



Tribal Traffic Safety Analysis for the Yakama Nation

DETAILED ANALYSIS OF CRASH DATA FROM 2010-2014

Tribal Traffic Safety Program
EASTERN WASHINGTON UNIVERSITY

Table of Contents

- 1.0 Introduction to Tribal Traffic Safety Analysis for the Yakama Nation 3
 - 1.1 Methodology and Supporting Data 3
 - 1.2 Background..... 4
 - 1.3 EWU Tribal Traffic Safety Model 4
 - 1.4 Yakama Tribal Traffic Safety Committee 7
- 2.0 Contributing Crash Factors in the Yakama Nation Study Area 8
 - 2.1 Lane departure and fixed object Crashes..... 11
 - 2.1.1 Lane departure and fixed object Crashes in the Yakama Nation 11
 - 2.1.2 Repeated lane departure and fixed object crash locations on and near the Yakama Nation 11
 - 2.1.3 Countermeasures for lane departure and fixed object Crashes 14
 - 2.2 Intersection related crashes..... 15
 - 2.2.1 Intersection related crashes on and near the Yakama Nation..... 15
 - 2.2.2 Repeated intersection and angle crash locations on and near the Yakama Nation 15
 - 2.2.3 Countermeasures for intersection related crashes 18
 - 2.3 Pedestrians and Pedacyclists..... 19
 - 2.3.1 Pedestrian and Pedacyclists related crashes on and near the Yakama Nation 19
 - 2.3.3 Countermeasures for Pedestrian and Pedacyclists related crashes 22
 - 2.4 Overturned vehicle crashes..... 24
 - 2.4.2 Repeated overturned vehicle related crashes locations on and near the Yakama Nation..... 24
 - 2.4.3 Countermeasures for overturned vehicle related crashes 27
 - 2.4.4 Resources for overturned vehicle related crashes 27
 - 2.5 Earthbank or ledge related vehicle crashes 28
 - 2.5.1 Earthbank or ledge related crashes on and near the Yakama Nation 28
 - 2.5.2 Repeated Earthbank or ledge crashes locations on and near the Yakama Nation 28
 - 2.5.3 Countermeasures for crashes Involving earth bank or Ledge 31
 - 2.5.4 Resources for crashes Involving earth bank or Ledge..... 31
- 3.0 High Risk Facilities in the Yakama Nation Study Area..... 32
 - 3.1 State Route 97 32
 - 3.2 State Route 22 33
- 4.0 Next Steps..... 34
 - 4.1 Road Safety Audit 34
- Sources: 35

List of Tables

Table 1. Contributing Crash Factors in the Yakama Nation survey area 2010-2014	9
Table 2. Tribal Target Zero Priority comparison	10
Table 3. Lane departure and fixed object crashes on and near the Yakama Nation 2010-2014.....	12
Table 4. Crashes Involving Driver Entering at an Angle 2010-2014.....	16
Table 5. Crashes Involving Pedestrians and Pedacyclists on and near the Yakama Nation	20
Table 6. Vehicle Overturned Crashes on or near the Yakama Nation 2010-2014.....	25
Table 7. Crashes Involving Earthbank or Ledge on or near the Yakama Nation 2010-2014.....	29

List of Figures

Figure 1. EWU Traffic Safety Model for the Yakama Nation	6
Figure 2. Contributing causes of crashes in percentages 2010-2014	9
Figure 3. Lane departure and fixed object crashes 2010-2014	12
Figure 4. Map of Crashes involving Object Collisions	13
Figure 5. Crashes driver entering at an angle	16
Figure 6. Maps of Crashes Entering at an Angle	17
Figure 7. Crashes Involving Pedestrians and Pedacyclists 2010-2014	20
Figure 8. Maps of Crashes Involving Pedestrians and Pedacyclists	21
Figure 9. Vehicle Overturned Crashes 2010-2014	25
Figure 10. Map of Crashes Involving Overturned Vehicles.....	26
Figure 11. Crashes Involving Earthbank or Ledge 2010-2014.....	29
Figure 12 .Map of Crashes Involving Earth bank or Ledge	30
Figure 13. WSDOT- Annual Average Daily Traffic volumes for Traffic counting locations.....	32

1.0 Introduction to Tribal Traffic Safety Analysis for the Yakama Nation

The EWU Tribal Traffic Safety Program was funded by the Washington Traffic Safety Commission to assist with the coordination of tribal traffic safety programs, and to better align tribal priorities and strategies with a common language and approach to traffic safety efforts, with three selected tribes across Washington State. The Confederated Tribes and Bands of the Yakama Nation, the Spokane Tribe of Indians, and the Confederated Tribes of the Colville Reservation. In 2015, the EWU Tribal Traffic Safety program conducted a preliminary crash data analysis that included crash survey information of the Yakama Nation, its trust lands and the adjoining area within a five-mile buffer of the nation. The preliminary crash data report found that from 2010-2014 there were a total of 15,805 total crashes in the survey area, with 310 serious injury crashes and 118 crashes that involved fatalities. On reservation land and trust lands, there were 47 fatal crashes and 87 serious injury crashes in the Yakama Nation. Additionally, there were 15,377 minor or no injury crashes during the same time. Most of serious injury and fatal crashes in the survey area are contributed to behavioral choices around habits, attitudes and patterns of driver education and experience. The preliminary crash data report found that the majority of crashes in the Yakama Nation involved drivers under the influence of alcohol or drugs, speeding, not granting right of way, and inattention.

For this traffic safety analysis, we offer an assessment of contributing crash factors, collision types, repeated crash locations, high risk facilities within the Yakama Nation that have the greatest opportunities to improve traffic safety and reduce fatalities and serious injury crashes. The objective of this analysis is for it to be utilized as a Traffic Safety resource to detect risk factors, identify roadway improvements, and assess countermeasures to improve traffic safety on and around the Yakama Nation.

1.1 Methodology and Supporting Data

This report constructs its analysis using reported crash data provided by the Washington State Department of Transportation (WSDOT), and Washington Traffic Safety Commission (WTSC), Department of Transportation (DOT). In addition, Five years of Fatality Analysis Reporting System (FARS) and serious injury crash data (2010-2014) and over 500,000 data points. The data points were converted into an Environmental Systems Research Institute (ESRI) Geographic Information System (GIS) database. After conversion, over 496,000 crash data points were used to develop the table, figures, and maps. Crash data points mapped are for crashes only and do not include the number of fatalities or vehicles involved. For example, a crash may have occurred with two fatalities but only the crash (1) was mapped. The data reports crashes and does not specify race or ethnicity of occupants involved. The

crash data points are mapped across the survey area in two groupings: 1) “On Reservation”, denoting reservation and off reservation trust land boundaries and 2) “Off Reservation”, denoting a five-mile buffer around official Reservation boundaries. As Tribal Transportation Program (TTP) roads include all public roads on or leading to the reservation, the five mile buffer allows for accidents on surrounding roads to be included in this study.

1.2 Background

Data driven research is the starting point for traffic safety analysis, and is a critical issue on reservations across the United States. According to the Center for Disease control (CDC), the leading cause of death for American Indians and Alaskan Natives (AI/AN) under the age of 44 is unintentional injury due to motor vehicle crashes (CDC, 2015). In Washington State, the Fatality Analysis Reporting System (FARS) database reports that American Indians and Alaskan Natives (AIANs) have higher fatality rates than all other ethnic and minority groups (WA FARS data, 2010-2014). Given these disproportionate high fatality rates among AIANs, traffic safety on reservations has become a top priority for the Washington state Target Zero plan.

The preliminary data analysis created in 2015 found that the majority of crashes in the Yakama Nation involved drivers under the influence of alcohol or drugs, speeding, not granting right of way, and inattention. Engineering roadway efforts can help eliminate safety concerns and promote safe roads, pathways, and transportation. However, more support of traffic safety initiatives and major changes need to occur with individual driver behaviors in order to reduce traffic deaths and serious injuries in the Yakama Nation.

The goal of the EWU Tribal Traffic Safety Program is to assist with the coordination of tribal traffic safety resources, and to better align tribal priorities and strategies with a common language and approach to traffic safety.

