

Grand Teton National Park

Bicycle Road Safety Audit

Gros Ventre Junction- US Highway 26/89/191



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Introduction

Purpose/Background

According to the Federal Highway Administration's (FHWA) *Bicycle Road Safety Audit Guidelines and Prompt Lists*, a Road Safety Audit (RSA) is a formal safety examination of a future roadway plan or project or an in-service facility and is conducted by an independent, experienced, and multidisciplinary RSA team. The primary focus of an RSA is safety while working within the context of mobility, access, surrounding land use, and/or aesthetics. RSAs enhance safety by identifying potential safety issues affecting all road users under all conditions and suggesting measures for consideration by the design team or responsible agency.

An RSA is not simply a standards check. Standards checks are part of the design process to ensure adherence to design standards and guidelines. Although the RSA team may identify safety issues by comparing items of concern to standards, the general intention of the RSA is to identify areas where applied standards may interact with road user behaviors to generate a potential safety issue.

In addition to using an RSA as a tool to improve safety performance of facilities in their jurisdiction, public agencies may wish to conduct RSAs oriented to address safety issues related to specific user groups, such as bicyclists. A Bicycle Road Safety Audit (BRSA) is an RSA conducted from a cyclist's perspective but still involves a review of all modal behaviors, needs, and facilities.¹

The purpose of this BRSA was to assess the safety of a shared use path² crossing near the intersection of Gros Ventre Road and US Highway 26/89/191, also known as the Outside Highway, in Grand Teton National Park, Jackson, Wyoming. This location was selected because since the 2012 completion of the Gros Ventre River to Moose Junction portion of pathway, there have been numerous observed near misses between cyclists, pedestrians and motor vehicles at this intersection. The BRSA team was comprised of individuals with a variety of backgrounds including: law enforcement, engineering,

¹ FHWA. *Bicycle Road Safety Audit Guidelines and Prompt Lists*. Available: http://safety.fhwa.dot.gov/ped_bike/tools_solve/fhwasa12018/fhwasa12018.pdf

² Shared Use Path terminology from the AASHTO *Guide for the Development of Bicycle Facilities* (2012).

planning, and landscape architecture. There were representatives from Grand Teton National Park, the National Park Service Intermountain Regional Office, the Wyoming Department of Transportation, the Federal Highway Administration (FHWA) Resource Center and Western Federal Lands Highway Division.

Grand Teton National Park, shown in Figure 1, was established in 1929 and was expanded to its current size in 1950. The park has approximately 2.5 million recreational visits per year, making it one of the top ten most visited national parks in the U.S.³ The peak season extends from May through September and in 2011, the park averaged about 500,000 visitors per month during this period.⁴

The 310,000 acre park is approximately 45 miles in length, 25 miles in width, and has varying terrain ranging from the sagebrush filled valleys at an elevation over 6,000 feet to the Teton Range with the highest peak at an elevation of 13,770 feet. Average temperatures range from about 70 degrees (F) in the summer to the single digits in the winter with snow blanketing the park from early November to May. The highest temperature ever recorded was 93 degrees in 2003 and the lowest was -63 degrees in 1933. Monthly

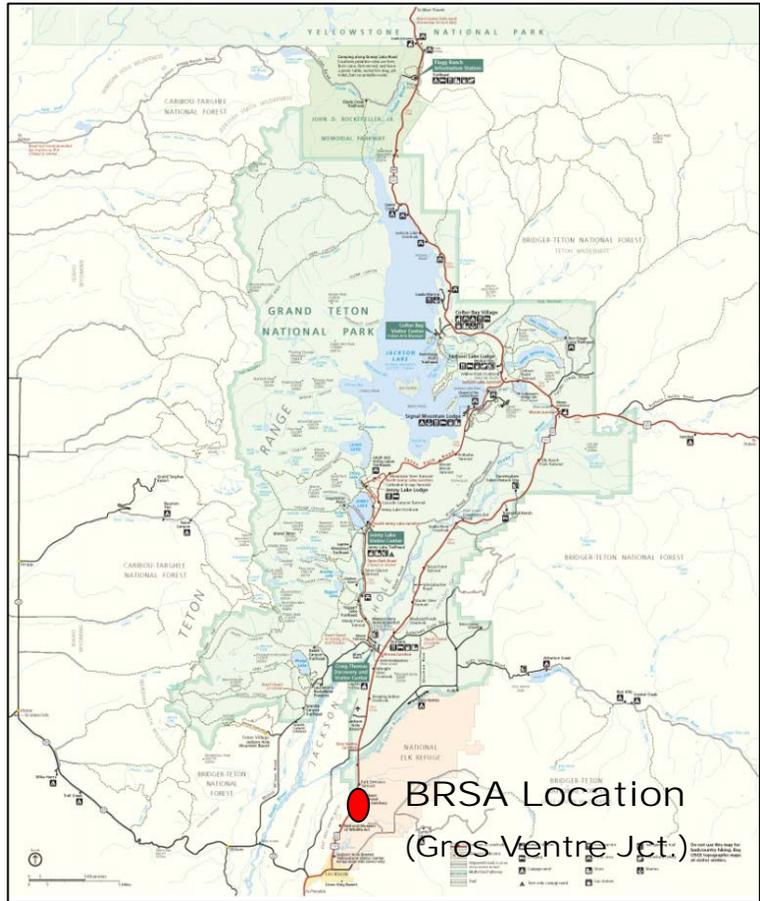


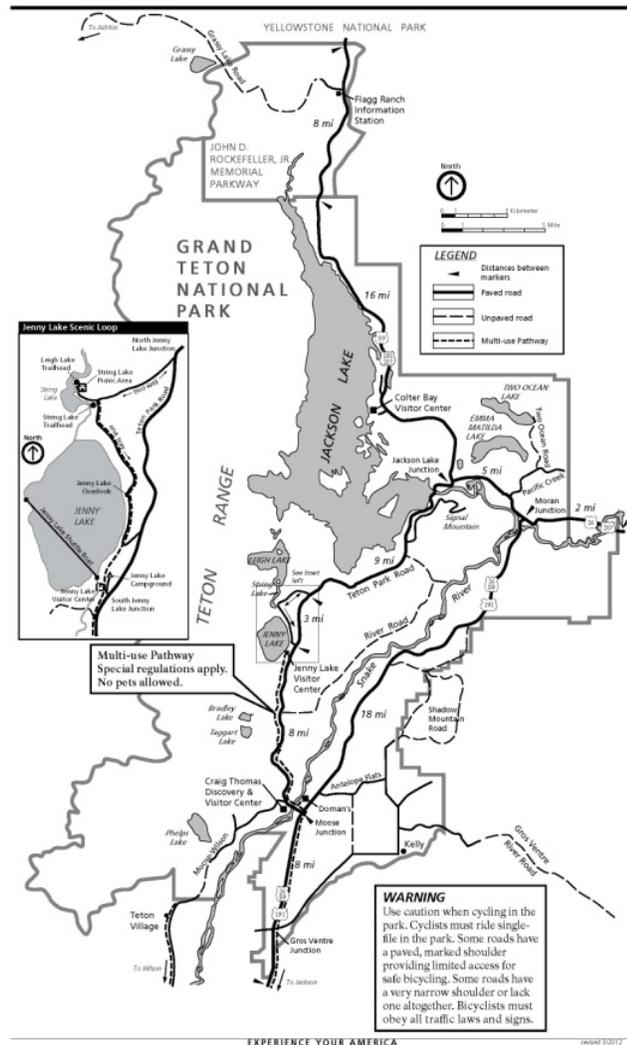
Figure 1. Map of Grand Teton National Park.

