# HIGHWAY 20 WILDLIFE CONNECTIVITY FEASIBILITY STUDY

**PREPARED FOR:**

Burns Paiute Tribe
100 Pasigo Street
Burns, OR 97720
Contact: Calla Hagle
541.573.8021

**PREPARED BY:**

ICF
1200 6th Avenue, Suite 1800
Seattle, WA 98101
Contact: Shannon Crossen
206.801.2870

**December 2021**

ICF. 2021. *Highway 20 Wildlife Connectivity Feasibility Study*. Final. December. (ICF 00026.20.) Seattle, WA. Prepared for Burns Paiute Tribe, Burns, OR.

# Abstract

The ability for wildlife to move across landscapes at various scales is necessary to fulfill their life history requirements and for their survival. At the local scale, this movement occurs as daily movements through a home range or territory. On a larger, landscape scale, movements may take the form of long-distance migrations. Ungulates, such as deer and elk, often have distinct summer and winter ranges, connected by migration corridors that offer fresh vegetation and opportunities for rest during the long migratory journey between ranges. If these important habitats become fragmented, such as by roads and development, access to migration routes, destination habitats, and resources necessary for survival may become difficult or dangerous for species to access.

Habitat fragmentation poses the immediate challenges of limiting species' access to life-sustaining resources, such as food, water, shelter, and seasonal habitats, such as summer and winter ranges. Without access to essential resources and safe, unimpeded movement across a species range, populations struggle to thrive, fail to adapt to changing conditions, and suffer from potentially significant declines. Ensuring both local and landscape-level connectivity is a critical step to ensuring sustainable wildlife populations and maintaining overall ecosystem health.

A variety of challenges related to wildlife movement and wildlife-vehicle collisions (WVCs) have been extensively documented along US Route 20 (Highway 20) in Oregon, particularly through Harney and Malheur Counties. In the Malheur River and Beulah Wildlife Management Units, which are the two units adjacent to the Malheur River corridor along Highway 20, mule deer population estimates have experienced a 20–40% decline in recent years. In this region, Highway 20 imposes a large physical barrier to wildlife movement, fragments important habitats and ungulate winter range, causes substantial wildlife mortality due to vehicle collisions, and lacks dedicated elements and infrastructure to facilitate safe and effective wildlife and habitat connectivity. The significance of this region and local wildlife to the Burns Paiute Tribe further emphasizes the importance of addressing wildlife-highway conflicts and habitat fragmentation in the region to conserve important natural and cultural resources.

This Highway 20 Wildlife Connectivity Feasibility Study report, initiated and led by the Burns Paiute Tribe, documents a wildlife connectivity assessment and a series of workshops held to elucidate the status of wildlife–highway conflicts in the region, gather agency and stakeholder input, identify feasible mitigation alternatives, and develop a path for implementing mitigation aimed at improving wildlife connectivity and road safety and reducing WVCs along Highway 20 in Harney and Malheur Counties.

# Contents

# List of Appendices

# Tables

# Figures

# Acronyms and Abbreviations

| | |
|---|---|
| FWC | Fish and Wildlife Commission |
| Highway 20 | US Route 20 |
| HSIP | Highway Safety Improvement Program |
| ODFW | Oregon Department of Fish and Wildlife |
| ODOT | Oregon Department of Transportation |
| PAS | passage assessment system |
| PSA | Public Safety Announcement |
| Tribe | Burns Paiute Tribe |
| WCA | wildlife connectivity assessment |
| WPA | Wildlife Passage Assessment |
| WSDOT | Washington State Department of Transportation |
| WVC | wildlife-vehicle collision |

Chapter 1
# Introduction

# Feasibility Study Overview

## Introduction

A variety of challenges related to wildlife connectivity have been documented along US Route 20 (Highway 20) in Oregon, particularly high levels of wildlife–vehicle collisions through Harney and Malheur Counties. This Highway 20 Wildlife Connectivity Feasibility Study report documents a wildlife connectivity assessment and series of workshops held to elucidate the status of wildlife-–highway conflicts, gather agency and stakeholder input, identify feasible mitigation alternatives, and develop a path for and resources to support implementation of mitigation aimed at improving wildlife connectivity, reducing wildlife–vehicle collisions, and improving road safety in the region.

This feasibility study was made possible by funding provided to the Burns Paiute Tribe from the 2019 Bureau of Indian Affairs Tribal Resilience Grant for Climate Adaptation Planning and 2020 Pew Charitable Trust funds to support agency and stakeholder workshops and facilitation.

## Goals and Objectives

The goal of the feasibility study was to identify opportunities to increase ecosystem function and value, ensure species' access to critical resources, and reduce wildlife-vehicle collisions (WVCs) along Highway 20 in the study area.

The objectives in support of this goal, were to:

1. Assess wildlife connectivity in the study area.
2. Identify and analyze mitigation (i.e., connectivity enhancement) alternatives.
3. Select connectivity enhancement measures in collaboration with agencies and stakeholders.
4. Support advancement of selected measures through development of concepts, action planning, identification of funding opportunities, and development of implementation planning guidance.

## Desired Outcomes

Study outcomes will enable the following next steps in connectivity enhancement measure implementation.

1. Development of design plans, specifications, and cost estimates.
2. Implementation of connectivity enhancement measures.

This report aims to directly facilitate the successful acquisition of funding, which will be used to support planning, design, and implementation of selected connectivity enhancement measures. The agency and stakeholder partnerships developed during the workshop process will foster a highly collaborative environment and result in actions that have been selected by stakeholders,

landowners, and agencies while incorporating and reflecting their diverse needs, concerns, and priorities.

The collaborations and projects developed from this study will facilitate a safer Highway 20 for wildlife and humans, improved ecosystem function and value in the study area, and infrastructure that reflects the needs of motorists, wildlife, and diverse stakeholders. Outcomes will also support public awareness on issues related to wildlife connectivity and conservation and cultivation of collaborative partnerships that will improve agency and stakeholder coordination for many years to come.

# Study Area

The study area includes the extent of the Highway 20 corridor through Malheur and Harney counties (Figure 1-1). Highway 20 through the study area traverses diverse topography including steep canyons, valleys, and the Malheur River Valley containing a diverse assemblage of habitats, including meadow, wetland, riparian, and shrub-steppe. The area is mainly rural and undeveloped with important land uses including farming and ranching.

The study area provides important habitat for many species, including mule deer (*Odocoileus hemionus*), pronghorn antelope (*Antilocapra americana*), Rocky Mountain elk (*Cervus elaphus nelsoni*), fox (*Vulpes spp*.), long-tailed weasel (*Mustela frenata*), porcupine (*Erethizon dorsatum*), cougar (*Puma concolor*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), sandhill crane (*Grus canadensis*), burrowing owl (*Athene cunicularia*), and greater sage-grouse (*Centrocercus urophasianus*). Several sensitive species have known ranges in the region, including Columbia spotted frog *(Rana luteiventris*), long-legged myotis (*Myotis volans*), pallid bat (*Antrozous pallidus*), and hoary bat (*Lasiurus cinereus*). The region also provides critical winter range habitat for migratory ungulates (mule deer, Rocky Mountain elk, pronghorn antelope) and provides important stopover migration habitat and nesting habitat for birds along the Pacific Flyway, a significant north–south bird migration route.

The Malheur River Wildlife Mitigation Site, which is owned and managed by the Burns Paiute Tribe (Tribe), is also located in the study area. The almost 32,000-acre site of deeded and leased lands is composed of wetland, meadow, riparian, and shrub-steppe habitats with various active habitat restoration and enhancement projects completed or underway. The Malheur River Wildlife Mitigation Site is recognized as an important element of habitat restoration efforts in the Malheur River Basin and is an important resource for wildlife species in the region.

The study area is also the traditional homeland of the Tribe. The Tribe belongs to the Great Basin culture, and its members practice the traditions of that culture. The ancestors of the Tribe, the Wadatika Band of Northern Paiutes, traditionally followed the food supply throughout central and eastern Oregon, Idaho, northern California, and northern Nevada. Major campsites were located along streams and rivers, where water and food could be collected. The resources found within this ancestral territory sustained the Wadatika, and provided for their material, spiritual, and medicinal needs. Today, The Burns Paiute Reservation is located in rural eastern Oregon, and the Tribe owns land in both Harney and Malheur Counties. The Tribe's prehistoric, historic, and contemporary cultural materials, including plant resources, medicines, fish, and wildlife, are on the decline throughout the Tribe's traditional territory. This decline places the preservation and maintenance of the Tribe's culture in jeopardy.

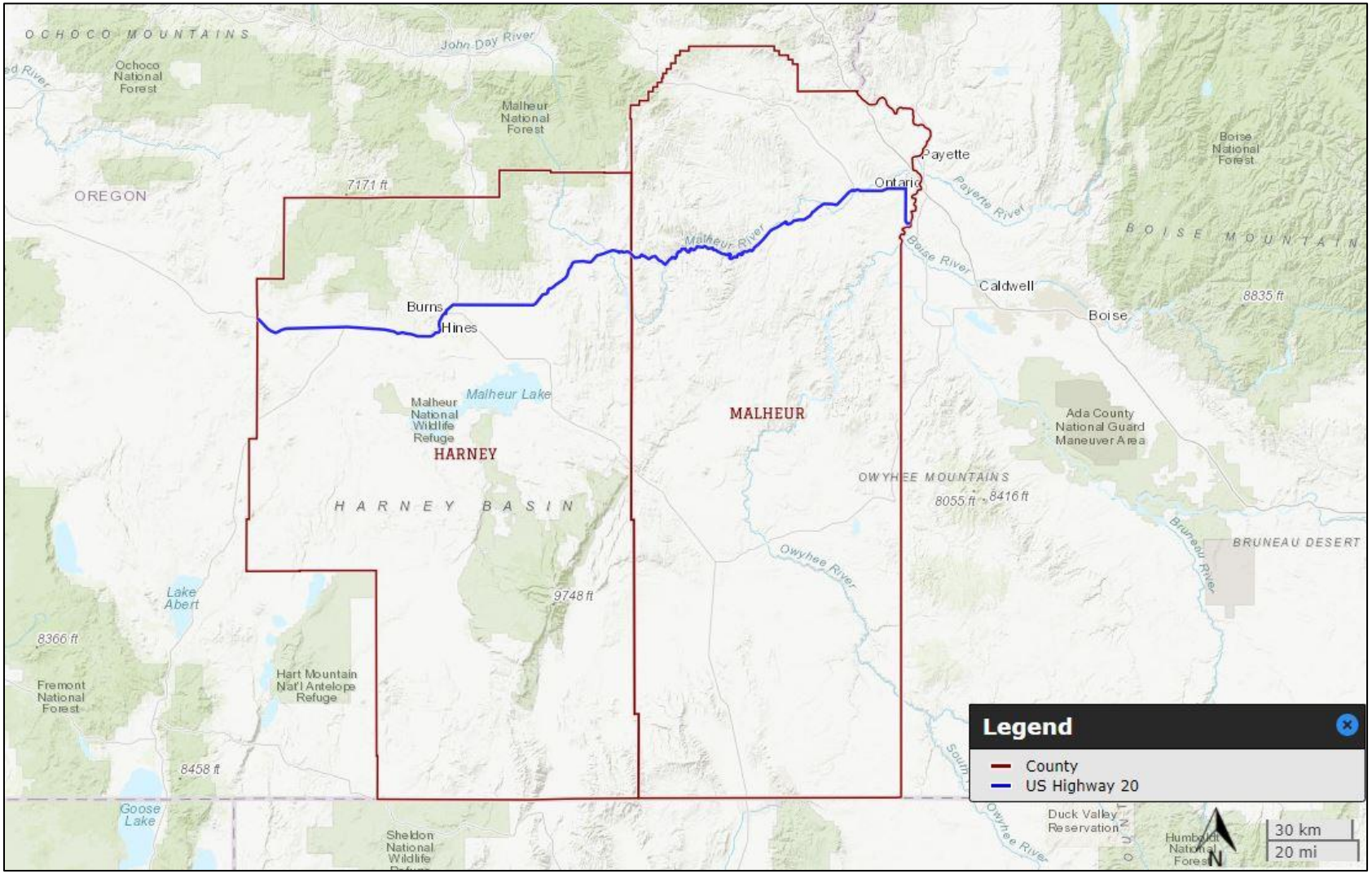



**Figure 1-1. Project Region Comprising Highway 20 through Harney and Malheur Counties (Study Area)**

# Ecological Importance of Wildlife Connectivity

Wildlife require the ability to move across landscapes at various scales to fulfill life history requirements they depend upon for survival. At the local scale, this movement occurs as daily movements through a home range or territory. On a larger, landscape scale, movements may take the form of long-distance migrations. Wildlife migration is the movement of species to and from different environments, typically occurring seasonally in response to changing availability of resources (Soule and Gilpin 1991). Migration is important for many species of fish, birds, mammals, and insects, and is even important for plant species to ensure genetic interchange, propagule dispersal (e.g., seed, pollen, and spore), and colonization of new habitats. Wildlife migration may occur seasonally or in response to habitat disturbance or habitat loss because species must move to colonize new regions. Migration allows species to access essential resources required to sustain their life cycles and to access conditions favorable for their survival. Additionally, when species seasonally migrate, they are typically following seasonal fluctuations in resource availability, such as food and water. Daily movements may occur when food, water, breeding areas, or other resources are dispersed across a landscape, requiring regular movement between resources to sustain populations.

Ungulates, such as deer and elk, often have distinct summer and winter ranges, connected by migration corridors that offer fresh vegetation and opportunities for rest during the long migration between ranges. These species will use the same migration corridors year after year. The corridor routes are learned by the young as they are demonstrated by the adults of each generation. For birds, flyways such as the Pacific Flyway are important migration corridors that provide forage and resting opportunities on the long migration between summer and winter ranges. Once animals reach their destinations (summer or winter range), they continue to require the ability to move on local scales to access vital ecological resources across the landscape,—such as food, water, and shelter—to ensure survival before they begin their migrations once again. Migration corridors and seasonal range habitats are essential to sustaining and conserving the many species that summer, winter, and migrate to and through the study area. If these important habitats become fragmented, access to migration routes, stopover habitats, destination habitats, and resources critical for survival may become difficult or dangerous for species to access.

While fragmentation poses the immediate problem of limiting species' access to resources—such as food, water, shelter, and destination winter range—it is also problematic on a landscape scale. Fragmentation results in habitat degradation and loss, impaired and precluded species movement and genetic exchange, reduced ecosystem resiliency, and reduced potential for both wildlife and plant species to adapt to climate change or other perturbations by limiting or precluding movement ability in response to changing conditions (Fischer and Lindenmayer 2007). Because fragmented landscapes result in reduced wildlife access to critical resources, species population declines can ensue. For areas fragmented by roads and highways, these effects are exacerbated by wildlife mortality caused by WVCs.

Simply stated, without access to essential resources and safe, unimpeded movement across a species range, populations will struggle to thrive, fail to adapt to changing conditions, and suffer from potentially significant declines. Ensuring both local and landscape-level connectivity is a critical step to ensuring sustainable wildlife populations and habitats and maintaining overall ecosystem health.

# Known Wildlife Connectivity Challenges

The most conspicuous wildlife connectivity issue in the study area is the substantial number of mule deer-vehicle collisions. Because of this, many of the wildlife movement studies that have been conducted to date in the region have focused on mule deer, although movement of other ungulates, such as pronghorn, have also been studied in the region. The section below summarizes previous studies relevant to wildlife movement in the study area.

## Mule Deer Movement and Mortality

In 2016, prompted by a high number of mule deer-vehicle collisions and a declining mule deer population, the Burns Paiute Tribe (Tribe) began researching and compiling data on mule deer movement, habitat use, road crossings, and vehicle collisions to better understand mule deer movement and vehicle collisions in and near the Tribe's Malheur River Wildlife Mitigation Site. Their research identified areas with concentrated mule deer habitat use that are bisected by Highway 20 (BPT 2016). Their study identified at least 387 mule deer-vehicle collisions recorded over a 7-year period in the Malheur River Wildlife Mitigation Site area alone, almost 90% of which occurred during the fall and winter months when mule deer were occupying the region as part of their winter range (BPT 2016). Collected mule deer collar data indicated that the number of deer-road crossings were variable with deer crossing Highway 20 as many as 370 times (BPT 2016). Data also indicated that most of the mule deer road crossings occurred between midnight and in the early morning hours of fall and winter months when it was more likely to be dark and icy, resulting in more limited visibility and more risky road conditions (BPT 2016). Additionally, areas with the highest mule deer road crossings coincided with areas experiencing high mule deer vehicle collisions (BPT 2016).

This study identified that the high numbers of WVCs in this region have resulted in *roadkill hotspots,* which are locations experiencing high concentrations of non-random WVCs. The most conspicuous WVCs in the region are of collisions with mule deer. In addition to the wildlife risk, these collisions pose a risk for humans as WVCs may result in human injury or fatality.

The study estimated that costs of deer-vehicle collisions along the 3-mile stretch of Highway 20 in the Malheur watershed exceeded $1 million annually. This study culminated in important findings supporting an enhanced understanding of the important conservation and road safety issues facing the region. It also initiated further investigations and interest in studying this issue in greater depth and exploring mitigation options to reduce mule deer-vehicle collisions and improving wildlife connectivity. A story map of the 2016 study can be found at the following link: https://www.arcgis.com/apps/MapJournal/index.html?appid=a5edb30ef896495fa849cbe5690d455c%20.

## Wildlife Passage Assessment

In December 2016 the Tribe convened an on-site meeting with local and regional staff from ODFW and ODOT, discussions from that meeting outlined the need to further study the existing bridges for their retrofit potential. ODOT staff indicated that if retrofits to structures could be identified these wildlife passage upgrades could be integrated into Oregon's transportation maintenance plans. In 2017, the Tribe conducted a wildlife passage assessment (WPA) study along a portion of Highway 20 in Malheur County in response to a substantial number of deer-vehicle collisions occurring in the region. The study (found in Appendix A) was conducted by Tribal staff and reviewed by staff from

the Oregon Department of Transportation (ODOT) and the Oregon Department of Fish and Wildlife (ODFW). This local- and landscape-level study assessed the ability of Highway 20 to facilitate deer movement, identified potential barriers to deer movement (such as roads, undersized culverts and bridges, or other developments), and identified connectivity enhancement measures (including retrofit potential on existing bridges) that could improve connectivity and remediate existing wildlife movement barriers.

Following the findings from the 2016 and 2017 studies, the Tribe and other partners and stakeholders recognized that the next step in the assessment process was to conduct a landscape-level wildlife connectivity assessment and identify feasible connectivity enhancement measures in the region. Enhancing connectivity would benefit the diverse assemblage of species, habitats, and ecosystem function in the region, as well as improve public safety.

# Mule Deer Population Declines

The outcome of historic land use, ownership, and management changes, the spread of invasive annual grasses and concurrent increase in fire return intervals in the rangelands of eastern Oregon have caused a decline in the amount, quality, and spatial pattern of habitat for some wildlife, such as mule deer. Mule deer are an iconic species in the West. To the Tribe, mule deer are important both for their intrinsic cultural value, and as an important source of game. Mule deer populations are in decline throughout their range. The study area serves as important winter range for mule deer populations in the area. In the Malheur River and Beulah Wildlife Management Units, which are the two units adjacent to the Malheur River corridor along Highway 20, mule deer population estimates have marked 20–40% declines in the last 4 years (ODFW 2020). Mule deer are valued by Tribal, state, and federal managers and their winter range requirements have often been at the center of the land use change debates. It is the Tribe's policy to endeavor to protect all species that have cultural, medicinal, food, traditional, or religious significance to the Tribe. The Tribe makes the protection and preservation of these threatened natural and cultural resources a priority and supported this study with the intent of reversing or stabilizing declining wildlife populations on and around the Malheur River Wildlife Mitigation Site, which is owned and operated by the Tribe.