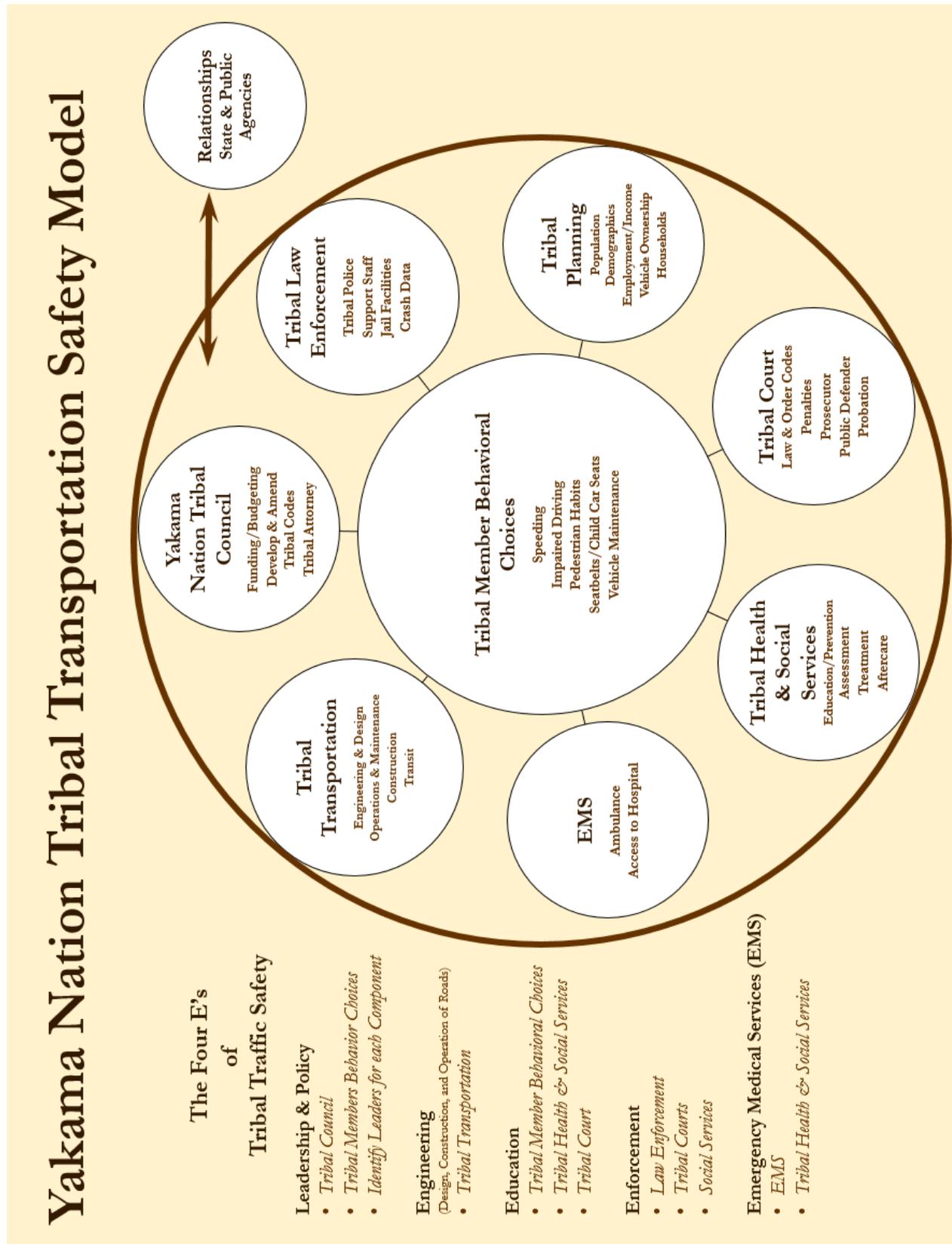
1.3 EWU Tribal Traffic Safety Model

The initial research conducted by the EWU Tribal Traffic Safety team incorporates the Four E’s and leadership as adapted from Target Zero: Education, Enforcement, Emergency Medical Services (EMS), Engineering and Leadership. The EWU team looked to expand this concept to be more culturally appropriate and specific for Tribal Traffic Safety needs. The team determined that the Four E’s and Leadership would not suffice for Tribal Traffic Safety since Tribal governments need to rebuild a change of traffic safety culture across all Tribal departments. We found that Tribes can effectively reduce traffic safety fatalities and serious injuries when tribal government programs and departments work together to share data and information, as opposed to operating in solos off by themselves. All of the top contributing

factors of reservation fatalities involve behavioral issues around habits, patterns of driver education and experience, and driver perception of punishment or determent to the community by not following traffic codes, as well as the effectiveness and impact of tribal codes on tribal members and the community (Hill & Meyers 2016).

The EWU Tribal Traffic Safety team created the Tribal Transportation Safety Model to identify all of the key stakeholders in transportation safety, which is a complex system of interaction and individual relationships, resources and responsibilities with each stakeholder being expected to do their part. The team placed the tribal member behavior choices at the center of the model because traffic safety is people-centric (Hill, 2017). The EWU Model encourages tribal elected leaders, government staff to develop or improve a system for data gathering and sharing to work across departments, and to create common goals to address behavior, and work with the public to interweave a traffic-safety culture into the community culture (See figure 1).

Figure 1. EWU Traffic Safety Model for the Yakama Nation



1.4 Yakama Tribal Traffic Safety Committee

The EWU model and the preliminary crash data report of the Yakama Nation study area were presented to the Yakama Tribal Council on January 5, 2017. The goal of the presentation was to encourage Tribal Council to establish a Tribal Traffic Safety Committee formed of various departments and disciplines that would work together to develop a culture of traffic safety (See Figure 1). The Yakama Tribal Council approved the Yakama Tribal Traffic Safety Committee (YTTSC) during the same meeting. In April 2017, the YTTSC was formed and the committee formulated a Traffic Safety Strategic Plan, and went before the Yakama Tribal Council to have it approved. Tribal Council passed a resolution in full support the YTTSC. The main goal of the YTTSC is to reduce traffic deaths and serious injuries on Yakama Nation lands with a focus on tribal membership and Native Americans.

Thus far, the YTTSC have met periodically to strategize targeted efforts to reduce traffic fatalities and serious injuries across the Yakama Nation. In early 2017, the YTTSC circulated information regarding their strategic plan to inform tribal departments and the public of current traffic safety issues and the work they will be conducting in the community. The committee has also been active in applying to funding for staff trainings and transportation conferences. In the summer, the YTTSC targeted youth activities and participated in special community events. The YTTSC worked with the Yakama Nation - Multi-media youth group and EWU to develop a Public Safety Announcement (PSA) on traffic safety. The subject matter for the PSA was developed by the youth who scripted and acted their story line based on their experiences.

In addition, the YTTSC have been present in Yakama Nation Housing Fair, Treaty Day Parade, White Swan Community Day Parade providing traffic safety signs for vehicles and pedestrian safety giveaway items. Currently, the YTTSC is carrying out several projects with the WSDOT on a Safety Corridor project for US 97, collaborating with the Mt. Adams School District to address Safe Routes to School, and applying for grants to address seatbelt use, road safety projects, and infrastructure improvements.

The YTTSC is working across all Tribal departments and reaching out to the public in an effort to reduce traffic fatalities and serious injuries in the Yakama Nation. To continue supporting the YTTSC, the EWU research team looked further into the crash data from 2010-2014 to identify collision types, repeated crash locations, high risk facilities and crash factors within the Yakama Nation that have the greatest opportunities to improve traffic safety and reduce fatalities and serious injuries.

2.0 Contributing Crash Factors in the Yakama Nation Study Area

After reviewing the preliminary crash data from 2010 - 2014, the EWU research team identified five contributing crash factors that can be emphasized by the YTTSC to improve traffic safety in the Yakama Nation. The five emphasis topics are summarized below:

1. Lane Departure and fixed object crashes - Drivers leaving road lane and crashing into objects.
2. Intersection crashes – Drivers entering intersections and roads at angles.
3. Pedestrians and pedacyclist crashes – Drivers directly crashing into pedestrians going straight on the road, at intersections, and driveways.
4. Overturned vehicle crashes – Involve drivers speeding and losing control of their vehicle.
5. Earthbank or ledge crashes – Driver speeding, no guardrail present or crashing into roadway ditch.

From 2010-2014 there were a total of 15,805 total crashes in the survey area, with 310 serious injury crashes and 118 crashes that involved fatalities. The highest contributing crash factor were 78 crashes that involved drivers leaving the road and crashing into physical objects. Seventy crashes from drivers entering at an angle of the street. Sixty-nine crashes involved pedestrians and cyclist that were directly hit by vehicles going straight on the road, vehicle backing up, or vehicles turning left. Sixty-two crashes involved overturned vehicles. Forty-eight crashes involved drivers falling into an earth bank/ledge or ditch, and drivers from the same direction. Forty-two crashes involved drivers from opposite directions. Nine crashes involved drivers hitting animals, and two crashes involved drivers falling into a river. Table 1 provides the full list crash factors identified in the 2010-2014 data. Figure 2 provides the percentages of the contributing crash factors.

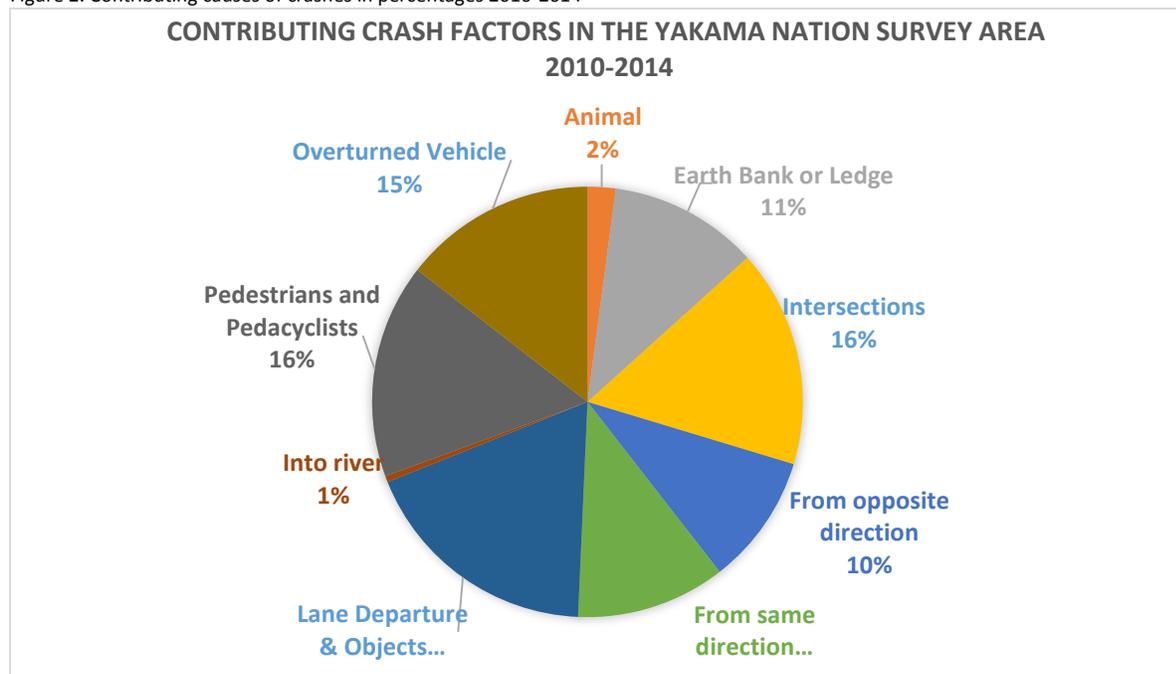
Our research assessed the top contributing crash factors and facilities with repeated crashes locations in the Yakama Nation survey area. This analysis will help guide tribal leaders and the YTTSC in identifying collision types, repeated crash locations, high risk facilities and crash factors within the Yakama Nation that have the greatest opportunities to improve traffic safety and reduce fatalities and serious injuries.

Table 1. Contributing Crash Factors in the Yakama Nation survey area 2010-2014

Contributing Crash Factors	Total Crashes	%	Fatal	Fatal Crashes On Res.	Fatal Crashes Off Res.	Serious	Serious Crashes On Res.	Serious Crashes Off Res.
Animal	9	2.10%	1		1	8	4	4
Earth Bank or Ledge	48	11.21%	20	9	11	28	13	15
Entering at angle	70	16.36%	18	11	7	52	16	36
From opposite direction	42	9.81%	10	3	7	32	30	2
From same direction	48	11.21%	7	1	6	41	11	30
Object	78	18.22%	19	9	10	59	12	47
Into river	2	0.47%	0			2	2	
Pedestrians and Pedacyclists	69	16.12%	23	8	15	46	10	36
Vehicle overturned	62	14.49%	20	6	14	42	17	25
Total for Fatal and Serious Injury Crashes 2010-2014	428	100%						

Source: Washington State Crash Data from 2010-2014

Figure 2. Contributing causes of crashes in percentages 2010-2014



Source: Washington State Crash Data from 2010-2014

The fatalities and serious injury crashes demonstrate high-risk trends in the Yakama Roadways. To successfully implement target zero goals, reduce traffic deaths and serious injuries on Yakama Nation, the YTTSC should prioritize and tailor specific needs from their Nation to meet the occurring fatalities and serious injuries. The overall priorities of Tribal Target Zero in Washington differ from the immediate needs found in the Yakama Crash data (See table 2). For this reason, it is important to utilize the data as a critical link to identify safety issues, select appropriate countermeasures and evaluate performance specific to the needs of the Yakama Nation.