³ National Park Service. Grand Teton National Park. Available: <http://www.nps.gov/grte/index.htm>

⁴ National Park Service. Visitor Use Statistics for the Grand Teton National Park. Available: <https://irma.nps.gov/Stats/Reports/ReportList>

average precipitation for the year ranges from 1.23 inches in August to 2.92 inches in November.⁵

There are a variety of ways to experience the park from boating and fishing, mountain climbing and hiking, to driving or biking through wildlife and scenic areas. Skiing and snowshoeing are popular winter activities at the park. There are three visitor centers, six campgrounds, 200 miles of hiking trails, and over 100 miles of paved roads and 14.5 miles of shared use paths available for walking, rollerblading and biking as shown in Figure 2 and Appendix B.^{6,7} The first 8 miles of shared use paths in the park were opened in 2009. The park opened a second phase of its system in spring 2012, which connected Moose to the Gros Ventre River, passing through Gros Ventre Junction. This new segment connects to a Jackson Hole Community Pathways segment which extends south from the river to the Town of Jackson, WY. This BRSA reviewed the shared use path use at Gros Ventre Junction to address visitor and park staff concerns about the safety of visitors using and accessing this portion of the pathway.



⁵ The Weather Channel. Monthly Averages for Grand Teton National Park.

⁶ National Park Service. Grand Teton National Park. Available: <http://www.nps.gov/grte/index.htm>

⁷ National Park Service. Grand Teton National Park Biking Brochure.

Study Area

The location for this Bicycle Road Safety Audit (BRSA) was the intersection of Gros Ventre Road and the US Highway 26/89/191. This intersection is located on the southern end of the park, between the town of Jackson and the Jackson Hole Airport, as shown in Figure 3. To the west, along Sagebrush Drive, is a large residential area and to the east, along the Gros Ventre Road, is the town of Kelly and the Gros Ventre Campground which is the largest campground in the park. As evidenced by its multiple US Highway system designations the US Highway 26/89/191 is the primary through highway in northwestern Wyoming and serves a wide range of users including park visitors, local commuters, airport traffic, general commercial and heavy through truck traffic. The pathway is used by park visitors and local residents for recreation and by commuters traveling to and from the Town of Jackson, WY.

Figure 2. Map of Park Bicycling Facilities
(see Appendix B for full-size map).

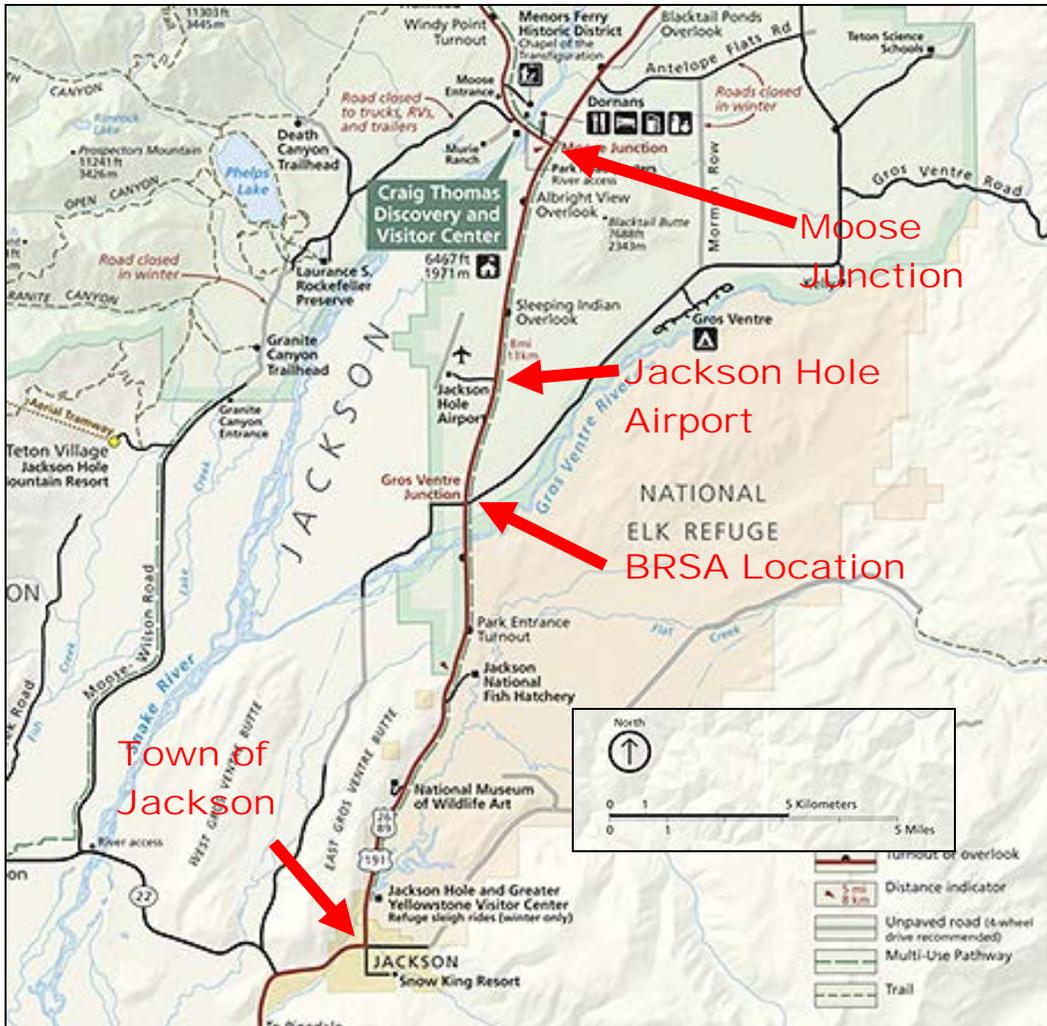


Figure 3. BRSA Location

Existing Conditions

Rules and Regulations

The National Park Service (NPS) has information regarding bicycling on their website which includes:

Guidelines for Safe Biking

- Wear a helmet at all times.
- Ride on the right side of the road in single file.
- Obey the rules of the road at all times.
- Use hand signals to communicate with drivers.
- Drivers are often distracted when driving through the park, ride defensively.