The ongoing habitat degradation which may be exacerbated by detrimental climate trends in the area, high rate of wildlife-vehicle collisions, and the significance of this location to the Tribe reinforce the importance of addressing habitat fragmentation and WVCs in the region. This along with the previous studies described above, resulted in the development of this feasibility study to further investigate and action plan around feasible solutions to conserve native wildlife populations.

Chapter 2
# Wildlife Connectivity Assessment

# Methods

ICF biologists conducted a landscape-scale wildlife connectivity assessment (WCA) to evaluate existing wildlife and habitat connectivity conditions in the study area. The WCA involved assembling available data and information related to wildlife movement and to assess the status of wildlife movement, mortality, and barriers for wildlife movement in the study area. The WCA also assessed the state of connectivity for ungulates, with a focus on mule deer, and identified areas of constrained ungulate connectivity. The WCA gathered data and information from a variety of sources including existing reports, field assessments, wildlife tracking/movement data, WVC data, and geographic information system (GIS) data including habitat and vegetation mapping and land use and land ownership data. The biologists compiled and analyzed the data to elucidate the wildlife and habitat connectivity conditions in the study area and inform mitigation planning.

The WCA results facilitated identification of focal areas within the study area where wildlife road crossing events, WVCs, and animal-related vehicle crashes are highest and where facilitating safe connectivity is the highest priority. The WCA findings also facilitated and supported substantive discussions and collaboration among agencies and stakeholders in a series of three workshops (Chapter 3, *Workshops and Facilitation*) where participants were introduced to the WCA methodology and results, and their feedback was gathered to collaboratively develop a vision for wildlife and habitat connectivity enhancement in the study area.

The WCA evaluated the portions of Highway 20 within both Harney and Malheur Counties (see Study Area in Figure 1-1).

## Data Compilation and Review

The data and imagery reviewed as part of the WCA included the following information.

- Google Earth and satellite imagery
- Critical habitat
- State wildlife habitat, linkages, and priority areas
- Protected areas and Areas of Concern
- National Hydrography Dataset
- WVCs and crashes
- Wildlife global positioning system (GPS) collar movements and ranges
- Fish passage barriers
- Existing (as-built) culverts and structures
- Traffic volume

- Land use
- Land ownership
- Past Tribe WCAs and reports

Data that were spatially processed and analyzed as part of the WCA include WVCs, animal-related vehicle crashes, and ungulate GPS collar data (Table 2-1). WVC data were analyzed as the number of collisions per mile resulting in a data layer depicting the density of WVCs per mile. Animal-related crash data were analyzed as the number of animal-related crashes per mile resulting in a data layer depicting the density of animal-related crashes per mile. Mule deer and pronghorn GPS collar data were analyzed to identify consecutive pairs of GPS points that crossed Highway 20 resulting in data layers depicting the density of mule deer and pronghorn road crossings per mile, respectively.

**Table 2-1. Wildlife-Vehicle Collision, Animal-Related Vehicle Crash, and Wildlife Collar Data Analyzed as Part of the WCA**

| Data Name | Data Description | Data Source |
|---|---|---|
| Wildlife-vehicle collisions | Description: This dataset represents carcasses removed from Oregon State Highways by ODOT maintenance crews over a 10-year period. Animals that were struck but died off-roadway and animals that died on county, city, and federal roadways are not included in this dataset.<br>File Name:<br>AnimalCollisions_Dispatch_Harney_Malheur_2010_2019 | ODOT |
| Reported wildlife crashes | Description: Animal-related vehicle crashes that were reported to the DMV for the years 2007-2017. This dataset is based on driver and/or police reports collected by the DMV. It includes crashes that occurred on county and city roadways, as well as on Oregon state highways.<br>File Name:<br>AnimalRelatedCrashes_DMV_2007_2017 | ODOT |
| Mule deer collar data | The purpose of this project is to mark mule deer with GPS-capable radio collars in order to define herd ranges for mule deer population segments in eastern Oregon, and to determine annual adult survival within those herd ranges. Herd ranges are an important biological parameter that frame population modeling efforts and, by extension, management of the species. This project is part of a multiyear effort. The standard procedure has been to mark deer in an area at a rate of 1 collar per 185–200 mule deer estimated population and use the knowledge gained from that effort to supplement marks and fill gaps in distribution in subsequent capture efforts. During Phases I and II of this project (Federal Aid in Wildlife Restoration Project #ORF14AF00690 and OR15AF00801,) we marked mule deer in the Blue Mountain zone of eastern Oregon. Phase II included extending the project area to all portions of Oregon east of Interstate 84 during the winter of 2015–16 and returning to the Blue Mountain zone to fill in data gaps during the winter of 2016–17. Phase III (ORF17AF00585) filled gaps in a small portion of the Phase 1 and Phase II areas and expanded to new areas in eastern Oregon to continue to | ODFW |

| Data Name | Data Description | Data Source |
|---|---|---|
| | define biological herd ranges. Phase IV will gain fill gaps from the Phase III area and expand to sections of southeast Oregon. | |
| Antelope collar data | The objectives of this study are to:<br>• Identify specific seasonal pronghorn distribution and ranges in southeastern Oregon.<br>• Identify location and timing of pronghorn migration corridors in southeastern Oregon.<br>• Identify potential barriers to pronghorn migration and movement in southeastern Oregon.<br>This basis of the study will be deployment of Iridium-based GPS telemetry collars. A total of 110 GPS/Iridium collars will be deployed via helicopter net gun capture during November and December. Location data will be remotely monitored by ODFW staff. ODFW District wildlife staff will recover collars from any mortalities as quickly as workloads allow. ODFW personnel will conduct analyses with potential consultation with USGS research staff. | ODFW |
| Mule deer collar data | The purpose of this project was to mark mule deer with GPS-capable radio collars in order to define herd ranges and seasonal migrations for mule deer population segments in the Malheur River Watershed near the Malheur River Wildlife Mitigation Site. These data provide locations of 31 adult female mule deer GPS collared by the Burns-Paiute Tribe from 2010-2013. Primary winter range for these deer is bisected by Highway 20.. | Burns Paiute Tribe |

ODOT = Oregon Department of Transportation; DMV = Oregon Department of Motor Vehicles; GPS = global positioning system; ODFW = Oregon Department of Fish and Wildlife; USGS = U.S. Geological Survey

## Data Mapping

The above data were compiled into an ICF WayPoint™ web map where data were explored and assessed as part of the WCA. The ICF WayPoint™ web map may be accessed at the following link using the following login credentials.

Website: https://ecosystems.azurewebsites.net/Login/?ReturnUrl=%2fBurns_Paiute%2f

Username: Highway20_WCA

Password: Highway20

# Results

## Wildlife-Vehicle Collisions (Carcass Data)

In Harney and Malheur Counties, Highway 20 experiences the highest rates of WVCs over any other highway in the region. Approximately 58% of all WVCs in Harney and Malheur Counties occurred on Highway 20 (Figure 2-1), despite the highway only accounting for approximately 54% of the total highway mileage in the two counties (ODOT 2020). Within Harney and Malheur Counties, on average per day, there were more WVCs on Highway 20 than all other highways combined during the 2010–2019 period (Figure 2-2).

Highway 20 is a substantial source of wildlife mortality, particularly in Malheur County, with consistently higher WVCs in Malheur County than Harney County, year by year from 2010–2019 with Malheur County experiencing 38% more WVCs than Harney County. The annual number of WVCs, as determined by carcass removals recorded along Highway 20 in Malheur and Harney Counties (Figure 2-3), ranged from a low of 151 in 2019 to a high of 330 in 2012 (Table 2-2 and Figure 2-4), with approximately 31% (782) occurring in Harney County and 69% (1,732) occurring in Malheur County.

Approximately 95% (2,400 of 2,514) of all WVCs recorded on Highway 20 in Harney and Malheur Counties from carcass removal data involved mule deer (92% in Harney County and 97% in Malheur County). The next highest proportions of WVCs involved elk (2%), large farm animals (1%), and domestic pets (1%). Antelope, small farm animals, small wildlife species such as birds, and cougars each made up less than 1% of all WVCs (Table 2-3 and Figure 2-5).

Total WVCs by milepost in Harney and Malheur Counties, as recorded by carcass removals, are shown in Figure 2-6. To identify hotspots, WVCs by milepost were compared to the mean number of WVCs per milepost (13.7), the mean plus one standard deviation (27.5), the mean plus two standard deviations (41.2), and the mean plus 3 standard deviations (55.0). Peak hotspots that had WVCs more than two standard deviations above the mean occurred at milepost 128 and milepost 130 in Harney County and at mileposts 197–201, 204/205, and 225/226 in Malheur County.

When WVC data from 2010 through 2019 were evaluated for seasonal patterns, WVCs appeared to shift along Highway 20. A large proportion of total WVCs occurred to the east in winter, a more even distribution across the highway occurred in spring, a larger proportion of total WVCs occurred to the west in summer, and a bimodal distribution occurred in autumn (which mirrored the annual total pattern most closely). Overall, WVCs were substantially highest in fall and winter, followed by summer and spring (Figure 2-7). The highest numbers of WVCs in Malheur County occurred in the fall and winter seasons, with substantially less occurring in spring and summer. Within Harney County, the most WVCs occurred in fall, followed by summer, with substantially less occurring in winter and spring (Figure 2-7 and Figure 2-8).

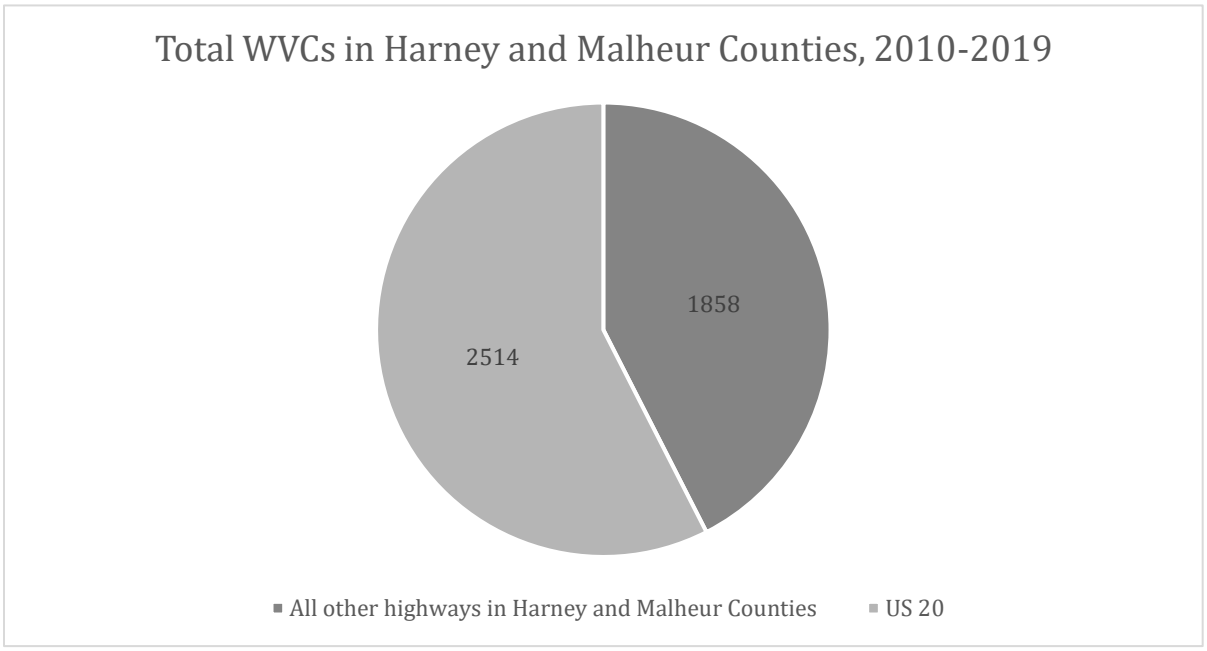



**Figure 2-1. Total Number of WVCs on Highway 20, as Recorded By Carcass Removals, Compared to All Other Highways in Harney and Malheur Counties, 2010–2019**

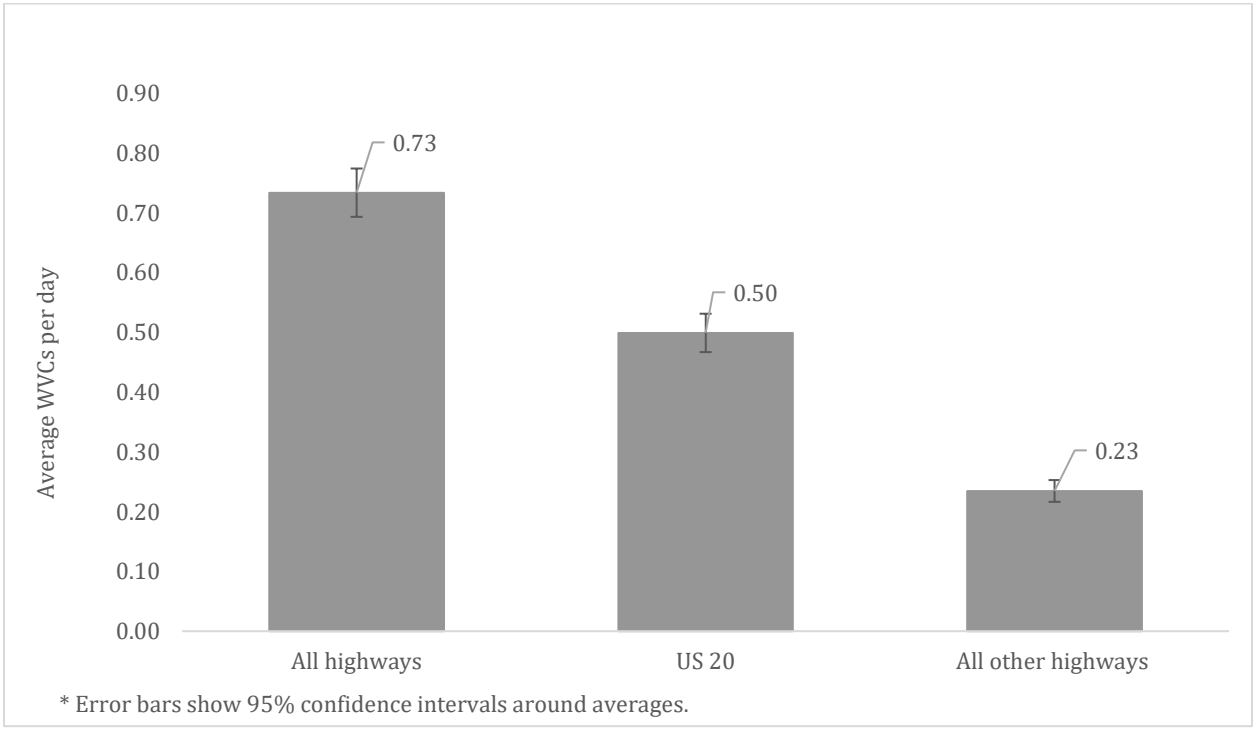



**Figure 2-2. Average Number of WCVs per Day on Highway 20, as Recorded By Carcass Removals, Compared to All Other Highways in Harney and Malheur Counties, 2010–2019**

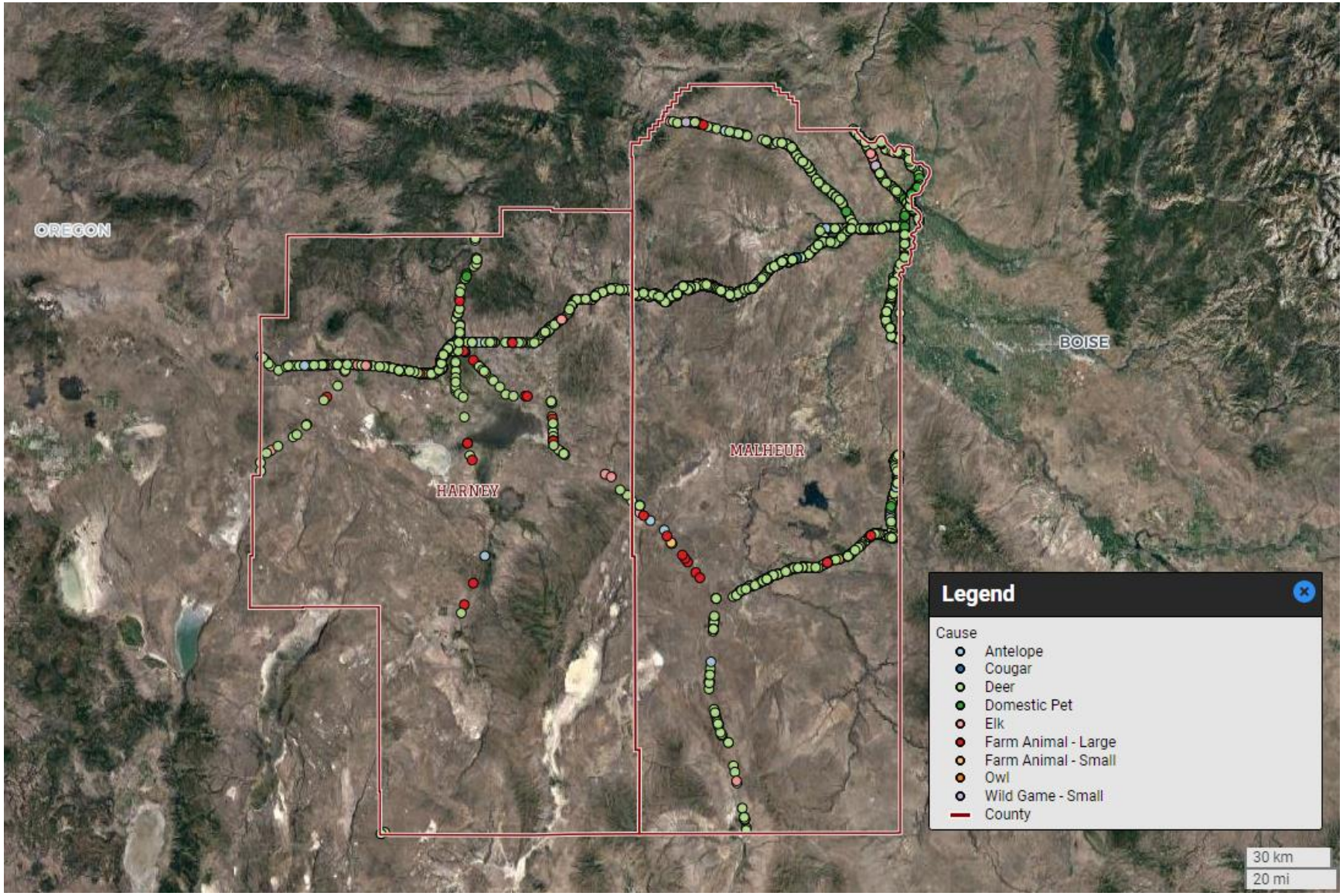



**Figure 2-3. WVC Carcasses Recorded in Harney and Malheur Counties, 2010–2019**

**Table 2-2. Number of WVC Carcasses Recorded in Harney and Malheur Counties between 2010 and 2019**

| | WVC Carcasses Recorded | | |
|---|---|---|---|
| **Year** | **Harney** | **Malheur** | **Grand Total** |
| 2010 | 93 | 192 | 285 |
| 2011 | 66 | 217 | 283 |
| 2012 | 95 | 235 | 330 |
| 2013 | 60 | 178 | 238 |
| 2014 | 94 | 173 | 267 |
| 2015 | 70 | 141 | 211 |
| 2016 | 82 | 214 | 296 |
| 2017 | 92 | 181 | 273 |
| 2018 | 77 | 103 | 180 |
| 2019 | 53 | 98 | 151 |
| **Total** | **782** | **1,732** | **2,514** |