Table 2. Tribal Target Zero Priority comparison

WA Tribal Target Zero Priorities 2012-2014		Yakama Nation Target Zero Priorities 2010-2014	
1	Impaired Driving	1	Impaired driving
2	Lane departure	2	Pedestrian Struck
3	Unrestrained Vehicle Occupants	3	Speeding
4	Intersection related	4	Over Center Line
5	Speeding	5	Distracted driving

Source: Washington State Highway Safety Plan 2016: Target Zero, Washington State Crash Data from 2010-2014

The following sections provide detailed analysis of crash contributing causes in the Yakama Nation. We have included national trends, data from Washington State and the Yakama Nation, maps, effective countermeasures and resources.

2.1 Lane departure and fixed object Crashes

The Federal Highway Administration (FHWA) defines lane departure crashes, as a crash that occurs after a vehicle crosses an edge line or a centerline, or otherwise leaves the traveled way (Roadway Safety, 2017). Lane departure crashes are a major contributor of highway fatalities in most states and localities. In Washington State, lane departure crashes have the second highest number of fatalities and the highest number of serious injuries of any emphasis area in the 2016 Target Zero plan (Washington State Strategic Highway Safety Plan, 2016)

2.1.1 Lane departure and fixed object Crashes in the Yakama Nation

The highest contributing crash factors on the Yakama Nation involved drivers departing lanes and crashing into fixed objects. We found a total of 78 crashes that involved nineteen fatal crashes, and 59 serious crashes. These crashes were a result of drivers changing lanes, making U-turns, switching lanes, passing cars, and driving straight on the road. The majority of crashes derived from drivers going straight into fixed objects. To better assess objects encountered on the road, we grouped recorded crashes associated with drivers directly hitting stationary objects such as signs, post, utility poles, buildings, walls, barriers, parked cars, mailboxes, trees, guardrails, bridge rails, fences, and boulders. We also included moving objects such as road debris and falling rocks (See Figure 2).

Speeding and driving under the influence of alcohol are the most frequent contributors that overlap with lane departure and fixed object crashes. In our research we found that 51% of crashes associated with lane departure involved drivers under the influence of alcohol, 15% of drivers exceeded speed limit, 9% of drivers were distracted, and 4% fell asleep at the wheel.

2.1.2 Repeated lane departure and fixed object crash locations on and near the Yakama Nation

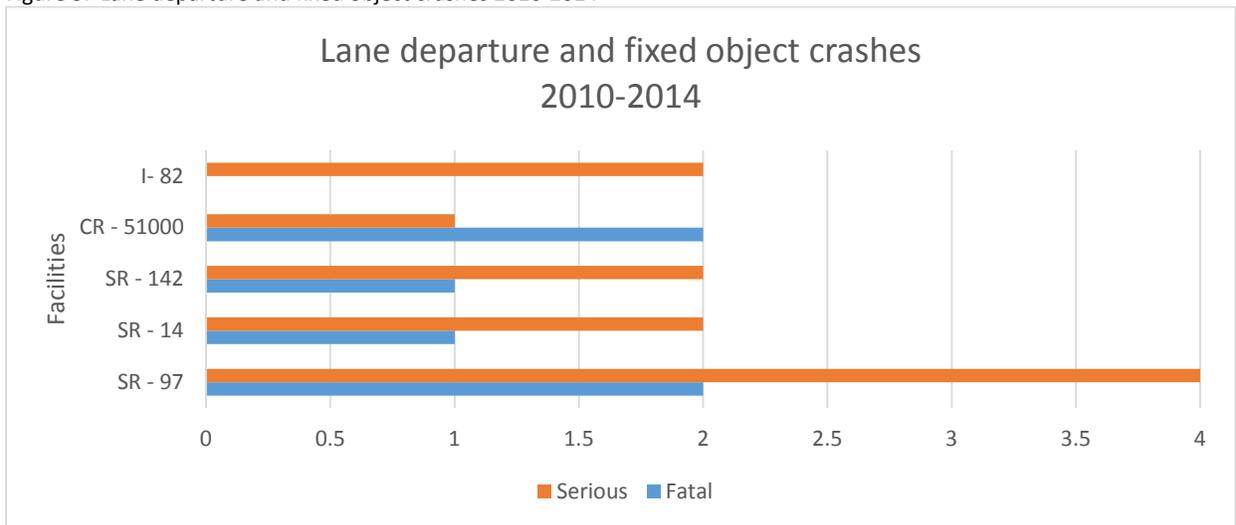
In our research, we found that State Route 97, running in Yakima and Klickitat Counties, held the highest number of crashes on and near the Yakama Nation study area. From 2010-2014, there were total of six crashes on State Route 97, resulting in two fatalities and three serious crashes on the Yakama Nation, and one serious crash off the Nation's boundaries (See Table 1). The second facility with the highest number of crashes on and near the Yakama Nation are State Route 14, 142, and County Route 51000 with fatalities and serious crashes on and near the Yakama Nation. The data shows us that there is a need to address and develop countermeasures to reduce crash rates on both State Route 97 and 14. (See Figure 2 the total crash rates from 2010 and 2014).

Table 3. Lane departure and fixed object crashes on and near the Yakama Nation 2010-2014

Lane departure and fixed object Crashes 2010-2014									
Facilities	County	Jurisdiction	Fatal	Fatal On Nation	Fatal Off Nation	Serious	Serious On Nation	Serious Off Nation	Total
SR - 97	Yakima/Klickitat	State Route	2	2		4	3	1	6
SR - 14	Klickitat	State Route	1		1	2		2	3
SR - 142	Klickitat	State Route	1		1	2		2	3
CR-51000/Track Rd.	Yakima	County Road	2	2		1	1		3
SR- 82	Yakima	State Route				2		2	2

Source: Washington State Crash Data from 2010-2014

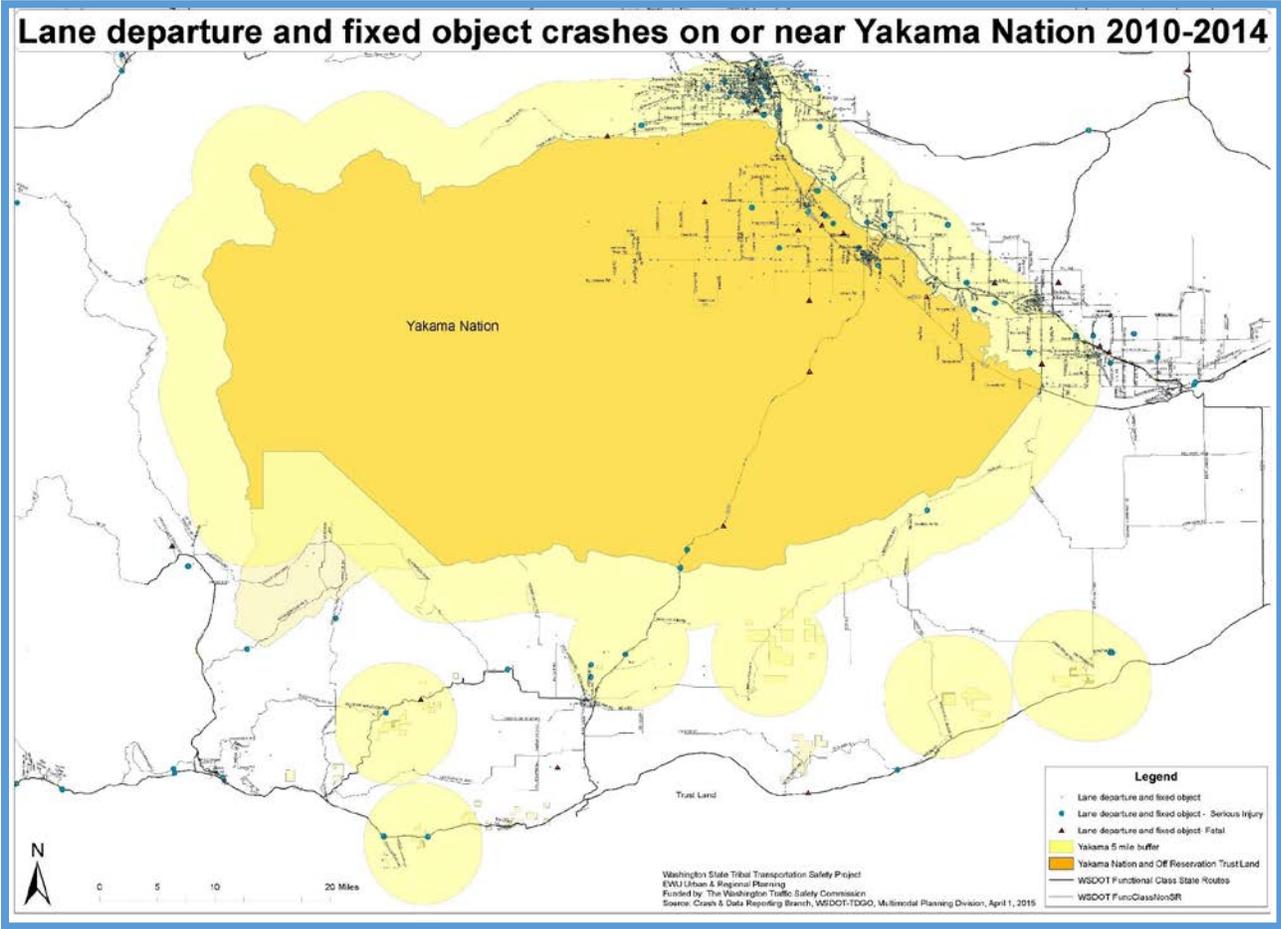
Figure 3. Lane departure and fixed object crashes 2010-2014



Source: Washington State Crash Data from 2010-2014

The crash data point locations in the lane departure and fixed object crash map (Figure 4) demonstrates several crash clusters located on State Route 97 and CR-51000/ Track Rd within the boundaries of the Yakama Nation. Outside of the Nation, there are high clusters of crash points located above the north border of the Nation in Yakima city. This area is included into the study area because of the proximity to the Yakama Nation and high frequent travel to Yakima city and Yakama Nation.