Bicycle Regulations

- The shared use path is closed from dusk to dawn to all users.
- Bicycle riders in the park and parkway must obey the same rules and regulations that apply to motorized vehicles.
- Bicycles are allowed only on paved and unpaved roads, unless otherwise posted. Bicycles are not allowed on any park or parkway trails or in any backcountry areas. Riding a bicycle abreast of another bicycle on paved roads within the park and parkway is prohibited. Ride single file for your safety.
- When riding on park roads during low visibility and between sunset and sunrise, bicyclists must display a white light or reflector from the front and a red light or reflector from the rear.

Use of the pathway is limited based on certain weather and environmental conditions. The park owned and managed pathway is closed daily from dusk to dawn and is open when snow conditions allow for use (i.e., snow free). The adjacent Jackson Hole Community Pathways managed pathway located within the National Elk Refuge from Jackson to the North Shore of the Gros Ventre River is closed seasonally from October 1 through April 30 for elk migration. Dogs are not allowed on either pathway section.

Site Characteristics and Bicycle Accommodations

The study area consists of the intersection of Gros Ventre Road/Sagebrush Drive and US Highway 26/89/191 and the intersection of the shared use path with Gros Ventre Road, as shown in Figure 4. The roadway intersection is two-way stop controlled with stop signs along Gros Ventre Road and Sagebrush Drive. The intersection of the shared use path and Gros Ventre Road is also two-way stop controlled with stop signs along the pathway.

Gros Ventre Road and Sagebrush are both two lane roads. The speed limit on the Gros Ventre Road is 45 MPH, on Sagebrush Drive it is 35 MPH. The Gros Ventre Road consists of two approximately ten-foot wide lanes. US Highway 26/89/191 is an approximately 32-foot wide, undivided highway with two 11 foot lanes and two five foot shoulders and a speed limit of 45 MPH through the intersection. At the intersection, the highway width is approximately 60 feet with both left- and right-turn lanes in the northbound and southbound directions. The closest edge of the 10-foot wide shared use path is located approximately 10 feet east of the roadway edge of pavement at the intersection.



Figure 4. BRSA Site

Traffic Data

At the Gros Ventre Junction intersection, US Highway 26/89/191 has an AADT of approximately 10,761 vehicles per day (VPD).⁸ An in-person bicycle count conducted by park staff over the four days of August 20th-24th of 2012 indicated that pathway usage averaged about 23 cyclists per hour. This count was conducted during the peak pathway use season and at peak times during the day. During the 14.5 hours in which the pathway was monitored a total of 333 cyclists, two (2) pedestrians and three (3) other users (rollerbladers, skateboarders, etc.) were observed. Figure 5 shows pathway user direction of travel for each day the volumes were recorded; the average direction of travel; 36 percent on the path coming from the south, 36 percent on the path coming from the north, 19 percent from Gros Ventre Road, and seven (7) percent from Sagebrush Road. Traffic records show that peak roadway and pathway traffic volumes coincide both in time of year and time of day, accentuating safety concerns due to vehicle-pathway user conflicts.

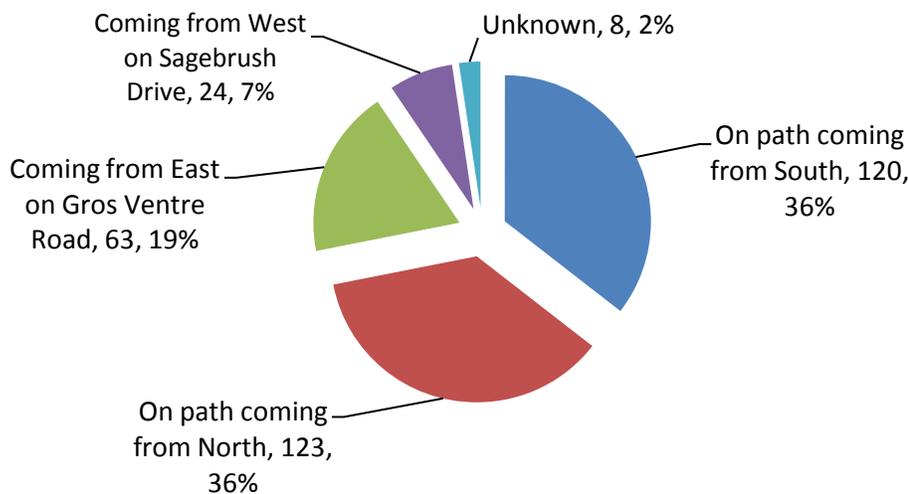


Figure 5. Pathway User Direction of Travel (August 20-24, 2012).

Collision Data

While the RSA is bicycle-focused, in order to gain a more complete understanding of how the intersection functions, it is important to look at crashes involving both motorized and non-motorized vehicles. This intersection averaged 4.25 vehicle crashes per year over the past four year and has a crash rate of 1.08 crashes per million entering vehicles (MEV). This crash rate is fairly similar to those found in other rural areas such as

⁸ 2010 data from WYDOT. Available: <https://www.dot.state.wy.us/files/content/sites/wydot/files/shared/Traffic/traffic%20data/2010/2010%20Routes%209-36.pdf>

Wisconsin which had a rural intersection crash rate of 0.94 MEV⁹ and Oregon where rural, unsignalized intersections had a crash rate of 1.03 MEV.¹⁰

While there is a record of vehicle crashes, this intersection does not currently have any recorded vehicle-bicycle crashes. The lack of recorded bicycle crashes may be attributable to the relatively new construction of the pathway or the fact that many bicycle crashes go unreported. Severe crashes resulting in fatality are reported; however, less serious crashes that are more frequent tend to be underreported.¹¹

To better understand cyclist exposure and behavior, the park recorded observed path volumes, travel direction, and behaviors. Regarding cyclist behavior, 23 percent of observed riders obeyed the traffic signs, 70 percent did not obey the traffic signs, 4 percent did not follow traffic signs or slow down when approaching the intersection, and 3 percent were unknown. Notes from the data collection that of those 4 percent that did not follow traffic signs or slow down, many did not appear to look for traffic, and at times cut through moving vehicles so as to not slow down.¹² Figure 6 shows a summary of those observations.

⁹ Knapp, K. K., and J. Campbell. Intersection Crash Summary Statistics for Wisconsin. FHWA/WisDOT, Wisconsin Department of Transportation, Madison, WI, 2005.

¹⁰ Bonn, E. Intersection Accident Rates. Unpublished internal Oregon DOT memorandum. File TRA-03-01, Dated September 4, 1994.

¹¹ Jane C. Stutts and William W. Hunter. Injuries to Pedestrians and Bicyclists: An Analysis Based on Hospital Emergency Department Data. Publication No. FHWA-RD-99-078. 1997. Available: <http://www.fhwa.dot.gov/publications/research/safety/pedbike/99078/index.cfm>.

¹² Data from the National Park Service. Data collection period ranged from 1 to 4 hours.