**Table 2-3. WVCs on Highway 20 in Harney and Malheur Counties, as Reported by Carcass Removals, by Season and Animal Type, 2010–2019**

| | Harney County | | | | | Malheur County | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Row Labels** | **Autumn** | **Spring** | **Summer** | **Winter** | **Subtotal** | **Autumn** | **Spring** | **Summer** | **Winter** | **Subtotal** | **Grand Total** |
| Deer | 298 | 98 | 220 | 107 | 723 | 732 | 152 | 164 | 629 | 1,677 | 2,400 |
| Antelope | | 1 | 2 | 2 | 5 | | 1 | | 1 | 2 | 7 |
| Elk | 17 | 4 | 6 | 1 | 28 | 5 | | 5 | 3 | 13 | 41 |
| Domestic pet | 3 | 2 | 1 | 2 | 8 | 6 | 4 | 1 | 2 | 13 | 21 |
| Farm animal - large | 3 | 3 | 4 | 1 | 11 | 7 | 5 | 5 | 3 | 20 | 31 |
| Farm animal - small | 1 | | | | 1 | 1 | | 2 | | 3 | 4 |
| Cougar | | | | | | | 2 | | | 2 | 2 |
| Wild game - small | 1 | 1 | 3 | 1 | 6 | 2 | | | | 2 | 8 |
| **Total** | **323** | **109** | **236** | **114** | **782** | **753** | **164** | **177** | **638** | **1,732** | **2,514** |

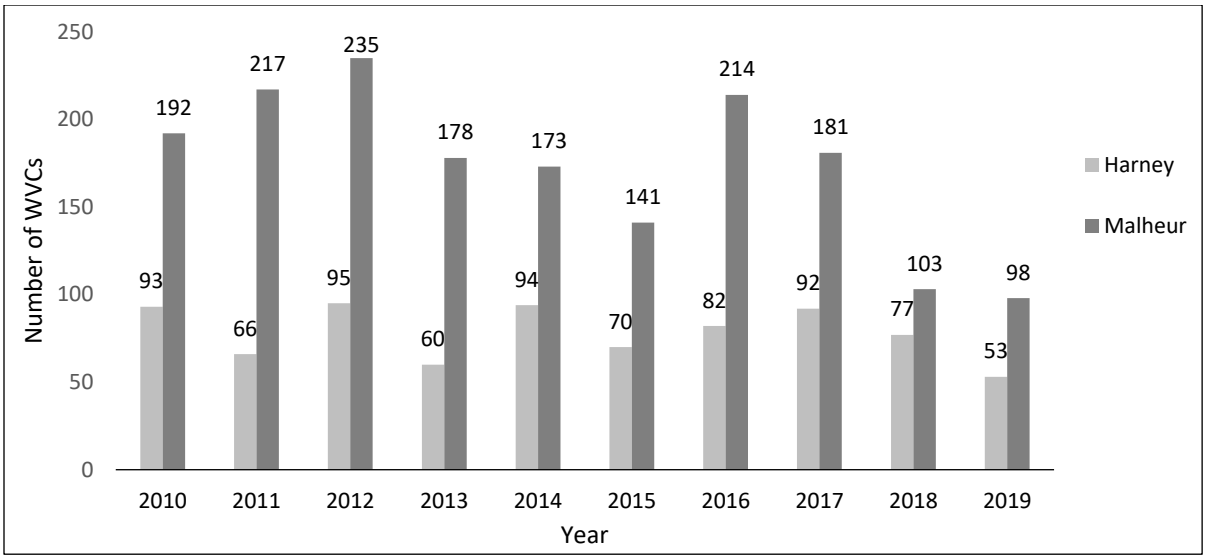



**Figure 2-4. Total WVCs on Highway 20, as Recorded by Carcass Removals, by County and Year, 2010–2019**

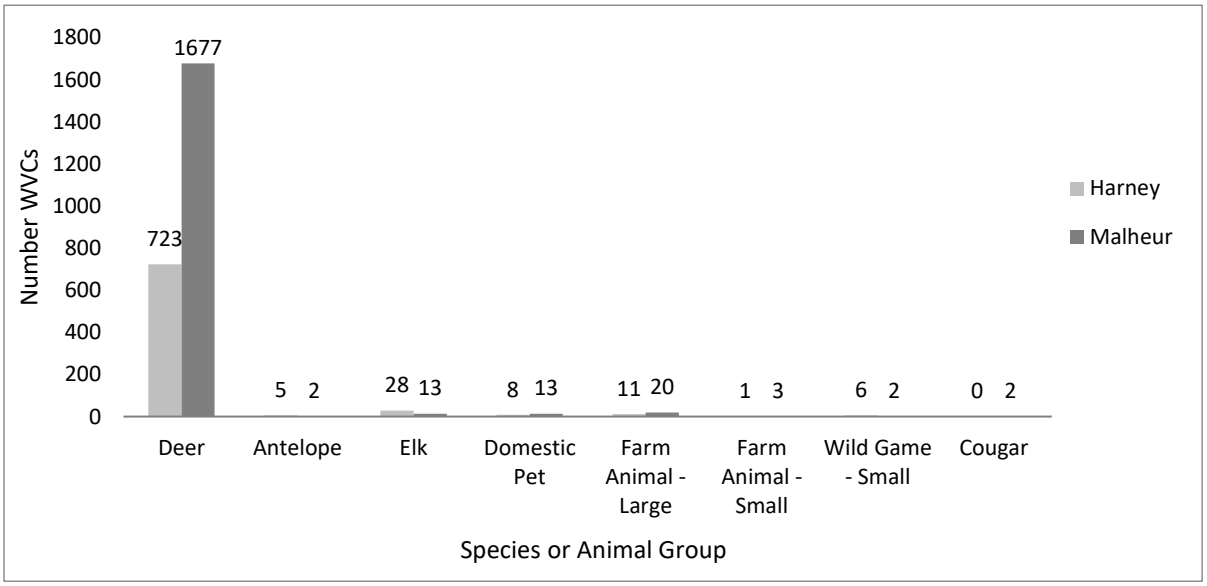



**Figure 2-5. Total WVCs on Highway 20, as Recorded by Carcass Removals, by Species or Group and County, 2010–2019**

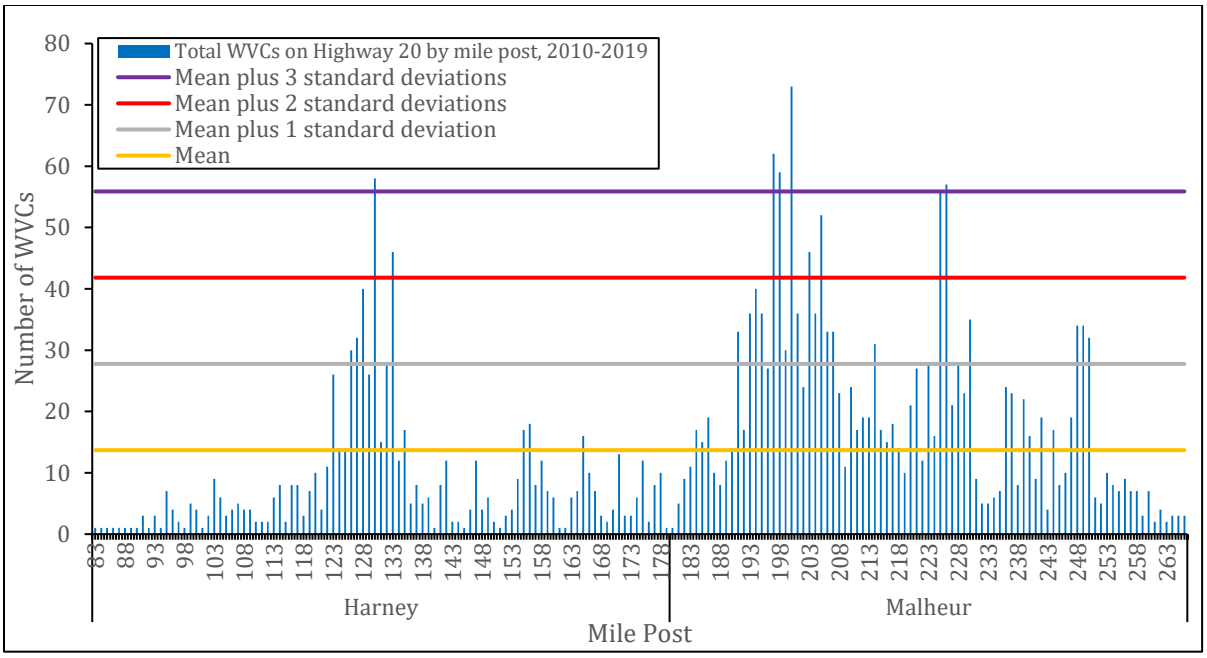



**Figure 2-6. Total WVCs on Highway 20, as Recorded by Carcass Removals, by Milepost and County, 2010–2019**

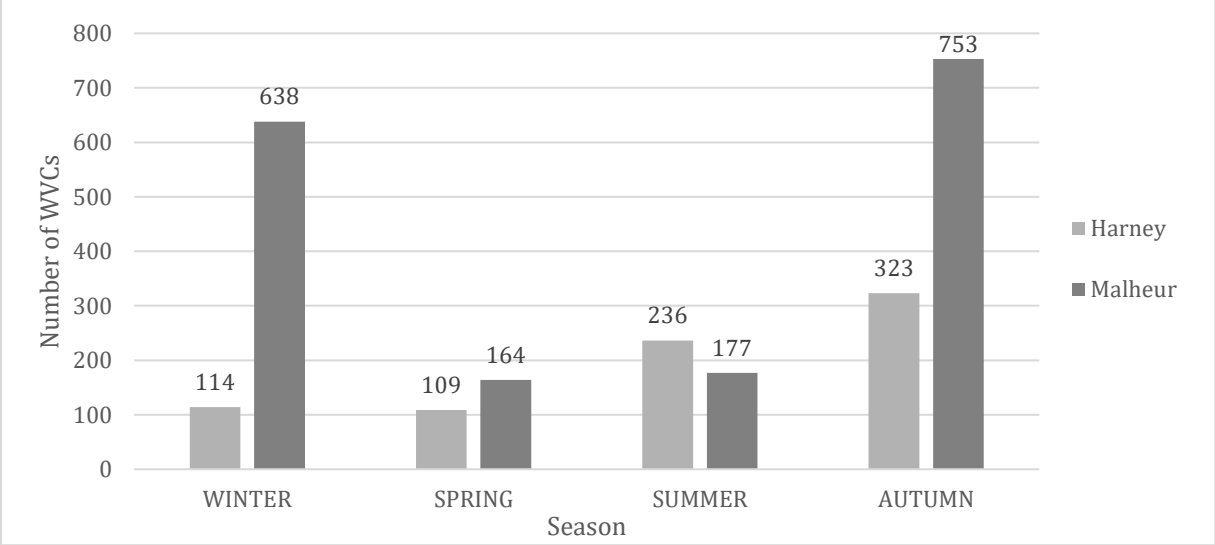



**Figure 2-7. Total WVCs on Highway 20, as Recorded by Carcass Removals, by Season and County, 2010–2019**

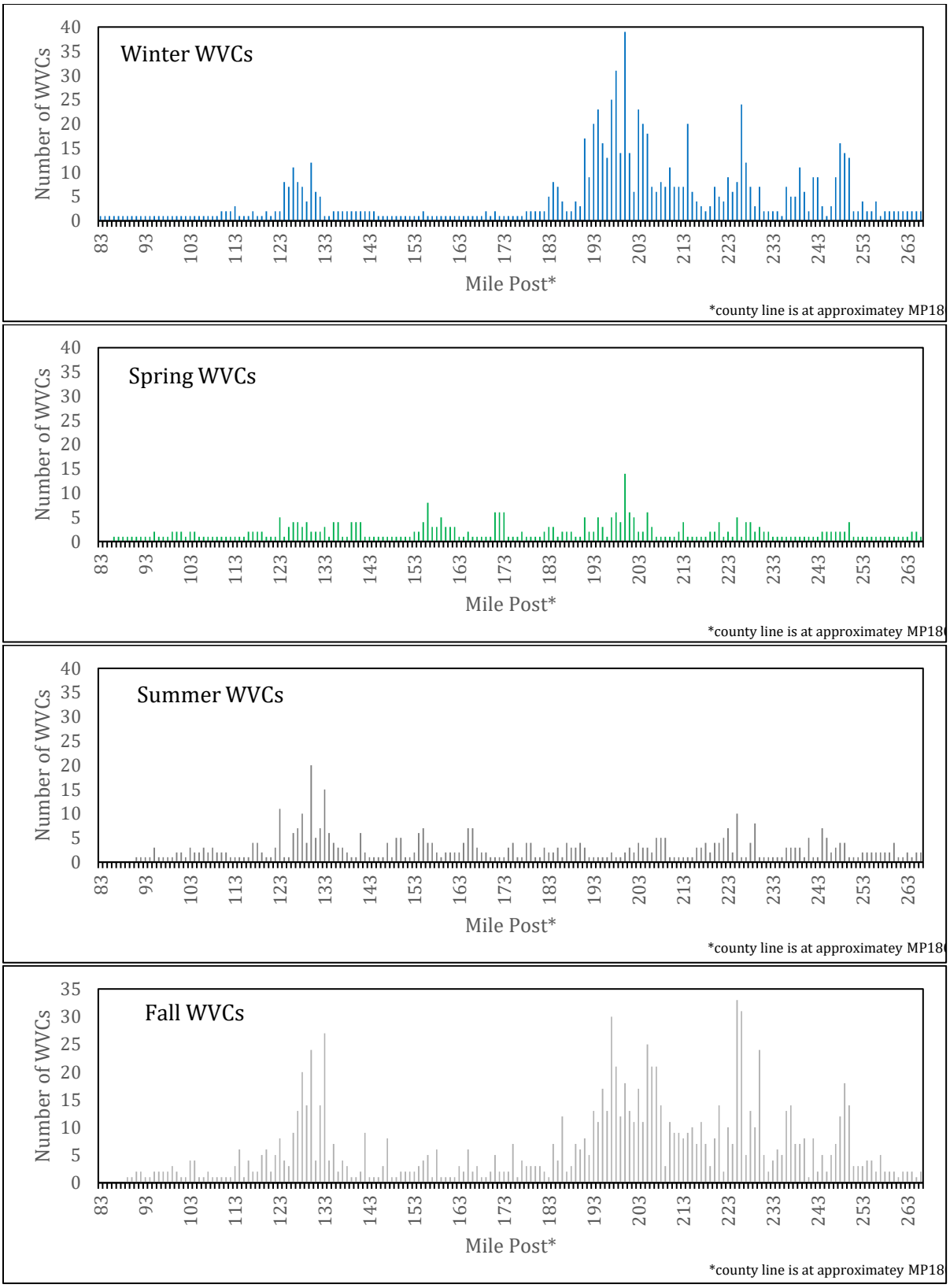



**Figure 2-8. Total WVCs on Highway 20, as Recorded by Carcass Removals, by Milepost, in Winter, Spring, Summer, and Fall, 2010–2019**

# Animal-Related Crashes

Available crash data reported between years 2007 and 2018 indicate that 12–15% of all crashes in Harney and Malheur Counties are animal-related collisions (Table 2-4 and Table 2-5), while the reported national average is 5% (Huijser et al. 2008). The total number of yearly reported animal-related crashes in Harney and Malheur Counties ranged between 4 and 27 crashes, with consistently more yearly animal-related crashes reported in Malheur County (Figure 2-9). Since 2007, animal-related crashes on Highway 20 have resulted in two human fatalities, 72 human injuries, and 269 crashes with property damage only (Table 2-6, Figure 2-10). The two documented human fatalities both occurred in 2007 in Harney County, one collision involving a mule deer and one collision involving a large farm animal.

Table 2-7 and Figure 2-11 summarize the crash types of each reported animal-related crash (e.g., if a driver was attempting to swerve to avoid an animal and their vehicle overturned, the crash would be categorized as overturned). Table 2-8 and Figure 2-12 summarize the initial cause of and/or animal involved with the reported animal-related crashes (i.e., first incident or object vehicle collided with), a majority of the reported animal-related crashes were deer- or elk-related incidents. First Crash Event information is also available for reported animal-related crashes. First Crash Events are the reported first incidents, or objects, involved in the crash. In Harney and Malheur Counties, Deer/Elk and livestock were the most common reported First Crash Events in reported animal-related crashes (See Figure 13 and 14). A map depicting the distribution of animal-related crashes in the study area is provided in Figure 2-15.

The total number of cumulative monthly reported animal-related crashes on Highway 20 in Harney and Malheur Counties combined fluctuated between 14 and 61, with higher numbers of animal-related crashes reported in Fall and Winter months (see Figure 2-16) The total number of cumulative monthly reported animal-related crashes on Highway 20 in each Harney and Malheur Counties fluctuated between 5 and 22 for Harney County, and 6 and 39 for Malheur County, with more consistently higher numbers of animal-related crashes reported in Fall and Winter months for both counties (see Figure 2-17). With respect to season, for Harney and Malheur Counties combined, animal-related crashes were highest in winter and fall, followed by summer and spring (Figure 2-18 and Table 2-9). Within Harney County, most WVCs were recorded in fall, followed by summer, with substantially less recorded in winter and spring; most crashes occurred in fall and summer (Figure 2-19). Notably, summer crashes (and WVCs) are higher in Harney County. It is unknown if this is due to increased risk of summer WVCs/animal-related crashes (e.g., caused by higher traffic volumes, timing of parturition and activity of young deer, or other causes) or due to sampling bias.