Figure 4. Map of Crashes Involving Object Collisions



Source: Washington State Crash Data from 2010-2014

2.1.3 Countermeasures for lane departure and fixed object Crashes

Keeping vehicles on the road, and minimizing the impacts of when and how drivers leave the road, are key to reducing lane departure and fixed object crashes. The Federal Highway Administration recommends the following road treatments to address lane departure crashes:

1. **Improving pavement friction on roads and curves.** Though increasing pavement friction is a good safety countermeasure in certain conditions or locations, it could lead to people learning to drive at higher speeds.
2. **Alerting drivers with rumblestrips.** Rumblestrips are grooves or bumps in the pavement that are designed to warn drivers by causing the wheels to vibrate and make noise when drivers are about to leave their travel lane. Rumblestrips are a cost-effective solution that can be cut into existing roads and do not require fresh pavement. They are highly recommended by the Roadway Safety Foundation for rural freeways and highways with speed limits of 50 mph or more. Center lined rumblestrips are recommended for two-lane rural highways.
3. **Enhancing delineation along horizontal curves**
4. **Improving nighttime visibility** – Retroflective signs, pavement markings, and roadway lighting.

2.1.4 Resources for lane departure and fixed object Crashes

Pavement friction fact sheet,

https://safety.fhwa.dot.gov/roadway_dept/pavement_friction/pavement_friction.pdf

Low-Cost Treatments for Horizontal Curve Safety 2016

https://safety.fhwa.dot.gov/roadway_dept/countermeasures/horicurves/fhwasa15084/

Low Cost Local Road Safety Solutions (American Traffic Safety Services Association),

<http://safety.fhwa.dot.gov/intersection/resources/fhwasa09027/resources/Low%20Cost%20Local%20Road%20Safety%20Solutions.pdf>

NCHRP Report 500, Volume 3, A Guide for Addressing Collisions with Trees in Hazardous Locations (National Cooperative Highway Research Program, Transportation Research Board),

http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_500v3.pdf

2.2 Intersection related crashes

Intersections are common points of conflict in traffic systems because they are located where all road users meet and cross each other. Intersections experience high volumes of traffic activities such as turning left, turning right and crossing over, any error made by drivers at intersections can lead to a crash. One of the major objectives of addressing intersection related crashes is to reduce the severity of those crashes when they occur. In Washington State, intersection related crashes generate 21% of statewide fatalities and 35% of statewide serious injuries from 2012–2014. Target zero identifies intersection related collisions as a high priority goal (Washington State Strategic Highway Safety Plan, 2016). The most common intersection related collisions in Washington State are entering at an angle (also known as T-bone and left turn crashes), hitting pedestrians or bicyclist, and rear-end crashes.

2.2.1 Intersection related crashes on and near the Yakama Nation.

The second highest contributing crash factors on and near the Yakama Nation are associated with drivers entering into intersections and drivers entering the road at angles. In total we found 70 crashes that involved 18 fatalities and 52 serious injury crashes that occurred between 2010-2014. Not granting right of way to other vehicles and disregarding stop signs are the most frequent contributors that overlap with intersection related crashes. Thirty-six percent of drivers in our study did not grant right of way, 11% disregarded stop signs, 11% drove under the influence of alcohol, 2% of drivers exceeded speed limits, and 2% were distracted driving.

Intersections are high-risk areas for pedestrians since they run the threat of encountering drivers that fail to yield right of way, are involved in speeding, distracted or under the influence of alcohol. Addressing pedestrian risks at intersections has the potential to reduce crashes at intersections and create safer access for all road users. More information on pedestrian risks can be found in the following chapter.

2.2.2 Repeated intersection and angle crash locations on and near the Yakama Nation

In our research, we found that State Route 97, running in Yakima and Klickitat Counties held the highest number of crashes related to intersections and angle crashes in the Yakama Nation survey area. From 2010-2014 there were a total of ten crashes on State Route – 97, which resulted in three fatalities and six serious crashes on the Yakama Nation’s boundaries, and one serious crash off of the Nation’s boundaries (See Table 2). The second facility with the highest number of crashes in the survey area is County Road-60150, in Yakima County. CR-60150/ Van Belle Rd. experienced four crashes from 2010-2014 that resulted in one fatality within the Nation’s boundaries, and three serious crashes off the boundaries.

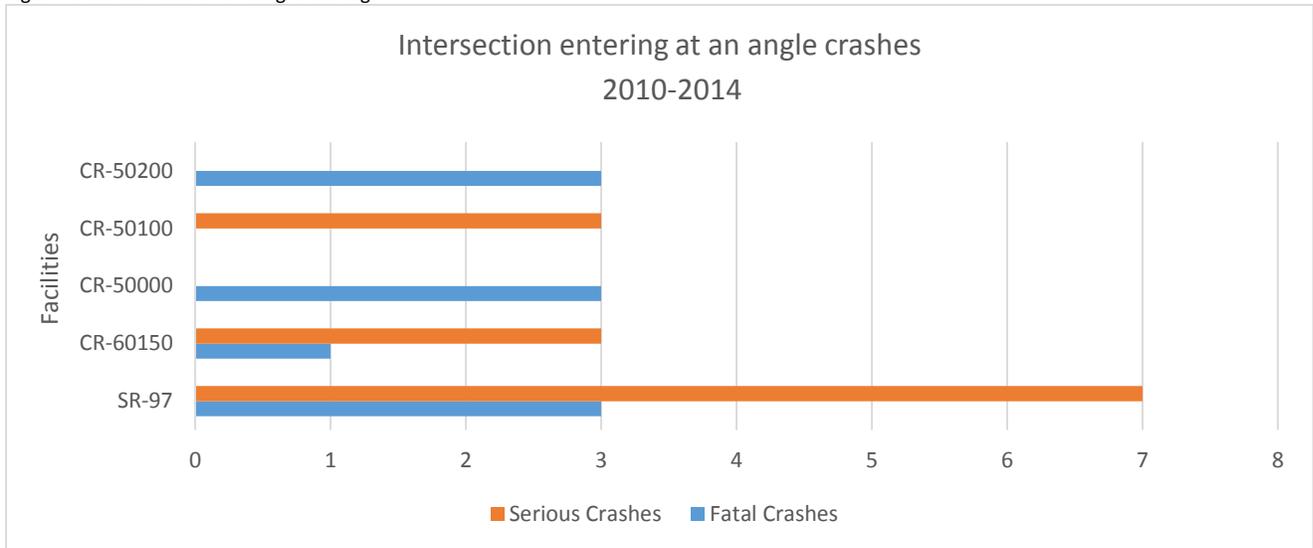
The collected crash data demonstrates that there is a pressing need to develop countermeasures to better guide drivers and keep people safe on the roads of the Yakama Nation. Figure 2 demonstrates the total crash rates from 2010 and 2014.

Table 4. Crashes Involving Driver Entering at an Angle 2010-2014

Intersection entering at angle crashes 2010-2014									
Facilities	County	Jurisdiction	Fatal	Fatal On Nation	Fatal Off Nation	Serious	Serious On Nation	Serious Off Nation	Total
SR-97	Yakima/Klickitat	State Route	3	3		7	6	1	10
CR-60150/ Van Belle Rd	Yakima	County Road	1		1	3		3	4
CR-50000/Fort Rd	Yakima	County Road	3	3					3
CR-50100/Branch Rd	Yakima	County Road				3	3		3
CR-50200/Progressive	Yakima	County Road	3	3					3

Source: Washington State Crash Data from 2010-2014

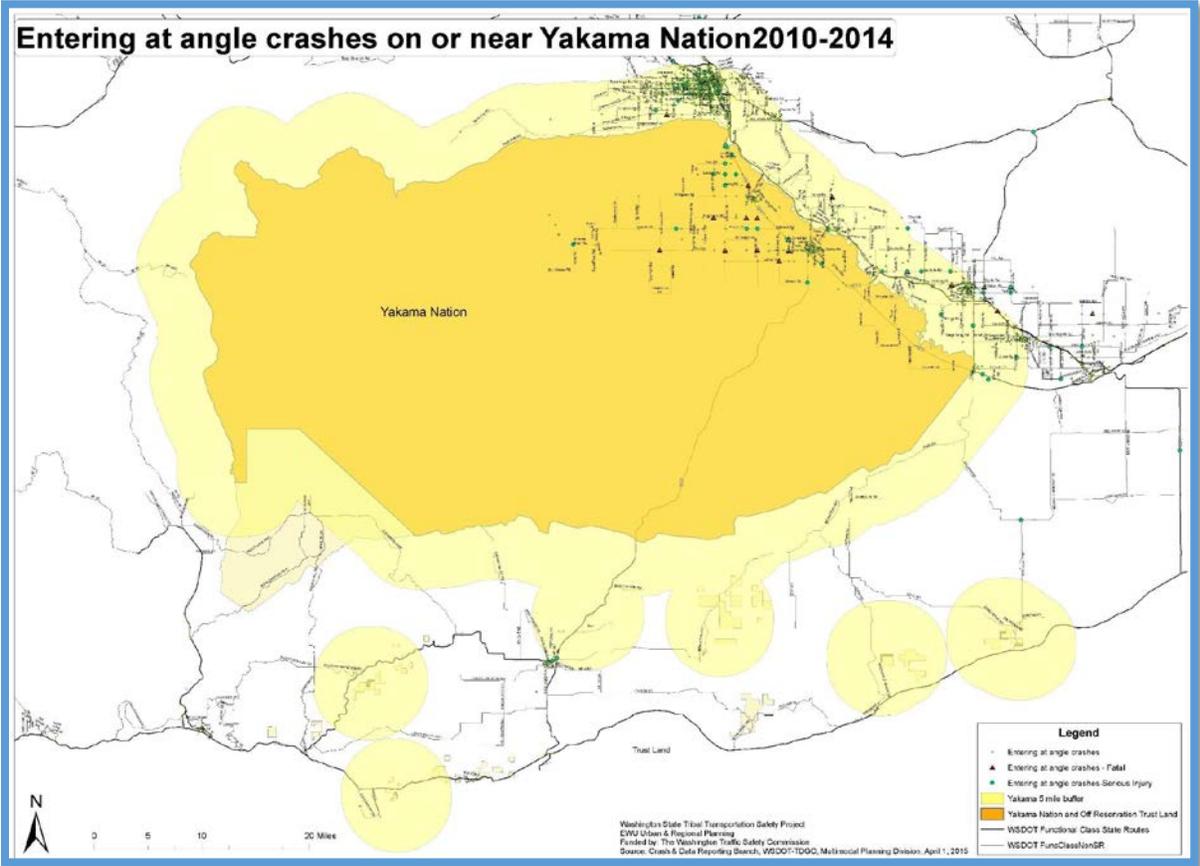
Figure 5. Crashes driver entering at an angle



Source: Washington State Crash Data from 2010-2014

The crash data point locations for entering at angle crashes (Figure 6) reveals there are several intersections in the Nation that have repeated crash locations. State Route 97 has the highest number of crash clusters along Wapato Road and E. McDonald Rd. Progressive Road and Fort Road have high number of fatalities along their intersections.