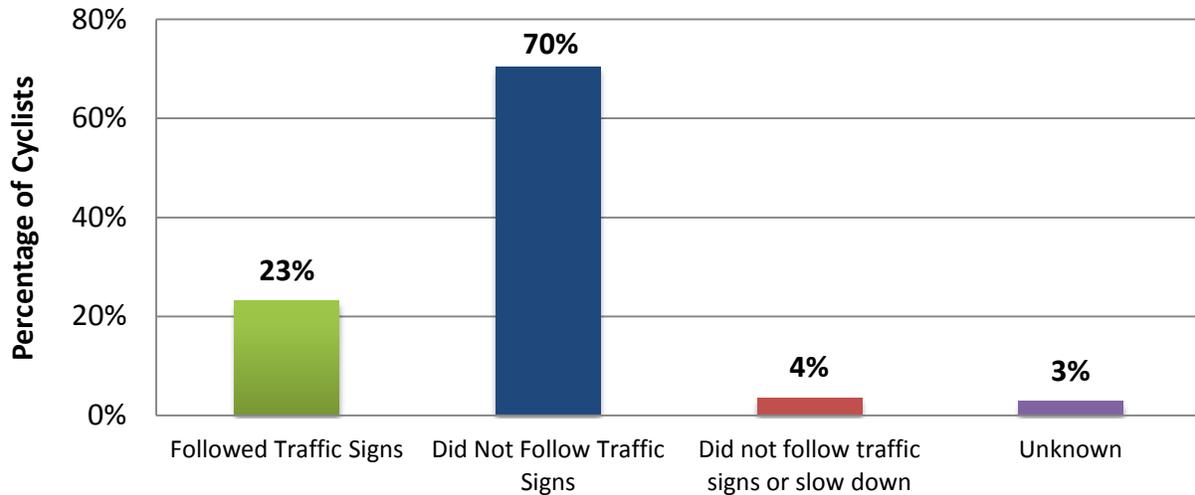


Figure 6. Percentage of Cyclists Adhering to Traffic Signs

Assessment of Findings

Safety Benefits of Existing Roadway and Shared Use Path Features

While conducting the BRSA, the BRSA team noted positive features of the existing roadway and shared use path, including the following.

- **Pavement condition:** Both the roadway and the shared use paths had surfaces that were free of cracks and were in generally good condition.
- **Maintenance of vegetation:** Vegetation was adequately trimmed so that it wasn't protruding onto the shoulders or pavement, or obstructing sight distance.
- **Sight triangles:** Intersection sight distance was not obstructed by signs or other obstacles for most of the intersection approaches.
- **Positive warning and guidance:** Signs and pavement markings were installed to indicate the location of the pathway crossing to motorists and to alert pathway users of the upcoming intersection.



Examples of positive warning and guidance. From left to right – northbound shared use path pavement markings, sign along US Highway 26/89/191 indicating pathway crossing location, pedestrian and bicycle crossing warning sign along Gros Ventre Road, pavement markings on Gros Ventre Road.

Constraints

Before examining the safety issues and suggestions for improvement, it was necessary to identify potential constraints. As the site is located in a National Park, there are both environmental and visual impacts to consider when suggesting mitigation strategies.

Identified Safety Issues

The following is a detailed discussion of each of the safety issues identified during the BRSA in order of priority with suggestions for improvement. Detailed explanations of the suggested improvements are provided in the following section.

Unprotected Highway Crossing

Cyclists currently do not have a protected method for crossing the highway. During peak periods, the highway experiences a high-volume of vehicles traveling at high speeds. Due to the speed and volume of highway traffic, cyclists may not have adequate gaps in traffic to cross the road due to the high traffic volumes and speeds. Additionally, the shared use path crossing of the highway is unmarked so motorized vehicles may not expect cyclists and pedestrians to cross the road at this location.

Due to the lack of a marked crossing across US Highway 26/89/191, some cyclists are crossing farther away from the intersection, where the road is narrower, and traveling against the flow of traffic to reach the intersection. According to an FHWA study, wrong way riding attributed to nearly one-third (32 percent) of all bicycle-vehicle collisions. For intersection collisions, 42 percent were attributed to wrong way riding.¹³ Additionally, vehicles are traveling at high speeds, therefore not only is the risk of collision higher, but so is the potential for increased crash severity.

Furthermore, park staff have observed large groups crossing US Highway 26/89/191. These groups, which are comprised of cyclists of a variety of ages and abilities, attempt to cross this high-speed, high-volume roadway without adequate warning to vehicles.

¹³ Hunter, W. W., J. C. Stutts, W. E. Pein, and C. L. Cox. Pedestrian and Bicycle Crash Types of the Early 1990s. FHWA-RD-95-163. June 1996.

Suggested Improvements:

- *Increased enforcement of speeds.*
- *Additional speed feedback sign.*
- *Grade-separated crossing.*
- *At-grade crossing in combination with a modern roundabout.*
- *Additional speed feedback sign north of intersection.*

Adherence to Posted Speed Limit

As witnessed during the BRSA and supported by field reviews and data collection, vehicles frequently travel above the posted 45 MPH speed limit on US Highway 26/89/191 through Gros Ventre Junction. This is of particular concern to cyclists whose bicycles do not have the crumple zone safety feature that is provided with motor vehicles. Increased speeds require additional perception and reaction time for drivers and an increased braking distance to avoid collisions. Additionally, as Figure 7 illustrates, the higher the speed, the greater chance of injury or fatality.¹⁴



Figure 7. The probability of a pedestrian being killed in a collision with a vehicle increases dramatically with speed. At 20 MPH, a pedestrian has a 5-percent chance of being killed in a collision with a motor vehicle; at 30 MPH, the probability of a pedestrian being killed increases to 45 percent; and at 40 MPH, the probability that a pedestrian will be killed in a collision with a motor vehicle is 85 percent.¹⁴

Suggested Improvements:

¹⁴ Federal Highway Administration. *PedSAFE: Crash Statistics*. Available: <http://www.walkinginfo.org/pedsafe/crashstats.cfm>.

- *Increased enforcement.*
- *Additional speed feedback sign.*
- *Converting the existing intersection to a modern roundabout.*

Lack of Pathway User Adherence to Traffic Controls

The BRSA team and park staff observed cyclists' lack of adherence to traffic controls on the shared use path. Cyclists may not want to come to a complete stop at intersections because of the energy it takes to regain full momentum, or because of the increased exposure time while crossing the roadway at slower speeds. However, yielding is a key behavior to avoiding collisions.¹⁵ Some short range measures can help to reinforce or bring attention to the traffic control signs. However, compliance may still be low, requiring longer range measures to help reduce the risk.

Suggested Improvements:

- *Move/extend pavement markings in combination with additional warning signage along the shared use path.*
- *Use of additional warning signs/beacons on US Highway 26/89/191 and along Gros Ventre Road.*
- *Treatments to slow/stop path users, such as a speed table on the path.*
- *Education.*
- *At-grade crossing further east on Gros Ventre Road.*
- *At-grade crossing in combination with a modern roundabout.*
- *Grade-separated crossing under Gros Ventre Road.*

Sight Distance and Lack of Advanced Warning Signs and Pavement Markings

Pathway users have good sight distance to the front and to the right or left, but they have a hard time seeing vehicles that are traveling in the same direction on the highway that is parallel to the pathway – especially as those vehicles are traveling at high speeds.