**Table 2-4. Number and Percentage of all DMV-Reported Crashes and Animal-Related Crashes in Harney and Malheur Counties**

| | All Highways | Highway 20 | All Highways | Percent of All Crashes that are Animal-Related (%) |
|---|---|---|---|---|
| Year | All Crashes | Animal-Related Only | | |
| 2007 | 457 | 22 | 54 | 11 |
| 2008 | 442 | 22 | 66 | 15 |
| 2009 | 432 | 15 | 60 | 14 |
| 2010 | 505 | 22 | 69 | 14 |
| 2011 | 505 | 32 | 76 | 15 |
| 2012 | 467 | 28 | 73 | 16 |
| 2013 | 502 | 20 | 71 | 14 |
| 2014 | 575 | 26 | 76 | 13 |
| 2015 | 631 | 41 | 98 | 16 |
| 2016 | 670 | 40 | 99 | 15 |
| 2017 | 721 | 38 | 90 | 13 |
| 2018 | 537 | 37 | 83 | 16 |
| **Total** | **6,444** | **343** | **915** | **--** |

**Table 2-5. Number of Animal-Related Vehicle Crashes Recorded in Harney and Malheur Counties between 2007 and 2018**

| | Animal-Related Crashes | | |
|---|---|---|---|
| Year | Harney County | Malheur County | Total |
| 2007 | 13 | 9 | 22 |
| 2008 | 10 | 12 | 22 |
| 2009 | 4 | 11 | 15 |
| 2010 | 10 | 12 | 22 |
| 2011 | 5 | 27 | 32 |
| 2012 | 8 | 20 | 28 |
| 2013 | 8 | 12 | 20 |
| 2014 | 6 | 20 | 26 |
| 2015 | 18 | 23 | 41 |
| 2016 | 16 | 24 | 40 |
| 2017 | 18 | 20 | 38 |
| 2018 | 21 | 16 | 37 |
| **Total** | **137** | **206** | **343** |

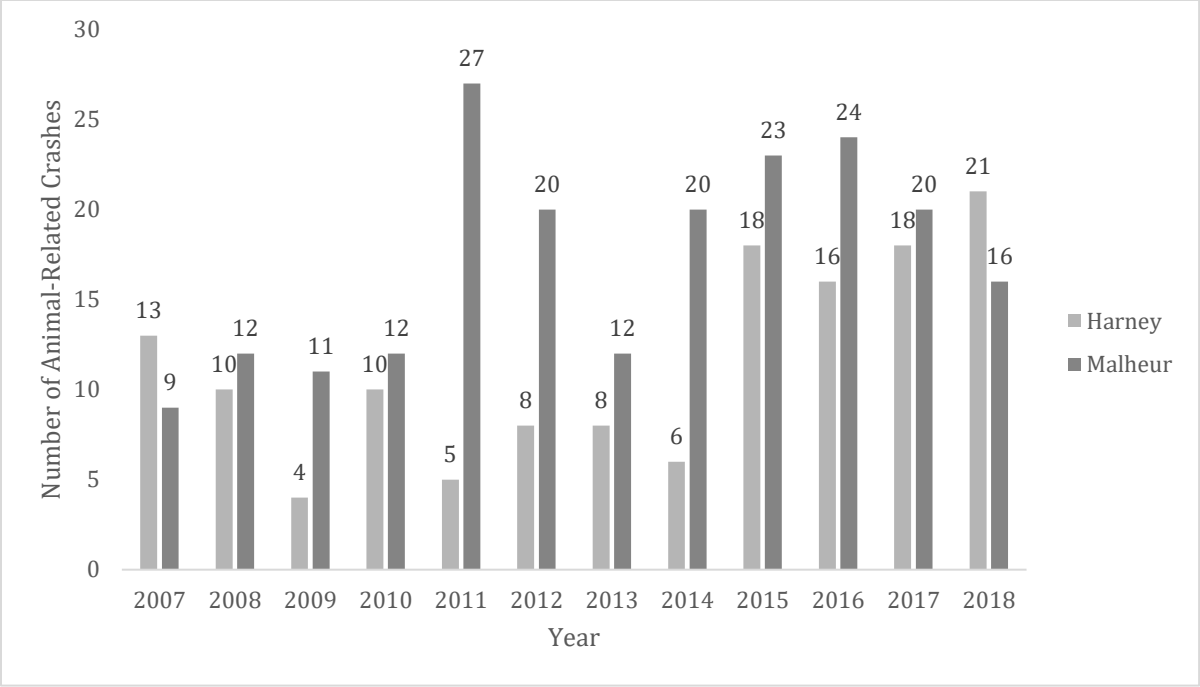



**Figure 2-9. Total Number of Reported Animal-Related Vehicle Crashes on Highway 20 in Harney and Malheur Counties Combined between 2007 and 2018**

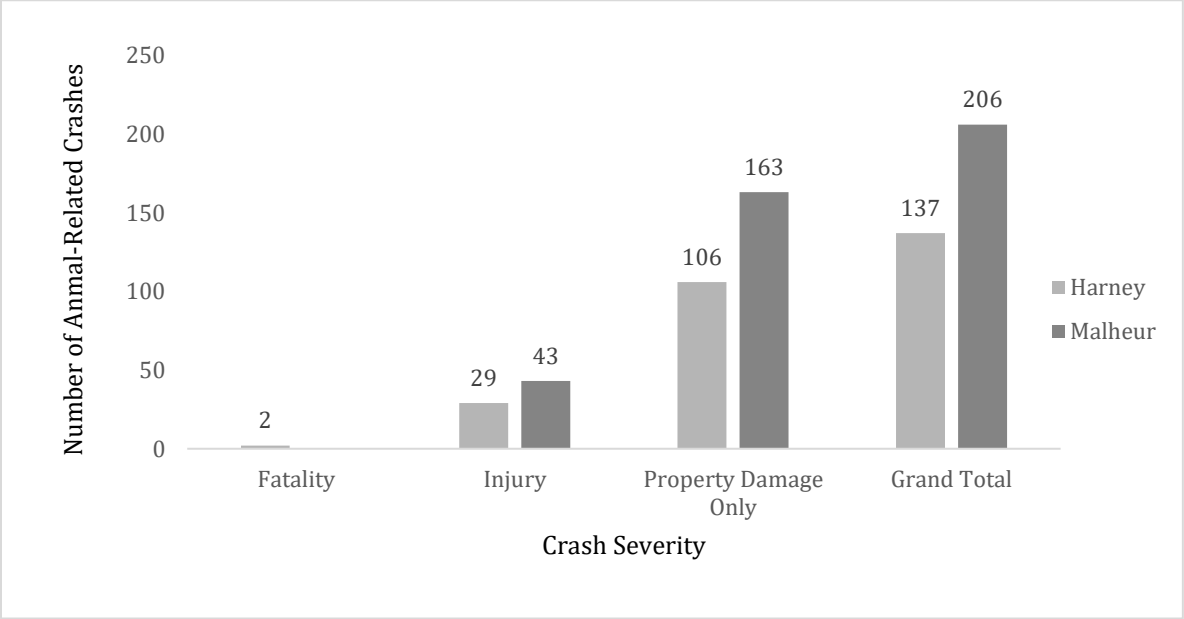



**Figure 2-10. Number of reported Animal-Related Vehicle Crashes on Highway 20 in Harney and Malheur Counties between 2007 and 2018 and Resulting Crash Severities**

**Table 2-6. Total Number of Reported Animal-Related Vehicle Crashes on Highway 20 in Harney and Malheur Counties between 2007 and 2018 as a Function of Crash Severity Category**

| Crash Severity | Harney County | Malheur County | Total |
|---|---|---|---|
| Fatalities | 2 | -- | 2 |
| Injuries | 29 | 43 | 72 |
| Property damage only | 106 | 163 | 269 |
| **Total** | **137** | **206** | **343** |

**Table 2-7. Total Number of Reported Animal-Related Vehicle Crashes on Highway 20 in Harney and Malheur Counties between 2007 and 2018**

| Crash Type[a] | Harney County | Malheur County | Total |
|---|---|---|---|
| Animal | 123 | 184 | 307 |
| Fixed object | 6 | 12 | 18 |
| Collision with vehicle opposite direction (both going straight) | -- | 1 | 1 |
| Overturned | 8 | 8 | 16 |
| Collision with vehicle same direction | | 1 | 1 |
| **Total** | **137** | **206** | **343** |

[a] Crash types not listed as Animal also involved other vehicles, resulted in an overturned vehicle, or resulted in a collision with a fixed object.

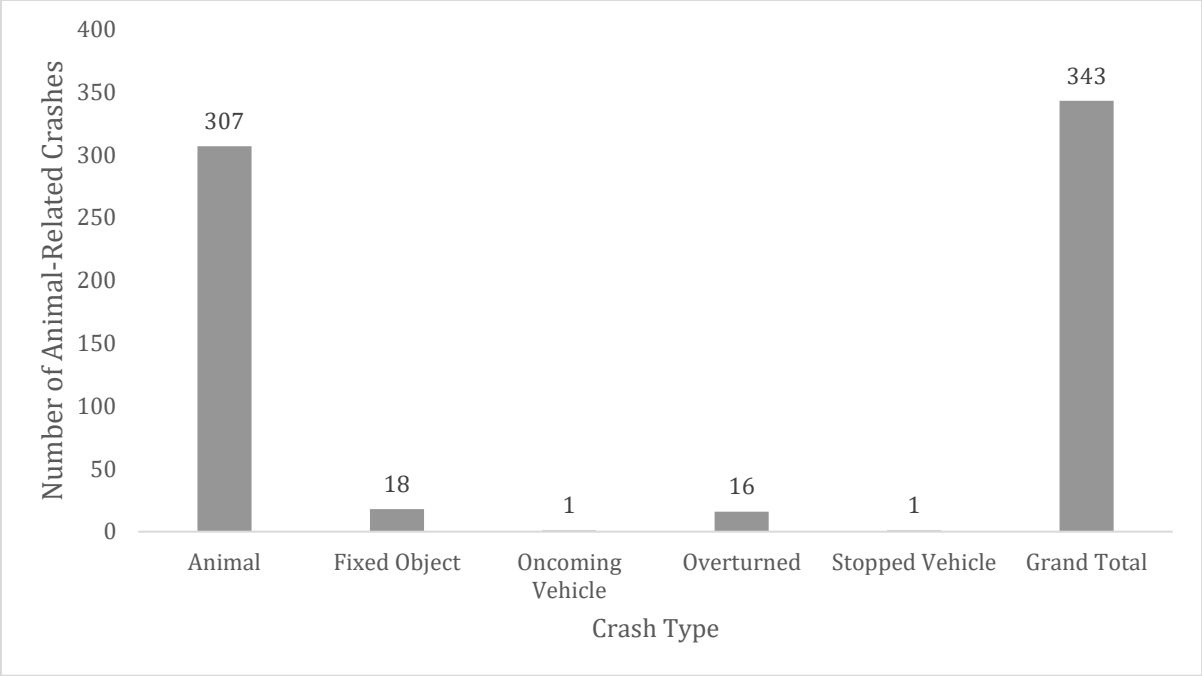



**Figure 2-11. Total Number of Reported Animal-Related Vehicle Crashes on Highway 20 in Harney and Malheur Counties Combined between 2007 and 2018**

Note: Crash types are the first harmful event that occurred in the crash. Crash types not listed as Animal were animal-related (e.g., swerving to avoid a deer collision) and either involved crashes with other vehicles (stopped, oncoming), resulted in an overturned vehicle, or resulted in a collision with a fixed object.

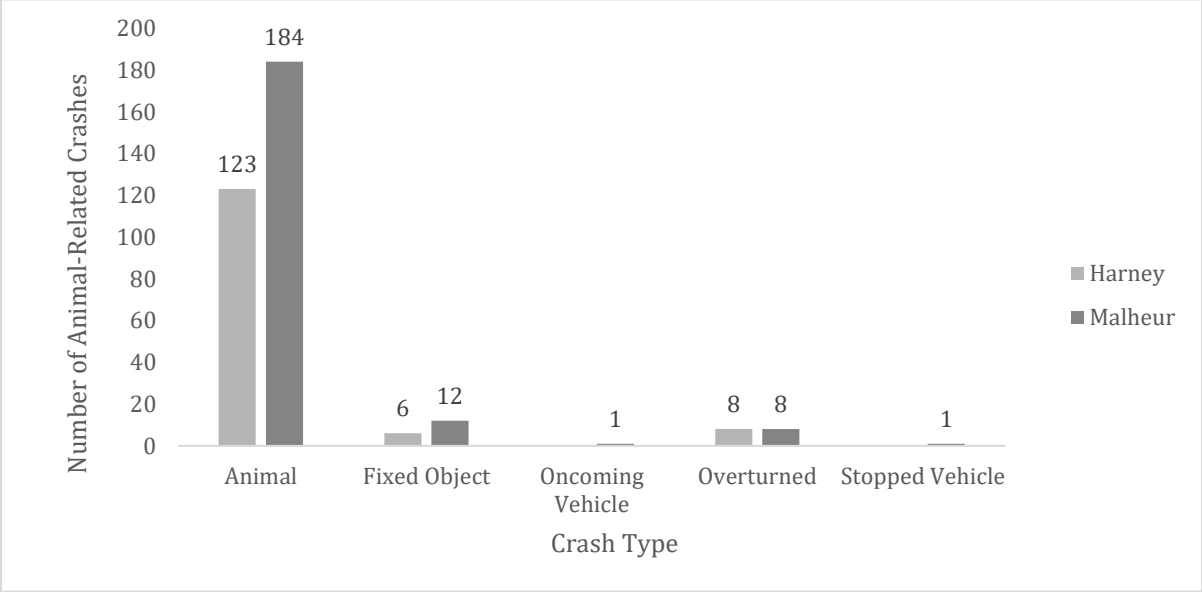



**Figure 2-12. Number of Reported Animal-Related Vehicle Crashes on Highway 20 in Harney and Malheur Counties between 2007 and 2018**

Note: Crash types not listed as Animal were animal-related (e.g., swerving to avoid a deer collision) and either involved crashes with other vehicles (stopped, oncoming), resulted in an overturned vehicle, or resulted in a collision with a fixed object.

**Table 2-8. Number of Reported Animal-Related Vehicle Crashes on Highway 20 in Harney and Malheur Counties Combined between 2007 and 2018 by First Crash Event (and Crash Severity**

| First Crash Event | Fatality | Injury | Property Damage Only | Total |
|---|---|---|---|---|
| Deer/elk | 1 | 44 | 206 | 251 |
| Ditch | -- | 5 | 4 | 9 |
| Game | -- | 1 | 3 | 4 |
| Guardrail | -- | 4 | -- | 4 |
| Horse | -- | 1 | 2 | 3 |
| Livestock | 1 | 11 | 48 | 60 |
| Marker | -- | 1 | -- | 1 |
| Pet | -- | -- | 4 | 4 |
| Pole utility | -- | 2 | -- | 2 |
| Slippery road | -- | -- | 1 | 1 |
| Snowbank | -- | 1 | -- | 1 |
| Tire fail | -- | 1 | -- | 1 |
| Unknown fixed object | -- | 1 | -- | 1 |
| Wheel off | -- | -- | 1 | 1 |
| **Total** | **2** | **72** | **269** | **343** |

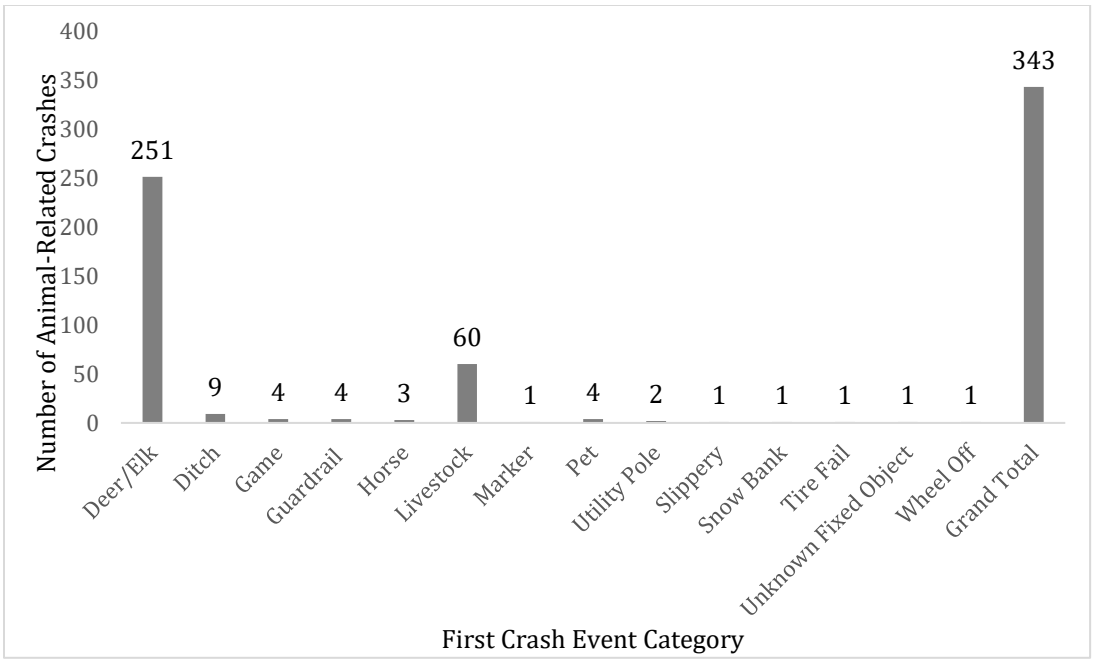



**Figure 2-13. Total Number of Reported Animal-Related Vehicle Crashes on Highway 20 in Harney and Malheur Counties Combined between 2007 and 2018 by First Crash Event Category**

Note: Crash events are incidents or situation contributing to or involved in the crash. The first crash events are the first incident, or object involved in the crash.

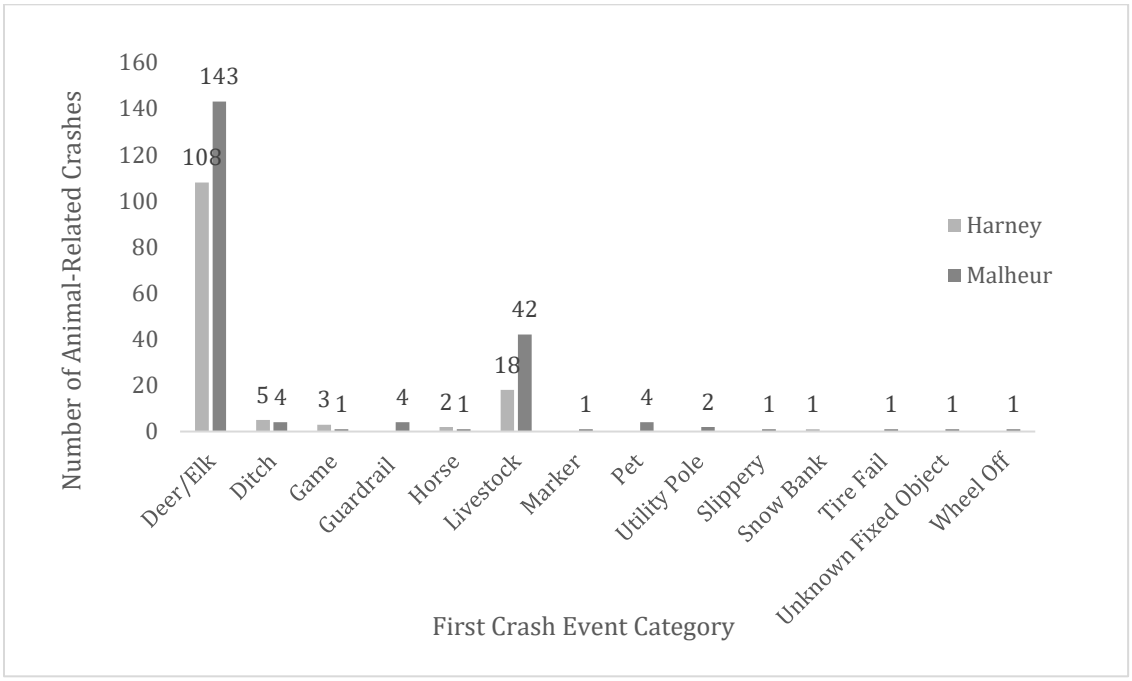



**Figure 2-14. Total Number of Reported Animal-Related Vehicle Crashes on Highway 20 in Harney and Malheur Counties between 2007 and 2018 by First Crash Event Category**

Note: The first crash events are the first incident, or object involved in the crash.