Figure 6. Maps of Crashes Entering at an Angle



Source: Washington State Crash Data from 2010-2014

2.2.3 Countermeasures for intersection related crashes

There are many low and high cost effective countermeasures to reduce intersection crashes. Low-cost strategies can include changing traffic control signs and signals. For example, modifying timing of traffic signals, adding back plates with retro-reflective borders to traffic signals, improving visibility of intersections with paint and rumble strips have proven to be effective low cost remedies. High-cost countermeasures could be converting intersections into roundabouts, or automated enforcement of red-lights running at locations with angle crashes.

2.2.4 Resources for intersection related crashes

Intersection safety

<https://safety.fhwa.dot.gov/intersection/>

NCHRP Report 500, Volume 5, A Guide for Addressing Unsignalized Intersection Collisions, (National Cooperative Highway Research Program, Transportation Research Board),

http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_500v5.pdf

NCHRP Report 500, Volume 12, A Guide for Reducing Collisions at Signalized Intersections, (National Cooperative Highway Research Program, Transportation Research Board),

http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_500v12.pdf

2.3 Pedestrians and Pedacyclists

Everyone is a pedestrian. At some point in our day we all make trips on foot for either practical purposes or for recreation. Walking and biking provide intangible health, social, economic, and quality of life benefits to our communities. Everyone needs to have safe and convenient access to walk. Unfortunately, pedestrians and pedacyclists are considered vulnerable road users since they are exposed to many risks on the road, compared to motorists that are protected by their vehicles. Since pedestrians and bicyclists share common characteristics, they are discussed together in this analysis.

In Washington State, pedestrians account for 15% of all traffic fatalities. The 2016 Washington State Strategic Highway Safety Plan reports that 14% of fatalities occurred on roads with posted speed of 25 mph or less, 42% on posted speed of 30-35 mph roads, 17% on posted speed of 40- 45 mph roads, and 23% on posted speed of 50 mph and above. Most pedestrian fatalities and serious injuries take place within cities where there are more traffic-congested areas. However, two-thirds of pedestrian fatalities within the Native American population occur in rural setting (WSSHSP, 2013). Despite the rural character of many reservations in Washington State, a high percentage of Native American residents walk, bicycle, and use other non-motorized transportation.

2.3.1 Pedestrian and Pedacyclists related crashes on and near the Yakama Nation

The third highest crash factor in the Yakama Nation are associated with pedestrians and pedacyclists. From 2010-2014 there were a total of 69 crashes that resulted in 23 fatalities and 46 serious. Pedestrians and pedacyclists experience the highest fatality rates across all other contributing causes in the Yakama Nation survey area. Twelve of the sixty-nine crashes involved pedacyclists. Typically vehicle crashes involving pedestrians occur at intersections where there tends to be a higher prevalence of pedestrians. However, in the Yakama Nation survey area we found that 57% of crashes involving pedestrians and pedacyclists did not take place at intersections. The crashes occurred in both city and county roads with vehicles driving straight into pedestrians. Thirty percent occurred at intersections, and 9% occurred at a driveway. Only one of the reported crashes involved a driver that was under the influence of alcohol.

2.3.2 Repeated Pedestrian and Pedacyclists related crashes on and near the Yakama Nation

State Route 97 serves as an important thoroughfare for all road users in the Yakama Nation. We found that State Route 97, running in Yakima County again held the highest number of crashes in the Yakama Nation survey area.

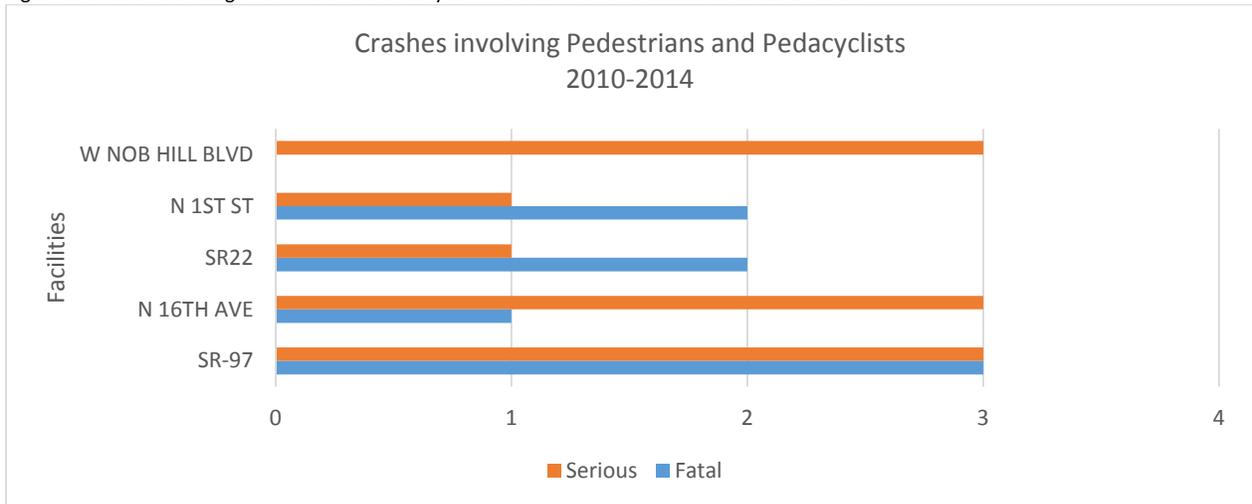
In total, there were six crashes; three fatal, and three serious crashes on SR-97 (See Table 3). The second facility with the highest number of crashes involving pedestrians and pedacyclists was North 16th Avenue in the Yakama City. This city street experienced four crashes; one fatal, and three serious crashes. State Route 22 experienced a total of three crashes; two fatal and one serious crash within the Nation’s boundaries. The data for pedestrians and pedacyclists demonstrate that there is a pressing need to address pedestrian safety in the Yakama Nation study area (See Figure 7).

Table 5. Crashes Involving Pedestrians and Pedacyclists on and near the Yakama Nation

Crashes involving Pedestrians and Pedacyclists 2010-2014									
Facilities	County	Jurisdiction	Fatal	Fatal On Nation	Fatal Off Nation	Serious	Serious On Nation	Serious Off Nation	Total
SR-97	Yakima	State Route	3	3		3	3		6
N 16TH Ave	Yakima	City Street	1		1	3		3	4
SR - 22	Yakima	State Route	2	2	0	1	1		3
N 1ST St.	Yakima	City Street	2		2	1		1	3
W Nob Hill Blvd	Yakima	City Street				3		3	3

Source: Washington State Crash Data from 2010-2014

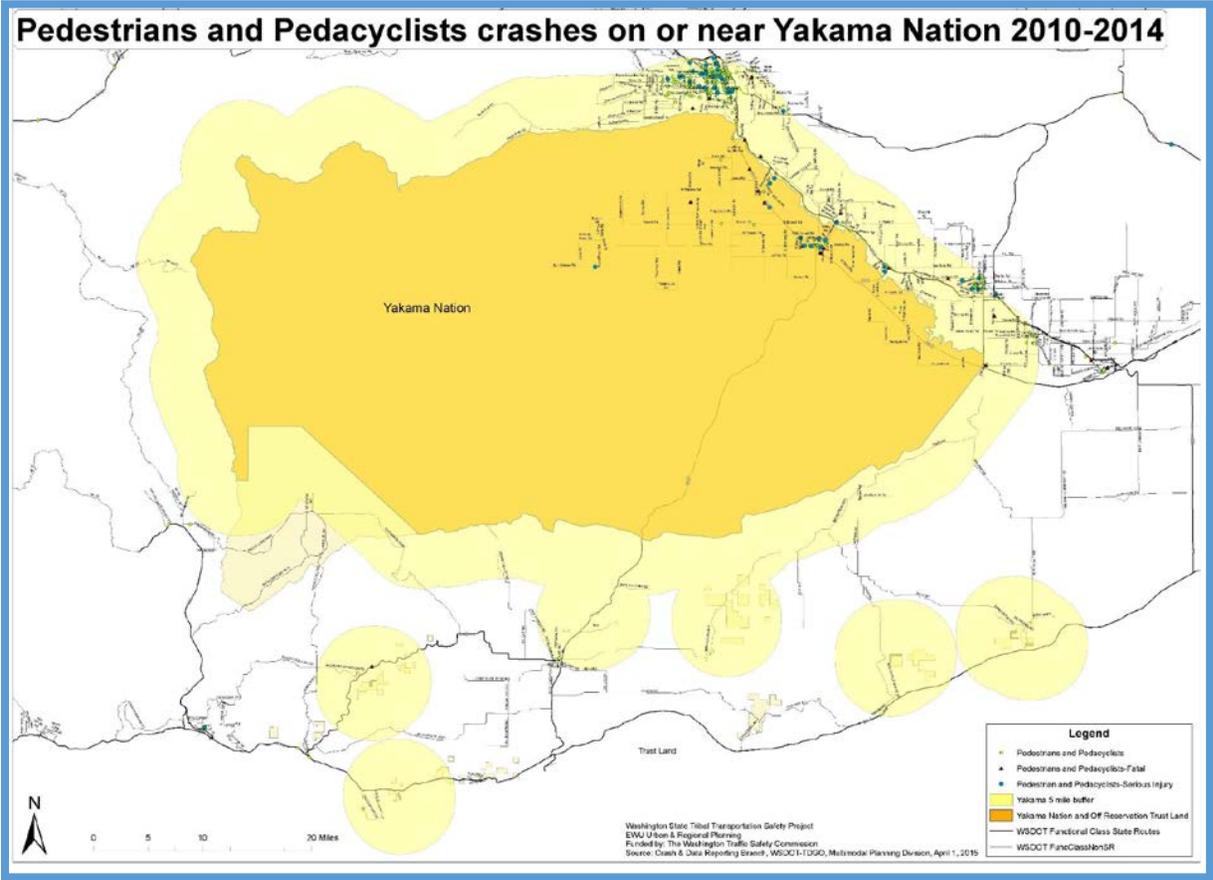
Figure 7. Crashes Involving Pedestrians and Pedacyclists on and near the Yakama Nation 2010-2014



Source: Washington State Crash Data from 2010-2014

The crash data point locations for pedestrians and pedacyclists (Figure 8) reveals that there is a pressing need to address pedestrian fatalities and serious injuries within the Yakama Nation. State Route 97 has the highest number of fatalities and serious injuries along Wapato Road and Fort Road.