¹⁵ American Association of State Highway Transportation Officials. Guide for the Development of Bicycle Facilities (2012).



Traveling northbound on the shared use path and approaching Gros Ventre Junction. It is difficult for cyclists to see vehicles traveling parallel to them from the south who may be turning onto Gros Ventre Road. Also, the pavement markings are not visible until the pathway user is close to the intersection.

Pathway users approaching the intersection do not see the existing pavement markings far enough in advance of the intersection to adequately react when travelling at higher speeds. There are no advance warning signs to alert pathway users of the intersection. There is a single advanced pathway crossing side road warning sign for northbound vehicles approaching the intersection. Approaching the intersection southbound the highway has a single general warning sign for bicycles.

Suggested Improvements:

- *Move/extend pavement markings in combination with additional warning signage along the shared use path.*
- *Use of additional warning signs/beacons.*
- *At-grade crossing further east on Gros Ventre Road.*
- *At-grade crossing in combination with a modern roundabout.*
- *Grade-separated crossing under Gros Ventre Road.*

Obstructions to Visibility of Pathway Users

Along the southern portion of Gros Ventre Road, just east of the Junction, there is an unofficial gravel parking area. The parked cars, particularly those closest to the intersection, can obstruct the view of the shared use path.

This parking area creates an additional safety concern. As many of the cars pull out from the parking area eastbound, they make a U-turn in the roadway to return back to Gros

Ventre Junction. Or, some of the vehicles will drive farther east on Gros Ventre Road and then make a U-turn. This maneuver adds to the confusion of the intersection and drivers turning onto Gros Ventre from US Highway 26/89/191 may not expect a vehicle conducting a U-turn.



Parking Area at Southeast Corner of Gros Ventre Junction.

The BRSA team witnessed multiple incidences of vehicles approaching the intersection from Gros Ventre Road, stopping on the crosswalk, and blocking the pathway. This reduces the visibility of both the pathway and the roadway.



A vehicle stopped on the crosswalk and blocking both the view of the pathway and the roadway.

In combination with the stopped vehicles blocking the pathway, the crosswalk markings and the pathway crossing warning pavement markings are not as visible traveling west on Gros Ventre.



Vehicles stopped on Gros Ventre Road at Gros Ventre Junction. The parked vehicles on the left and the stopped vehicles on the right obscure visibility of the pathway, the pathway crossing pavement markings, and the crosswalk.

Suggested Improvements:

- *Move/extend pavement markings in combination with additional warning signage along the shared use path.*
- *Use of additional warning signs/beacons.*
- *Additional pavement markings along Gros Ventre Road.*
- *Signage along Gros Ventre Road instructing motorists to not block the crossing.*
- *At-grade crossing further east on Gros Ventre Road.*
- *At-grade crossing in combination with a modern roundabout.*
- *Grade-separated crossing under Gros Ventre Road.*

Confusion among Unfamiliar Drivers

Drivers in this intersection are a mix of local residents, visitors, and commercial entities. Users of the intersection encounter numerous conflicts from other traffic movements, mixed with high speeds on the highway, and numerous drivers who are unsure about their location. The community and BRSA team have witnessed many drivers making illegal and unsafe maneuvers - such as stopping in the turn lane on US Highway 26/89/191 or conducting U-turns near the intersection - while trying to determine where to go.

Suggested Improvements:

- *Additional wayfinding signage.*

Suggestions for Improvement

The following are suggestions for improvement for the identified safety issues.

Short Term

- **Pavement Markings and Warning Signs on Pathway–**

Move/extend current pavement markings along the pathway and add additional advance warning signage and pavement markings along the pathway to reinforce that pathway users are approaching an intersection. The existing pavement markings are close to the intersection and cyclists approaching at a high rate of speed may not see them in time to stop.

According to the *AASHTO Guide for the Development of Bicycle Facilities*, advance warning signs and solid centerline striping should be placed at the required stopping sight distance from the roadway edge but not less than 50 feet (see Figures 5-18 and 5-19 of the *AASHTO Guide*). The distance of the existing pathway pavement markings to the intersection, along with the stopping sight distance for cyclists on the pathway, should be verified.

Additional "ROAD XING" markings and warning signs along the pathway should also be considered to give cyclists additional time to prepare for the crossing and to reinforce the message that there is a crossing and they should use caution.

- **Pavement Markings on Road–**

Add additional pavement markings such as “BIKE XING AHEAD”, farther east on Gros Ventre Road and consider modifying the crosswalk pavement markings to a more visible design (see MUTCD Figure 3B-19). The crosswalk currently is marked with a continental pattern.¹⁶ Placing the markings closer together or using a zebra or ladder pavement marking may improve the visibility of the crosswalk.



The existing crosswalk along with examples of crosswalk pavement markings. From left to right – view of the existing crosswalk traveling westbound on Gros Ventre Road, an example of a continental crosswalk with pavement markings closer together, ladder crosswalk pavement markings, and zebra crosswalk markings.

- **Warning Signs/Beacon on Road –**

On the US Highway 26/89/191, the pathway crossing location is currently shown on the warning signs located to the north and south of the intersection (see photo). Add additional warning signs or beacons (see Section 4L.03 of the MUTCD) along the highway for turning vehicles to be aware of crossing pathway users.



The existing warning sign along the US Highway 26/89/191 along with a variety of warning and stop beacons.

Along Gros Ventre Road, additional signage instructing drivers not to block the crosswalk would help to improve visibility of the pathway.

¹⁶ FHWA. A Review of Pedestrian Safety Research in the United States and Abroad: Part 3. Overview of Pedestrian Crash Countermeasures and Safety Programs. Available: <http://www.fhwa.dot.gov/publications/research/safety/pedbike/03042/part3.cfm#fig23>.

- **Parking Modifications -**

Restricting parking near the shared use path crossing would help to facilitate use of the intersection and would improve visibility of the pathway.

- **Education and Coordination with the Bicycle Community-**

Working with the public, bike rental companies, bike outfitters, and resorts who lend bikes to their guests can help to relay the safety message along with notifying pathway users of new changes to the pathway. Some potential methods for relaying this information is through word of mouth, fliers, brochures, a form that conveys any safety guidance or rules that renters sign before riding.

- **Measures to Address Speed -**

There are two short-term measures for addressing speed through the intersection. One measure is to install an additional speed feedback sign north of the intersection for southbound traffic to help slow down vehicles before they enter the intersection.

Another possible measure is to increase enforcement of the speed limit as funding and staffing allow.

- **Wayfinding Signage –**

Add additional wayfinding signage to help to reduce confusion among drivers.

Mid Term

- **Measures to Reduce Pathway User Speed -**

If short term measures, such as additional signs and pavement markings, are ineffective at reducing speeds along the path, consider additional treatments to slow or stop bikes such as a speed table.



An example of a speed table.

