on each of the Bois Forte, Grand Portage, and Mille Lacs Reservations; four sites were monitored on the Fond du Lac Reservation. At five of the sites, a Minnesota Trunk Highway (TH) was the highest volume roadway; at the other five sites, a County

State Aid Highway (CSAH) was the highest volume roadway. The minor roads at seven were county or reservation roads. Nine of the crossings were unmarked; two of these locations, one in Grand Portage and one in Mille Lacs, were not at intersections. Nearby land uses likely associated with pedestrian crossings included small residential subdivisions, casinos, grocery stores, Tribal government offices and facilities, and other places of employment or destination. Additional information and pictures of each location are included in the reservation summaries (Chapter 4).

To increase understanding of the safety history at each site, the research team obtained information about crashes that occurred between 2006 and 2015 (Table 3.2). In general, on both reservations and non-reservations, not all crashes are reported to or investigated by police, so police reports are not filed for some crashes. The frequency of non-reporting is believed to be higher on reservations. Because the MDPS crash database is built from police crash reports, analyses based on it are underestimates of the actual number or frequency of crashes. It is likely that the number of crashes that actually occurred at near these 10 sites during the 10 years summarized was higher than the total reported here. The Minnesota Department of Public Safety (MDPS) crash database includes 50 crashes across the 10 sites, one of which resulted in a fatality and serious injury, 25 that resulted in other, less-serious injuries, and 24 that included property damage only. None of these crashes involved non-motorists (i.e., pedestrians or bicyclists). Most (34) of these crashes, including the crash that involved a fatality/serious injury, occurred on the Fond du Lac Reservation where four sites were studied. Eleven occurred on the Mille Lacs Reservation on TH 169, and five occurred on TH 61 in the Grand Portage Reservation. None occurred at the intersections studied on the Bois Forte Reservation.

Table 3.1 Site Locations

Reservation	Crossing Locations	Crossing Type	Nearby Site Features
Bois Forte Band of Chippewa	CSAH 104 (Gruben Rd) / T-3256 (Farm Rd)	Unmarked	<ul style="list-style-type: none"> • Small residential subdivisions • Vermillion Pedestrian/Bike Trail • Bois Forte Boys and Girls Club • Tribal Government/Community Center
	CSAH 104 (Gruben Rd) / Gold Mine Spur Rd	Unmarked	<ul style="list-style-type: none"> • Small residential subdivisions • Fortune Bay Casino • Wilderness Golf Course at Fortune Bay • Bois Fort Heritage Museum
Fond du Lac Band of Lake Superior Chippewa Cloquet	CSAH 7 (Big Lake Rd) / CR 115 (Pinewood Dr)	Unmarked	<ul style="list-style-type: none"> • Small residential subdivisions • Fond du Lac Gas and Grocery • Carmen’s Bar and Restaurant
Cloquet	CSAH 7 (Big Lake Rd) / CR 114 Trettel Lane)	Unmarked	<ul style="list-style-type: none"> • Small residential subdivisions • Fond du Lac Reservation Police
Cloquet	CSAH 7 (Big Lake Rd) / CSAH 5 (Brevator Road)	Unmarked	<ul style="list-style-type: none"> • Small residential subdivisions • Fond du Lac Ojibwe High School • Fond du Lac Reservation offices • Fond du Lac Natural Resources offices
Sawyer	TH 210 / CSAH 25 (Mission Road)	Unmarked	<ul style="list-style-type: none"> • Small residential subdivisions • Gas station/general store/US Post Office
Grand Portage Band of Ojibwe	TH 61 / Blazes Pit Rd (north of Marina Rd)	Unmarked (from path in woods)	<ul style="list-style-type: none"> • Small residential subdivisions • Trading Post • Grand Portage Lodge and Casino
	TH 61 / Stevens Rd	Unmarked	<ul style="list-style-type: none"> • Small residential subdivisions • Grand Portage Tribal offices • Grand Portage Tribal School • Grand Portage Monument
Mille Lacs Band of Ojibwe	TH 169 / Casino Road	Marked	<ul style="list-style-type: none"> • Small residential subdivisions • Grand Casino Mille Lacs
	TH 169 / north of Casino Road	Unmarked (from break in fence)	<ul style="list-style-type: none"> • Small residential subdivisions • Grand Market (groceries) • Grand Makwa Cinema • Grand Casino Mille Lacs

*TH = Trunk Highway **CSAH = County State Aid Highway

Table 3.2 Crashes within 500-Foot Buffer of Intersection, 2006 – 2015

Intersection		Fatal and Serious Injury	Injury	Property Damage Only	Non-motorist Crashes	Total
Bois Forte	CSAH 104 (Gruben Rd) / T-3256 (Farm Rd)	0	0	0	0	0
	CSAH 104 (Gruben Rd) / Gold Mine Spur Rd	0	0	0	0	0
Fond Du Lac	CSAH 7 (Big Lake Rd) / CR 115 (Pinewood Dr)	0	4	3	0	7
	CSAH 7 (Big Lake Rd) / CR 114 Trettel Ln)	0	5	3	0	8
	CSAH 7 (Big Lake Rd) / CSAH 5 (Brevator Rd)	1	5	2	0	8
	TH 210 / CSAH 25 (Mission Rd)	0	8	3	0	11
Grand Portage	TH 61 / Blazes Pit Rd	0	1	2	0	3
	TH 61 / Stevens Rd	0	1	1	0	2
Mille Lacs	TH 169 / Casino Road	0	1	10	0	11
Total		1	25	24	0	50

3.3 MONITORING METHODS AND DATA ANALYSIS

Following site identification, the research team reviewed technical options for monitoring pedestrian crossings, discussed options with MnDOT and Tribal representatives, and prepared monitoring plans. The research team determined that the only feasible means of observing pedestrian crossings was through installation of video cameras and manual reduction of video recordings. Although other methods of monitoring (e.g., use of infrared sensors) were considered, these alternatives were rejected as infeasible because of the variability in pedestrian crossing behaviors at each site. Following approval of the general approach by MnDOT and the Tribes, the MTO applied for the permits required for installation of video cameras. After acquiring the permits and obtaining authorization of Tribal representatives, the MTO installed customized battery-powered traffic surveillance systems at each of the 10 crossings.

The MTO traffic surveillance systems include a high-resolution video camera mounted to an extendable mast or directly to existing infrastructure with non-invasive steel bands. A weatherproof steel container houses recording equipment and batteries used to power the equipment. The entire system attaches non-invasively to conveniently placed poles or trees. Figure 3.2 lists the equipment in the system. Figure 3.3 includes images of a standard deployment.

Components of Traffic Monitoring System

Steel all-weather enclosure



- Includes recording equipment and independent power
- Able to autonomously record for up to 4 weeks
- High voltage stickers used only as deterrent for tampering (12v system)
- Mount uses rubber stopper and rubber-enclosed chain to non-invasively attach
- Secondary chain around base of unit for security
- Contact information (including business cards) mounted to units



Inflatable mast (if applicable)

- Extends up to nearly 30 feet
- Secondary stabilization point at roughly 7 feet from ground
- Secured with rubber-ended brace arm and metal bands



High resolution, all weather video camera mounted at top of mast (1080 pixel)

Physical characteristics

- Footprint: 3 foot x 3-4 foot
- Mount points: 3 foot (main), 7 foot (secondary)
- Power: 3-6 deep cycle (75AH@12V)
- Weight: 150-200 lbs. depending on # of batteries deployed

Figure 3.2 Equipment Used in Minnesota Traffic Observatory Monitoring System



Figure 3.3 Images of Standard MTO Monitoring System Used in Project.

The MTO set a goal of monitoring long enough at each location to observe at least 200 pedestrian crossings. The video cameras were operable only during daylight hours; electronic timers were used to stop video during night-time hours when traffic could not be observed and to re-start at daybreak. Each video camera continued operating until its batteries were dead. Given this procedure, the number of days each video camera operated varied across sites. The number of observations that were obtained also varied across sites.

The number of days the MTO monitored pedestrian crossings at each site ranged from 11 days at two crossings on the Fond du Lac Reservation (i.e., CSAH 7 and Trettel and Brevator, respectively) to 20 days at two locations (i.e., CSAH 7 and Pinewood on the Fond du Lac Reservation and on the Mille Lacs Reservation at the unmarked crossing on TH 169 through the gap in the fence along the a frontage road; Table 3.3). The total number of pedestrian crossings observed ranged from a low of 63 over 16 days at the formal, marked crosswalk across TH 169 in Mille Lacs to a high of 2,728 over 20 days at the informal, unmarked crosswalk across TH 169 near the break in the fence along the frontage road.

The MTO used standard protocols to observe and reduce the video, count the number of crossings, classify and code interactions, and analyze results. Interactions were defined as crossings in which (a) pedestrians altered behaviors in anticipation of, or because of, interactions with a vehicle, or (b) drivers altered behaviors in the presence of pedestrians. Examples of interactions include pedestrians waiting on the shoulder or on the median while vehicles pass or drivers slowing or stopping to allow pedestrians to cross. Data analyses were limited to calculation and presentation of simple descriptive statistics. The project was exploratory in nature, and the scope-of-work did not call for modeling of traffic flows or pedestrian crossings or for formal analyses of risk.

Table 3.3 Summary of Site Monitoring

Reservation	Crossing Locations	Monitoring Begin Date	Monitoring End Date	Days Video Camera Deployed	Pedestrian Crossings Observed
Bois Forte Band of Chippewa	CSAH 104 (Gruben Rd) / T-3256 (Farm Rd)	5/30/17	6/13/17	15	548
	CSAH 104 (Gruben Rd) / Gold Mine Spur Rd	5/30/17	6/11/17	13	313
Fond du Lac Band of Lake Superior Chippewa Cloquet	CSAH 7 (Big Lake Rd) / CR 115 (Pinewood Dr)	7/27/2017	8/13/2017	20	578
Cloquet	CSAH 7 (Big Lake Rd) / CR 114 (Trettel Lane)	7/27/2017	8/07/2017	11	339
Cloquet	CSAH 7 (Big Lake Rd) / CSAH 5 (Brevator Road)	7/27/2017	8/07/2017	11	33
Sawyer	TH 210 / CSAH 25 (Mission Road)	7/27/2017	8/13/2017	17	206
Grand Portage Band of Ojibwe	TH 61 / Blazes Pit Road (north of Marina Rd)	5/23/2017	6/09/2017	16	218
	TH 61 / Stevens Rd	5/23/2017 6/20/2017	5/31/2017 6/24/2017	13	147
Mille Lacs Band of Ojibwe	TH 169 / Casino Road	5/17/2017 7/14/2017	5/24/2017 7/23/2017	16	63
	TH 169 / north of Casino Road	5/17/2017	5/24/2017	20***	2,728
		7/14/2017	7/23/2017	(3)	(375)

*TH = Trunk Highway

**CSAH = County State Aid Highway

*** Counts only: 20 days; detailed reduction (interactions): 3 days

3.4 IDENTIFICATION OF POTENTIAL COUNTERMEASURES

The final substantive task involved identification of potential countermeasures that could be pursued to address safety concerns identified at each crossing. The process used to identify potential countermeasures was iterative and consultative:

- Meetings with Tribal representatives at each reservation to discuss monitoring results, explore concerns, and brainstorm strategies and countermeasures to address concerns;
- Additional review of the literature, including FHWA, MnDOT, and other guides that address pedestrian risk in rural areas, to develop expanded lists of potential countermeasures;
- Meetings with MnDOT safety and district engineers to review and refine the expanded lists to ensure suitability and consistency with agency policies and priorities; and
- Follow-up meetings with Tribal representatives, MnDOT district engineers, and County engineers to identify countermeasures to be included on short lists for future consideration as new projects are planned or funds for local agencies become available.

Given similarities in roadways, contexts, pedestrian volumes, and safety concerns across sites, many of the same countermeasures eventually were identified as relevant across sites. The principal exception was on the Mille Lacs reservation where the volumes of pedestrians crossing TH 169 at an informal crossing accessed through a break in the fence warranted more complex and expensive countermeasures. Details about these potential countermeasures are presented in Chapter 4.

CHAPTER 4: MONITORING RESULTS, SAFETY CONCERNS, AND POTENTIAL COUNTERMEASURES

The MnDOT technical liaison (TL) and research team summarized results for each reservation separately in short memos and then met with Tribal transportation personnel on each reservation to discuss concerns and brainstorm potential countermeasures. The TL and the research team then reviewed lists of potential countermeasures with MnDOT safety and district engineers to determine which potential countermeasures would be feasible and appropriate. The TL, the research team, the Tribal representatives, the MnDOT district engineers, and the respective county engineers then met a final time to confirm working lists of potential countermeasures that could be implemented as planned roadway improvement projects were undertaken or new funding sources were identified.

Traffic engineers typically follow procedures outlined in the Minnesota Manual of Uniform Traffic Control Devices (MUTCD) when assessing the need for measures to reduce risks at pedestrian crossings. For example, traffic engineers apply warrants to assess the need for site specific investigations to determine whether controls such as Pedestrian Hybrid Beacons (PHBs) or traffic signals are needed. Three factors used to apply warrants are vehicular traffic volumes, pedestrian traffic volumes, and crossing width. For example, minimum pedestrian crossing volumes for warrants for PHBs are 20 pedestrians per hour. Based on the traffic volumes observed, warrants for PHBs and traffic signals were not met at these sites. However, warrants are intended to assess cumulative level of risk and to prioritize or justify investments in treatments at particular crossings in complex networks that may comprise hundreds or thousands of crossings. Warrants do not describe a level of risk to individual pedestrians, and the fact that warrants are not met does not mean that pedestrians who cross roads at the sites monitored in this study face no risk. In addition, a limitation of applying warrants to existing traffic levels is the number of pedestrians may be suppressed because of perceived or actual risk. Opportunities to reduce risk for pedestrians crossing at these locations exist. A challenge for state, county, and Tribal transportation managers is to align investments in interventions with levels of risk.

Detailed monitoring results for each location on each reservation and potential countermeasures specific to crossing locations are presented in Sections 4.1 through 4.4 of this Chapter. Each location summary includes pictures of monitoring locations, a summary of monitoring results, and discussion of strategies and potential countermeasures to reduce risk and increase safety.