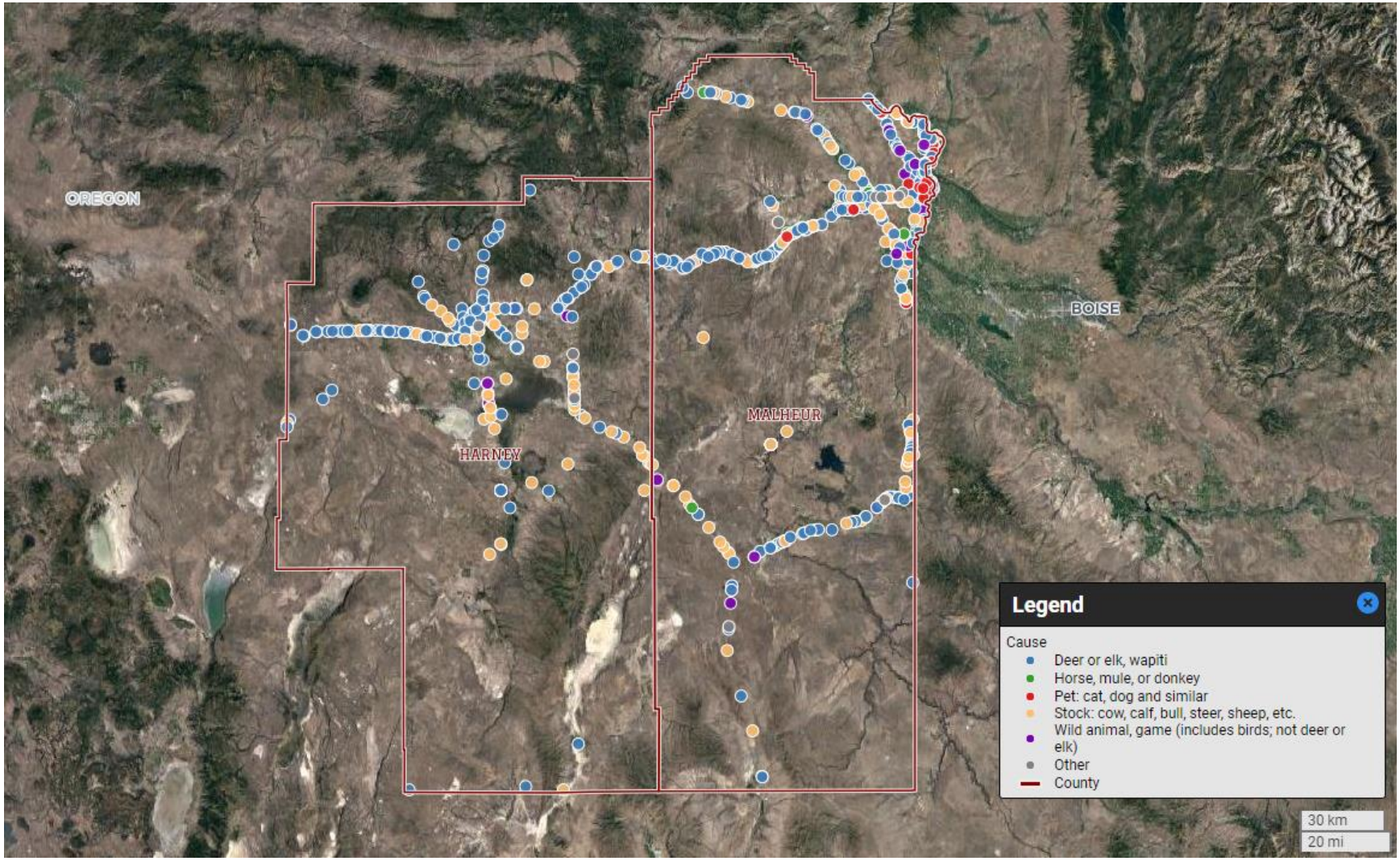



**Figure 2-15. Animal-Related Vehicle Crashes Recorded in Harney and Malheur Counties between 2007 and 2018**

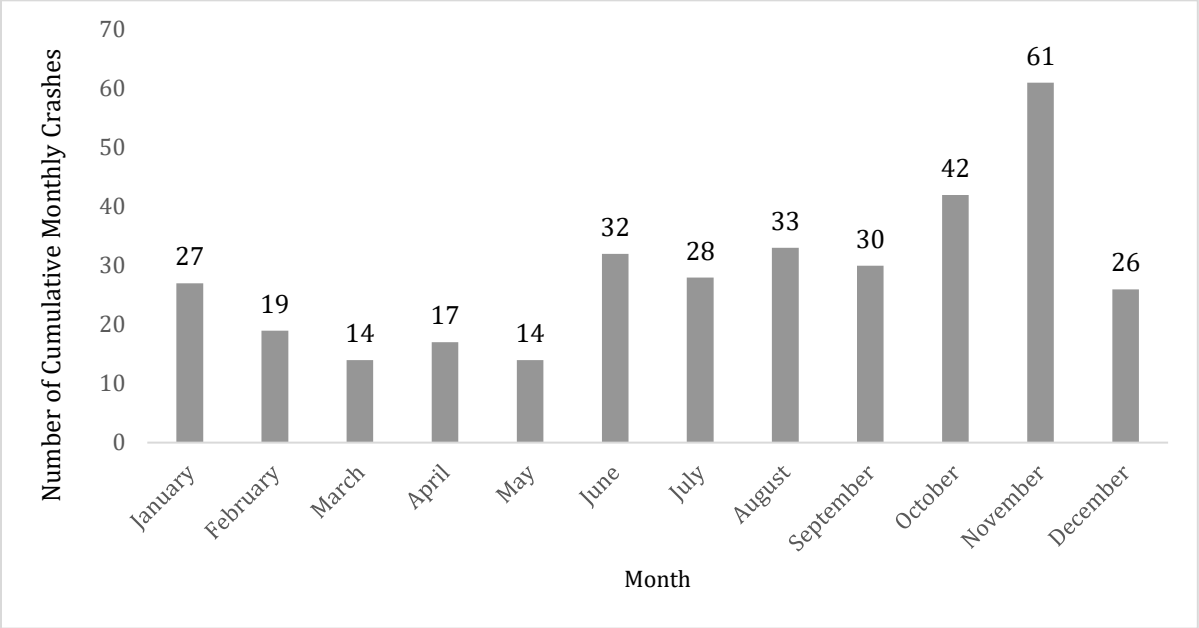



**Figure 2-16. Total Number of Cumulative Monthly Reported Animal-Related Vehicle Crashes on Highway 20 in Harney and Malheur Counties between 2007 and 2018**

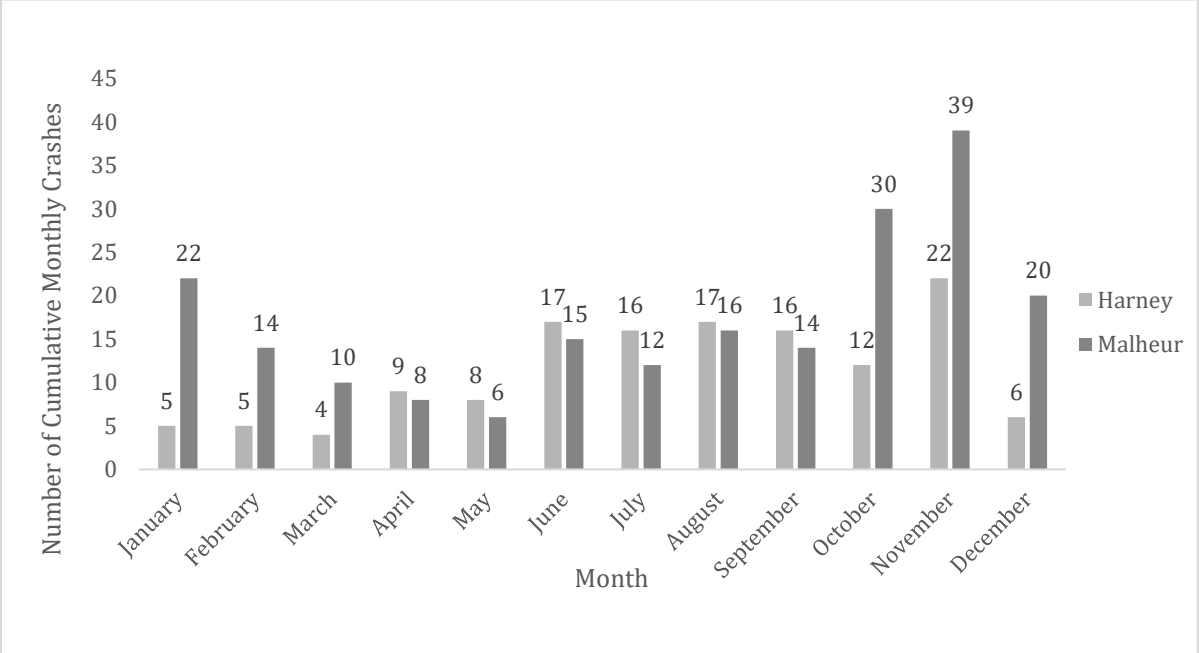



**Figure 2-17. Number of cumulative Monthly Reported Animal-Related Vehicle Crashes on Highway 20 in Harney and Malheur Counties between 2007 and 2018**

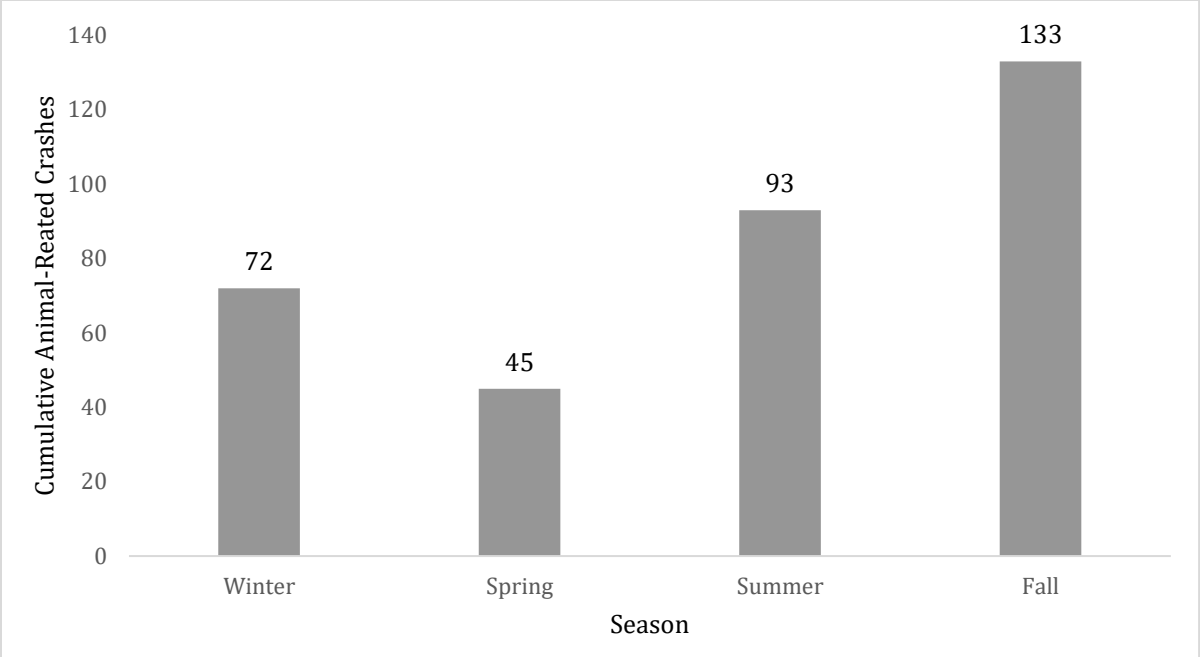



**Figure 2-18. Cumulative Sum Seasonal Number of Reported Animal-Related Vehicle Crashes on Highway 20 in Harney and Malheur Counties between 2007 and 2018**

**Table 2-9. Total Number of Animal-Related Crashes Recorded between 2007 and 2018 by Season and County**

| Season | Harney County | Malheur County | Total |
|---|---|---|---|
| Winter | 33 | 81 | 114 |
| Spring | 18 | 32 | 50 |
| Summer | 41 | 33 | 74 |
| Fall | 45 | 60 | 105 |
| **Total** | **137** | **206** | **343** |

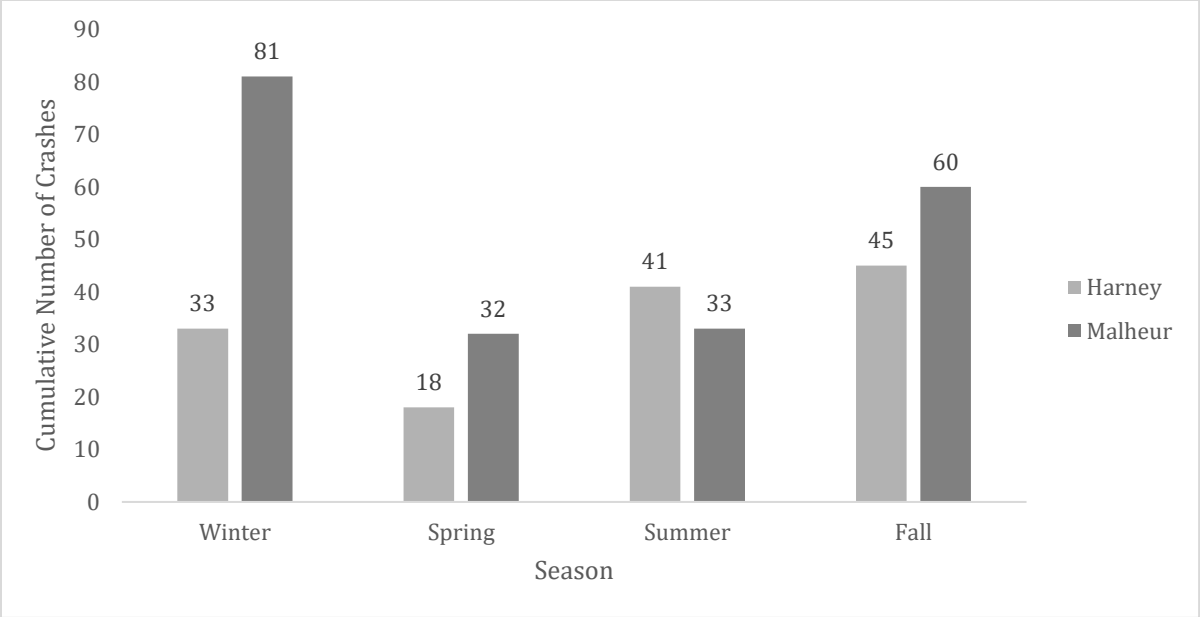



**Figure 2-19. Cumulative Seasonal Number of reported Animal-Related Vehicle Crashes on Highway 20 in Harney and Malheur Counties between 2007 and 2018**

# Wildlife-Vehicle Collisions and Animal-Related Crash Data

Overall, there were many more documented WVCs than animal-related crashes with approximately 86% more WVCs documented than animal-related crashes in both Harney and Malheur Counties (Table 2-10). There were more documented animal-related crashes (150% more) and WVCs (221% more) in Malheur County than Harney County, further indicating that Highway 20 in Malheur County experiences a disproportionate level of WVCs and animal-related crashes (Figure 2-20).

The combined costs associated with documented WVCs and animal-related crashes from 2007-2019 is $24,040,131 for both counties and $7,945,642 for Harney County and $16,094,488 for Malheur County (Table 2-11), a 200% higher accumulated cost in Malheur County than Harney County. These numbers are reported in 2020 dollars and informed by Huijser et al. (2018) estimated average costs of WVCs/animal-related crashes. Costs associated with wildlife/animal-vehicle collisions in both counties are estimated to be $2 million annually. These values are only based on reported WVCs and animal-related crashes, and do not include WVCs and animal-related crashes that are not documented or reported. Shilling et al. (2017) reported that "Others have reported under-reporting rates of collisions with ungulates (e.g., deer) of 5 to 10 fold (Donaldson and Lafon, 2008; Olson et al., 2014)." Huijser et al. (2008) state that "researchers have calculated the underestimation by 10.3 percent, 25 percent, 50 percent, 77.5 percent, and 87.9 percent. (See references 4, 68, 72, and 88.)". Given this information, the actual numbers of WVCs and animal-related crashes and associated costs are likely much higher than reported here.

**Table 2-10. Number of WVC Carcasses and Animal-Related Vehicle Crashes Recorded in Harney and Malheur Counties between 2007 and 2019**

| Year | WVCs | Animal-Related Crashes[a] | Total WVC + Crashes Combined |
|---|---|---|---|
| 2007 | -- | 22 | 22 |
| 2008 | -- | 22 | 22 |
| 2009 | -- | 15 | 15 |
| 2010 | 285 | 22 | 307 |
| 2011 | 283 | 32 | 315 |
| 2012 | 330 | 28 | 358 |
| 2013 | 238 | 20 | 258 |
| 2014 | 267 | 26 | 293 |
| 2015 | 211 | 41 | 252 |
| 2016 | 296 | 40 | 336 |
| 2017 | 273 | 38 | 311 |
| 2018 | 180 | 37 | 217 |
| 2019 | 151 | -- | 151 |
| **Total** | **2,514** | **343** | **2,857** |

[a] Animal-related crashed account for 13% of WVC carcass data.


**Figure 2-20. Density of WVC Carcasses and Animal-Related Vehicle Crashes Recorded in Harney and Malheur Counties between 2007 and 2019**

**Table 2-11. Number of Large WVC Carcasses and Animal-Related Vehicle Crashes Recorded in Harney and Malheur Counties between 2007 and 2019 including Animal Type and Estimated Costs**

| Animal | Harney | Cost—Harney | Malheur | Cost—Malheur | Total Cost |
|---|---|---|---|---|---|
| Deer | 723 | $4,784,091.00 | 1677 | $11,096,709.00 | $15,880,800.00 |
| Antelope | 5 | $33,085.00 | 2 | $13,234.00 | $46,319.00 |
| Elk | 28 | $489,524.00 | 13 | $227,279.00 | $716,803.00 |
| Farm animal - large | 11 | $192,313.00 | 20 | $349,660.00 | $541,973.00 |
| Cougar | No data | $0.00 | 2 | $13,234.00 | $13,234.00 |
| Animal-related crashes (Elk - estimated)[a] | 5 | $87,415.00 | 2 | $34,966.00 | $122,381.00 |
| Animal-related crashes (Deer - estimated)[a] | 132 | $873,444.00 | 204 | $1,349,868.00 | $2,223,312.00 |
| Total | 904 | $6,459,872.00 | 1920 | $13,084,950.00 | $19,544,822.00 |
| In 2020 dollars[b] | -- | $7,945,642.56 | -- | $16,094,488.50 | $24,040,131.06 |
| Average annual cost | -- | $662,136.88 | -- | $1,341,207.38 | $2,003,344.26 |

Cost Source: Huijser et al. 2009

[a] Deer and elk crash numbers were estimated using the percent carcasses that were elk and applying that percentage to crash data.