Long Term

- **Parking Modifications -**

Consider relocating the gravel parking area on the southeast corner of Gros Ventre Junction farther away from the intersection and install turn-around. See Concept Drawing #2 in Appendix A

- **Relocate existing path crossing –**

Relocate the existing at grade crossing of the Gros Ventre Road crossing further east, providing a better angle to see on-coming traffic and to improve driver visibility of pathway users. See Concept Drawing #2 in Appendix A.

- **Grade separated path crossings –**

There are three options for grade separated path crossings. The first one is to construct a grade separated shared use path crossing (underpass) under the highway to reduce the potential for conflicts with vehicles on the highway. See Concept Drawing #1 in Appendix A.

The second option is to construct a shared use path grade separated crossing (underpass) under Gros Ventre Road to reduce the conflicts between motorized and non-motorized users. See Concept Drawing #1 in Appendix A.

The third option is to construct a grade separated shared use path crossing under the highway and under the Gros Ventre Road. See Concept Drawing #1 in Appendix A.

- **Modern Roundabout –**

Construct two new at grade shared use path crossings surrounding a modern roundabout. The roundabout would provide multiple benefits; provide an intersection with less conflict points and would also allow for cyclists to cross one lane at a time with a splitter island serving as a median refuge. See Concept Drawing #3 in Appendix A.



Modern Roundabout: Hoback Junction; South of Jackson, WY.

In addition to these specific suggestions, a general suggestion is enhance public information regarding the importance of safe behavior when using park pathways with an emphasis on Gros Ventre Junction. Efforts to disseminate information regarding cycling related laws and safety considerations would benefit all interested parties; drivers, cyclists, and the community at large as improving safety awareness benefits the community as a whole.

Conclusions

BRSAs are not solely based on documented crash data but also take into consideration the perceived risk.¹⁷ Using

Table 1 along with the information gathered prior to, and during the BRSA, the perceived risk of the Gros Ventre Road pathway crossing is moderately-high to high. This is because there is a risk of frequent crashes with moderate injury levels. The perceived risk for bicycles crossing the US Highway 26/89/191 is high to highest because there is an occasional risk of crashes with serious or fatal injury levels.

Table 1. Prioritization Matrix

Potential Crash Frequency	Potential Crash Injury Severity			
	Minor	Moderate	Serious	Fatal
Frequent	High	High	Highest	Highest
Occasional	Moderate	Moderate	High	Highest
Infrequent	Low	Low	Moderately	High
Rare	Lowest	Low	Moderate	High

During the BRSA, six safety issues were identified. While all of the safety issues are important, the combination of cyclists crossing the highway with lack of vehicle adherence to the posted speed limit was identified as the top priority by the BRSA team due to their combined potential crash severity. The other issues, in order of priority, were lack of pathway user adherence to traffic controls, sight distance and advanced warning signs and pavement markings, obstructions to visibility of pathway users, and finally confusion among unfamiliar drivers.

Engineering, education, and enforcement suggestions have been provided for each of the safety issues and have been categorized into short-, mid, and long-term implementation time frames. Public information may be an effective tool to help improve the level of education and awareness of bicycle-related laws and safety issues in the community.

¹⁷ FHWA. Bicycle Road Safety Audit Guidelines and Prompt Lists.

Appendix A

This appendix includes some concepts illustrating potential layouts for three of the long term recommendations in this report.

Elements Common to All Three Concepts

The western end of all concepts presented in this report would be a separated pathway segment which terminates west of Gros Ventre Junction at a crosswalk across Sagebrush Drive (see figures 8, 9, and 11). This crosswalk would allow non-motorized users to cross the roadway and travel in the appropriate direction with respect to traffic (cyclists in the same direction as traffic and pedestrians traveling in the opposite direction of traffic). Appropriate road and pathway signs and pavement markings would be installed in conjunction with this crosswalk. Pathway users would arrive/continue from the pathway sharing the Sagebrush Drive roadway.

A crosswalk is not recommended on US Highway 26/89/191 due to road width, traffic volumes and posted speed. Table 2 contains information from a study conducted by FHWA providing guidance regarding the appropriate conditions for marking a crosswalk based on the number of lanes, vehicle ADT, and posted speed. In rural areas, crosswalks are typically only applied on low-speed roadways (i.e., those with a posted speed limit of 40 mph or less).¹⁸ US Highway 26/89/191 at Gros Ventre Junction falls into category “N”.

¹⁸ Zegeer, C, Stewart J, Huang H, Lagerwey P. Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations: Executive Summary and Recommended Guidelines. FHWA-RD-01-075 Federal Highway Administration, U.S. Department of Transportation, McLean, VA, 2002. Available: http://www.walkinginfo.org/pdf/r&d/crosswalk_021302.pdf. Accessed: December 13, 2005.

Table 2. Crosswalk Marking Guidance for Roadways < 9,000 vpd (from Zegeer et al., 2005).

Roadway Type (Number of Travel Lanes and Median Type)	Speed Limit		
	≤30 mph	35 mph	40 mph
2 Lanes	C	C	P
3 Lanes	C	C	P
Multilane (4 or More Lanes) With Raised Median	C	C	P
Multilane (4 or More Lanes) Without Raised Median	C	P	N

C = Candidate site for marked crosswalks.

P = Possible increase in pedestrian crash risk may occur if crosswalk markings are added without other pedestrian facility enhancements.

N = Marked crosswalks alone are insufficient, and pedestrian crash risk may increase when providing marked crosswalks alone. Consider using other treatments, such as traffic signals with pedestrian signals where warranted or other substantial crossing improvements to increase crossing safety.

Concept Drawing #1: Two Grade Separated Pathway Crossings

Figure 8 shows the potential location of two separate tunnels. One under the highway south of Gros Ventre Junction and another under the Gros Ventre Road east of the intersection. These tunnels would allow for both motorized and non-motorized traffic to flow freely and by separating the two traffic flows would greatly reduce conflicts between pathway users and motorized vehicles at the intersection. There is a nearby example of a grade separated shared use path crossings using an underpass in the park at Moose Junction.



Figure 8. Concept Diagram: Two New Grade Separated Pathway Crossings.

Concept Drawing #2: Relocated At-Grade Crossing of Gros Ventre Road With New Grade Separated Pathway Crossing of the Highway

In the second concept, shown in Figure 9, the existing at grade crossing of the Gros Ventre Road would be relocated farther east of the intersection. The new at grade crossing location would reduce the number of pathway-vehicle conflicts in the intersection, provide additional time for drivers to recognize and respond to the pathway crossing before approaching the intersection or after turning onto Gros Ventre Road, and would provide stacking space for vehicles after the crossing so the crossing is not blocked by vehicles waiting at the intersection. There is an example of an at-grade shared use path crossing in the park near the Taggart Lake Trailhead on the Teton Park Road. A grade separated crossing of the highway would be very similar to that proposed in Concept #1.