Monitoring results for all locations on the four reservations are summarized in Table 4.1. The greatest number of pedestrian crossings observed was at an unmarked crossing in Mille Lacs where, on average, between 125 and 136 pedestrians crossed TH 169 during daylight hours. More than half of these crossings (54%) involved some interaction with vehicles, meaning that either the pedestrians or drivers sped-up, slowed, or stopped and waited. At the other nine locations, the mean number of crossings observed per day ranged from a low of 3 at the marked crossing on TH 169 in Mille Lacs to 39 at the CSAH 104 (Gruben Road)-Farm Road intersection on the Bois Forte Reservation. Among the other nine sites, with the exception of the formal crosswalk in Mille Lacs on 169 where 65% of pedestrians interacted with vehicles, the percentage of pedestrians who interacted with vehicles ranged from 9%

(CSAH 104 (Gruben Road)-Farm Road intersection) at the Bois Forte Reservation to 33% on the Fond du Lac reservation (TH 210-Mission Road intersection in Sawyer).

Table 4.1 Summary of Monitoring Results.

Reservation	Crossing Locations	Days of Data	Total Pedestrians Observed	Mean Pedestrians / Day	Maximum Pedestrians / Day	Mean Vehicles Per Day Observed	Total Pedestrians with Interactions	Percent Pedestrians with Interactions
Bois Forte	CSAH 104 (Gruben Rd) / T-3256 (Farm Rd)	14	548	39	70	845	51	9.3%
	CSAH 104 (Gruben Rd) / Gold Mine Spur Rd	12	313	26	46	2,033	50	16.0%
Fond du Lac	CSAH 7 (Big Lake Rd) / CR 115 (Pinewood Dr)	20	578	29	61	4,034	166	28.7%
	CSAH 7 (Big Lake Rd) / CR 114 Trettel Lane)	11	339	31	56	6,497	99	29.2%
	CSAH 7 (Big Lake Rd) / CSAH 5 (Brevator Road)	11	33	3	8	1,242	3	9.1%
	TH 210 / CSAH 25 (Mission Road)	17	206	12	23	4,086	68	33.0%
Grand Portage	TH 61 / Blazes Pit Road (north of Marina Rd)	16	218	14	38	2,077	46	21.1%
	TH 61 / Stevens Rd/	13	147	11	23	2,111	28	19.0%
Mille Lacs Band of Ojibwe	TH 169 / Casino Road	16	63	4	11	14,246	41	65.1%*
	TH 169 / north of Casino Road	20	2,728	136	210	--	--	--
	TH 169 / north of Casino Road	3	375	125	155	17,342	204	54.4%

* Estimate includes pedestrians observed waiting at traffic signal at formal crossing.

With the exception of the site in Mille Lacs where the volume of informal crossings raised special concerns, Tribal leaders on each reservation acknowledged crossing volumes were low relative to urban areas but noted that risk exists because drivers may not expect to see pedestrians along or crossing trunk or county highways in these rural locations. Tribal leaders helped to identify countermeasures that might help increase awareness of pedestrians and thereby reduce risk. Examples of countermeasures that were discussed include pedestrian actuated controls such as Rectangular Rapid Flashing Beacons (RRFBs); multiple types of roadway markings and signs; roadway or lane narrowing; improved night-time lighting; education; and enforcement.

Specific concerns varied by site and with the magnitude of pedestrians and interactions. For example, the Mille Lacs Tribal representative called for copies of results immediately after learning about the numbers of pedestrians crossing TH 169 through the gap in the fence because they were higher than anticipated and he wanted to use findings to support proposals for funding. At Bois Forte, the highest volume of pedestrians, including children, was observed crossing near the CSAH 104 (Gruben Road)-Farm Road intersection near the Boys and Girls Club and Tribal government center. In Fond du Lac, the pedestrian crossings at the TH 210-Mission Road intersection in Sawyer were of particular interest because the Band is planning a trail along Mission Road to provide access to the grocery store and post office. In Grand Portage, more pedestrians, including children, were observed crossing TH 61 from a path from a subdivision through the woods than at an intersection further to the north.

As noted in the Introduction to this report, this research project did not include funding for implementation of countermeasures to address the risks identified at these locations. The MnDOT TL stressed this point in final meetings with Tribal representatives and district and county engineers. Participants in the meetings agreed the evidence produced in the study helped to document pedestrian traffic volumes and was useful in identifying relatively low-cost measures to reduce risk and increase safety that could be implemented as roadway improvement projects are implemented or new sources of funding are identified. For example, in Grand Portage, Tribal representatives and engineers discussed how different countermeasures could be integrated into a road resurfacing project for which financing was available and already was scheduled for the following fiscal year year.

4.1 BOIS FORTE BAND OF CHIPPEWA

Representatives of the Bois Forte Band identified two intersections along CSAH 104 where concerns about pedestrian safety had been raised by Band members:

- CSAH 104 (Gruben Road) and Farm Road (T-3256), and
- CSAH 104 (Gruben Road) and Gold Mine Spur Road.

They explained that residents from nearby homes and subdivisions, including un-accompanied children, use the Vermillion Multiuse Trail that parallels CSAH 104 to walk to the Boys and Girls Club and the Tribal Government Center, including the health clinic, near Farm Road, and, further west, to the Fortune Bay Casino on Gold Mine Spur Road.

Representatives of the Band also noted that counts of users on the Vermillion Trail would be helpful in developing plans to expand the trail network on the reservation. The Vermillion Trail parallels CSAH 104, running along its northern side. They identified two locations on the trail where monitoring potentially could capture variations in patterns of use. These locations were approximately 50 yards west of Farm Road and 50 yards west of Cemetery Road. MnDOT and the research team installed infrared trail monitors at these locations. The trail monitor near Cemetery Road malfunctioned, however, and no data were collected at this location.

4.1.1 Bois Forte Monitoring Locations

4.1.1.1 CSAH 104 (Gruben Road) and Farm Road (T-3256)

Figure 4.1 is a picture of the CSAH 104 and Farm Road Intersection taken from the video camera used to monitor pedestrian crossings. Farm Road, to the north, ends at a T-intersection with CSAH 104. An entrance to the Tribal Government Center complex is located just to the east of the intersection. Further to the east is an asphalt pathway that connects the Vermillion Trail to the Tribal Government Center complex via its access road or driveway. This connection is an unmarked crossing. Pedestrian warning signs have been posted along CSAH 104 on the western approach to the Farm Road Intersection. The green arrows depict vehicular flows. The letters and numbers in the image are general locations where pedestrians and vehicles, respectively, were coded.

The major concern with this location is that pedestrians, including unaccompanied children, who use the Vermillion Trail or walk along Farm Road need to cross CSAH 104 to reach the Government Center. Tribal representatives said drivers on CSAH 104 sometimes speed along this section.



Figure 4.1 County Road 104 and Farm Road

4.1.1.2 CSAH 104 (Gruben Road) and Gold Mine Spur Road

Figure 4.2 is a picture of the CSAH 104 and Goldspur Road Intersection looking south taken from the video camera used to monitor pedestrian crossings. Gold Spur Road, which runs to the north and provides access to the Fortune Bay Casino, the Wilderness Golf Course, and the Bois Forte Heritage Center, ends in a T-intersection with CSAH 104. An entrance to a low-volume used intersection is located immediately to the south of the intersection. A small subdivision is located south of the overflow parking lot. The green arrows depict vehicular flows. The letters and numbers in the image are general locations where pedestrians and vehicles, respectively, were coded.

The major concern with this location is that pedestrians walk through or near the parking lot on the south side of the CSAH 104 to access Gold Spur Road. The crossing is not marked. Many vehicles heading east on CSAH 104 turn left (north) on Gold Spur Road to go the Casino.



Figure 4.2 County Road 104 and Gold Spur Road

4.1.1.3 Vermillion Trail, north side of CSAH 104.

Figure 4.3 is a picture of the infrared pedestrian and bicycle monitor installed on the Vermillion Trail on the north side of CSAH 104, east of Farm Road. The Bois Forte Tribal Government Center complex is in the background. The Vermillion Trail provides a safe place to walk and has reduced concerns among Tribal members about the safety of pedestrians who previously walked along CSAH 104. The Bois Forte Band is seeking funds to expand its trail network. The infrared monitor was installed to provide information to support these planning efforts.



Figure 4.3 Infrared Pedestrian and Bicycle Monitor on Vermillion Trail West of Farm Road

4.1.2 Bois Forte Monitoring Results

Two video cameras were installed to observe pedestrians crossing CSAH 104. Video was obtained for 14 days at the Farm Road crossing and for 12 days at the Boise Forte Road crossing (Table 4.2). Video was taken only during daylight hours. Because some pedestrians probably walk after dark, the volumes presented here should be interpreted as minimums. Vermillion Trail counts are available for the Farm Road location from December 22, 2016 through October 15, 2017. Results are presented for the nine month period from January 1, 2017 through September 30, 2017 so that totals for complete months can be compared.

Table 4.2 summarizes counts of pedestrian crossings at both intersections on CSAH 104. Figures 4.4 and 4.6 present pedestrian traffic by hour at the Farm Road and Gold Spur Road intersections, respectively. Figures 4.8 through 4.13 present Vermillion Trail traffic monitoring results.

Table 4.2 Pedestrian Crossings, Bois Forte

Bois Forte Sites	Days of Data	Total Pedestrians Observed	Average Pedestrians Per Day	Maximum Pedestrians Per Day	Average Vehicles Per Day Observed	Total Pedestrians With Interaction	% Pedestrians With Interaction
County Road 104 & Farm Rd	14	548	39	70	845	51	9.3%
County Road 104 and Gold Mine Spur Road	12	313	26	46	2,033	50	16.0%

4.1.2.1 CSAH 104 (Gruben Road) and Farm Road (T-3256)

The average number of pedestrians crossing County Road 104 at Farm Road during daylight hours was 39 per day (Table 4.2). The maximum number of pedestrians observed crossing at Farm Road during a single day was 70. Approximately 9% of the crossings at Farm Road involved interactions with vehicles. The actual number of pedestrians crossing at this location each day is likely higher because it is probable that some pedestrians cross during the night.

At the Farm Road location, the crossings of County Road 104 were highest from 3:00 p.m. to 4:00 p.m. (nearly six pedestrians per hour) and from 4:00 p.m. to 5:00 p.m. (almost four pedestrians per hour). These patterns may reflect activities at the Boys and Girls club or at the clinic.

Analyses of video revealed instances where unaccompanied children crossed CSAH 104. The analyses also revealed that pedestrians often did not use the unmarked crossing to the Vermillion Trail east of Farm Road, especially if they were heading north or south along Farm Road or were to or from the west on the Vermillion Trail. Instead, these pedestrians typically walked southeast at angles from the Vermillion Trail or Farm Road to access the Tribal Government Complex. Figure 4.5 is a picture of pedestrians, including children, approaching this crossing.

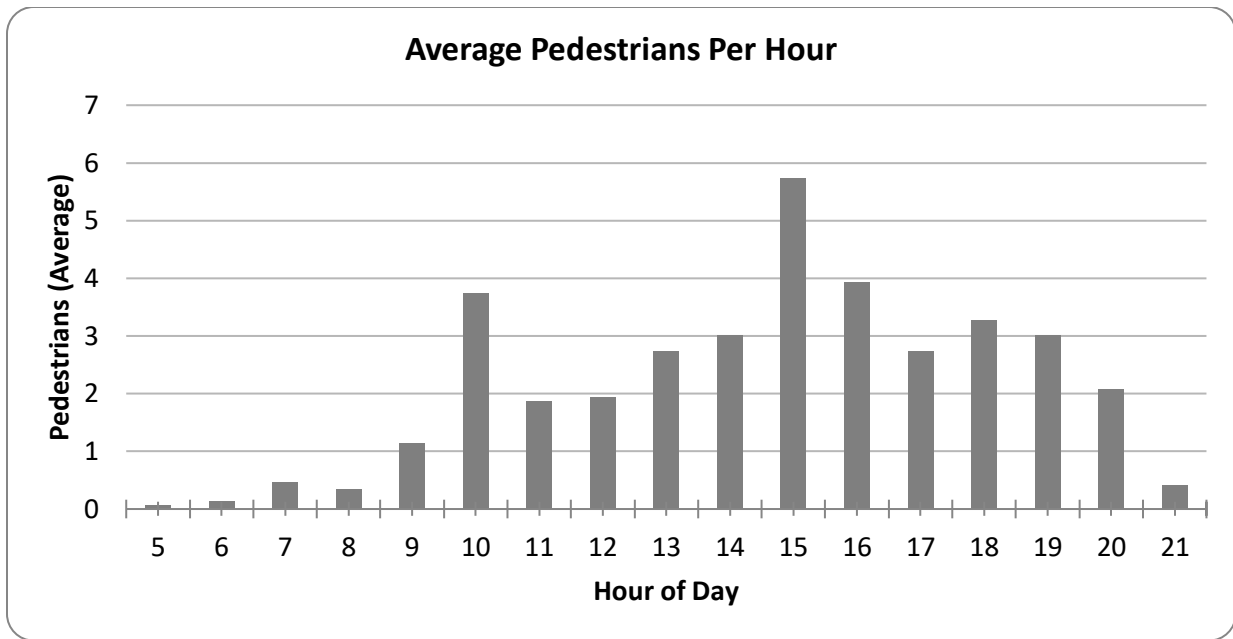


Figure 4.4 CSAH 104: Average Hourly Pedestrian Crossings near Farm Road



Figure 4.5 Pedestrians Approaching CR 104 and Farm Road Crossing

4.1.2.2 CSAH 104 (Gruben Road) and Gold Mine Spur Road

At the Gold Mine Spur Road intersection, the average number of pedestrians crossing each day over the 12 day period was 26. The maximum number of pedestrians observed crossing during any day was 46.

Approximately 16% of these crossings involved interactions (e.g., vehicles waited for pedestrians or vice-versa). The highest volume of crossings per hour occurred between 6:00 p.m. and 7:00 p.m. and between 7:00 p.m. and 8:00 p.m. (between three to four pedestrians per hour during each of these hours). Figure 4.7 is a picture of pedestrians, including children, crossing at this location.