Figure 8. Maps of Crashes Involving Pedestrians and Pedacyclists



Source: Washington State Crash Data from 2010-2014

2.3.3 Countermeasures for Pedestrian and Pedacyclists related crashes

Keeping pedestrians and pedacyclists safe on roads are key to reducing fatalities and serious injuries in the Yakama Nation. Targeting pedestrian safety will result in fast and favorable outcomes to improving traffic safety. Linking problems to solution actions will help curve the current crash trend facing the Yakama Nation. In order to fully address long term commitments to pedestrian and pedacyclist safety, the EWU team recommends the YTTSC work towards developing a more walkable and better connected community for the Yakama Nation through the following strategies that encompass Education, Engineering and Enforcement, that address pedestrian and pedacyclist safety:

- Conduct a walkability audit to assess existing pedestrian and bike accommodations (sidewalks, crosswalks, visibility to detect traffic, timing to cross streets, access to sidewalks, bike lanes, signs and markings), and emphasize attention to crash locations based on land use context where people are most likely to walk and traffic ways where bicyclist are most present
- Address driver and pedestrian behaviors through enforcement and education
- Assess pedestrian connections to transit
- Implement Complete Streets policies to provide access for all modes of transportation
- Enforce speeding
- Improve sight distance and visibility at pedestrian crossings
- Promote the use of reflective apparel among pedestrians
- Provide safe routes to School to ensure children's safety
- Provide sustained education and public awareness campaigns
- Photo enforcement
- Ticketing

Engineering solutions to develop physical improvements to keep pedestrians safe:

- Sidewalks
- Buffer zone separating pedestrians from moving cars
- Curb extensions, refuge islands, roundabouts
- Traffic signs
- Traffic calming
- Road diet
- Street lighting

Investing time and funding on pedestrian and bike accommodations in the Yakama Nation can help improve the health, safety, and environment of Yakama Nation members as well as provide future economic benefits to the Nation.

2.3.4 Resources for Pedestrian and Pedacyclists related crashes

NCHRP Report 500, Volume 10: A Guide for Reducing Collisions Involving Pedestrians (National Cooperative Highway Research Program, Transportation Research Board),
<http://safety.transportation.org/guides.aspx?cid=29>

Safe Routes to School

<http://www.saferoutesinfo.org/>

State Highways as Main Streets: A Study of Community Design and Visioning (Washington State Department of Transportation and University of Washington),

<http://www.wsdot.gov/research/reports/fullreports/733.1.pdf>

2.4 Overturned vehicle crashes

Overturned vehicle/ rollovers crashes are complex violent crashes that result from a combination of speeding, drivers losing directional control of their vehicle, and running the risk of hitting fixed objects, or rolling down a slope. Rollovers, more so than other types of crashes, reflect the interaction of the driver, road, vehicle, and environmental factors. Vehicle types play a significant role, other factors such as driver behavior and road and environmental conditions can also cause a vehicle to roll over. These type of crashes are commonly coupled with high-risk behavior choices such as driving under the influence of alcohol and distracted driving. Nearly 75% of all rollover crashes in the U.S. occur on rural roads (Safecar, 2017). Rollover crashes also have a higher fatality rate than other types of crashes.

Additionally, topography, soils and slopes of the area play a key role in contributing to overturned/roll over crashes. For example if a vehicle is run off the road and there is no road should it is easier for the vehicle to result in a rollover. According to the National Highway Traffic Safety Administration, overturned vehicle /rollover crashes commonly occur when cars are tripped and un-tripped. The strong force applied to car tires in these situation causes vehicles to roll over. Tripped crashes occur when a vehicle leaves the lane and slides sideways and tips, or when it strikes a fixed object like a curb or guardrail. Un-tripped rollovers usually occur during high-speed collision avoidance maneuvers.

2.4.1 Overturned related crashes on and near the Yakama Nation

The fourth highest contributing crash factors on the Yakama Nation involve overturned vehicles. We found 62 crashes resulting in 20 fatal crashes, and 42 serious crashes. These crashes overlap with high-risk behavioral choices such as speeding, changing lanes without precaution, or making turns in risky areas. Other contributing factors that lead to the above-mentioned crashes were driver's behavior. In our study we found that 35% of drivers were under the influence of alcohol, 22% exceeded speed limits, and 12% were distracted driving.

2.4.2 Repeated overturned vehicle related crashes locations on and near the Yakama Nation

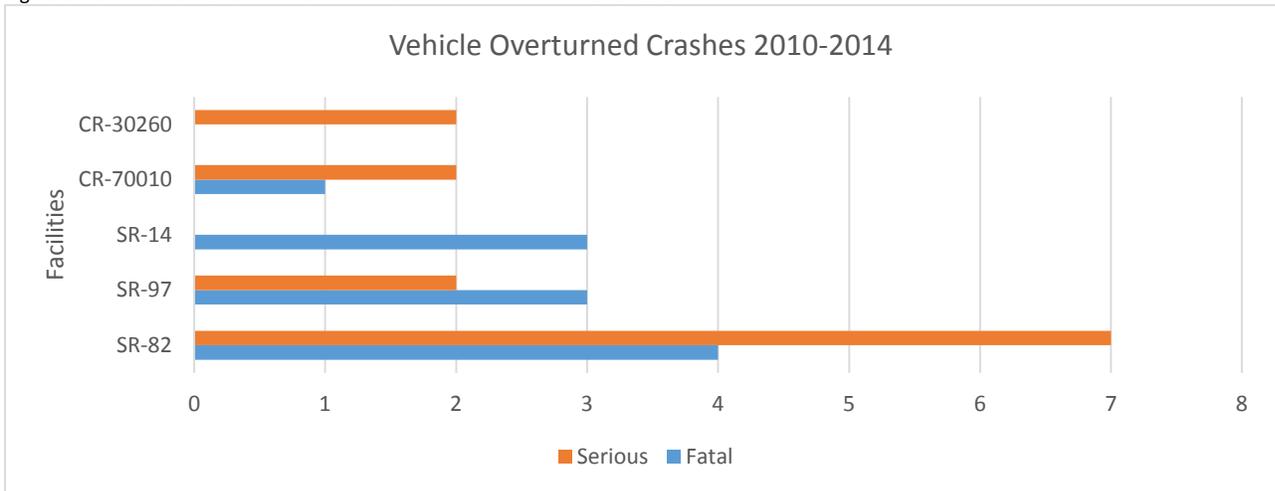
For facilities, we found that Interstate Route 82, running in Yakima County held the highest number of overturned crashes overlap with high-risk behavior choices within the Yakama Nation survey area. From 2010-2014 there were total of eleven crashes involving overturned vehicles; four fatal crashes within the nation's boundaries, and seven serious crashes near the boundaries (See Table 2). The second facility with the highest number of crashes involving overturned vehicles is State Route – 97 running in Yakima and Klickitat Counties. There were three fatalities, one of those occurred within the Nation's boundaries; three serious crashes one on and off the Nation's boundaries (See Figure 4).

Table 6. Vehicle Overturned Crashes on or near the Yakama Nation 2010-2014

Vehicle Overturned Crashes on or near the Yakama Nation									
Facilities	County	Jurisdiction	Fatal	Fatal On Nation	Fatal Off Nation	Serious	Serious On Nation	Serious Off Nation	Total
SR-82	Yakima	State Route	4		4	7		7	11
SR-97	Yakima/Klickitat	State Route	3	1	2	2	1	1	5
SR-14	Klickitat	State Route	3		3				3
CR-70010	Yakima	County Road	1		1	2		2	3
CR-30260	Yakima	County Road				2		2	2

Source: Washington State Crash Data from 2010-2014

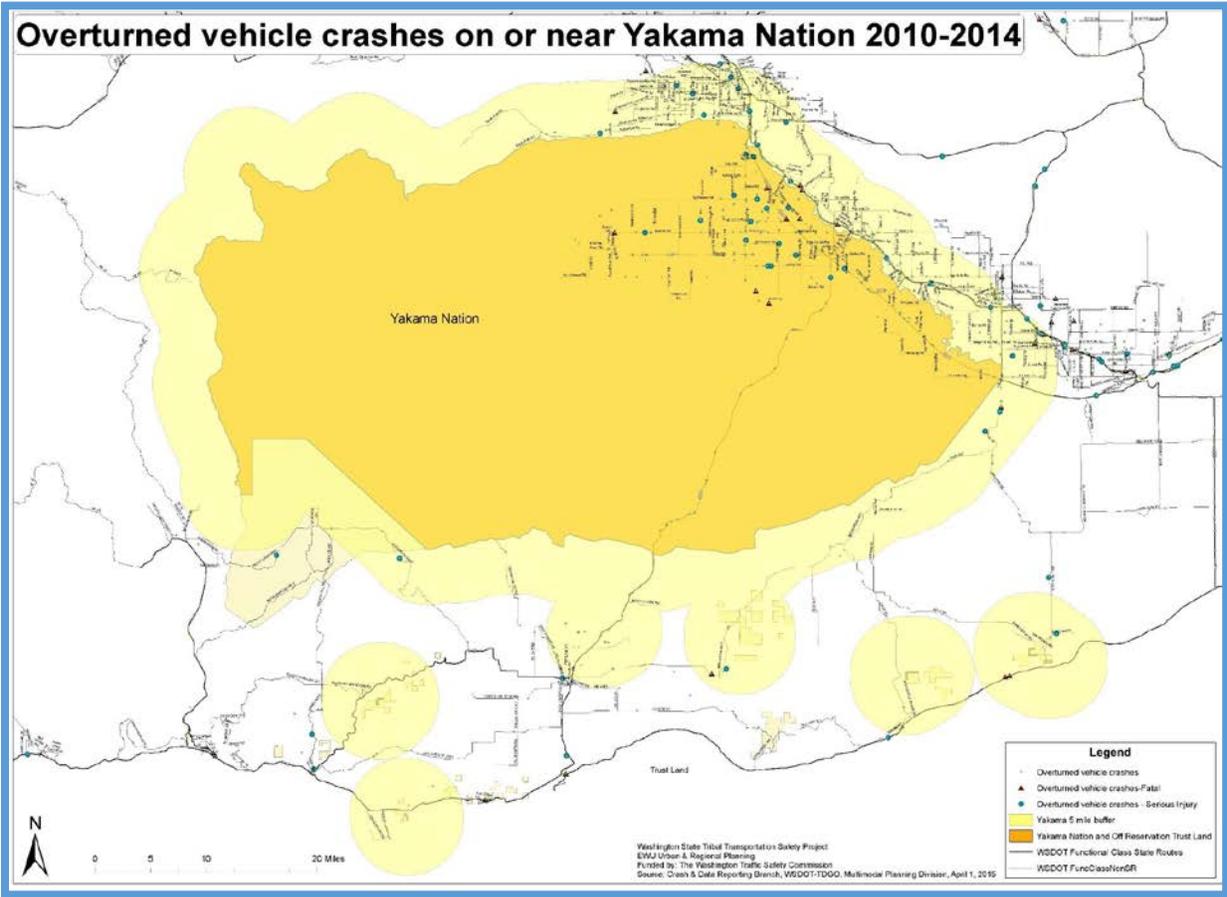
Figure 9. Vehicle Overturned Crashes on or near the Yakama Nation 2010-2014



Source: Washington State Crash Data from 2010-2014

The crash data point locations for overturned vehicle crashes (Figure 10) demonstrates there are high numbers of fatal and serious injury crashes along State Route 82. State Route 97 holds several crash points along Jones Road and Progressive Road.