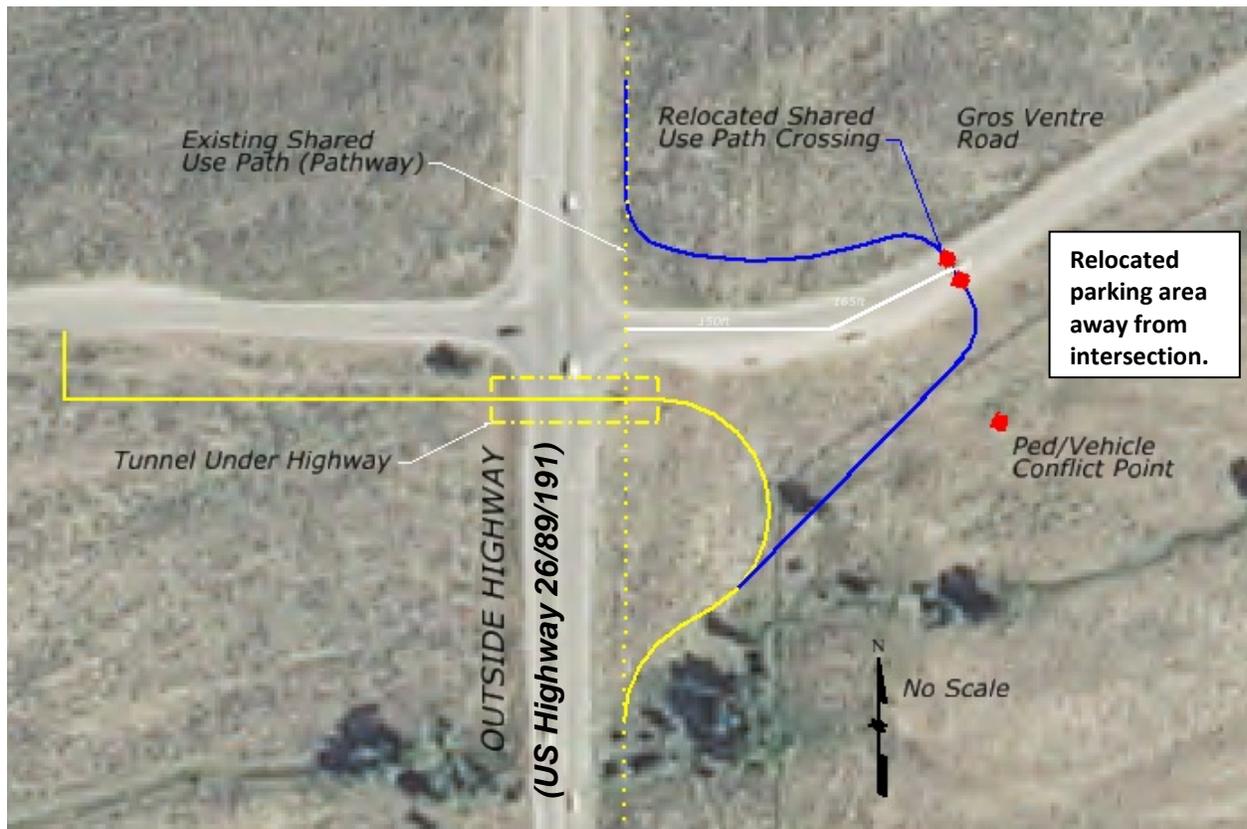


Figure 9. Concept Diagram: New Grade Separated and Relocated At-Grade Pathway Crossings.

Concept Drawing #3: At-Grade Pathway Crossing with Modern Roundabout

This concept involves at-grade pathway crossings of the Gros Ventre Road and southern leg of the US Highway 26/89/191 integrated into a modern roundabout. A modern roundabout is not a traffic circle, such as what can be found at the Jackson Hole Airport or in Idaho Falls. There is an example of a modern roundabout at Hoback Junction south of the town of Jackson, WY. The modern roundabout would improve pathway user safety in multiple ways including;

1. Reduce pathway user-vehicle conflicts.
2. Facilitate pathway user roadway crossing.
3. Improve pathway user visibility to motorists.
4. Reduce severity of pathway user- vehicle collisions.

The existing intersection presents 16 pathway user- vehicle conflict points. A modern roundabout concept presents four, as shown in Figure 11. The refuge area within the splitter islands allows users to cross one lane of traffic at a time and would be large enough to handle bikes towing trailers and groups crossing together. These pathway user crossing points are set back from the intersection improving visibility. The slower speed of the vehicles moving through the roundabout (approximately 20 MPH) reduces the severity of the conflicts (compared with vehicles travelling at the currently posted speed of 45 MPH).

Roundabouts can be used without lighting in rural areas but may require additional signage and pavement markings including the use of reflective pavement markers and retroreflective signs (such as chevrons and one-way signs).¹⁹

Figure 10 shows the reduction in conflict points associated with converting a traditional four-legged intersection to a roundabout.

¹⁹ FHWA. Roundabouts: An Informational Guide. Available: <http://www.fhwa.dot.gov/publications/research/safety/00067/00067.pdf>.

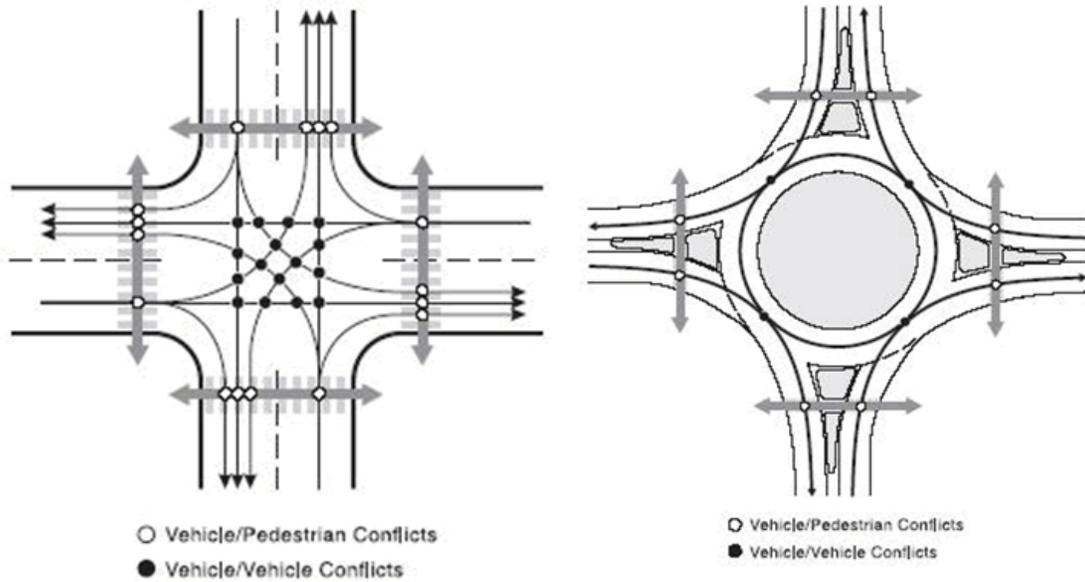


Figure 10. Roundabouts Reduce Pathway User-Vehicle Conflict Points.²⁰

Figure 11 shows the approximate roundabout footprint with crossings for pathway users.