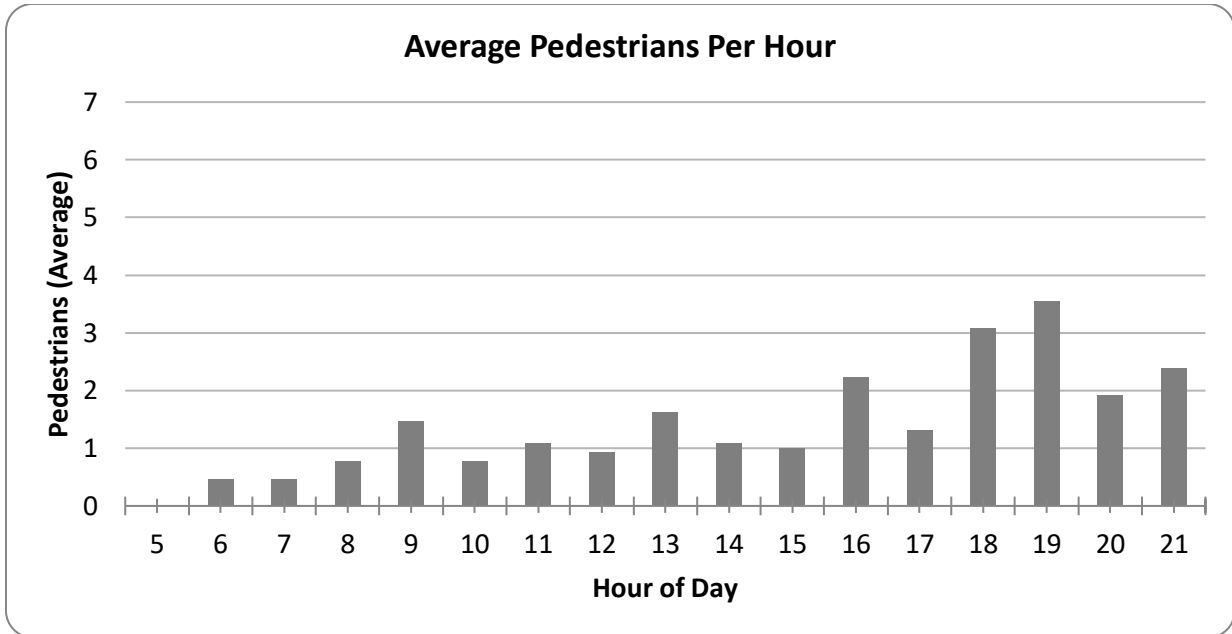


Figure 4.6 County Rd 104: Average Hourly Pedestrian Crossings at Gold Mine Spur Road



Figure 4.7 Pedestrians Crossing CR 104 at Gold Mine Spur

4.1.2.3 Use of the Vermillion Trail

For the nine-month period from January 1 through September 30, 2017, the total traffic recorded by the infrared monitor on Vermillion Trail was 13,081 (Figure 4.8). The average daily traffic during this period was 48, with little variation between average weekday traffic (46) and average weekend day traffic (52). The single highest recorded daily traffic was 1,016 on Saturday, July 8, 2017 (Figure 4.9). This single day accounted for 7.7% of all traffic recorded during the monitoring period. The second and third highest daily traffic volumes during the monitoring period also occurred in July: 486 on July 10 and 396 on July 14.

Monthly traffic volumes are summarized in Figure 4.8. For the nine-month monitoring period, the average monthly traffic volume was 1,458. Volumes reflected seasonal weather, ranging from a low of 185 in January (an average daily traffic of three per day) to a high of 5,035 in July (an average daily traffic of approximately 162 per day; Figure 4.9). The second highest monthly traffic volume was 2,092 in June (an average daily traffic of 67).

Trail traffic for the monitoring period varied by day-of-week, with Saturdays accounting for most traffic (19%) and Sundays accounting for least traffic (11%; Figure 4.10). Among weekdays, Tuesdays accounted for 15% of total traffic; Wednesdays accounted for approximately 11.6%. The relative proportions of traffic by day-of-week are affected by the high total recorded on Saturday, July 8.

Hourly traffic profiles for weekdays and weekend days, respectively, are presented in Figures 4.11 and 4.12. Trail traffic peaks between 3:00 p.m. and 5:00 p.m. on both weekdays and weekends, with the busiest hours accounting for 12% to 15% of traffic. A small morning peak exists on weekends that does not exist on weekdays.

As noted above, the traffic on July 8 accounted for approximately 7.7% of all traffic in the nine-month monitoring period and for 20% of the July monthly traffic. This volume, which is more than 21 times average daily traffic for the nine-month period, seems unusually high and could be an anomaly, although very high daily counts associated with organized events are common on trails. To help determine whether the July 8 traffic count volume is valid, hourly totals for the day were analyzed (Figure 4.13). The hourly patterns are suggestive of some type of day-long event, with traffic in and out. A traffic volume of 250 was recorded between 7:00 a.m. and 8:00 a.m., and a comparable volume (220) was recorded between 3:00 p.m. and 4:00 p.m.

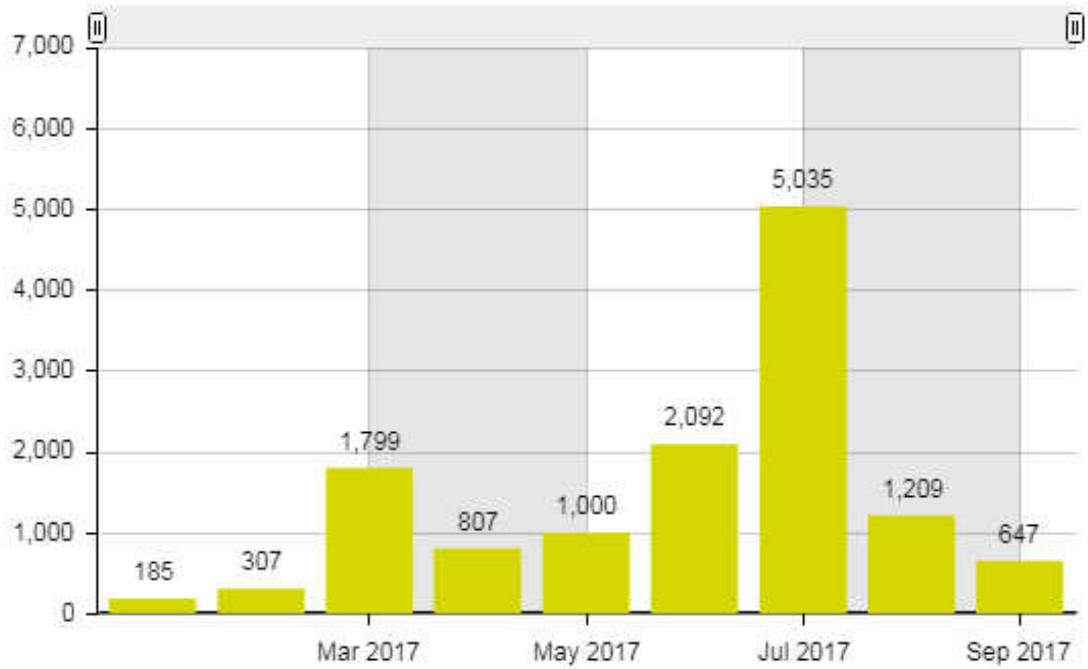


Figure 4.8 Vermillion Trail Monthly Trail Traffic: January 2017 – September 2017

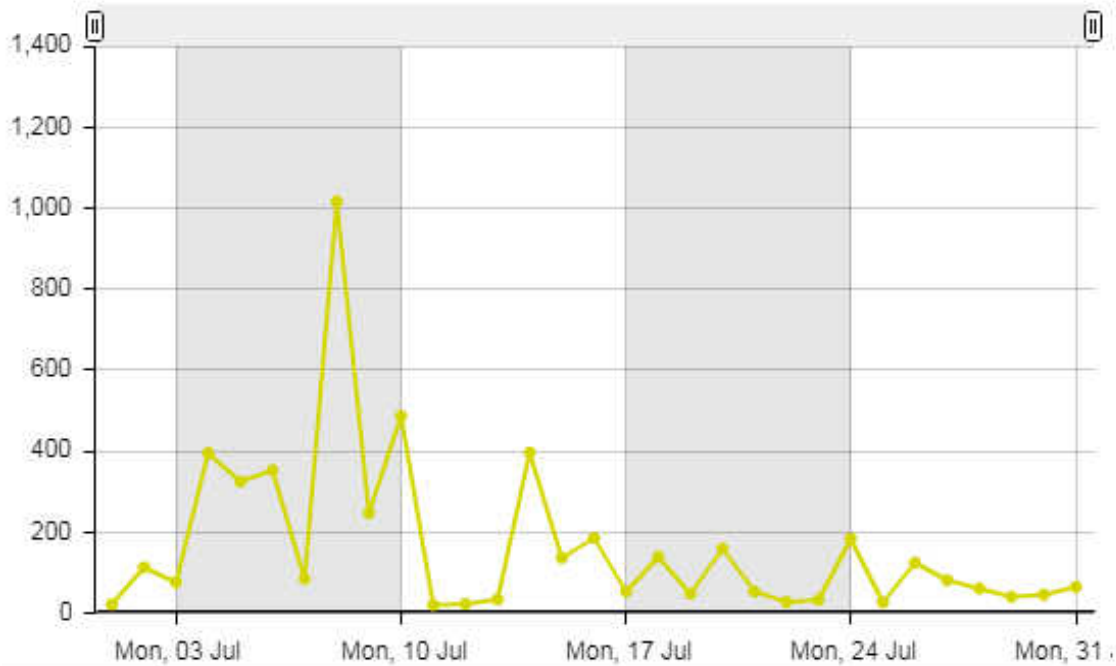


Figure 4.9 Vermillion Trail Daily Trail Traffic: July 2017

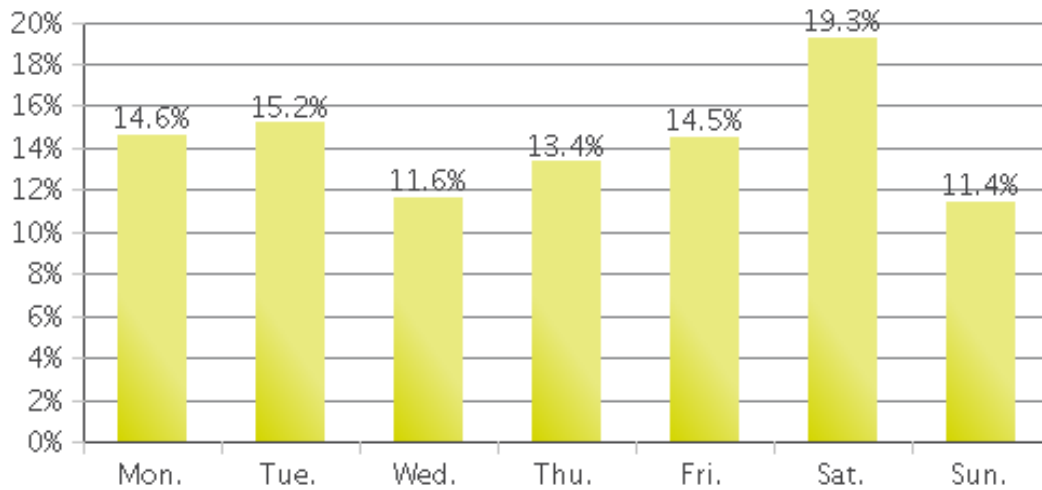


Figure 4.10 Vermillion Trail Percent of Total Traffic by Day of Week: January 2017 – September 2017

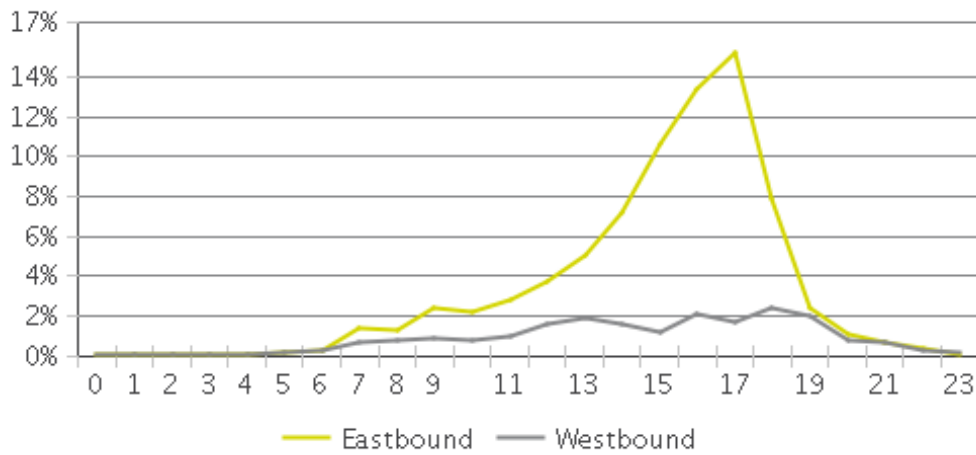


Figure 4.11 Vermillion Trail Weekday Hourly Traffic Profile



Figure 4.12 Vermillion Trail Weekend Hourly Traffic Profile

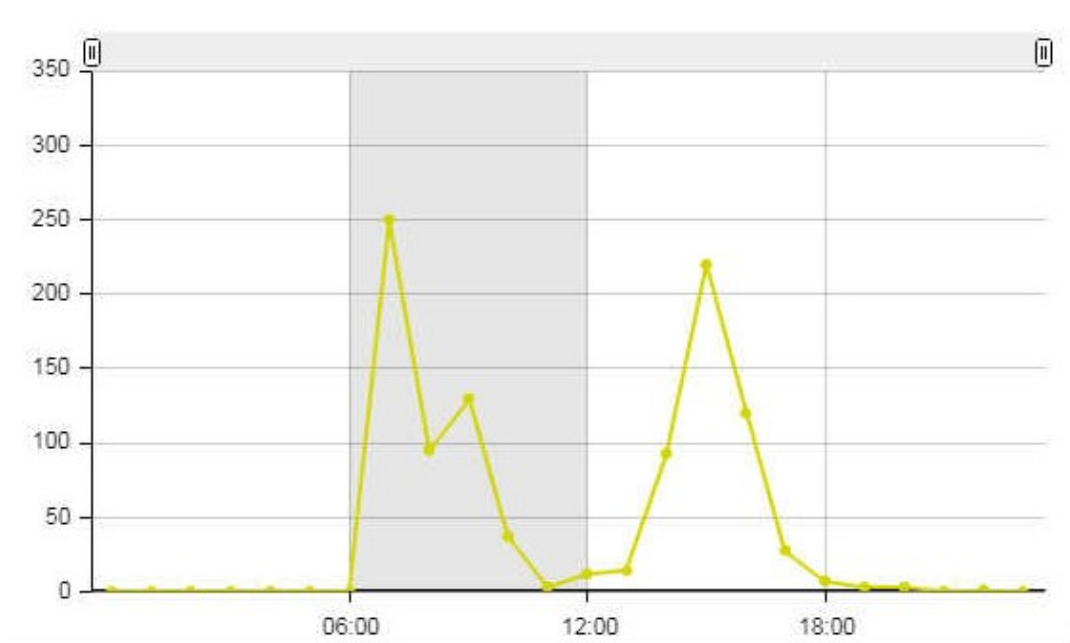


Figure 4.13 Vermillion Trail: July 8, 2017 Hourly Trail Traffic Counts

4.1.3 Potential Countermeasures to Reduce Risk at Bois Forte

Two representatives of the Bois Forte Band, the MnDOT TL, the principal investigator, a MnDOT safety engineer, a MnDOT District 1 engineer, and a St. Louis County engineer met to review findings and confirm a list of potential countermeasures that could be implemented to reduce risk to pedestrians as new opportunities for projects emerge in the future.