[b] The 2020 dollar amount values include inflation rate of 0.23 % since 2009 per U.S. Bureau of Labor Statistics (https://www.bls.gov/data/inflation_calculator.htm).

# Wildlife Highway Crossings

Using data derived from GPS collars deployed on mule deer and pronghorn in Harney and Malheur Counties, the density of animal highway crossings across Highway 20 was determined by identifying consecutive pairs of GPS fixes on either side of Highway 20. Figure 2-21 depicts the density of highway crossing for mule deer throughout the study area and Figure 2-22 depicts the mule deer road crossing density by mile post and includes mean and standard deviations to aid in identifying above-average animal highway crossing density locations. Figure 2-23 depicts the density of highway crossing for antelope throughout the study area and Figure 2-24 depicts the antelope road crossing density by mile post and includes mean and standard deviations to aid in identifying above-average animal highway crossing density locations. For mule deer, the highest highway crossings (more than the mean plus 1 standard deviation) occurred near mileposts 203, 205, 213, 214, and 237—all within Malheur County (Malheur County spans mileposts 180.5–267; Figures 2-21 and 2-22). For antelope, the highest highway crossings (more than the mean plus 1 standard deviation) occurred near mileposts 143, 144, 156, 157, 166, 168, 169, 170, 181—all but milepost 181 within Harney County (Harney County spans mileposts 84–180.5; Figures 2-23 and 2-24).

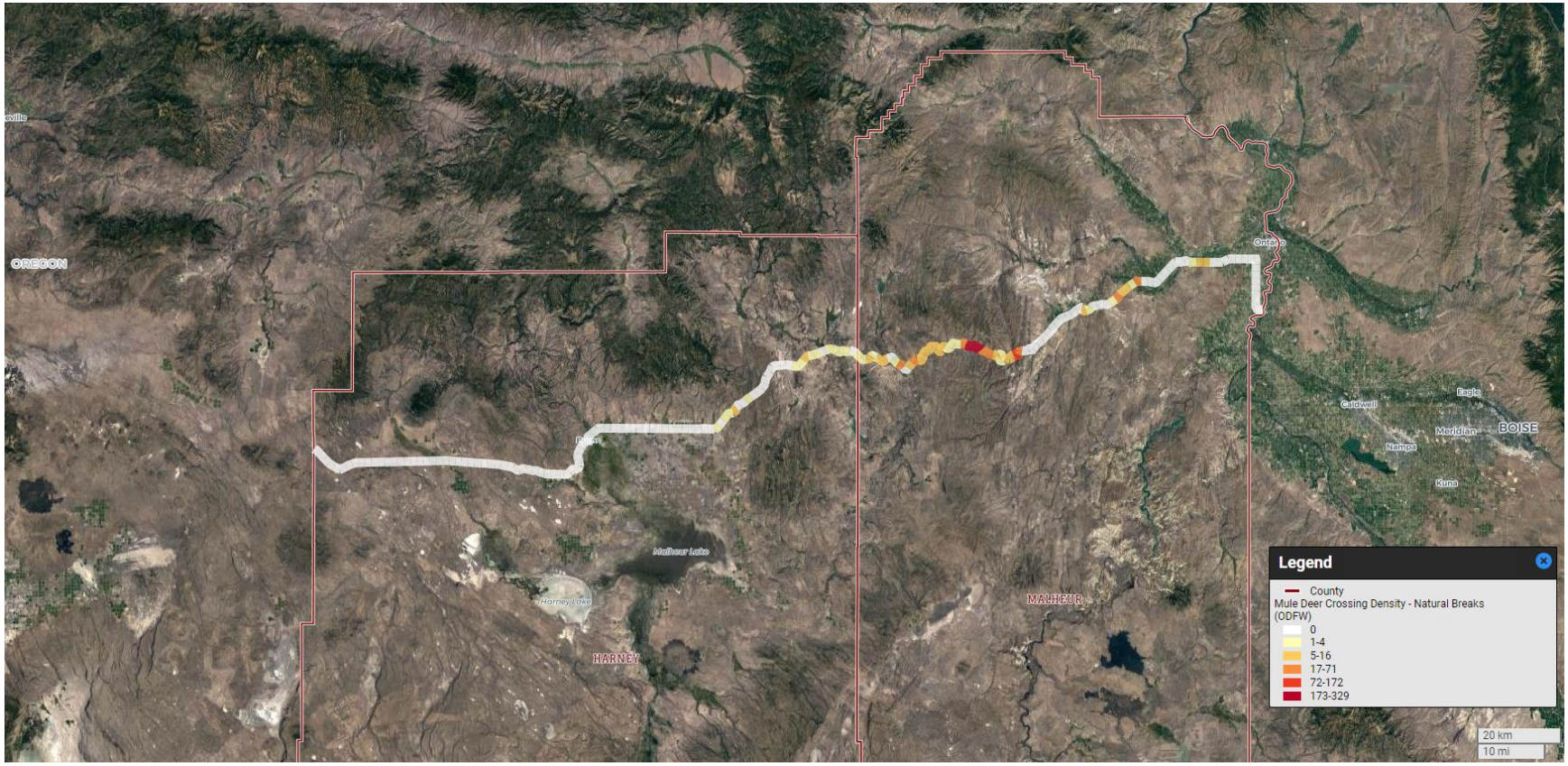



**Figure 2-21. Mule Deer Crossing Densities in the Study Area**

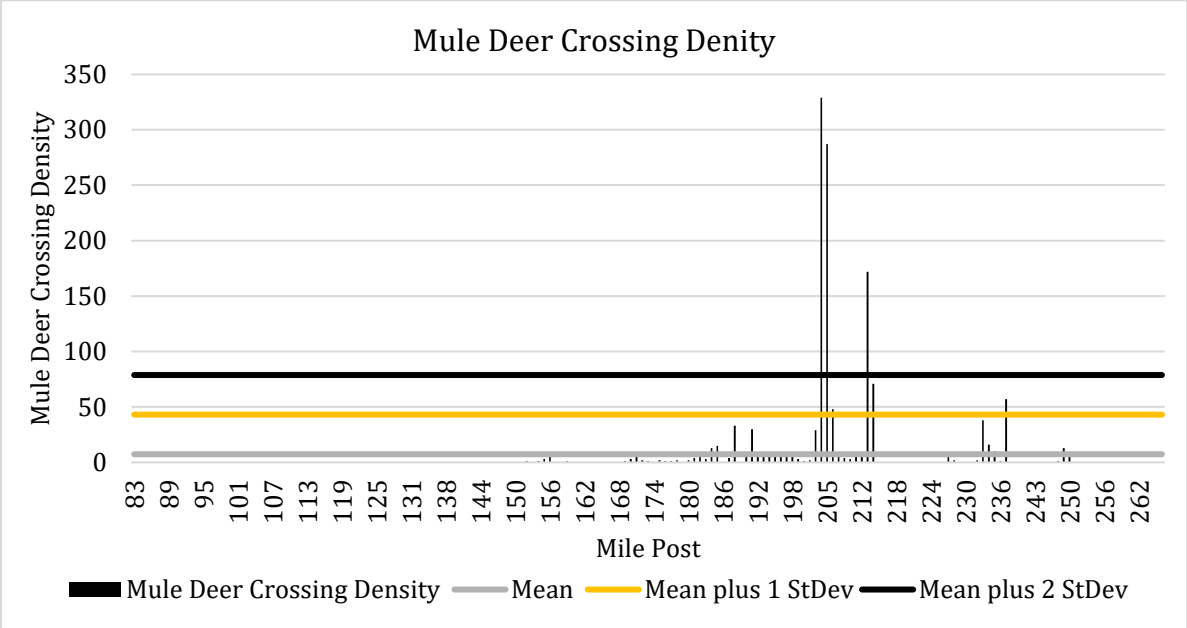



**Figure 2-22. Mule Deer Crossing Density by Milepost**

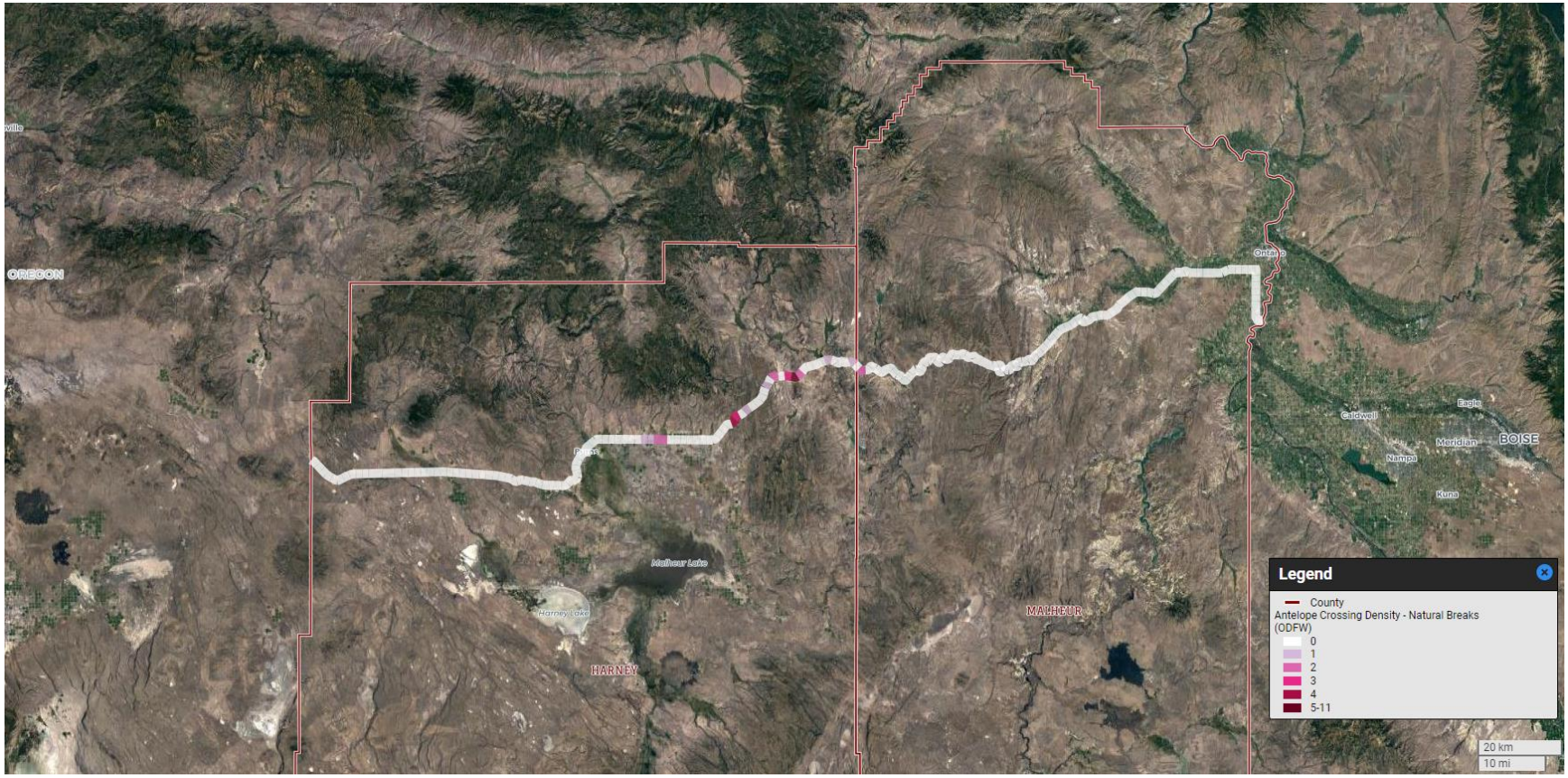



**Figure 2-23. Antelope Crossing Densities in the Study Area**

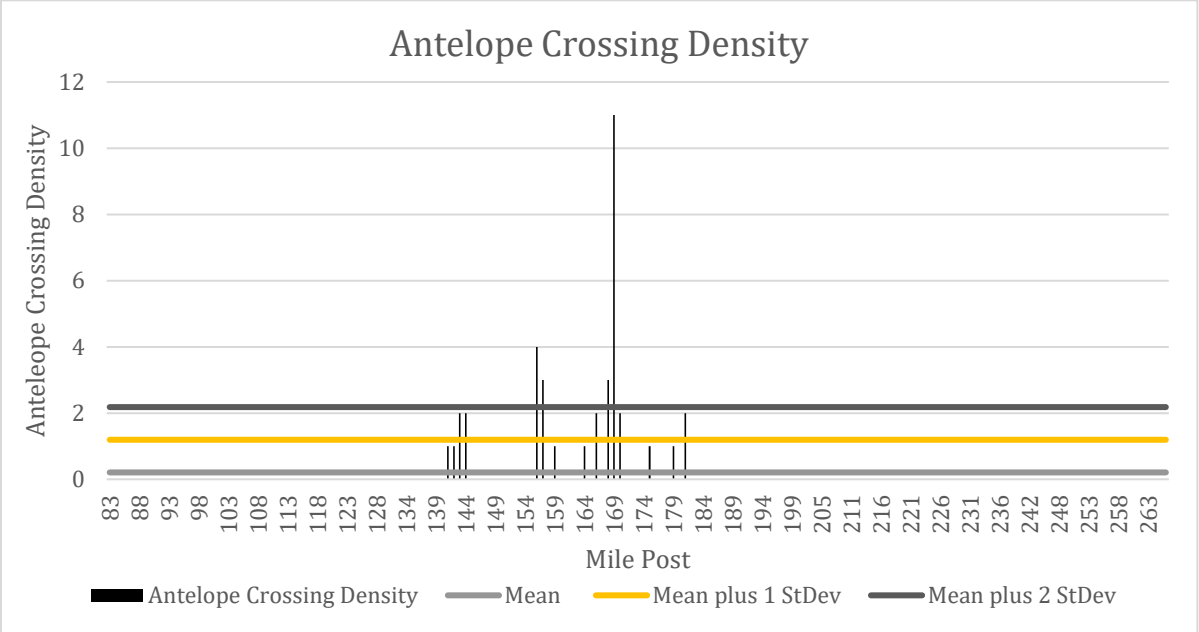



**Figure 2-24. Antelope Crossing Density by Milepost**

# Focal Areas

Locations in the study area experiencing the highest levels of WVCs, animal-related crashes, and animal road crossings were identified and advanced as focal areas for more detailed and localized assessment and consideration. Focal areas occurred in Malheur County only and were delineated into four regions generally coinciding with associated U.S. Geological Survey 7.5 Minute Quadrangle Topographical Map areas (Figure 2-25). Figure 2-25 depicts these four focal areas with combined WVC and animal-related crash density and mule deer road-crossing density.

It should be noted that although no focal areas were moved forward in Harney County, wildlife movement, WVCS, and animal-related crashes are still an important issue in that region and warrant further investigation. The resources provided in this report may serve as a guide and tools for further investigations and connectivity enhancement development in that region.

This section presents details on the land use, vegetation, topography, existing bridges, summaries of descriptive data related to documented WVCs, animal-related crashes, and wildlife road crossings, as well as photographs and maps for each focal area (Figures 2-26, 2-27, 2-28, and 2-29).

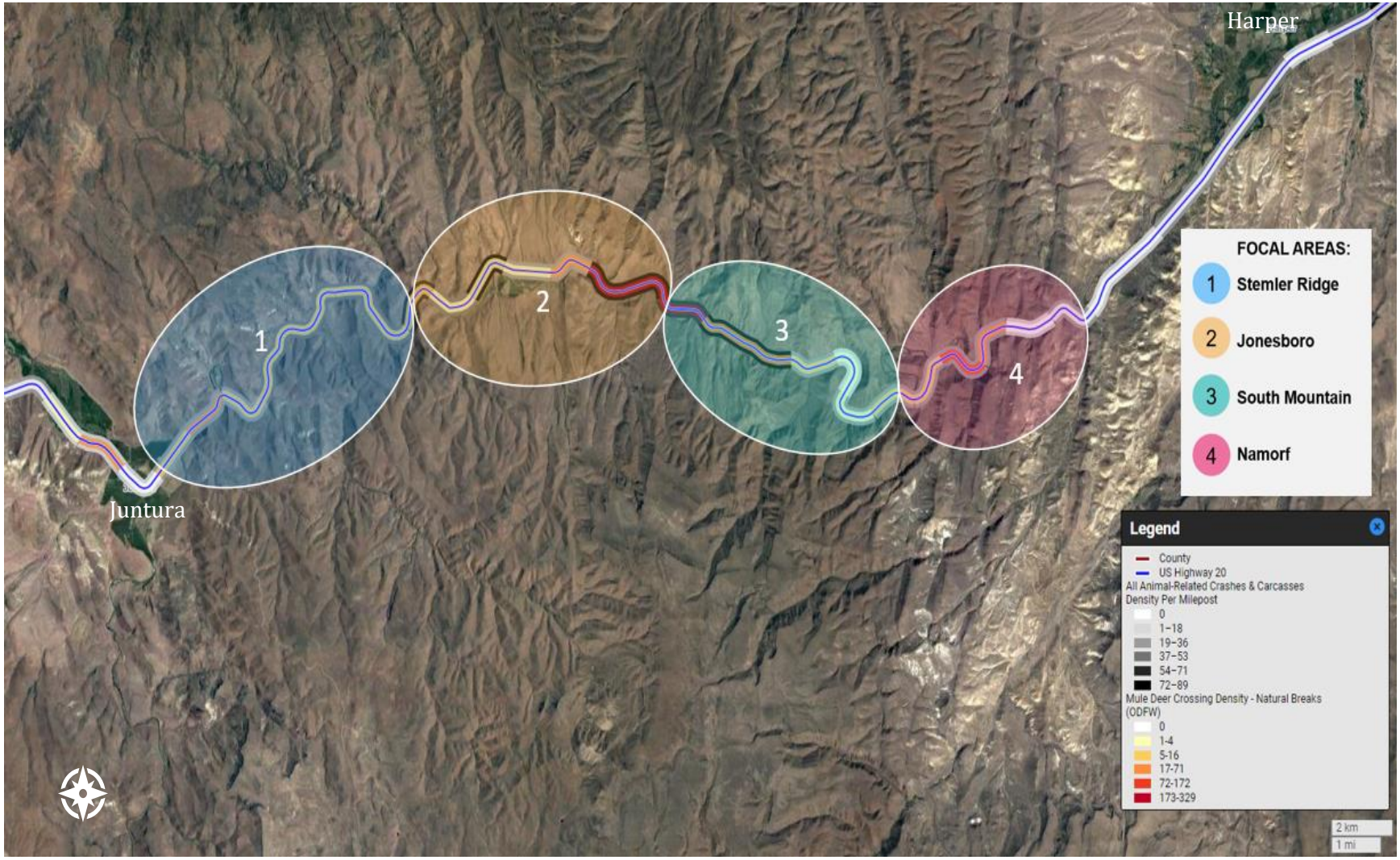



**Figure 2-25. Focal Area Overview**

# Focal Area 1: Stemler Ridge

## Location on Highway 20

- Mileposts 190–199

## Land Uses

- Primarily undeveloped
- Extensive agriculture at mileposts 190–191
- Primarily undeveloped, few buildings near milepost 199

## Vegetation Cover

- Primarily surrounded by shrubland
- Narrow riparian/wetlands corridor along Malheur River, few trees

## Recent Wildfires

- Multiple fires adjacent to the north side of Highway 20 from mileposts 191–197
- Currey Canyon (2018), Stemler Ridge (2006 and 2016), Stemler (2014), Juniper Reservoir (2007)

## Notable Topography/Features

- Open valley on western end between mileposts 190 and 191
- Highway mostly adjacent to river through most of focal area
- Highway is confined at steep slopes/river bends near mileposts 192–195, 197, and 199
- Highway crosses rivers at three large bridges
- Three large culverts in focal area

## Bridges Assessed for Retrofit by Burns Paiute Tribe using Passage Assessment System (listed west to east)

- North Fork Malheur River bridge
- Malheur River (Horseshoe Bend) bridge
- Malheur River (Gwynn) bridge

# Focal Area 1: Stemler Ridge

## Descriptors

- Location: approx. MP 190-199 (red stars = boundaries)
- Land ownership = Private and Federal Govt.