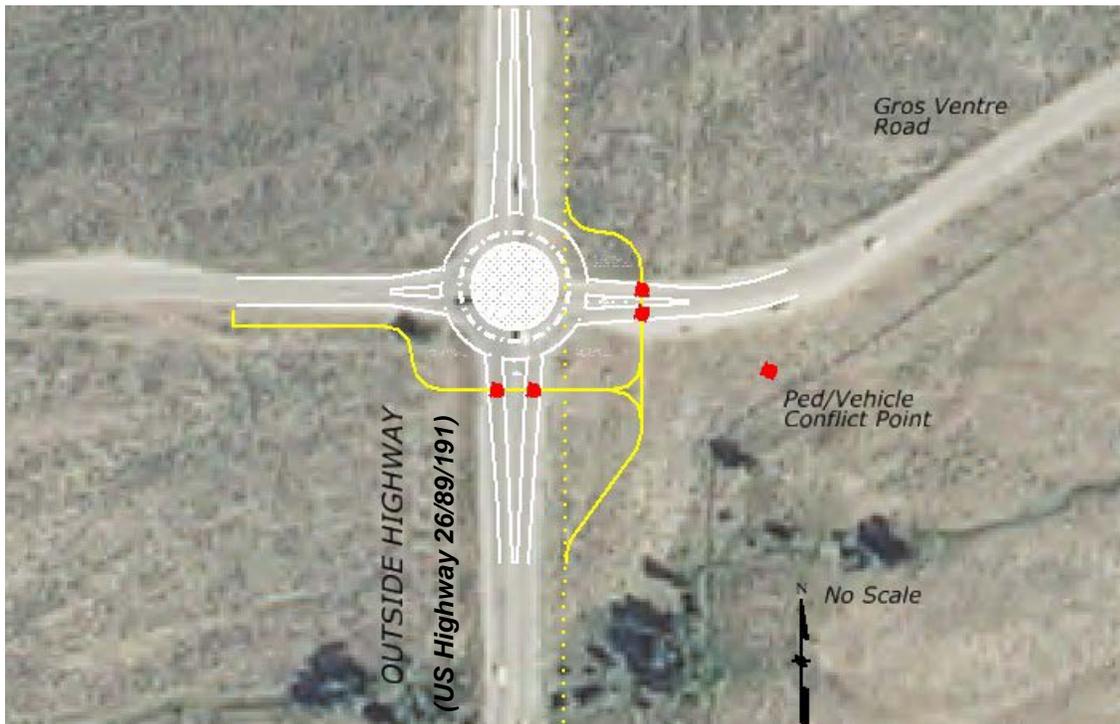


Figure 11. Concept Diagram: Two At-Grade Pathway Crossings Integrated Into a Modern Roundabout with Conflict Points.

²⁰ From FHWA presentation. Highways for Life -Web Series: Modern Roundabouts – The Safer Intersection Choice. Available: http://blog.mlive.com/judy_mcgovern/2009/02/roundabout%20PP.copy.pdf

Appendix B

The following two pages are from the park bike brochure, which can be found here:

http://www.nps.gov/grte/planyourvisit/upload/Bike_12.pdf

Grand Teton

National Park Service
U.S. Department of the Interior

Grand Teton National Park
John D. Rockefeller, Jr.
Memorial Parkway



Bicycling



Grand Teton National Park and the John D. Rockefeller, Jr., Memorial Parkway offer more than 100 miles of paved roads and a multi-use pathway that provides spectacular views of the rugged Teton Range.

Rules and Regulations

- Bicyclists must obey all traffic laws and signs.
- Bicycles are allowed on paved and unpaved roads open to motorized vehicles, unless otherwise posted.
- Between sunset and sunrise an operator or bicycle must have a white light or reflector that is visible from at least 500 feet to the front, and a red light or reflector that is visible from at least 200 feet to the rear.
- Bicycles are allowed on the multi-use pathway from dawn to dusk only.
- Bicycles are NOT allowed on trails or in backcountry areas.
- In the park, operating a bicycle abreast of another bicycle is prohibited.
- The use of personal audio devices is strongly discouraged.
- Notify other recreators before passing. Yield to slower users.
- Helmets and bright-colored clothes are recommended due to heavy traffic.
- Pets are not allowed on the multi-use pathway.

WARNING

Use caution when cycling in the park. Some roads have paved, marked shoulders providing limited access for safe bicycling. Some roads have very narrow shoulders or lack them altogether. Narrow unpaved roads become extremely dusty during dry weather. Ride single file on the right side of the road and be alert for vehicles. Traffic is heavy during the summer, with daily peaks mid morning to late afternoon. Road construction and repairs occur every year. Be prepared for delays and rough roads.

Wildlife and Weather



Wildlife

The multi-use pathway and roads pass through a variety of wildlife habitats. Users must be prepared for wildlife encounters. NEVER FEED, APPROACH OR HARASS WILDLIFE—especially large mammals. Stay at least 100 yards from bears and wolves and 25 yard from other wildlife. Maintain control of your speed and stay aware of your surroundings. Never leave food unattended including backpacks and bike panniers. Follow food storage regulations. Travel in groups if possible. Carry and know how to use bear spray.

Weather

- **Spring** (April-June) Days are cool and cloudy with rain showers and occasional snow.
- **Summer** (July-August) Weather is generally good for bicycling with mid-day temperatures around 80 degrees. Afternoon thunder showers may form quickly with heavy, cold rain and dangerous lightning.
- **Fall** (September-early October) Days are often clear and cool, but rain and snow showers frequently occur.

Recommended Bicycling Routes

ROAD BIKING

Multi-use Pathway

Paved pathway heads north from Jackson paralleling US 26/89/191 to Moose Junction; then follows the Teton Park Road to South Jenny Lake. Open to non-motorized users from dawn to dusk. The section of the pathway from Jackson to Gros Ventre Junction is closed from Oct. 1 to April 30.

Jenny Lake Scenic Loop (One-Way)

Access this 7-mile loop from South Jenny Lake. Ride north along the Teton Park Road 3 miles, turn left at North Jenny Lake Junction, and left again on the "one-way" Jenny Lake scenic road with a striped lane for stunning views of the Teton Range. Turn right onto a paved pathway to return to South Jenny Lake.

Antelope Flats – Kelly Area

Secondary paved roads wind through sagebrush flats with spectacular views of the Teton Range.

MOUNTAIN BIKING

Two Ocean Lake Road

Three miles of dirt road lead from Pacific Creek Road to Two Ocean Lake for a scenic ride over rolling terrain.

Grassy Lake Road

Travel an old American Indian route through the John D. Rockefeller, Jr. Memorial Parkway. Ride all or part of the 52-mile dirt road from Flagg Ranch to Ashton, ID.

Outside the Park

Venture into the surrounding Bridger-Teton National Forest for additional adventures. For information about area trails such as Shadow Mountain, Teton Pass, Snow King or Cache Creek inquire at area bicycle shops.

RENTALS

Bicycles can be rented at Dorman's in Moose, or in the nearby towns of Jackson and Teton Village.