The St. Louis County engineer described the County’s approach to pedestrian safety as a “crosswalk plus” strategy that involves installation of crosswalks, where appropriate, along with other treatments to make crossings more visible and safe. The County, for example, has installed three Rectangular Rapid Flashing Beacons (RRFBs). He noted there were both short-term and longer-term opportunities to address safety at each location, that there were multiple conflict points, and that it would be useful to address these points simultaneously. The engineer noted that St. Louis County follows a standard partnership approach to small projects. The County’s partnership approach involves County contributions of design, engineering, and administrative costs, and Tribal or local governments paying for capital items, equipment, installation, and maintenance, with longer-term maintenance responsibilities and costs the subject of negotiated agreements. The County has no projects along CSAH 104 planned for at least five years, so all projects would need to be stand-alone projects.

Bois Forte representatives noted speed along CSAH 104 historically has been a concern. Following a recent speed study, St. Louis County had replaced speed limit signs, reducing the speed limit from 40 mph to 30 mph, and added new fluorescent yellow-green pedestrian crossing signs (W11-2) in advance of the intersection at Farm Road.

The Band representatives also noted that the intersection of CSAH 104 and New Moon Road (located between the two locations that were studied) presented many of the same risk factors as the other two sites, that Tribal elders had received many complaints, and that the types of countermeasures identified for the other two would be relevant for this intersection. They noted the Tribal Council would need to approve funds for any traffic-safety related project.

The Bois Forte Band, St. Louis County engineer, the MnDOT engineers, and the research team agreed the countermeasures listed in the subsections below would reduce risk and could be considered for implementation as new projects are undertaken or new sources of funding are identified.

4.1.3.1 CSAH 104 (Gruben Road) and Farm Road (T-3256)

Potential countermeasures at the CSAH 104-Farm Road intersection that could be considered in the short-term include:

- Improvements to the crosswalk from Vermillion Trail across CSAH 104 to the Boys and Girls Club and Tribal Government Center, including:
 - Realigning and straightening the trail connection to the entrance to better align with walking path observed in the video;
 - Marking (painting) the crosswalk to complement advance warning signs;
 - Adding ADA truncated domes to curb ramps, in combination with:
 - Installing speed display/warning signs; or
 - Installing and evaluating an RRFB that includes flashing lights on both sides of the roadway prior to the crossing.
- Evaluation of in-street pedestrian crossing signs (R1-6A) for speed control in some locations.
- Educational efforts to address risks associated with unwarranted confidence when entering marked crosswalks

A potential countermeasure that could be implemented in the longer-term is:

- Realigning the entire intersection so that Farm Road lines up with the entry to the Tribal Government Center and Boys and Girls Club.

4.1.3.2 CSAH 104 (Gruben Road) and Gold Mine Spur Road

The CSAH 104-Gold Mine Spur intersection is more complicated than the Farm Road intersection from an engineering perspective because the speed limit is higher (55 mph) and because more vehicles turn at the intersection to visit the Fortune Bay Casino. Across CSAH 104 from the casino is an overflow parking lot that is only used 1-2 times/year for casino events and is well hidden from the road by rows of evergreen trees. Residents from nearby subdivisions walk through this parking lot to reach to Casino. From a safety perspective, the principal objective is to make pedestrians who are crossing CSAH 104 more conspicuous so drivers are more aware of them.

Potential countermeasures at the CSAH 104-Gold Mine Spur Road intersection include options similar to those at the CSAH 104-Farm Road intersection:

- Improved lighting by the Gold Mine Spur entryway to the casino;
- Implementation of the St. Louis County’s “crosswalk plus” approach that includes marking (painting) the crosswalks accompanied by signs or other countermeasures; and
- In the longer-term, realignment of the informal crosswalk to simplify pedestrian pathways and reduce conflict points.

4.1.3.3 CSAH 104 (Gruben Road) and New Moon Road

Band representatives explained that residents of a supportive housing development off New Moon Road use cross CSAH 104 to reach the Vermillion Trail and to walk to employment at the Fortune Bay Casino, the Tribal Government Complex or to other destinations. Drivers may not see pedestrians at this informal crossing because of the current road configuration and bordering vegetation. This is a safety risk for pedestrians that would be reduced by increasing their visibility. Increasing the visibility of pedestrians would reduce risk to item. Potential countermeasures for this site include many of the same measures as for the other locations:

- Improved lighting by the New Moon Road-CSAH 104 intersection;
- Implementation of the St. Louis County’s “crosswalk plus” approach that includes marking (painting) the crosswalks accompanied by signs, improving line-of-sight, or other countermeasures such as RRFBs.

4.2 FOND DU LAC BAND OF LAKE SUPERIOR CHIPPEWA

Representatives of the Fond du Lac Band identified four intersections on the reservation where concerns about pedestrian safety had been raised by Band members:

1. CSAH 7 (Big Lake Road) and CR 115 (Pinewood Drive) in Cloquet,
2. CSAH 7 (Big Lake Road) and CR 114 (Trettel Lane) in Cloquet,
3. CSAH 7 (Big Lake Road) and CSAH 5 (Brevator Road) in Cloquet, and
4. TH 210 and CSAH 25 (Mission Road) in Sawyer,

Many Tribal facilities and services are located on county roads that intersect with Big Lake Road. Band representatives explained that residents from various locations on the reservation in Cloquet frequently walk along Big Lake Road because of the lack of pedestrian facilities. The Band since has constructed a trail along the south side of Big Lake Road. Speed limits along Big Lake Road vary and increase as the road extends west out of Cloquet. No formal crossings are located across Big Lake Road in the areas of interest.

On the reservation in Sawyer, people walk along Mission Road and cross TH 210 to reach a grocery/gas station and post office. The Band has plans to build a trail adjacent to Mission Road north of TH 210 that

eventually will end at TH 210, but details for the facility, including the location and designs for pedestrian crossings at TH 210 had not been determined at the time this report was completed.

4.2.1 Fond du Lac Monitoring Locations

4.2.1.1 CSAH 7 (Big Lake Road) and CR 115 (Pinewood Drive), Cloquet

Figure 4.14 is an east-facing picture of the Big Lake Road and Pinewood Drive intersection in Cloquet taken from the video camera used to monitor pedestrian crossings. Big Lake Road runs east-west at this location. Pinewood Drive ends at a T-intersection on the south side of Big Lake Road. The major safety concern with this location is that pedestrians walk along the northern side of Big Lake and cross to the gas station and convenience store. No formal pedestrian facilities are located at this intersection. The letters and numbers in the image are general locations where pedestrians and vehicles, respectively, were coded.



Figure 4.14 Cloquet: Big Lake Road and Pinewood Drive (Location 1)

4.2.1.2 CSAH 7 (Big Lake Road) and CR 114 (Trettel Lane), Cloquet

Figure 4.15 is a northwest-facing picture of the Big Lake Road and Trettel Lane intersection in Cloquet taken from the video camera used to monitor pedestrian crossings. Big Lake Road runs east-west at this location; it includes right-turn lanes in both directions to facilitate smooth traffic flow. Trettel Lane runs north-south at this intersection. The green arrows show the direction of vehicular traffic flow. The letters and numbers in the image are general locations where pedestrians and vehicles, respectively, were coded.

The major safety concerns with this location are that pedestrians walking along Trettel Lane cross Big Lake Road at an unmarked crossing and that pedestrian's walk along the northern side of Big Lake Road. No pedestrian facilities are located at this intersection.

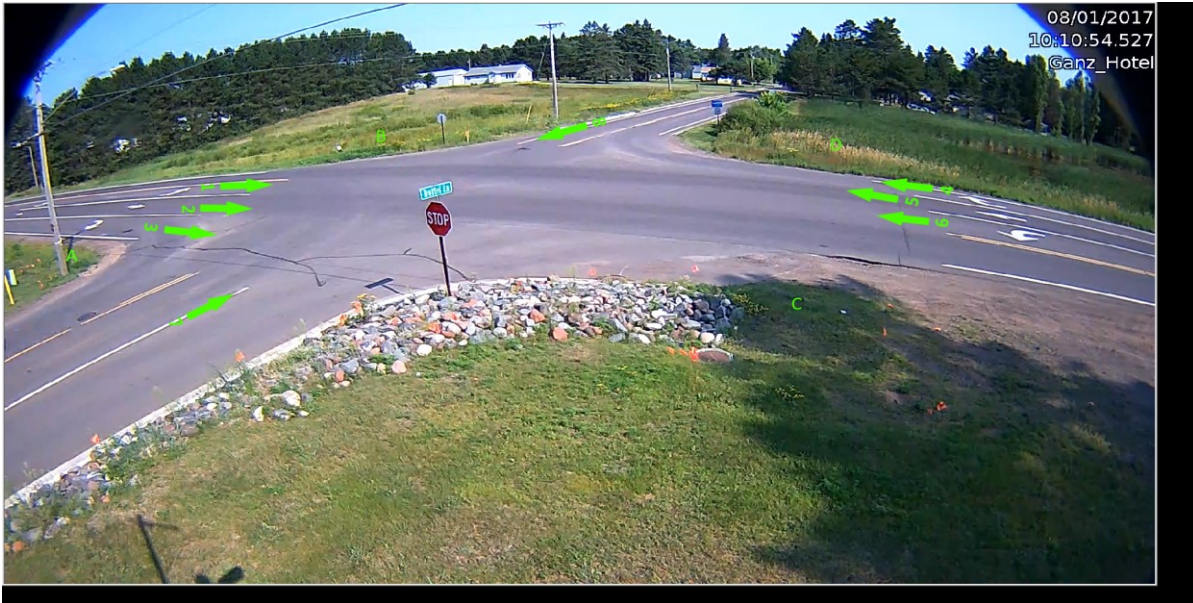


Figure 4.15 Cloquet: Big Lake Road and Trettel Lane (Location 2)

4.2.1.3 CSAH 7 (Big Lake Road) and CSAH 5 (Brevator Road), Cloquet

Figure 4.16 is a west-facing picture of the Big Lake Road and Brevator Road intersection in Cloquet taken from the video camera used to monitor pedestrian activity. Big Lake Road runs east-west at this location; Brevator Road runs north-south at this intersection. The green arrows show the direction of vehicular traffic flow. This section of road has wide shoulders used by pedestrians. The letters and numbers in the image are general locations where pedestrians and vehicles, respectively, were coded.



Figure 4.16 Cloquet: Brevator Road (Location 3)

4.2.1.4 TH 210 and CSAH 25 (Mission Road), Sawyer

Figure 4.17 is a north-facing picture of the TH 210 and Mission Road intersection in Sawyer taken from the video camera used to monitor pedestrian activity. The video camera is located on a post on Mission Road south of TH 210. TH 210 Road runs east-west at this intersection; Mission Road runs north-south. The green arrows show the direction of vehicular traffic flow. The letters and numbers in the image are general locations where pedestrians and vehicles, respectively, were coded.

The major safety concerns with this location are that pedestrians walking south along Mission Road from an elderly housing unit and other points of origin cross TH 210 to access the grocery store/gas station and post office. The crossing is unmarked. No pedestrian facilities are located at this intersection.



Figure 4.17 Sawyer: Minnesota 210 and Mission Road (Location 4)

4.2.2 Fond du Lac Monitoring Results

Video cameras were installed to observe pedestrians at the four locations identified by the Fond du Lac Band (Table 4.3). The numbers of days that video of pedestrians were obtained ranged across sites from 11 at the Trettel Land and Brevator Road sites to 20 at the Pinewood Drive location. The number of days varied due to video camera rotation among sites and because batteries powered the video camera for different periods until losing their charges. Video was taken only during daylight hours.

Table 4.3 summarizes counts of pedestrian crossings at all four locations. Figure 4.18 presents pedestrian traffic by hour at the locations, respectively. The average number of crossings per day ranged from 3 to 31. The percent of crossings involving interactions with vehicles (e.g., either vehicles or pedestrians altering their behavior) ranged from 9% to 33%. In Cloquet, the Pinewood Drive and Trettel Lanes were comparable in terms of average daily pedestrian crossing volumes and percentage of crossings involving interactions with vehicles. Pedestrian crossings were lowest of Brevator Road. In Sawyer, the average number of crossings per day was lower (12), but one-third of all crossings involved interactions with vehicles. The peak hours for pedestrian crossings varied across the sites (Figure 4.18).