Figure 10. Map of Crashes Involving Overturned Vehicles



Source: Washington State Crash Data from 2010-2014

2.4.3 Countermeasures for overturned vehicle related crashes

Drivers can significantly reduce their chances of a fatal rolling over crash if they observe speed limits, wear seat belts, and not drive under the influence of alcohol or drugs. Drivers are 75% less likely to be killed in a rollover crash if drivers are wearing a seatbelt (Safecar.gov, 2017). Enclosed we have provide strategies that encompass Education, Engineering and Enforcement, to address overturned vehicle related crashes:

- Frequent review of road surface conditions
- Reduce Speed limits
- Enforcement to reduce speed
- Paved Shoulder treatment
- Shoulder rumble strips

2.4.4 Resources for overturned vehicle related crashes

Rumble strips and Rumble stripes

https://safety.fhwa.dot.gov/roadway_dept/pavement/rumble_strips/general-information.cfm

Paved Shoulder Treatment

https://safety.fhwa.dot.gov/roadway_dept/horcurves/fhwasa07002/ch6.cfm

Seatbelt safety campaigns

<https://www.trafficsafetymarketing.gov/get-materials/seat-belts/seat-belt-safety-tweens-ages-8-14>

http://wtsc.wa.gov/wp-content/uploads/dlm_uploads/2015/10/30PiecesQuickView.pdf

2.5 Earthbank or ledge related vehicle crashes

Between 2010 and 2014, 2,062 of reported fatalities on roads in tribal areas nationwide derived from roadway departures. This data represents 63% of all reported motor vehicle fatalities in tribal areas nationwide. Many tribes and states identify roadway departure as an emphasis area in transportation safety plans (Tribal Transportation Strategic Safety Plan, 2017).

The topography of the Yakama Nation varies from North to South and East to West. The West and South have mountainous areas where many roads have narrow shoulders or no guardrails present leaving drivers in a constant threat of driving over embankment or falling into a ditch. Road shoulders serve as an emergency stopping lane that allows drivers to pull out of their lane, stop or take control of a driving error. Narrow shoulders can create a situation where drivers will not have a recovery area in case of lane deviation and they therefore increase the likelihood of off-road collision (Mohan & Tiwari 2016).

2.5.1 Earthbank or ledge related crashes on and near the Yakama Nation

The fifth highest contributing crash factor on the Yakama Nation study area involve vehicles departing from their lane and crashing onto earth bank or ledge. We grouped collisions that involved ledges, roadway ditches, culverts and all types of earth banks to better assess the crash data. We found 48 crashes that resulted in 20 fatal crashes, and 28 serious crashes. Driving under the influence of alcohol and speeding are high-risk behavioral choices that overlap with earthbank and ledge related crashes. In our research we found that 44% of the drivers were under the influence of alcohol, 15% of drivers exceeded speed limits, 8% were asleep at the wheel or fatigued, and 8% were distracted.

2.5.2 Repeated Earthbank or ledge crashes locations on and near the Yakama Nation

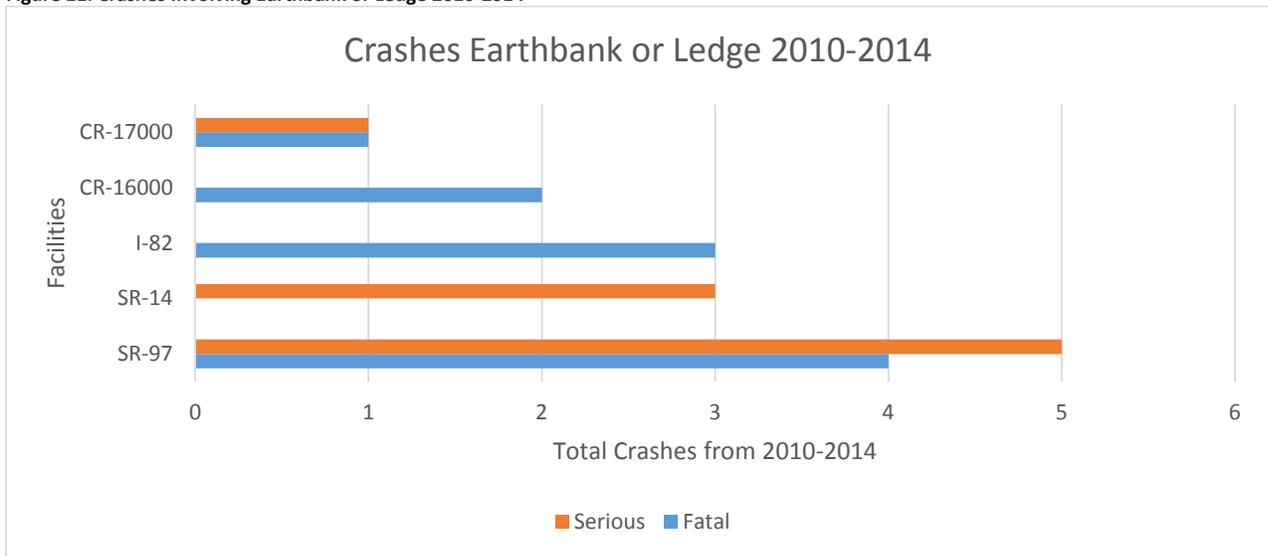
For facilities, State Route 97 running in Yakima and Klickitat County again held the highest number of crashes in the Yakama Nation survey area. From 2010-2014 there were a total of nine crashes involving earthbank or ledges vehicles; four fatal crashes within the nation's boundaries and one off the Nations boundaries (See Table 5). The second facilities with the highest number of crashes involving earthbanks and ledges is State Route 14 in Klickitat County, and State Route 82 in Yakima County. Both had a total of three crashes each with fatalities and serious crashes off the Nations boundaries. Figure 5 demonstrates the different crash rates between each of the facilities. An important consideration is that Klickitat County roads are subject to mountainous terrain (curves & elevation change). Yakima County roads in lower Yakima Valley follow rectangular survey system. Making 'intersections' a bigger safety issue in the Yakima County.

Table 7. Crashes Involving Earthbank or Ledge on or near the Yakama Nation 2010-2014

Earthbank or ledge crashes									
Facilities	County	Jurisdiction	Fatal	Fatal On Nation	Fatal Off Nation	Serious	Serious On Nation	Serious Off Nation	Total
SR-97	Yakima/Klickitat	State Route	4	3	1	5	3	2	9
SR-14	Klickitat	State Route				3		3	3
SR-82	Yakima	State Route	3		3				3
CR-16000/ BZ-Glenwood Hwy	Klickitat	County Road	2	2					2
CR-17000/ Trout Lake Hwy	Klickitat	County Road	1	1		1	1		2

Source: Washington State Crash Data from 2010-2014

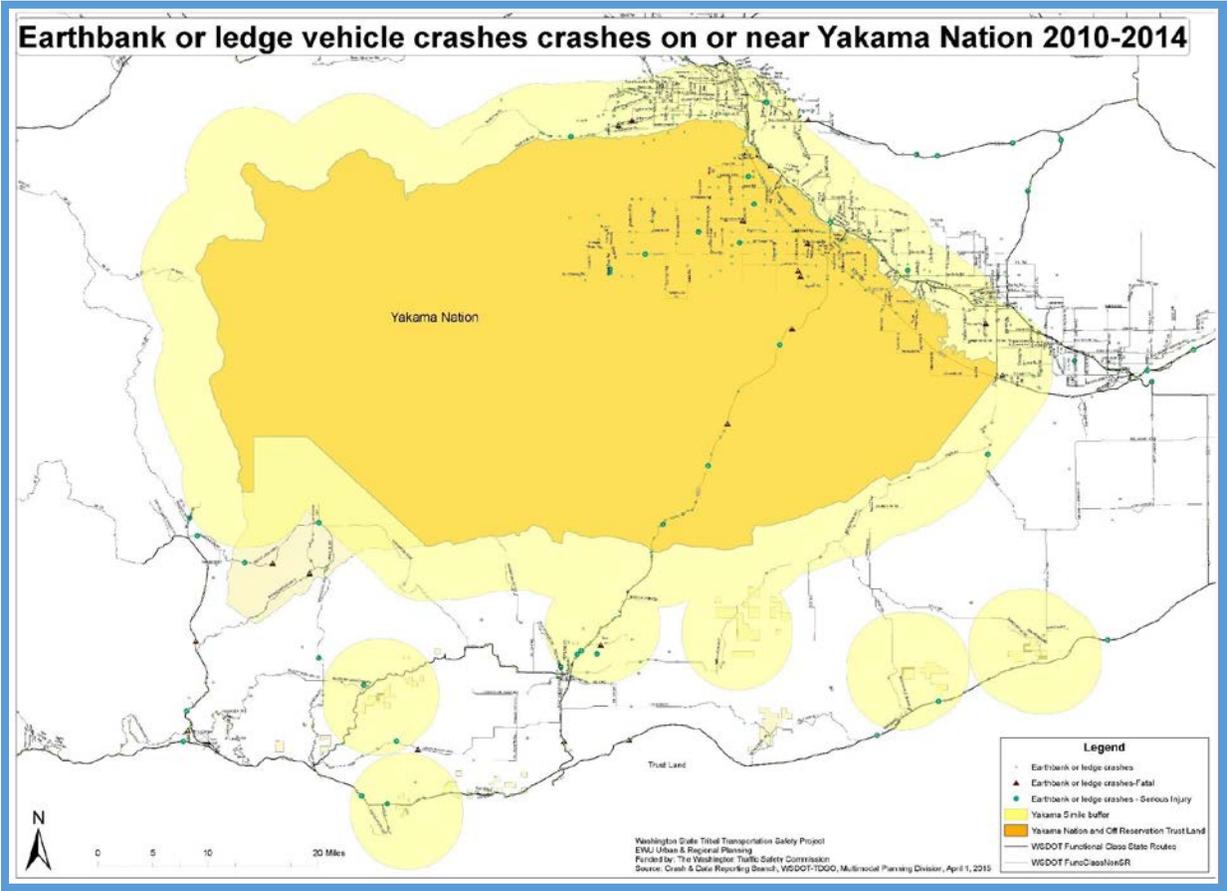
Figure 11. Crashes Involving Earthbank or Ledge 2010-2014



Source: Washington State Crash Data from 2010-2014

The crash data point locations for earthbank or ledge crashes (Figure 8) reveals that there is much concern to address fatalities and serious injuries along the mountainous and curvy terrains of State Route 97. The southern portion of SR 97 is a narrow two-way road with little shoulder space and narrow roads that leave little room for errors, and few opportunities for cars to turn around.