## Key issues

- Moderate WVC densities
  - Total carcasses[1] = 363, or 40.3/mi
  - Total animal-related crashes[2] = 11, or 1.2/mi
  - Total WVCs (both datasets) = 374, or 41.6/mi
- High-moderate mule deer crossing densities
  - Total deer crossings[3] = 83, or 9.2/mi
- Estimated costs
  - Total estimated WVCs cost per year range: $253,642 - $338,190

[1] (ODOT, 2010-2019) [2] (ODOT, 2007-2018) [3] (ODFW collar data)

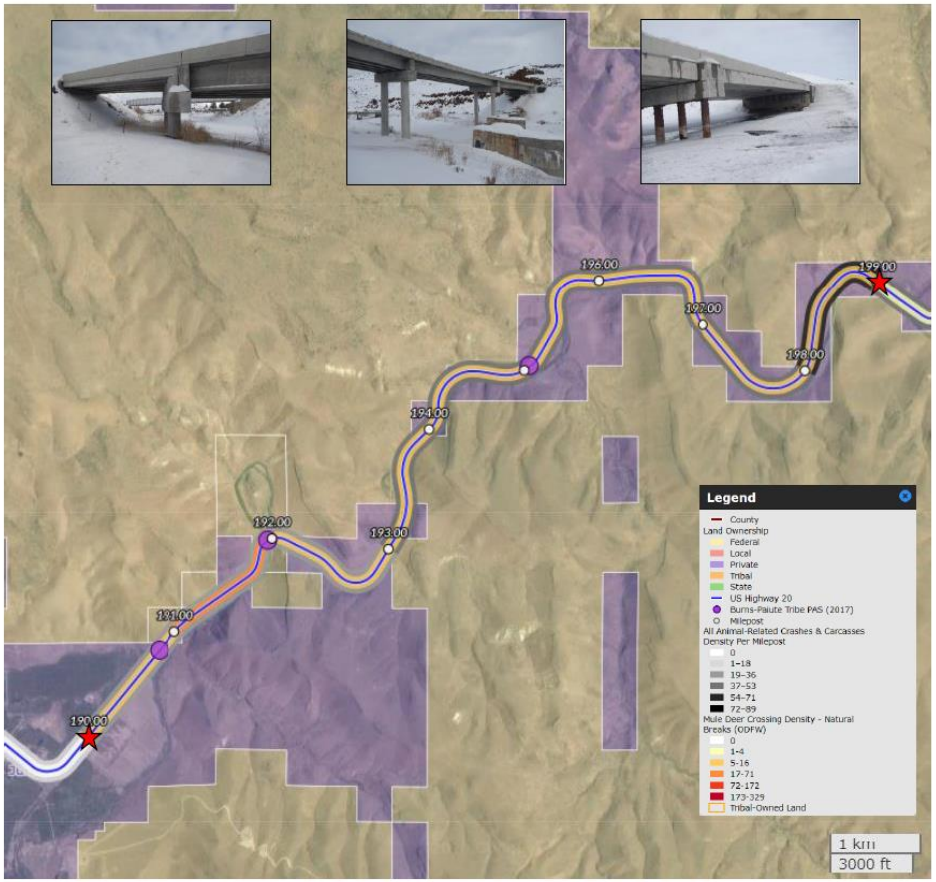




**Figure 2-26. Focal Area 1: Stemler Ridge**

# Focal Area 2: Jonesboro

## Location on Highway 20

- Mileposts 199–206

## Land Uses

- Primarily undeveloped, few buildings at mileposts 199 and 201
- Agriculture at mileposts 201–202

## Vegetation Cover

- Primarily surrounded by shrubland
- Narrow riparian/wetland corridor along Malheur River, few trees
- Some grassland habitat on river valley floor/floodplain terrace along Highway 20
- Recent wildfires
- Indian Creek wildfire (2020) adjacent to north side of Highway 20 between mileposts 200 and 205

## Notable Topography/Features

- Generally, more open river valley compared to other focal areas
- Highway occasionally adjacent to river, often separated by floodplain
- Highway crosses streams at three large bridges, including Malheur River once and at two major tributaries
- Area can be prone to flash flooding
- Potentially eight large culverts in focal area

## Bridges Assessed for Retrofit by Burns Paiute Tribe using Passage Assessment System (listed west to east)

- Black Canyon Creek bridge
- Malheur River bridge
- Sperry Creek bridge

# Focal Area 2: Jonesboro

## Descriptors

- Location: approx. MP 199-206
- Land ownership = Tribal, State, and Federal Govt.

## Key issues

- Highest WVC densities of study area
  - Total carcasses[1] = 319, or 45.6/mi
  - Total animal-related crashes[2] = 16, or 2.3/mi
  - Total WVCs (both datasets) = 335, or 47.9/mi
- Highest mule deer crossing densities of study area
  - Total deer crossings[3] = 651, or 93/mi
- Estimated costs
  - Total estimated WVCs cost per year range: $227,566 - $303,422

[1] (ODOT, 2010-2019) [2] (ODOT, 2007-2018) [3] (ODFW collar data)

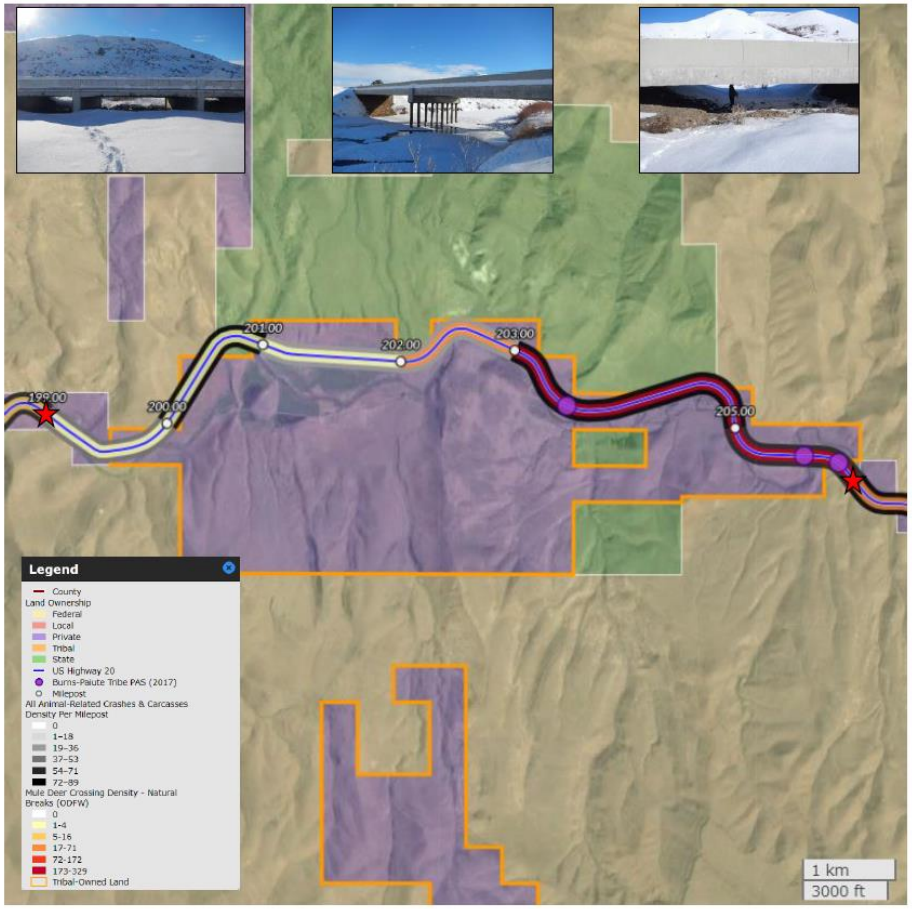




**Figure 2-27. Focal Area 2: Jonesboro**

# Focal Area 3: South Mountain

## Location on Highway 20

- Mileposts 206–211

## Land Uses

- Nearly entirely undeveloped
- A few buildings west of milepost 211

## Vegetation Cover

- Primarily surrounded by shrubland
- Minimal riparian/wetlands corridor along Malheur River, few trees

## Recent Wildfires

- None since 2000

## Notable Topography/Features

- Highway mostly adjacent to river through most of focal area
- Fairly narrow river/floodplain corridor between steep terrain and slopes
- Highway is confined at steep slopes/river near mileposts 206–208, and 211
- Pond/wetland present adjacent to south side of Highway 20 west of milepost 208
- Highway crosses one major tributary
- Area can be prone to flash flooding
- Potentially two large culverts in focal area

Highway crosses stream with smaller bridge

## Bridges Assessed for Retrofit by Burns Paiute Tribe using Passage Assessment System

- Gold Creek bridge

# Focal Area 3: South Mountain

## Descriptors

- Location: approx. MP 206-211
- Land ownership = Private and Federal Govt.

## Key issues

- High WVC densities
  - Total carcasses[1] = 121, or 24.2/mi
  - Total animal-related crashes[2] = 4, or 0.8/mi
  - Total WVCs (both datasets) = 125, or 25.0/mi
- High mule deer crossing densities for study area
  - Total deer crossings[3] = 62, or 12.4/mi
- Estimated costs
  - Total estimated WVCs cost per year range: $84,780 - $113,040

[1] (ODOT, 2010-2019) [2] (ODOT, 2007-2018) [3] (ODFW collar data)

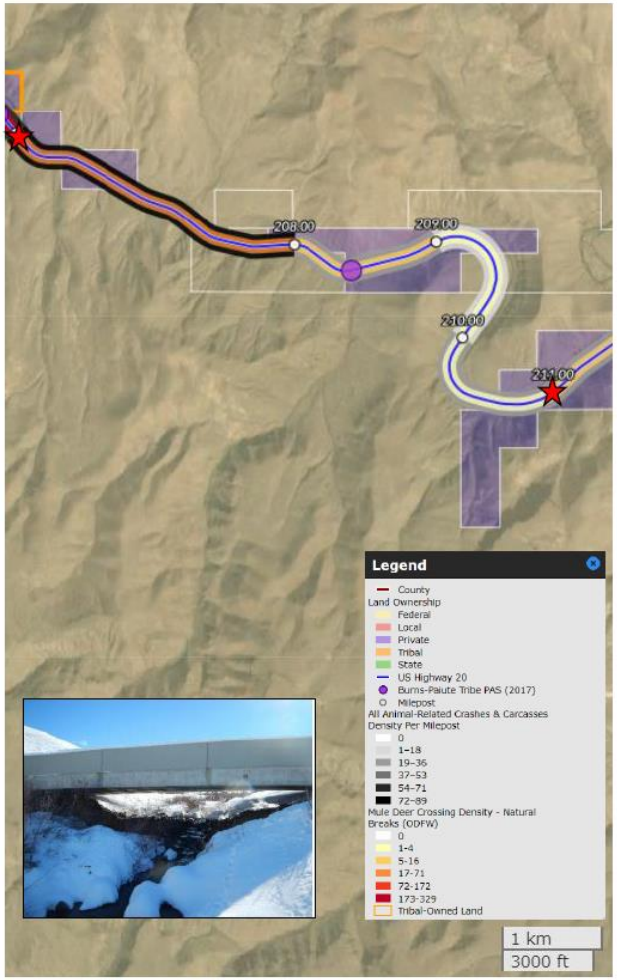




**Figure 2-28. Focal Area 3: South Mountain**

# Focal Area 4: Namorf

## Location on Highway 20

- Mile posts 211–217

## Land Uses

- Primarily undeveloped
- Agriculture near Highway 20 approximately at mileposts 212 and 217
- Some buildings west of mileposts 212 and 213

## Vegetation Cover

- Primarily surrounded by shrubland; some grassland within floodplain/river valley
- Narrow riparian/wetlands corridor along Malheur River, more trees east of milepost 215

## Recent Wildfires

- Simmons Gulch fire (2016) adjacent to southside of Highway 20 from mileposts 211–212

## Notable Topography/Features

- Extremely narrow river/floodplain corridor between steep hillsides and slopes, though valley opens at eastern end of focal area
- Highway is often off-channel or across floodplain, occasionally adjacent to river
- Highway confined by steep slopes/river near mileposts 211 and 213, west of milepost 215, and near milepost 216; many curves within steep canyon
- Crosses rivers at three large bridges, including at one major tributary
- Area can be prone to flash flooding
- Potentially one large culvert in focal area

## Bridges Assessed for Retrofit by Burns Paiute Tribe using Passage Assessment System (listed west to east)

- Malheur River Diversion bridge
- Malheur River Namorf bridge
- Squaw Creek (aka Yapaa Creek) bridge

# Focal Area 4: Namorf

## Descriptors

- Location: approx. MP 211-217
- Land ownership = Private and Federal Govt.

## Key issues

- Moderate WVC densities
  - Total carcasses[1] = 133, or 22.2/mile
  - Total animal-related crashes[2] = 12, or 2.0/mile
  - Total WVCs (both datasets) = 145, or 24.2/mile
- High mule deer crossing densities
  - Total deer crossings[3] = 257, or 42.8/mile
- Estimated costs
  - Total estimated WVCs cost per year range: $98,284 - $131,045

*[1] (ODOT, 2010-2019) [2] (ODOT, 2007-2018) [3] (ODFW collar data)*

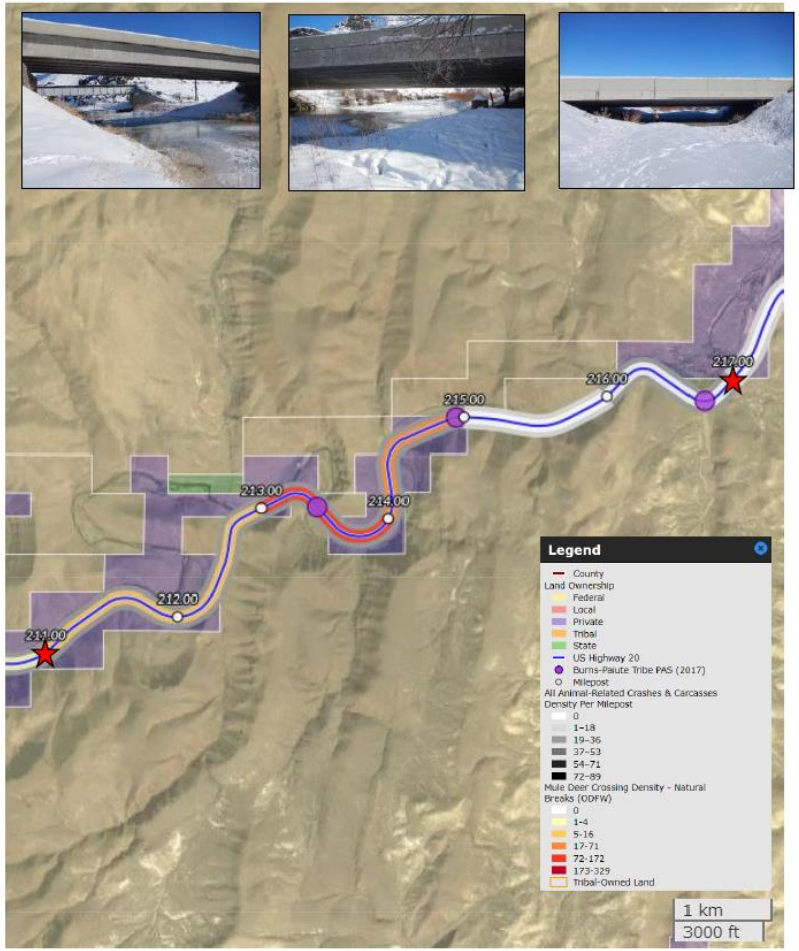




**Figure 2-29. Focal Area 4: Namorf**

Chapter 3
# Workshops and Facilitation

# Overview

A series of three remote workshops were held and facilitated to engage Tribal partners, agencies, and stakeholders on the Wildlife Connectivity Feasibility Study. These workshops were held to ensure that the connectivity enhancement measures selected for Highway 20 throughout the study area were supported by each participant and that consensus was achieved around priority actions for specific WVC hotspots and other priority areas.

Each workshop covered one of the following topics.

- **Workshop 1:** Introduction to Connectivity Assessment Data and Results
- **Workshop 2:** Assess Feasibility of Potential Connectivity Enhancement Alternatives
- **Workshop 3:** Select and Prioritize Connectivity Enhancement Measures and Produce an Implementation Plan Including Insights on Planning, Design, Costs, And Funding Strategies

During the facilitated workshops, participants were guided through a series of structured decision-making activities using an online whiteboarding tool and video conference via Zoom. Activities were sequenced to help participants develop a perspective on the most critical aspects and issues related to WVCs, wildlife connectivity, and potential tools and connectivity enhancement measures. Facilitators aligned participants according to a shared vision for success and identified critical risks and deployment challenges throughout the process. Based on that common framework, the facilitators helped the group drill deeper by reviewing specific scenarios to help identify clear solution requirements and priorities. The final workshop consisted of action planning and aligning participants according to concrete next steps and clear accountabilities for development and implementation of connectivity enhancement measures.

Detailed summaries of each workshop including workshop objectives, discussions, outcomes, participant lists, and next steps can be found in Appendix B. In addition, workshop lightning talks (brief presentations reviewing pertinent background information given at the beginning of workshop 1 and 2) are provided at the end of the workshop 1 and 2 summaries (Appendix B). A summary of key workshop outcomes is provided below.

# Key Workshop Outcomes

## Workshop 1

- Introduced participants to connectivity assessment data, results, and focal areas.
- Collaboratively developed the following vision statement to guide the workshop process: “In 15 years, we will have reduced wildlife-vehicle collisions on Highway 20 by 75% by collaborating to implement wildlife crossing structures and other measures that improve habitat connectivity and quality for wildlife species, road safety, and driver awareness.”

## Workshop 2

- Introduced connectivity enhancement tool options including information on costs, effectiveness, and planning timeframes.
- Gathered valuable feedback on the feasibility of connectivity enhancement tools in focal areas and other considerations (e.g., pros/cons, planning design considerations).

## Workshop 3

- Developed a shared vision for action planning and prioritization of connectivity enhancement tools.
- Identified and delineated critical steps and next steps in the implementation of connectivity enhancement tools.
- Identified funding opportunities and specific participants who are willing to participate in project development and implementation.
- Initiated the formation of a Highway 20 Coalition composed of agencies and partners to lead the development of connectivity enhancement tools across the Highway 20 corridor and collaborate toward realizing the vision statement from Workshop 1.