Table 4.3 Pedestrian Monitoring Sites, Fond du Lac Reservation

Site	Days of Data	Total Pedestrians Observed	Average Pedestrians Per Day	Maximum Pedestrians Per Day	Average Vehicles Per Day Observed	Total Pedestrians With Interactions	% Pedestrians With Interaction
Cloquet - Big Lake Rd & Pinewood Dr	20	578	29	61	4034	166	28.7%
Cloquet - Big Lake Rd & Trettel Ln	11	339	31	56	6497	99	29.2%
Cloquet - Brevator Rd	11	33	3	8	1242	3	9.1%
Sawyer - MN 210 & Mission Rd	17	206	12	23	4086	68	33.0%

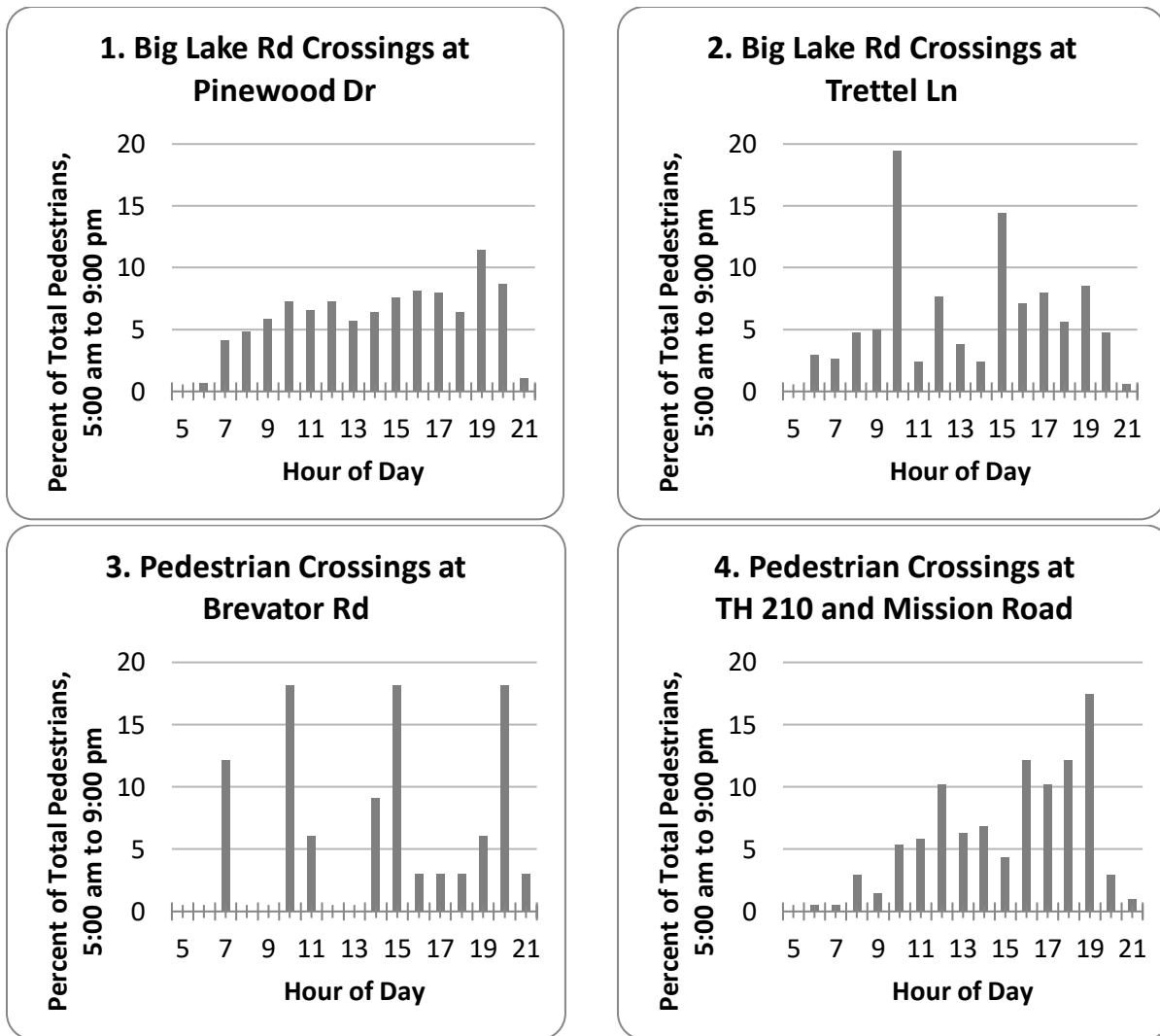


Figure 4.18 Percent of Crossings by Hour of Day, Fond du Lac Monitoring Sites

4.2.2.1 CSAH 7 (Big Lake Road) and CR 115 (Pinewood Drive), Cloquet

The average number of pedestrians crossing Big Lake Road at Pinewood Drive during daylight hours was 29 per day (Table 4.3). The maximum number of pedestrians observed crossing during a single day was 61. Approximately 29% of these crossings involved interactions with vehicles. The crossings were highest from 7:00 p.m. to 8:00 p.m. (11% of daily traffic; Figure 4.18). The actual number of pedestrians crossing at this location each day is likely higher because it is probable that some pedestrians cross at night-time. Figures 4.19 is a picture of pedestrians observed crossing at this location.



Figure 4.19 Pedestrians Crossing Big Lake Road at Pinewood Drive

4.2.2.2 CSAH 7 (Big Lake Road) and CR 114 (Trettel Lane), Cloquet

The average number of pedestrians crossing Big Lake Road at Trettel Lane during daylight hours was 31 per day (Table 4.3). The maximum number of pedestrians observed crossing during a single day was 56. Approximately 29% of these crossings involved interactions with vehicles. The crossings were highest from 10:00 a.m. to 11:00 a.m. (19% of daily traffic) and from 3:00 p.m. to 4:00 p.m. (14% of daily traffic; Figure 4.18). The actual number of pedestrians crossing at this location each day is likely higher because it is probable that some pedestrians cross at night-time. Figures 4.20 is a picture of pedestrians observed crossing at this location.



Figure 4.20 Pedestrians Crossing Big Lake Road at Trettel Lane

4.2.2.3 CSAH 7 (Big Lake Road) and CSAH 5 (Brevator Road), Cloquet

The average number of pedestrians crossing Big Lake Road at Brevator Road during daylight hours was 3 per day (Table 4.3). The maximum number of pedestrians observed crossing during a single day was 8. Approximately 9% of these crossings involved interactions with vehicles. Because the total volumes were so low, identification of peak crossing times involves great uncertainty. The greatest numbers of pedestrians were observed at 10:00 a.m., 3:00 p.m., and 8:00 p.m. (Figure 4.18). The actual number of pedestrians crossing at this location each day is likely higher because it is probable that some pedestrians cross at night-time. Figure 4.21 is a picture of a pedestrian walking in the right-of-way at this location.



Figure 4.21 Pedestrians and Cyclists in the Right-of-Way

4.2.2.4 TH 210 and CSAH 25 (Mission Road), Sawyer

The average number of pedestrians crossing TH 210 at Mission road in Sawyer during daylight hours was 12 per day (Table 4.3). The maximum number of pedestrians observed crossing during a single day was 23. Approximately 33% of these crossings involved interactions with vehicles. The majority of crossings occurred during mid- to late-afternoon and early evening, peaking from 7:00 p.m. to 8:00 p.m. (17% of daily traffic; Figure 4.18). The actual number of pedestrians crossing at this location each day is likely higher because it is probable that some pedestrians cross at night-time. In addition, pedestrians and cyclists do not present the only risks associated with this crossing. Figure 4.22 is a picture of an off-road vehicle observed crossing at this location.



Figure 4.22 Off-road, Four-wheel Vehicle Crossing TH 210 at Mission Road

4.2.3 Potential Countermeasures to Reduce Risk at Fond du Lac

Five representatives of the Fond du Lac Band, the MnDOT TL, the principal investigator, two MnDOT District 1 engineers, and two Carlton County engineers met to review findings and confirm a list of potential countermeasures that could be implemented to reduce risk to pedestrians as new opportunities for projects emerge in the future. Participants in the meeting discussed monitoring results and options in the context of current projects planned by the Reservation and by St. Louis County. Fond du Lac Band representatives stated they thought pedestrian crossings of TH 210 at Mission Road in Sawyer pose the greatest risk. The Band is implementing a trail project along Mission Road between a an elderly housing unite 0.6 miles north of TH 210 and TH 210, but this project does not include plans or budget for the crossing.

Within the Big Lake Road Corridor, the Band is implementing a trail project along the south side of Big Lake Road to address safety concerns voiced by pedestrians who historically have walked on the shoulders along the stretch of road that includes the three intersections investigated in the study (i.e., Pinewood Drive, Trettel Lane, Brevator Road). The trail project is being funded with resources from MnDOT State Aid and the Band. Band representatives acknowledged traffic signals or RRFBs would reduce risk to pedestrians crossing Big Lake Road to access the trail. However, they noted that community members generally have been opposed to signals, even though employees at the Reservation health clinic have recommended them to facilitate access to and from Big Lake Road during peak hours of traffic. Participants discussed options to reduce risk and increase safety, including improving lines-of-sight, marking crosswalks, creation of pedestrian landings along the trail, and

additional signs. Participants noted the possibility of using transverse lane markings through the Big Lake Road corridor in the area of study as a way to slow traffic and heighten awareness of pedestrians and cyclists. Participants identified other projects that will contribute to pedestrian safety at or near the study sites; these projects are summarized in the following subsections on the study sites.

4.2.3.1 CSAH 7 (Big Lake Road) and CR 115 (Pinewood Drive), Cloquet

The greatest risks to pedestrian safety near the Big Lake Road-Pinewood Drive intersection are associated with pedestrians walking west along Big Lake Road who cross south to Pinewood Drive. Participants noted west-bound drivers on Big Lake Road tend to increase speed as they leave the city of Cloquet.

A short-term option to reduce this risk is a marked crosswalk with advanced warning signs. Carlton County engineers expressed concern that painting crosswalks could induce an unwarranted sense of security among pedestrians, especially without advanced warning signs.

A longer-term option may be to extend the pedestrian trail now being constructed along the south side of Big Lake Trail east to a large supermarket by adding a crosswalk and extending the trail on the north side of Big Lake Road to the east where it could connect with a sidewalk. County engineers noted that the parking lanes on the north side of this section of Big Lake Road are not heavily used, which provides an opportunity for re-design of the roadway.

4.2.3.2 CSAH 7 (Big Lake Road) and CR 114 (Trettel Lane), Cloquet

Similar to the Big Lake Road-Pinewood Drive intersection, the main safety concern at the Big Lake Road-Trettel Lane intersection is associated with pedestrians crossing Big Lake Road from north to south (or vice-versa). Carlton County previously explored construction of a round-about at the intersection of Big Lake Road and Trettel Lane to slow traffic and increase safety, but this countermeasure was determined to be infeasible because of public opposition and lack of space.

Participants identified the opportunity to increase visibility of pedestrians by improving lines-of-sight but did not consider this intersection as high a priority as other locations. No specific plans other than increasing pedestrian visibility were agreed upon.

4.2.3.3 CSAH 7 (Big Lake Road) and CSAH 5 (Brevator Road/University Road), Cloquet

Participants noted the principal concern near the Big Lake Road-Brevator/University Road intersection is to the south of the intersection itself near where a school and other facilities are located. The Band is implementing a Safe Routes to Schools trail project, scheduled to begin in 2019, that will include a connection to the trail along the south side of Big Lake Road. This project also will include a pedestrian crossing across Brevator/University Road and other improvements to enhance circulation among Tribal buildings and activity centers. The Band and the County have not finalized plans for this improvement, but it likely will include a marked crosswalk, an RRFB, and ADA-compliant pedestrian ramps on

both sides of the trail. A mill and overlay project is scheduled for University Road in 2021 that may present additional opportunities to reduce potential conflicts, including reconfiguration of access points from parking lots along Brevator/University Road. Because these planned projects will address many of the issues related to pedestrian traffic near this intersection, no additional improvements were suggested.

4.2.3.4 TH 210 and CSAH 25 (Mission Road), Sawyer

Pedestrians walk along Mission Road to get to a convenience store and post office south of TH 210. The principal sources of risk to pedestrians at the TH 210-Mission Road intersection is associated the absence of a shoulder along Mission Road and the lack of a formal crossing at TH 210. As noted, Band representatives stated this intersection poses the greatest risk among the four intersections that were studied. Participants noted that improvements to reduce risk at this intersection can be implemented in 2020 when the Band constructs an off-road bicycle and pedestrian trail along Mission Road. Detailed engineering plans have not yet been prepared, but completion and approval of plans will require coordination between the Band, Carlton County, and MnDOT because all three entities have jurisdiction and share responsibility. Plans for this project will need to be completed in 2019 for construction to be completed in 2020. Issues to be addressed as plans are finalized include the presence of historic grave sites along Mission Road and whether and how to accommodate all-terrain vehicles and snowmobiles. The plans for the trail do not include plans for the crossing. Participants agreed on the need to:

- Review options to improve lighting;
- Install additional signs;
- Remove vegetation, improve lines-of-sight for drivers, and increase visibility of pedestrians,
- Construct some type of landing for pedestrians leaving the trail to cross TH 210.

MnDOT District 1 engineers expressed concern about an RRFB or other type of beacon because of risks associated with vehicles stopping suddenly on a high-speed roadway. They also expressed concern that an RRFB may provide pedestrians an unwarranted sense of security. Participants discussed countermeasures such as narrowing lanes to induce slower speeds, but no consensus on these measures was reached. Since the meeting, three countermeasures to reduce pedestrian risk have been implemented: lighting improvements were made, additional signs were installed, and vehicular travel lanes were narrowed.

4.3 GRAND PORTAGE BAND OF OJIBWE

Representatives of the Grand Portage Band identified two locations on the reservation where concerns about the safety of pedestrians crossing TH 61 had been raised by Band members:

1. An unmarked crossing at Blazes Pit Road, north of Mile Creek/Marina Road, that is used by pedestrians to walk from residential subdivisions on the west side of HWY 61 to destinations on the east (lake) side of TH 61 (e.g., Trading Post, Grand Portage Casino, Grand Portage National Monument); and

2. An unmarked crossing at Stevens Road that pedestrians use to walk from residential subdivisions on the west side of HWY 61 to destinations on the east side of TH 61 (e.g., Tribal offices, a school and a clinic, Grand Portage National Monument).

Most Tribal government offices and many commercial services are located east of TH 61 adjacent to Lake Superior. Band representatives explained that residents both walk along TH 61 and cross TH 61 as part of their daily routines. The speed limit along TH 61 is 55 m.p.h. No formal crossings are located across TH 61 in the areas of interest.

4.3.1 Grand Portage Monitoring Locations

4.3.1.1 TH 61 and Blazes Pit Road (north of Marina Road)

Figure 4.23 is a north-facing picture of TH 61 taken from the video camera used to monitor pedestrian crossings at Blazes Pit Road north of the Marina Road entrance to the Trading Post and Grand Portage Casino. TH 61 runs mostly north-south at this location. The green arrows show the direction of vehicular traffic flow. The letters and numbers in the image are general locations where pedestrians and vehicles, respectively, were coded.

The major safety concerns at this location are that pedestrians cross TH 61 at an unmarked crossing from the gravel exit (on the west side of the road in Figure 4.23) down an informal footpath on the east side of TH 61 that leads to the Trading Post and other destination. Given the remote area and density of forest along TH 61, it is unlikely that drivers expect pedestrians to cross at this location. No pedestrian facilities exist at this location.



Figure 4.23 TH 61 and Blazes Pit Road (unmarked crossing north of Marina Road)

4.3.1.2 TH 61 and Stevens Road

Figure 4.24 is a north-facing picture of TH 61 taken from the video camera used to monitor pedestrian crossings at the TH 61 and Stevens Road intersection. TH 61 runs mostly north-south at this location. The green arrows show the direction of vehicular traffic flow. The letters and numbers in the image are general locations where pedestrians and vehicles, respectively, were coded.

The major safety concerns at this intersection are pedestrian crossings from a residential subdivision to the west to various destinations on the east, or the Lake Superior side of TH 61. No pedestrian facilities exist at this location.



Figure 4.24 TH 61 and Stevens Road

4.3.2 Grand Portage Monitoring Results

Video cameras were installed to observe pedestrians at the two locations identified by the Grand Portage Band (Table 4.4). Video was obtained for 16 days at the informal crossing at Blazes Pit Road north of Marina Road, and 13 days of video were obtained at the TH 61-Stevens Road intersection. Video was taken only during daylight hours.