Figure 12 .Map of Crashes Involving Earth bank or Ledge



Source: Washington State Crash Data from 2010-2014

2.5.3 Countermeasures for crashes Involving earth bank or Ledge

Drivers can significantly reduce their chances of avoiding an earthbank or ledge if they observe speed limits, wear seat belts and not drive under the influence of alcohol or drugs. Enclosed are strategies that encompass Education, Engineering and Enforcement, to address earth bank and ledge crashes:

- Increase sign posts in crash cluster areas
- Frequent review of road surface conditions
- Enforcement to reduce speed
- Pave shoulder
- Install guardrails in hazardous areas
- Update guardrail that does not meet a recent crashworthiness standards
- Shoulder rumble strips & delineators

2.5.4 Resources for crashes Involving earth bank or Ledge

MUTCD 2A.15 Enhanced Conspicuity for Standard Signs:

<https://mutcd.fhwa.dot.gov/htm/2009/part2/part2a.htm>

Retroflective signs

https://safety.fhwa.dot.gov/roadway_dept/night_visib/policy_guide/sign_15mins/

Guardrail 101

https://safety.fhwa.dot.gov/roadway_dept/countermeasures/reduce_crash_severity/guardrail101.cfm

3.0 High Risk Facilities in the Yakama Nation Study Area

The contributing crash factors and repeated crash locations on the facilities described in this report demonstrate that the data serves as a critical link in identifying traffic safety issues. The fatalities and serious injury crashes across the Yakama Nation exhibit alarming trends, and the data specifically to State Route 97 indicate that crashes have been continuous over the past years. Addressing this facility as a high priority can provide favorable results to decrease crashes and improving safety in the Yakama Nation.

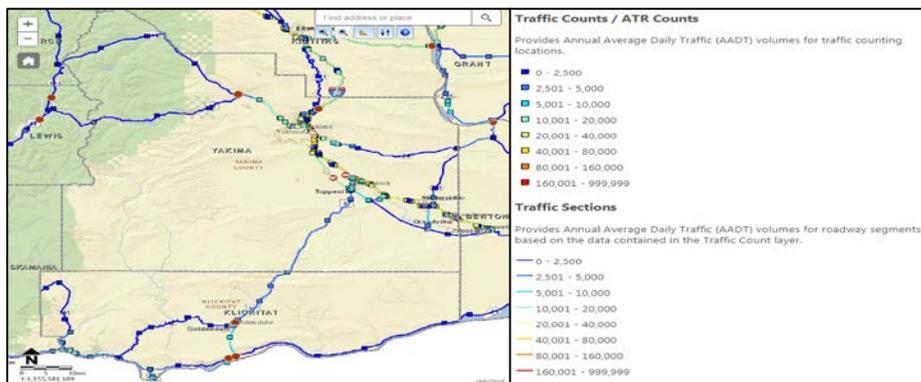
3.1 State Route 97

State Route 97 begins in the Washington-Oregon boundary on the interstate bridge that crosses the Columbia River at Biggs Rapids. It then stretches north to the eastern edges of the Yakama Nation connecting access to the city of Toppenish, Wapato, and to Union Gap and Yakima. SR-97 is a central corridor for the Yakama Nation connecting to Fort Road, 1st Avenue in Toppenish, and 1st Street in Wapato. SR-97 experiences high volume commercial trucks, shipping fleets, local traffic running north, and south. In addition, there are major traffic generators along SR-97 and 1st Street. Major traffic generators such as gas stations, access to industrial areas of Wapato, and a lack of road paint which can cause confusion to drivers.

According to the Washington State Department of Traffic, the annual average daily traffic count runs between 2,501-5,000 traffic counts between the lower southern portions to the City of Toppenish. From Toppenish to Wapato, the annual average daily traffic count changes to 10,001-20,000 counts. See figure 8 for AADT volumes in the Yakama Nation (see figure 13).

Speed limits run high between 55 to 65 MPH on SR-97. Milepost 33.52 to 56.0 are two lane roads that run north and south with little options for cars to turn around or pass. Milepost 61.5 to 76.15 convert to four lanes, two running north and two south.

Figure 13. WSDOT- Annual Average Daily Traffic volumes for Traffic counting locations.



Source: WSDOT

There are three designated crosswalks with pedestrian amenities along the seven mile stretch that connects the Yakama Nation on SR-97; Ford Road and SR-97, South Wapato Road and SR-97, and West 1st Street and SR-97. There is an additional streetlight located on SR-22 and SR-97, but there are no pedestrian or crosswalk amenities. It is also important to note that there are no designated bike lanes along SR-97. The data here tells us that there is a pressing need to address crash clusters and provide road treatments to improve safety. Most importantly, the data reveals that even though there are few crosswalks, and no designated pedestrian or bikeways people still walk and bike in this area. SR-97 is the facility with the highest number of crashes involving pedestrians and pedacyclists in the Yakama Nation. SR-97 also experienced the most crashes involving drivers entering at an angle, object collisions, and earth bank/ledges.

3.2 State Route 22

State Route 22 begins at the junction with State Route 82, then stretches south to a junction of SR-97 in the City of Toppenish. From this intersection, SR-22 runs south east to the City of Mabton and then to a second junction on SR-82 in the City of Prosser. Speed limits run high between 20 to 35 MPH in the residential areas, and 55 mph along the commercial and agriculture sections. SR-22 has two lanes that run north and south along the entire route. There are four designated crosswalks within the city limits of Toppenish; S. Elm St and W 1st Avenue, Monroe Avenue and South Elm Street, Evergreen Highway and Madison Avenue, and Toppenish Middle School.

There is an additional street light located on SR-22 and SR-97, but there are no pedestrian or crosswalk amenities. Like SR-97, it is also important to note that there are no designated bike lanes along SR-22.

SR-22 held the second highest number of crashes involving pedestrians and pedacyclists in the Yakama Nation. The crash data in this analysis tells us that there is a need to address crash clusters and provide road treatments to improve pedestrian safety along SR-22.

4.0 Next Steps

The main goal of the Yakama Nation Tribal Traffic Safety Committee Strategic Plan FY 2017 is to improve pedestrian and vehicle safety. In order to achieve this goal of fewer crashes in the Yakama Nation each year, the YTTSC must work on strategies to maintain a momentum towards accomplishing goals and set performance measures to quantify outcomes. Using data-driven approaches to identify issues, defining near term and long term goals will provide local-level justifications to allocate funds to improve pedestrian and traffic safety in the Yakama Nation. The success of the YTTSC will be dependent on the efforts across all Tribal departments and Tribal leaders.

4.1 Road Safety Audit

The EWU Traffic Safety team highly recommends that the Yakama Tribal Traffic Safety Committee invest time in developing a Road Safety Audit for SR- 22 and SR-97. A Road Safety Audit is a formal and independent safety performance review of a road transportation project by an experienced multi-disciplinary team of safety professionals that address the safety of all road users. A great collaborative approach that involves multi-disciplinary departments who have particular areas of expertise in the Yakama Nation. RSAs are an effective way get a good picture of what is occurring along the routes, as well as an effective way to develop appropriate short term and long-term countermeasures to increase safety as well as opportunities to improve the community's health and mobility.

In conclusion, the collected crash data from 2010-2014 reveals that there is a need to address traffic and pedestrian safety, as well as behavioral choices around driving in the Yakama Nation. Conducting a Road Safety Audit along State Route 22 and 97 will help the YTTSC address specific crash sites, and identify short term and long term effective countermeasures to increase safety and save lives in the Yakama Nation. The data from this analysis along with the short and long-term countermeasures identified in the Road Safety Audit ought to be incorporated into the Tribal Transportation Safety Plan (TTIP). Having this data included into the TTIP can help the YTTSC apply for grants based on traffic safety priorities that can then lead to construction. This research developed in this report can also be utilized to extend data driven research and analysis into other topics remaining in the EWU Tribal Traffic Safety Model.

Sources:

Center for Disease Control and Prevention, Tribal Road Safety: Get the Facts, (September 15, 2017)
<https://www.cdc.gov/motorvehiclesafety/native/factsheet.html>

Federal Highway Administration Research, Roadway departure, (September 15, 2017)
<https://www.fhwa.dot.gov/research/topics/safety/roadwaydeparture>

Hill, M. & Meyers, C. (2016). Creating a Culture of Traffic Safety on Reservation Roads: Tribal Law & Order Codes and Data Driven Planning. *The Indigenous Peoples' Journal of Law, Culture & Resistance*. 2016; 3(1): 43-80.

Hill, M. (2017). *Creating a Culture of Traffic Safety*. WIT press.

National Highway Traffic Safety Administration, *Safecar.gov*, (October, 2017)
<https://www.safercar.gov/Vehicle-Shoppers/Rollover/Causes>

Washington State Fatality Analysis Reporting System, data for 2010-2014

Washington State Strategic Highway Safety Plan 2016: Target Zero. Washington State Department of Transportation.

Tiwari, G., & Mohan, D. (Eds.). (2016). *Transport Planning and Traffic Safety: Making Cities, Roads, and Vehicles Safer*. CRC Press.