Table 4.4 summarizes counts of pedestrian crossings at these two locations. Figures 4.26 and 4.28 present images of pedestrians observed crossing at these locations during the monitoring period. Figures 4.25 and 4.27 present pedestrian crossing by hour at the two sites, respectively. The average numbers of crossings per day at the two locations were comparable, with volumes slightly higher at the informal crossing north of Marina Road.

Table 4.4 HWY 61 Pedestrian Crossings, Grand Portage

Reservation	Crossing Locations	Days of Data	Total Pedestrians Observed	Mean Pedestrians / Day	Maximum Pedestrians / Day	Mean Vehicles Per Day Observed	Total Pedestrians with Interactions	Percent Pedestrians with Interactions
Grand Portage	TH 61 / Blazes Pit Road (north of Marina Rd)	16	218	14	38	2,077	46	21.1%
	TH 61 / Stevens Rd/	13	147	11	23	2,111	28	19.0%

4.3.2.1 TH 61 and Blazes Pit Road (north of Marina Road)

The average number of crossings per day was about 14. Approximately 21% percent of these crossings involved interactions with vehicles (e.g., either vehicles or pedestrians altering their behavior). The maximum number of pedestrians observed crossing in any one day was 38. The peak hour for pedestrian crossings was between 7:00 and 8:00 p.m. (approximately 18% of total traffic; Figure 4.25). Figure 4.26 is a picture of pedestrians observed crossing at this location.

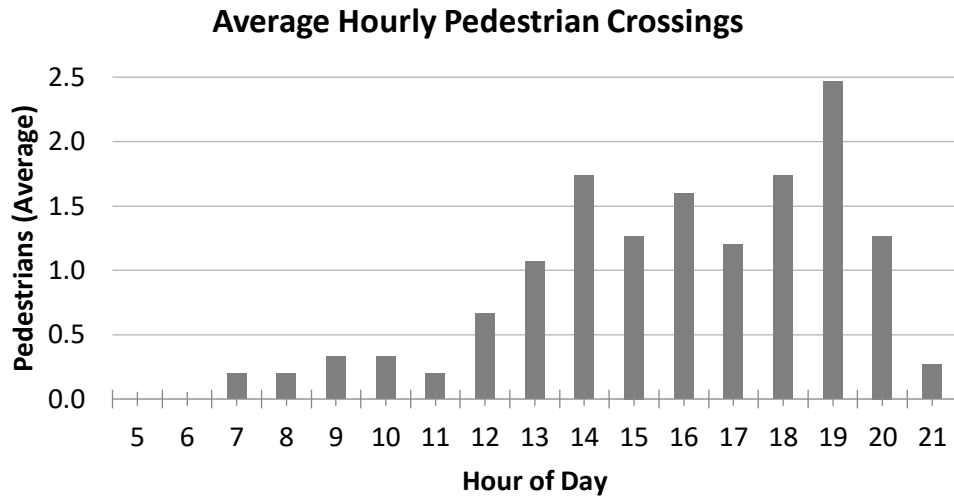


Figure 4.25 TH 61 and Unmarked Crossing by Blazes Pit Road: Average Hourly Pedestrian Crossings



Figure 4.26 Pedestrians Crossing TH 61 at Blaze’s Pit Road

4.3.2.2 TH 61 and Stevens Road

The average number of crossings per day was approximately 11. Approximately 19% percent of these crossings involved interactions with vehicles. The maximum number of pedestrians observed crossing in any one day was 23. The peak hours of pedestrian crossings were between 3:00 p.m. and 7:00 p.m.

(Figure 4.27). Pedestrian crossing TH 61 are not the only activity associated with risk at this location. Figure 4.28 is a picture of is picture of a cyclist riding in the wrong direction on TH 61.

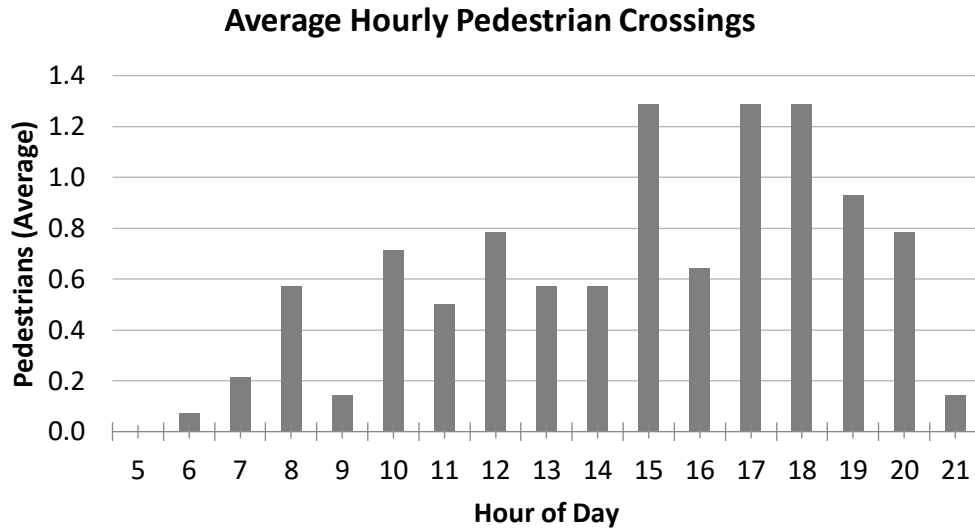


Figure 4.27 TH 61 and Stevens Road: Average Hourly Pedestrian Crossings



Figure 4.28 Cyclist Riding into Oncoming Traffic Flow on TH 61 near Stevens Road

4.3.3 Potential Countermeasures to Reduce Risk at Grand Portage

Six representatives of the Grand Portage Band, the MnDOT TL, a MnDOT safety engineer, and two MnDOT District 1 engineers met to review findings and confirm a list of potential countermeasures that could be implemented to reduce risk to pedestrians as new opportunities for projects emerge in the future. Participants in the meeting discussed monitoring results and options in the context of a resurfacing project planned by MnDOT for the TH 61 corridor on the Grand Portage Reservation to be implemented in 2021. District 1 engineers presented three conceptual options to increase pedestrian safety that potentially could be integrated into the project at each of the two intersections. The features of the options preferred by Band members are summarized in the following subsections.

In addition to the intersection-specific countermeasures summarized below, Band members expressed a preference for:

- A 60 mph speed limit on TH 61 in rural areas between the Grand Portage Reservation and Duluth; and
- A 55 mph speed limit on the Grand Portage Reservation between Store Road and Mineral Center Road.

District 1 engineers will continue to coordinate with the Grand Portage Band as plans for the 2021 project are finalized. In the interim, the research team will provide District 1 and the Band additional information, including educational and training materials for RRFBs and crossing techniques and comments on proposed pedestrian and bicyclist countermeasures.

4.3.3.1 TH 61, Blazes Pit Road (north of Marina Road)

Pedestrians from a subdivision west of TH 61 use informal pathways and Blazes Pit road to access employment, retail, and other services on the east side of TH 61 near Lake Superior. The principal source of risk for these pedestrians is that people driving may not anticipate their presence in this remote location. On the east side of TH 61, pedestrians must go up and down a steep embankment to reach TH 61.

The Band representatives preferred several features among the options presented by the MnDOT District engineers. These features were:

- A paved ADA-compliant ramp switchback with adjacent stairs leading from the Trading Post parking lot to a landing on the east side of TH 61;
- New lighting on the east side of TH 61 near the pedestrian landing;
- A crosswalk on the north side of the Blazes Pit intersection from the new pedestrian landing on the Lake Superior side, across TH 61, to a short paved trail on the western side;
- A paved trail that connects to Blazes Pit Road on the western side of TH 61;
- Pedestrian crossing warning signs placed 500ft before the intersection in both directions;
- An RRFB or static pedestrian crossing signs at the crosswalk;

- Assistance with educating reservation residents about use of the RRFB;
- A shared center left-turn lane for NB traffic to turn into Blazes Pit and for SB traffic to turn into the Trading Post; and
- A new guardrail on the eastern side of TH 61 to deter ATVs and snowmobiles from riding on the side of the hill and causing erosion and to funnel pedestrians to the new crossing.

Meeting participants identified tradeoffs with the different measures. For example, Band members recognized that addition of a center turn lane would increase crossing distance but believed the benefits of the turn lane outweighed this disadvantage. One engineer was concerned the guardrail might reduce the line-of-site for drivers and make pedestrians less visible. Another option reviewed was a pedestrian tunnel under TH 61. Although a tunnel would effectively eliminate conflicts for pedestrians who chose to use it, this option was not preferred by Band members because it involved a less direct route than the at-grade crossing, involved actual or perceived risks to personal security, and presented the potential drainage problems and snow buildup.

4.3.3.2 TH 61 and Stevens Road

The principal source of risk at the TH 61-Stevens Road intersection is similar to the source at the TH 61-Blazes Pit Road intersection: people driving at highway speeds along this heavily-wooded stretch of TH 61 may not anticipate the presence of pedestrians. The TH 61 improvements planned for 2021 already include dedicated north- and south-bound turn lanes to minimize conflicts between vehicles. The District 1 engineers presented options to increase pedestrian safety, and the Band members expressed their preferences. These options under consideration include:

- A proposed crosswalk on the southern side of the intersection to connect with the existing ATV / snowmobile crossing;
- An RRFB with pedestrian crossing signs 500 feet in advance of the intersection in both directions;
- Two new light posts on the NW and SE corners of the intersection, respectively; and
- Guardrails on the western edge of the south-bound traffic lane.

The new crosswalk linking to the existing ATV/snowmobile crossing will be re-oriented to be perpendicular to TH 61.

4.4 MILLE LACS BAND OF OJIBWE

Representatives of the Mille Lacs Band identified two locations on the reservation where concerns about pedestrian safety had been raised by Band members:

1. The marked crosswalk at the intersection of TH 169 and Casino Drive (Grand Avenue); and
2. An unmarked crossing on TH 169 that pedestrians access through a break in a fence that separates Virgo Road (a frontage road), from TH 169, about one-half mile north of TH 169-Casino Drive intersection and crosswalk.

The intersection of TH 169 and Casino Drive is controlled by a stoplight. Pedestrians use this crossing to walk from subdivisions and other places on the east of TH 169 to a large complex that includes employment, retail, and entertainment destinations, including the Grand Casino Mille Lacs, a grocery store, and a movie theater. This intersection is the principal entrance to the Grand Casino Mille Lacs. Band representatives explained that many members cross TH 169 through the break in the fence along Virgo Road to reach to reach these destinations. They said the reason people choose to cross TH 169 at this unmarked crossing it offers a more direct route from their homes.

The Band has recognized the safety risks posed to pedestrians crossing TH 169 through the break in the fence for several years and has explored options to reduce risk, including a PHB, a pedestrian overpass, and a new crosswalk and traffic signal integrated with the signal at TH 169 and Casino Drive. Although the Band has been unsuccessful in obtain funding for these projects, it did obtain funding to build a sidewalk on the western side of Virgo Road to connect pedestrians from Atooban Drive (just north of the break in the fence) to the crosswalk at the TH 169 Casino Drive. This sidewalk was constructed in fall 2018 after monitoring at this site was completed. To provide information about how the new sidewalk was being used, the research team conducted supplemental monitoring in 2019.

4.4.1 Mille Lacs Monitoring Locations

4.4.1.1 TH 169 and Casino Drive (Grand Avenue)

Figure 4.29 includes two photographs: an overhead plan view of the TH 169-Casino Drive intersection and a north-facing picture of TH 169 taken from the video camera used to monitor pedestrian crossings at this intersection. TH 169, which runs mostly north-south at this location, including turning lanes for drivers to enter Casino Drive. The sidewalks extending from the crosswalk on the eastern side of TH 169 were built in anticipation of the planned sidewalk on the western side of Virgo Road. The letters and numbers in the image are general locations where pedestrians and vehicles, respectively, were coded. Because of the existence of the traffic signal and crosswalk, Band representatives did not consider this intersection to pose major risks. However, the volume of pedestrians using the site was unknown, and monitoring was undertaken to provide this information and for purposes of comparing to the pedestrian crossing volumes at the unmarked crossing to the north.



Figure 4.29 TH 169-Casino Drive Intersection: Plan View and Marked Crosswalk, Facing North.

4.4.1.2 Unmarked Crossing on TH 169, north of Casino Drive

Figure 4.30 includes three photographs: an overhead plan view of the unmarked informal crossing on TH 169, a north-facing view of TH 169 at this location, and the view from the video camera installed to count pedestrians using the informal path through the break in the fence to cross TH 169. TH 61 runs

mostly north-south at this location. Ataage Drive and some of the destinations for pedestrians who use the informal crossing can be seen in the third image. The letters and numbers in the images are general locations where pedestrians and vehicles, respectively, were coded.

The major safety concerns at this location were conflicts between people walking and driving. Transportation managers had observed pedestrians walking, running, and sometimes pushing baby carriages across TH 169, often pausing to wait on the raised median. Drivers had been observed slowing or stopping to allow pedestrians to cross. As noted, the Band already had identified potential countermeasures to address these risks. The principal objective of monitoring was to identify actual crossing volumes and provide more information about the magnitude of risk.



Figure 4.30 Unmarked Crossing on TH 169: Plan View, North-Facing View, Video Camera View.

4.4.2 Mille Lacs Monitoring Results

Video cameras were installed to observe pedestrians at the two locations identified by the Mille Lacs Band (Table 4.5). Video was obtained for 16 days at the TH 169–Casino Drive intersection. Video was obtained for 20 days at informal TH 169 crossing to the north; detailed analyses of interactions were completed for only three days of counts because these analyses yielded the planned number of crossings required for analysis. Video was taken only during daylight hours, so the actual numbers of pedestrians crossing at each location likely is higher.

Table 4.5 summarizes counts of pedestrian crossings at these two locations. Figures 4.31 and 4.33 present pedestrian crossing by hour at the two sites, respectively. The average number of crossings per day were more than 40 times higher at the unmarked crossing than at the marked crosswalk.

Table 4.5 TH 169 Pedestrian Crossings, Mille Lacs

Reservation	Crossing Locations	Days of Data	Total Pedestrians Observed	Mean Pedestrians / Day	Maximum Pedestrians / Day	Mean Vehicles Per Day Observed	Total Pedestrians with Interactions	Percent Pedestrians with Interactions
Mille Lacs Band of Ojibwe	TH 169 / Casino Road	16	63	4	11	14,246	41	65.1%*
	TH 169 / north of Casino Road	20	2,728	136	210	--	--	--
	TH 169 / north of Casino Road	3	375	125	155	17,342	204	54.4%

*Estimate includes pedestrians observed waiting at traffic signal at formal crossing.

4.4.2.1 TH 169 and Casino Road

The average number of pedestrians crossing TH 169 during daylight hours was four persons per day (Table 4.5). The maximum number of pedestrians observed crossing during a single day was 11. These crossings were highest from 11:00 a.m. to noon (Figure 4.31). Figure 4.32 is a picture of pedestrians, including an individual in a wheel chair, crossing TH 169.

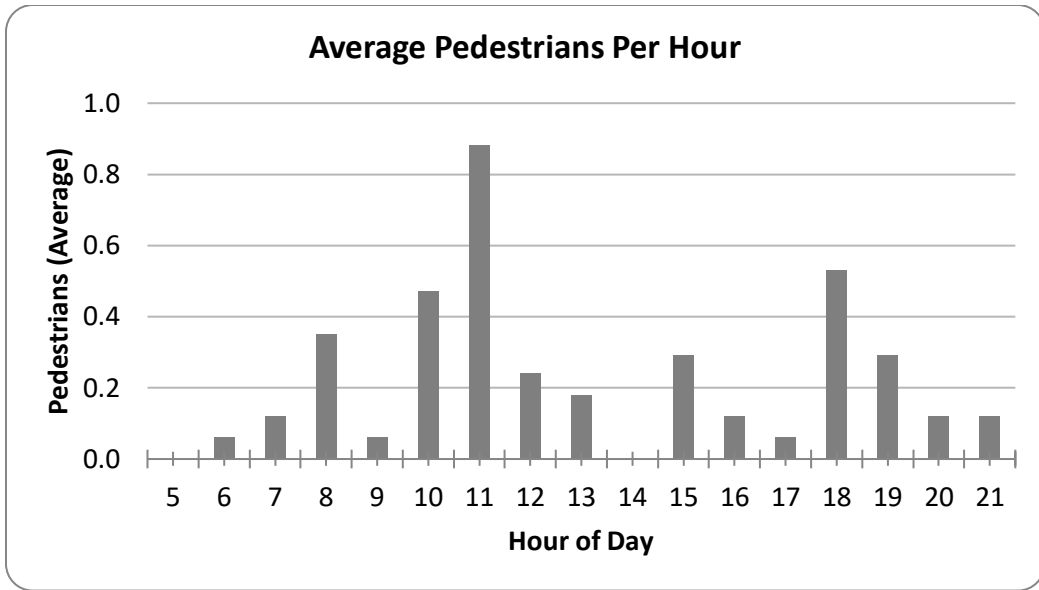


Figure 4.31 TH 169-Casino Drive Intersection: Average Hourly Pedestrian Crossings



Figure 4.32 Pedestrians Crossing TH 169

4.4.2.2 TH 169, North of Casino Road at Ataage Drive

The average number of pedestrians using the informal crossing to Ataage Drive was 136 per day for the 20-day sample and 125 per day for the 3-day sample (Table 4.5). The maximum number of pedestrians observed crossing were 210 and 155 for the two samples. Approximately 54% of the crossings involved interactions with vehicles. Crossings were highest, about 9 to 11 persons per hour, from 3:00 p.m. through 9:00 p.m. (Figure 4.33). Figure 4.34 is a picture of pedestrians crossing TH 169 at this location.

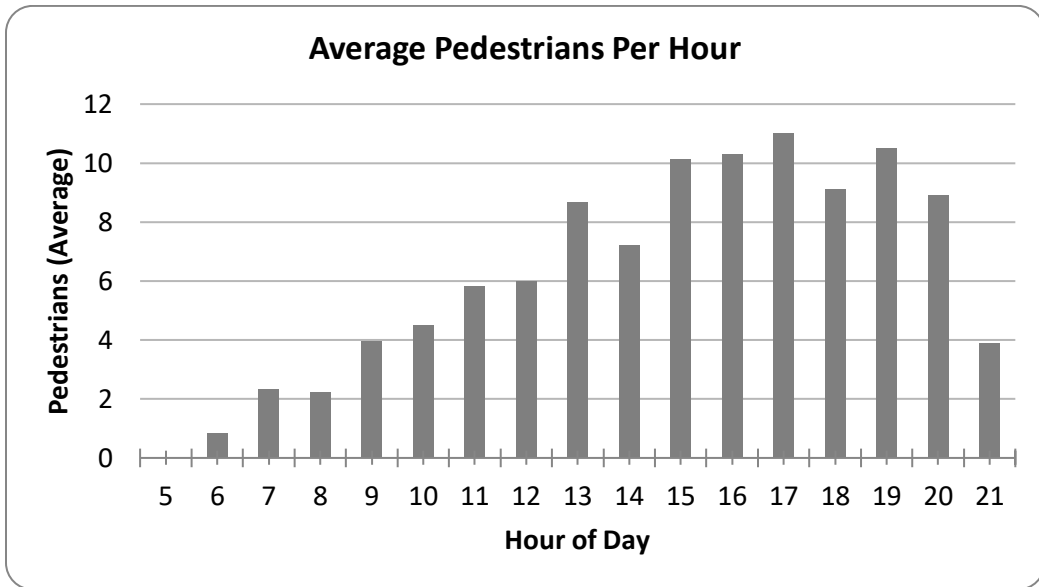


Figure 4.33 TH 169 Unmarked Crossing from Virgo Road to Ataage Average Hourly Pedestrian Crossings



Figure 4.34 Pedestrians Crossing TH 169 at unmarked crossing

4.4.3 Potential Countermeasures to Reduce Risk at Mille Lacs

A representative of the Mille Lacs Band, the MnDOT TL, the principal investigator, and the co-investigator from the Minnesota Traffic Observatory (MTO) met to discuss the monitoring results and potential countermeasures to reduce risk. The release of the monitoring results and the timing of the meeting coincided with the timing for local and Tribal governments to submit grant proposals to MnDOT's Transportation Alternatives Program (TAP) for non-motorized (i.e., walking and bicycling) and other alternative transportation projects.

All participants in the meeting agreed that no additional countermeasures were needed at the TH 169-Casino Drive intersection because the intersection already is controlled with stop lights and the average daily volume of pedestrians (< 4/day) is so small. Discussion focused on countermeasures for the unmarked TH 169 crossing north of Casino Drive accessed by reservation residents through the break in the fence between Virgo Road, a frontage road, and TH 169.

4.4.3.1 TH 169, Unmarked Crossing (north of Casino Road)

The research team independently identified several options including (1) construction of a more substantial barrier to prevent pedestrians from crossing HWY 169; (2) construction of a pedestrian bridge over HWY 169; (3) installation of a marked crosswalk and a second light north of the existing light at Casino Road that could be timed with the existing light; and (4) movement of the existing light to the location of the unmarked crossing, along with a new marked crosswalk.

The Band representative explained that, even before this research project documented the volume of pedestrian crossings, the Band's Tribal Transportation Safety Plan had identified two safety concerns, "169 Pedestrian crossing/light move" and "169 intersection safety improvements" as two of the three highest priority safety-related issues in its District 3 safety plan (Mille Lacs Band of Ojibwe 2018). The Band already had attempted to close the gap in the fence and had investigated the feasibility of building a pedestrian bridge and reconfiguring the intersection and adding a new traffic signal. The Band's attempts to close the gap had failed: people had cut gaps into the new fence to take the shortest distances to their destinations and to avoid walking to the TH 169-Casino Drive intersection. The options of building a pedestrian bridge and reconfiguring the intersection exceeded funds available to the Band. For example, to be ADA-compliant, a pedestrian bridge would require an access ramp for individuals in wheel chairs, which would either require more space than available at the site or designs that would be prohibitively costly to construct. Similarly, the costs of reconfiguring the TH 169-Ataage Drive intersection, linking to Virgo Road with a marked crosswalk, and installing a new traffic signal that would be coordinated with the existing signal at the TH 169-Casino Drive intersection, were considered prohibitive.

The Band representative explained the Band was preparing a proposal in response to the 2017-18 Greater Minnesota Transportation Alternatives Solicitation for a project to address the risks to pedestrians documented through the monitoring. The proposal, titled "HAWK Pedestrian Crossing Project," (Mille Lacs Band of Ojibwe 2018) requested funding for a PHB that pedestrians could activate to stop traffic on TH 169 to permit safe crossing. The Band had been working with the Bureau of Indian Affairs, MnDOT District 3, and other federal, state, and local agencies and to develop the project. The monitoring results provided the strongest evidence base for the countermeasure yet developed. Participants agreed the findings should be incorporated into the Band's TAP proposal. The Band estimated the cost of installation of the PHB and related improvements (e.g., advance warning signs) to be \$350,025, including \$200,000 specifically for the signal equipment. The TAP potentially funds a maximum of 80% of a project's costs; local partners are required to provide a minimum match of 20%. The Mille Lacs Band Assembly, the elected governing body of the Mille Lacs Band, passed a resolution authorizing submission of the proposal, including the commitment to pay 20% of the project costs.

MnDOT administrators responsible for the TAP, none of whom were involved in this research project, approved the Band's TAP proposal. At the time of this writing, project implementation was scheduled for the summer of 2020. The Band, MnDOT, and the research team plan to monitor pedestrian activity and assess use of the HAWK signal in the summer or fall of 2020 as the Phase 2 follow-up to this study.

4.4.4 Supplemental Monitoring

As previously noted in Section 4.4, in 2018 after the initial monitoring in 2017, the Mille Lacs Band built a sidewalk along the western side of Virgo Road to connect pedestrians from Atooban Drive (just north of the break in the fence) to the crosswalk at the TH 169 Casino Drive. This project included a new

crosswalk across Virgo Road. The research team completed supplemental monitoring of pedestrian activity in the summer of 2019 to provide information about use of the new sidewalk and to provide additional information about pedestrian crossings through the break in the fence prior to installation of the PHB. The research team followed the same procedures and used the same protocols for video camera installation and data reduction. Video camera perspectives were adjusted to provide views of the new sidewalk. Figure 4.35 is a picture of the marked crosswalk across TH 169 at Casino Drive. Figure 4.36 is a picture of the informal, unmarked crossing across TH 169 accessed through the break in the fence that separates Virgo Road and TH 169. Figure 4.375 is a picture from the video camera used to monitor pedestrian use of the new crosswalk across Virgo Road and the new sidewalk. The letters and numbers in the image are general locations where pedestrians and vehicles, respectively, were coded.



Figure 4.35 Traffic Flows at Marked Crosswalk across TH 169 at Casino Drive.

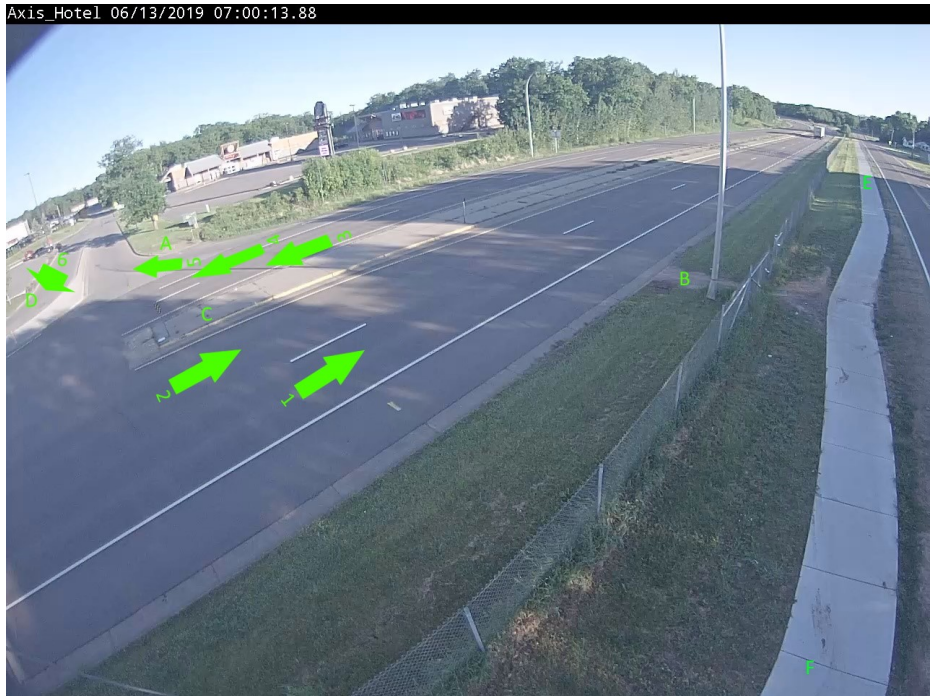


Figure 4.36 Traffic Flows at Marked Crosswalk across TH 169 at Casino Drive.



Figure 4.37 Video Camera Perspective Used to Monitor Used of Sidewalk and Virgo Road Crosswalk

The MTO monitored traffic at the two locations during daylight hours for approximately 5 days from June 18, 2019 through June 22, 2019. A total of 69 pedestrians were observed crossing TH 169 on the marked crosswalk to Casino Drive, for an average of about 15 pedestrians per day (Table 4.5). In addition, 13 bicyclists were observed, or an average of about three per day. A few other crossing events, included vehicles, were recorded but not included in analyses. Few of the crossings involved interactions with vehicles: 2.9% of the pedestrian crossings, and none of the bicycle crossings. The lack of interactions is likely because this crossing is controlled by a traffic signal. These results are consistent with results from 2017, although the pedestrian crossing volumes were nearly four times the volumes previously observed (i.e., about 4/day; Table 4.5). The pedestrian directional flows were evenly split: 52% of all crossing events were east-bound; 48% were westbound.

At the informal, unmarked TH 169 crossing accessed through the break in the fence along the frontage road, 467 crossing events were observed. Pedestrians accounted for approximately 78% of all crossings, an average of about 79 per day. Bicyclists accounted for about 22% of all crossings, an average of about

22 per day. Nearly half of all pedestrian crossings (45.8%) involved interactions with vehicles. A smaller proportion of crossings by bicyclists (30%) involved interactions with vehicles. In almost all instances, pedestrians and bicyclists yielded to vehicles. Vehicles yielding to pedestrians or bicyclists accounted for only about one percent of all interactions. The daily mean number of crossing events observed in 2019 was lower than the volume observed in 2017.

Table 4.6 TH 169 Pedestrian Crossings, Mille Lacs in 2019 Following Virgo Road Sidewalk Construction.

Location	Days of Counting	Crossings Observed	Average Crossings / Day	Maximum Crossings / Day	Pedestrian Crossings with Interactions (%)
TH 169 Marked Crosswalk – Casino Rd					
Pedestrians	4.6	69	15		2.9%
Bicycles	4.6	13	4		0%
Total Peds & Bikes	4.6	82	18	23	2.4%
TH 169 Unmarked Crossing					
Pedestrians	4.6	365	79		45.8%
Bicycles	4.6	102	22		30.3%
Total Peds & Bikes	4.6	467	101	136	42.4%

To provide additional insight into pedestrian activity, including use of the new sidewalk, researchers observing the video also recorded approach routes and directional flow through the break in the fence. It was not possible to identify and code the specific origins (e.g., a specific store or home in a residential subdivision) of all pedestrians crossing TH 169 because the video cameras’ fields of vision were not large enough. However, researchers did observe and code specific points from which pedestrians approached TH 169 from the west and the break in the fence from the north, east, and south. In photographs 4-24 and 4-25, the letters (e.g., A) superimposed on the photographs represent these points along these different approach “routes”.

East- and westbound crossing events were evenly split. Eastbound crossing events accounted for 50.2% of all crossings; westbound events accounted for 49.8% of total observed crossings. Approximately 70% of eastbound crossings originated from location A in Figure 4-24, which is located along the most direct route from the break in the fence, across TH 169, to the grocery market. Approximately 30% of the crossings originated from location D, which is along the straightest path to and from the casino. Nearly 26% of the individuals who crossed eastbound stopped on the median and waited for vehicles to pass before completing the crossing to the break in the fence.

With respect to west-bound crossings, 61% approached location B, the break in the fence, from the north (locations E, K, L in Figure 4-25), while 22% approached B from the locations further east (locations G, H, J), and 17% approached from the south (locations F, O, N). Slightly more than half (51%)

of westbound individuals were recorded at location C, indicating they stopped on the median prior to completing their crossing of TH 169.

One of the objectives of the supplemental monitoring was to document use of the new sidewalk. Virtually all individuals observed on the sidewalk between points E and F were using it to access the break in the fence. Only one individual observed on the sidewalk between these points passed the break in the fence without entering it to cross the highway.

With respect to southbound individuals approaching the break in the fence from the north (n=141), 52% were on the sidewalk (location E), while 45% were observed on or along the east side of the frontage road (location L). Only 1 individual was observed along the shoulder of the west side of the frontage road (location K). With respect to individuals approaching the break in the fence from origins further to the east (n=52), 35% were observed at location G and 65% were observed at location H. With respect to individuals approaching the break in the fence from the south (n=39), 51% were observed on the sidewalk at location F, 31% at location O on the road shoulder, and 18% at location N on the road. In sum, 92 of all westbound individuals were observed on the new sidewalk (i.e., at either points E or F). These individuals account for 51% of all individuals approaching point B (i.e., the break in the fence) from the north and south. These results indicate success in moving most pedestrians to the sidewalk.

CHAPTER 5: SUMMARY AND CONCLUSIONS

MnDOT initiated this research project in 2016 to increase understanding of pedestrian behavior and exposure to risk on Native American reservations. Four Anishinaabe Bands collaborated in the project:

- Bois Forte Band of Chippewa
- Fond du Lac Band of Lake Superior Chippewa
- Grand Portage Band of Ojibwe
- Mille Lacs Band of Ojibwe

Key substantive project tasks included:

- Consultation with Tribal representatives about pedestrian safety and selection of monitoring sites
- Preparation of monitoring plans and monitoring of pedestrian behavior through video observation
- Video reduction and data analysis
- Identification of potential countermeasures to address observed risks

The Minnesota Traffic Observatory monitored pedestrian crossings at 10 locations using video cameras and analyzed the frequency of pedestrian-vehicle interactions. Total pedestrian crossings at nine of 10 locations were low relative to urban intersections, and frequencies of interactions with vehicles varied. At one location on TH 169 at the Mille Lacs Reservation, crossing volumes were higher, and risks to pedestrian safety were determined to be higher.

Tribal transportation managers, MnDOT and county engineers, and the research team reviewed monitoring results and identified potential countermeasures to increase pedestrian safety at each location of concern. (These countermeasures are summarized in Table 5.1.) No funding for implementation of countermeasures was included in this project, but state, county, and Tribal engineers and managers identified planned projects and other opportunities to integrate installation. The Mille Lacs Band was successful in obtaining funding for installation of a PHB; installation was planned for summer 2020.

Several observations may be drawn from project results that have relevance for other state DOTs and Tribes working together to address transportation safety on reservations. First, plans and policies matter. MnDOT has a number of initiatives to strengthen collaboration with Minnesota's Tribes and Minnesota Walks, and the state's pedestrian policy plan, identifies Tribal populations as a priority population. Funding for this research project was authorized in the context of these plans and policies. Similarly, the Mille Lacs Band had identified the TH 169-Ataage Drive informal crossing as a priority in its Tribal Transportation Safety Plan and already had explored potential countermeasures. When the new evidence became available, the Band was able to move quickly. More generally, embedding commitments to address risks and disparities in safety within official agencies policies and planning documents will be a good step and will help to pave the way for future investments to reduce risk.

Second, evidence is essential. As illustrated by the Mille Lacs case, the information produced in this project – simple counts, estimates of interactions, and images – provided a basis for action. In Fond du Lac, new information about the volumes of pedestrian crossings provided an additional rationale for Tribal transportation managers and county and state engineers to review proposed projects and identify opportunities for incremental improvements that could be incorporated into projects already planned and funded such as the trail along Mission Road to TH 210. Although the evidence that is leading to implementation in this project was produced by a university-based research team, the type of evidence is not complicated and potentially could be collected by Tribal personnel or even volunteers on committees working on programs like Safe Routes to Schools.

Table 5.1 Potential Countermeasures to Increase Pedestrian Safety on Reservations

Reservation / Roadways / (pedestrian crossings / day)	Potential Countermeasures to Increase Pedestrian Safety on Reservations													Scheduled
	Crosswalk; Signs	Re-alignment	Pedestrian Crossing Signs	Pedestrian Education	Improved Lighting	RRFB & Signs	Access Ramps	Line of Sight Improvements	Access Management	Trails	Other*			
Boise Forte														
CSAH 104-Farm Rd (39)	X	X	X	X								A, B	NA	
CSAH 104-Gold Mine Spur Rd (26)	X	X	X		X								NA	
Fond du Lac														
Big Lake Rd-Pinewood Dr (29)	X		X			X							NA	
Big Lake Rd-Trettel Ln (31)								X					NA	
Big Lake Rd-Brevator (3)						X	X		X	X			NA	
TH 210 and Mission Rd (12)			X		X					X		C	2019, 2021	
Grand Portage														
TH 61-Blazes Pit Rd (14)	X		X	X	X	X	X					D, E	2021	
TH 61-Stevens Rd (11)	X		X		X	X						E	2021	
Mille Lacs														
TH 169-Casino Dr (4)	<i>None required: crossing controlled with traffic signal.</i>													
TH 169-Ataage Dr (125)	X		X									F	2019-2020	
*A= speed warning signs. B=in-street bollards. C=pedestrian landing. D=center turn lane. E=guardrails. F=Pedestrian Hybrid Beacon														

A third observation, related to the second, is that risks are relative. Although the volumes of pedestrian crossings documented were low relative to urban contexts, all participants agreed that the risks were real to the residents of the reservations who were making the crossings. In Grand Portage, for example, Tribal transportation managers and MnDOT district engineers agreed that drivers traveling at posted speeds (i.e., 55 m.p.h.) on TH 61 past Blazes Pit Road, the location of the informal crossing, were unlikely to expect pedestrians crossing from a gravel exit from the woods. Video images of youth pushing bicycles up the embankment behind the Trading Post and waiting for traffic to pass effectively illustrated the nature of the risks at this site. Similar images – mothers pushing baby carriages across TH 169 in Mille Lacs and unaccompanied youth crossing CSAH 104 in Bois Forte to reach the Boys and Girls Club – effectively communicate why countermeasures may be warranted.

A fourth observation is that equity rather than efficiency may be an appropriate basis for investments to address risks in transportation systems. As already noted, pedestrian crossing volumes were low relative to urban locations. None of the intersections, including the location in Mille Lacs where a PHB is being installed, met MUTCD warrants for PHBs or traffic signals. However, if efficiency, or even the numbers of individuals potentially affected, were the sole basis for investments in countermeasures, few to none ever would be implemented on reservations, simply because of the comparatively small populations. Engineers are trained and work hard to eliminate subjectivity from analyses and prioritize projects according to objective criteria. Decisions to allocate scarce financial resources, however, are inherently political while only partially technical. Equity considerations, including the need to address historical disparities in investments on reservations, are important.

Fifth, it is important to involve all relevant units of government early in the processes for studies such as this one. In this case, MnDOT and the research team selected project sites in consultation with the individual Bands and only engaged county engineers later after results were obtained. County engineers asked why the particular sites were chosen and expressed concern about reliance on subjective assessments of risks and anecdote as opposed to more systematic reviews of all potential candidate sites within a jurisdiction. Although the engineers' concerns subsequently were addressed, the lesson is to engage all relevant county and district engineers earlier in the process. All transportation managers share the challenges of addressing increasing traffic safety with inadequate resources. This project has illustrated one approach to achieving incremental reductions of risk to pedestrians on rural reservations.

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APPENDIX A

Advancing Pedestrian Safety

Pedestrian Activity & Safety on Four Anishinaabe Reservations

Project Highlights

- MnDOT, the Advocacy Council on Tribal Transportation, and the University of Minnesota collaborated to observe pedestrian activity and identify countermeasures to reduce pedestrian risk.
- Researchers documented pedestrian crossing volumes and interactions with vehicles at 10 priority locations identify by Tribal transportation managers on four rural reservations.
- Crossing volumes ranged from 3 to 136 persons per day during daylight hours.
- Across the 10 locations, 9% to 54% of observed crossings involved interactions with vehicles.
- MnDOT, Tribal transportation managers, and county engineers identified potential countermeasures such as crosswalks, advance warning signs and Rectangular Rapid Flashing Beacons (RRFBs) to address observed risks.
- The Mille Lacs Band used project results to support a successful grant proposal to install a crosswalk and pedestrian hybrid beacon across TH 169.
- Collaborative efforts to collect evidence can inform efforts to increase pedestrian safety.

Background & Purpose

Minnesota Walks, Minnesota's policy framework for advancing safe, convenient walking, identifies Native American as one of six priority populations who are more likely to walk in their everyday lives. Tribal transportation managers identify pedestrian safety as one or their top safety concerns on reservations.

The Minnesota Department of Transportation (MnDOT) funded a research project with the University of Minnesota (UMN) to document pedestrian behavior on reservations and identify potential countermeasures to reduce risks to pedestrians. The Advocacy Council on Tribal Transportation (ACTT) agreed to serve as the Technical Advisory Panel. Transportation managers from the Bois Forte Band of Chippewa; Fond du Lac Band of Lake Superior Chippewa; Grand Portage Band of Ojibwe; and Mille Lacs Band of Ojibwe identified sites where Tribal elders and members were concerned about pedestrian safety. UMN researchers conducted field studies and collaborated with MnDOT, Tribal transportation managers, and county engineers to identify potential countermeasures.

A Collaborative Approach



- Consulted Tribal transportation managers who identified priority sites for monitoring.
- Prepared monitoring plans and obtained approval from Tribes and agencies for monitoring.
- Installed video equipment and analyzed videos.
- Reviewed findings with Tribal representatives.
- Identified potential countermeasures in consultation with Tribes and county engineers

Multiple representatives from each reservation and county engineers participated in meetings to identify potential countermeasures and review opportunities to integrate them into planned projects. MnDOT and researchers reviewed the literature and:

- Met with Tribal representatives to review results and brainstorm countermeasures;
- Met with MnDOT safety and district engineers to refine possible countermeasures;

MnDOT’s approach to the project was consultative and collaborative. MnDOT’s Tribal liaison advised staff and researchers on project development and implementation. Following ACTT’s agreement to participate in the project, MnDOT and the researchers:

- Met jointly with Tribal representatives, MnDOT district engineers, and county engineers to finalize short-lists of countermeasures and opportunities to integrate them into scheduled or planned projects.

Potential Countermeasures to Increase Pedestrian Safety on Reservations													
Reservation / Roadways / (pedestrian crossings / day)	Crosswalk; Signs	Re-alignment	Pedestrian Crossing Signs	Pedestrian Education	Improved Lighting	RRFB & Signs	Access Ramps	Line of Sight Improvements	Access Management	Trails	Other*	Scheduled	
Boise Forte													
CSAH 104-Farm Rd (39)	X	X	X	X							A, B	NA	
CSAH 104-Gold Mine Spur Rd (26)	X	X	X		X							NA	
Fond du Lac													
Big Lake Rd-Pinewood Dr (29)	X		X			X						NA	
Big Lake Rd-Trettel Ln (31)								X				NA	
Big Lake Rd-Brevator (3)						X	X		X	X		NA	
TH 210 and Mission Rd (12)			X		X					X	C	2019, 2021	
Grand Portage													
TH 61-Blazes Pit Rd (14)	X		X	X	X	X	X				D, E	2021	
TH 61-Stevens Rd (11)	X		X		X	X					E	2021	
Mille Lacs													
TH 169-Casino Dr (4)	<i>None required: crossing controlled with traffic signal.</i>												
TH 169-Ataage Dr (125)	X		X								F	2019-2020	

*A=speed warning signs. B=in-street bollards. C=pedestrian landing. D=center turn lane. E=guardrails. F=pedestrian hybrid beacon

Lessons Learned

6. *Plans and policies matter.* MnDOT’s commitments to pedestrian safety and equity institutionalized in *Minnesota Walks* and other policies and programs provide a rationale for this project and increases likelihood of future implementation.
7. *Evidence is essential.* Rural and Tribal transportation managers often lack data about pedestrian activity. Evidence such as simple user counts can inform decision-making. Collaborative efforts can produce evidence that matters.

8. Risks are relative, but real. Rural pedestrian crossing volumes are low relative to urban volumes, but the risks pedestrians face are real: drivers may not expect to see pedestrians on remote rural roadways. Low volumes are not a reason for no action to reduce risks.
9. Equity, as well as efficiency, is important. If efficiency (i.e., numbers of pedestrians) were the sole basis for investments, agencies would rarely fund countermeasures on reservations. Investments on reservations are needed to redress historical marginalization of Tribes and existing disparities in traffic safety.
10. Engage collaborators early-on. Tribes are sovereign governments with participatory decision-making processes. Pedestrian safety issues on reservations often are addressed in cooperation with county and state highway departments. Meetings to plan research, share and review findings, and discuss implications can increase likelihood of project funding and implementation.