Detailed summaries and results of each workshop including workshop exercises and outcomes can be found in Appendix B

Chapter 4
# Connectivity Enhancement Tools

As part of the WCA and workshop process, ICF evaluated a variety of connectivity enhancement options and alternatives for potential implementation in the study area. Connectivity enhancement measures aim to facilitate safe wildlife movement, decrease WVCs, improve habitat connectivity, and increase road safety. Connectivity enhancement options along Highway 20 that were reviewed during workshops included retrofitting existing structures and upgrades to facilitate connectivity (e.g., upsizing culverts, adding dry paths to stream crossings, substrate enhancements/removal of obstructive riprap); adding new wildlife-crossing structures (e.g., new culverts, bridges, or wildlife crossings); adding wildlife fencing, habitat restoration, experimental animal-detection systems, reducing roadside value and attractiveness to animals, signage, and traffic control such as adjusting speed limits. Because standard wildlife warning signs have not been proven effective at reducing WVCs, they will not be considered as standalone connectivity enhancement measures. However, warning signs with increased effectiveness (wildlife detection-warning systems, warning signs with specific instructions and flashing beacons) may be considered in combination with other connectivity-enhancement measures to increase effectiveness of enhancements during the alternatives analysis. These connectivity enhancement tools are discussed in more detail below.

# Connectivity Enhancement Tool Options

ICF developed a list of available connectivity enhancement tool options for consideration and evaluation by partner agencies and stakeholders participating in Workshop 2. These tools are described below. Outcomes of the workshop evaluations of these connectivity enhancement tool options are presented in the following section.

## Reduce Roadside Value

Animals may be attracted to roads for a wide variety of reasons including roadside vegetation foraging, utilizing roadside for cover, using roadside vegetation or other cover, warming up on warm/hot pavement, desire to consume road minerals (e.g., salt and sand), access to roadside water (i.e., roadside ditches/wetlands), and some animals may feed on roadkill carcasses found on/near roadways.

Reducing roadside value involves removing suitable conditions for foraging, feeding, or other desirable resources that might attract animals to roadways and their vicinities. Examples of this practice include regular roadkill carcass removal, routine vegetation maintenance, and reducing applications of road salt. This can be a useful tool particularly in areas with high wildlife use or where adjacent to active wildlife or riparian corridors so that incentives to forage closer to the roadway are reduced thereby reducing wildlife-roadway interactions and risks of WVCs. Actions considered to reduce roadside value should be assessed alongside careful consideration of any additional costs needed to implement as well as consideration of staffing and maintenance needs.

## Public Education and Awareness

Part of the greater issue in WVCs stems from the lack of proper public/driver education and instructions about roadway safety associated with risks of hitting wildlife. A significant number of drivers are not trained to properly maintain awareness or react appropriately when avoiding animal-vehicle collisions. A large number of people desire some form of additional education about collision prevention. Through Public Safety Announcements (PSAs), advertisements, and driver's education courses, the general public could have a greater awareness about the possibility of wildlife collisions and can be properly prepared when reacting to potential scenarios involving wildlife crossing roadways. In addition to every day drivers, those potentially unfamiliar with the risks in high wildlife-use areas (i.e., out-of-state visitors, young drivers, semitruck drivers) also make the ideal targets for these awareness campaigns and having additional signage at local trails or public information centers could provide warnings of the risks.

## Signage

Standard wildlife warning signs (such as the standard deer crossing road sign) are NOT effective in reducing WVCs. Wildlife-specific roadway signage could potentially be effective in reducing or avoiding WVCs if the signage is highly visible, provides specific messaging and/or instructions to drivers, and has elements to reduce driver habituation. Having such messaging posted in in high-risk areas could easily grab a passerby's attention and posting repeated messages in certain areas could reinforce the message that drivers should exercise greater caution and specific actions in such areas. Utilizing flashing lights or more personal, localized information and graphics on signs could prove more effective at communicating and preparing drivers for any potential risks.

## Traffic Control

In addition to posted speed limits, an increase in on-road graphics or other traffic-control elements, as truckers and drivers approach wildlife hotspots, could help prevent collisions from occurring. Since Highway 20 is known as an important transportation corridor for freight trucks, use of rumble strips and other road restrictions (i.e., restrictions on speed, time, load size) are *not* considered practical. It would be important, however, to enforce some form of traffic control via posted signage in areas featuring tight curves and/or riparian zones. Having a presence of multiple signs prior to reaching wildlife corridors could also help inform drivers of possible dangers that lie ahead.

## Existing Infrastructure Retrofit

Utilizing existing structures such as bridges or culverts to support wildlife movement can be a relatively fast and cost-effective way of facilitating safe wildlife movement. Retrofitting culverts and bridges, coupled with proper wildlife fencing and habitat restoration efforts, can improve wildlife use and movement function of existing structures. Like with new infrastructure, retrofits can be expensive or may create environmental impacts associated with construction, but the benefit of having an effective solution opposed to the longer process of

installing a new wildlife crossing structure or taking no action may prove worthwhile given the resources available. Retrofits may be able to be implemented on a faster time-horizon than new infrastructure, allowing them to serve as a supplemental or interim solution while dedicated wildlife crossing structures are being planning, designed, and built, often a multi-year process.

## Wildlife Crossings

Wildlife crossings are used to facilitate safe wildlife passage across roads/highway and other areas by providing passages through culverts, underpasses, or via overpasses designed to guide wildlife under/over traffic. Wildlife crossing structures have proven to be highly effective when coupled with wildlife fencing and when both are properly designed. Whenever possible, wildlife crossings should be designed to accommodate a wide variety of species and ecological processes. The location, type, and specific design of wildlife crossings are dependent on the context, species, and goals and objectives of a given project.

## Wildlife Fencing

Properly designed wildlife fencing is highly effective at reducing WVCs. Wildlife fencing may be used to exclude wildlife access to particular areas and/or to guide wildlife movement toward safe crossings such as wildlife crossing structures. Wildlife fencing should almost always be used in conjunction with existing, safe crossings or suitable underpasses/overpasses to help guide wildlife towards safe crossing areas and fence ends must be carefully chosen and designed to prevent fencing end effects (e.g., high numbers of WVCs at fence ends). Fencing should always be site-specific with a design considering target specific species, topography, public assess, and land ownership. Care should be taken to ensure that fencing design considers measures required to withstand various wildlife breech methods including jumping, climbing, pushing, and digging. Longer stretches of fencing may require measures to facilitate escape for animals trapped inside the fenced area of the roadway such as jump-out ramps. Longer fencing stretches may also have gaps in fencing which can lead to animals having access to the roadway. Fencing gaps may be treated with a variety of treatments to prevent animal access into the roadway such as cattle guards or electromats which can deter animals away from unsafe access points.

## Habitat Enhancement

Habitat restoration and enhancement in areas that are degraded may prove beneficial in drawing and supporting animals into areas away from roadways. Restoration efforts would be concentrated near retrofits or suitable wildlife crossings and may consist of shrub and willow plantings within draws, enhancement of grassland and other forage habitat, and restoration/creation of wetlands or other water sources. Strategic placement of water tanks could also help wildlife by providing a source of water that decreases the need to cross roadways. These efforts can prove to be time intensive and not always 100% effective; however, habitat enhancement and restoration is still a practice that should be carried out regardless of the outcome as it provides a net benefit to wildlife and the greater ecosystem. There are a variety of habitat enhancement opportunities throughout the study area including grassland, shrubland, riparian, and wetland habitat enhancement and restoration opportunities.

## Experimental Techniques

The science behind deterring wildlife from entering and crossing roadways is still in development, and as such, there are still new and undeveloped ideas that could potentially be adapted for reducing WVCs. Installation of wildlife motion sensors and alert systems (i.e. flashing lights) could be used to alert drivers approaching a section of roadway with crossing wildlife. These methods are still under research and development, which could be perceived as "unproven" by the general public, though it should be noted that even at this experimental stage they have value in facilitating research and adaptive management and further developing and refining such technologies. Further studies on a particular experimental technique's effectiveness are generally encouraged as well as careful consideration of feasible locations and species these techniques may target.

## Monitoring and Adaptive Management

Monitoring is an essential component of any of the connectivity enhancement measures being used, because monitoring helps inform management decisions and ensures stakeholders that their methods are working (or not). Whether this involves monitoring the success of a restoration site or using trail cameras to assess the use of newly constructed or retrofitted wildlife crossings, having clear data over a long-term study is essential in determining the success of mitigation.

# Connectivity Enhancement Tool Feasibility

Based on the feedback received and outcomes of facilitated discussions and activities in workshops—most specifically Workshop 2, which focused on assessing the feasibility of connectivity enhancement measure alternatives in the focal areas—a refined list of feasible connectivity enhancement measures was developed (Table 4-1). Of the potential connectivity enhancement measure alternatives considered, the only measure that was deemed infeasible in the study area and focal areas was Traffic Control. Traffic Control was deemed infeasible due to concerns with such elements potentially negatively affecting, being infeasible, or having limited effect given the Highway 20 corridor in this region is an important freight corridor. Experimental Measures and Reducing Roadside Value were considered feasible though their value is considered unknown at this time. All other connectivity enhancement measure alternatives were deemed feasible. Table 4-1 summarizes these feasibility determinations. Details on feedback received from workshop participants including pros and cons, effort versus impacts mapping, advantageous connectivity enhancement measure coupling, planning and design considerations, and prioritization of several example connectivity enhancement projects are detailed in the Workshop 2 and Workshop 3 summaries located in Appendix B.

The Tribe, with input from ODOT and ODFW, authored a report in January 2017 documenting opportunities for retrofitting existing bridge structures along Highway 20 between Juntura and Harper using the Washington State Department of Transportation *Permeability of Existing Structures for Terrestrial Wildlife: A Passage Assessment System (PAS)* (Kintsch and Cramer 2011) and the *Maine Terrestrial Wildlife Crossings Survey Report: Potential for Retrofitting Transportation Infrastructure to Benefit Movement of Terrestrial Wildlife* (Charry and Kintsh 2015). The Tribe's assessment was modified to assess only the retrofit potential of structures for large structure generalists (i.e., Rocky

Mountain elk and mule deer). A copy of this report and its findings can be found in Appendix A. In addition, the results of this assessment were included in workshop discussions (see Appendix B for Workshop summaries) and considered as part of action planning included in Chapter 5, *Action Planning and Project Implementation*, of this report.

Details on the planning and development of connectivity enhancement measures, funding opportunities, and potential partnership opportunities are described in Chapter 5 of this report and are also detailed in Workshop 3 Summary in Appendix B.

Concepts for each of the connectivity enhancement tools deemed feasible are provided in Appendix C.

**Table 4-1. Connectivity Enhancement Tool Options Feasibility Determinations**

| Connectivity Enhancement Tool | Feasible (Yes/No/Maybe) |
|---|---|
| Public Education and Awareness | ☑ |
| Signage | ☑ |
| Traffic Control | ⊘ |
| Experimental Techniques | ? |
| Reduce Roadside Value | ? |
| Retrofit | ☑ |
| Wildlife Crossings | ☑ |
| Wildlife Fencing | ☑ |
| Habitat Enhancement | ☑ |

Chapter 5

# Action Planning and Project Implementation

This section integrates and summarizes the action planning and project development considerations discussed and developed during the workshop process. This information is intended to serve as a reference guide and roadmap for potential project proponents and partners when navigating the action planning and project development process.

One of the primary goals of this project was to develop consensus around a clear path toward implementing feasible connectivity enhancement tools in the study area and focal areas. To do this, Workshop 3 focused on action planning (i.e., identifying the steps needed to implement specific connectivity enhancement tools) and aimed to develop a shared vision among participants to identify the key next steps, priorities and considerations, and major milestones for implementation of connectivity enhancement tool projects. This chapter outlines the results of Workshop 3, action planning steps and considerations developed by workshop participants, and provides additional tools and resources to support the implementation process.

## Connectivity Tool Prioritization

Workshop 3 included a connectivity tool project prioritization activity where eight potential connectivity tool projects, based on the list of feasible connectivity tools, were ranked by workshop participants. Figure 5-1 below summarized the top three ranked projects. To support and facilitate action planning of these three projects, Project Information Sheets have been developed for each that contain general project overview information, locations, assumptions, cost estimates, and tasks involved in the planning, design, and construction/implementation of each project. See Appendix D for Project Information Sheets and more details.

**#1st Place – Highest Priority**

| **Simple Retrofits – Passage Enhancements** |
|---|
| Create a pathway for wildlife under an existing bridge without modifying the structure. This may include removal of derelict fencing, addressing steep grades and/or increasing riparian vegetation cover, etc. |

**#2nd Place – Second Priority**

| **Wildlife Crossing** |
|---|
| New Crossing Project within one of the focal areas that includes fencing design and installation and riparian habitat enhancement within the vicinity of the structure to facilitat willdife use. |

**#3rd Place – Third Priority**

| **Complex Retrofits- Focal Area 2** |
|---|
| Integrated retrofit of 3 bridges in highest WVC and crossing Focal Area, includes fencing, openness, and habitat enhancement within the vicinity to facilitate wildlfie use. |

**Figure 5-1. Results of Workshop 3 Connectivity Tool Project Prioritization Activity.**

# Connectivity Enhancement Tool Project Implementation

During Workshop 3, participants identified the steps in the project implementation process that would need to be started first in order to assure project success. Once these critical first steps were identified, the remainder of the workshop was spent brainstorming critical tasks, actions and partners that could be involved for the first three key steps.

## Implementation Steps

Below are the key implementation steps identified by workshop participants in the order they should be executed.

### Step 1. Community Outreach

Workshop participants agreed that prior to conducting *any* action planning or project development efforts, community outreach should be developed and implemented. Community outreach may be achieved by utilizing a wide variety of partners from local representatives to community members that can help elevate project ideas and gain support from a wider audience. Such partners could include ODFW, the Oregon Hunters Association, the Tribe, state senators, county commissioners, and even local reporters or newspapers that could help generate discussion. Through a broad use of social media, local to state government outreach and education, and community field trips or workshops, information about pertinent issues and opportunities can become more readily available and can garner support from a larger audience with varying backgrounds and viewpoints that would help inform an open discussion.

### Step 2. Project Selection and Opportunities to Combine Projects

Once a problem with wildlife connectivity and/or WVCs has been identified, decisions must be made as to which connectivity enhancement tool/tools may be best suited to address the problem. Selection should be based on tool feasibility in the proposed project area, whether there are opportunities to retrofit existing infrastructure, community and public feedback, cost-benefit analysis and/or effort-impact considerations (see the *Cost-Benefit Considerations* section this chapter for information and resources pertaining to cost-benefit considerations) and whether the proposed solution should aim to address driver and/or wildlife behavior. Figure 5-2 provides a decision-making framework flow chart that can be used to identify connectivity enhancement tools available for a specific location or region and specific issues.

Additionally, it is important to consider projects that are currently being planned or proposed as opportunities for integrating connectivity enhancement tools via retrofitting existing structures, implementing new wildlife crossings or fish passages, and other options that can be integrated into the project's design (see *Case Studies* below for examples). The combination of wildlife crossings with fish passages and/or with maintenance projects may be feasible depending on the available resources in the area or based on preliminary review by the project engineer. Retrofitting existing structures or the addition of a new wildlife crossing to enhance wildlife connectivity may also be feasible on a planned roadway widening or bridge replacement project. The opportunity to couple connectivity enhancement tools with existing planned projects can provide a streamlined, fast-tracked, and cost-effective pathway toward connectivity tool implementation. This process can be

initiated with discussions with the state and local planning and transportation departments and potential project proponents and partners and should be explored with any potential connectivity enhancement tool project involving infrastructure or right-of-way modifications (e.g., retrofits, construction, or habitat enhancements).

Additional project-selection considerations include the following.

- Objective/Target: Driver behavior versus wildlife behavior/movement.
- Location: Project location and jurisdictions.
- Scale: Location-specific versus A larger scale.
- Proponent/Partners: Required proponents, champions, and partners.
- Prioritization: Consideration of project priority.
- Value: Cost/effort versus. benefit/impact.
- Innovation and Research: Opportunities to integrate innovation and research.

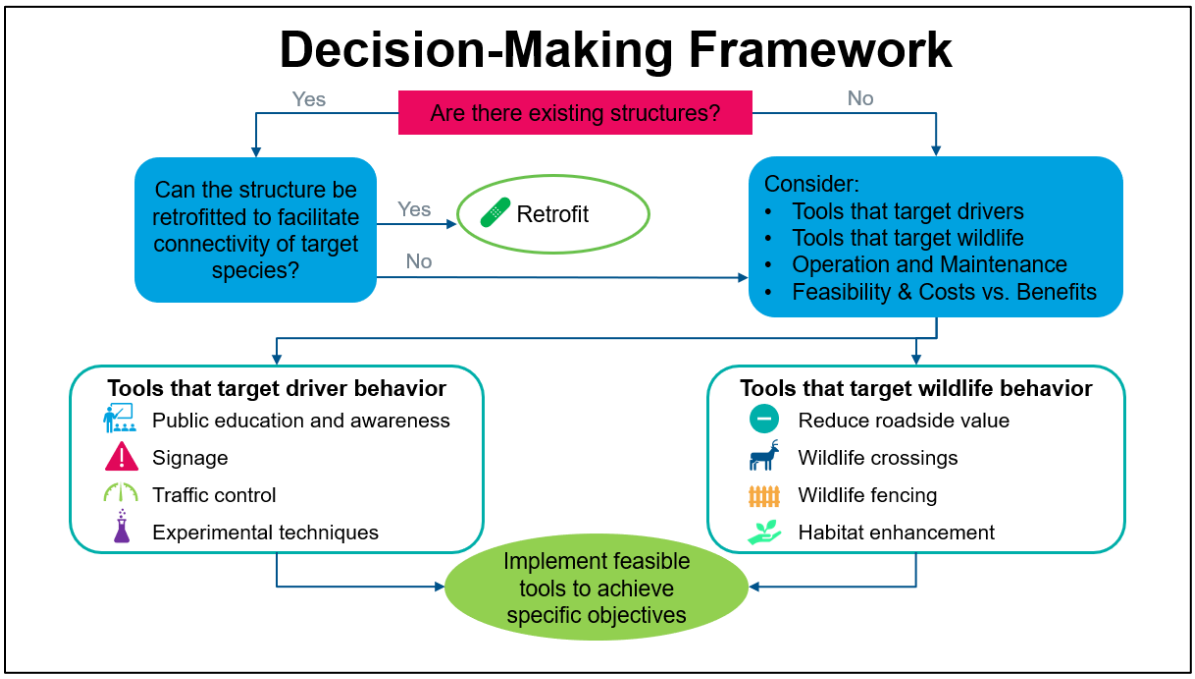



**Figure 5-2. Decision-Making flowchart for Identifying Connectivity Enhancement Tools**

## Step 3. Private Landowner and Public Engagement Plan

Following general community outreach in Step 1, project-specific efforts to engage with private landowners and public stakeholders should commence so that a Local Champion is identified early in the conversation. Engaging with these key figures and their own interests relevant to the project can result in greater collaboration for identifying solutions to issues regarding conflicts with the project and public or private land. Some potential candidates for the Local Champion could include county representatives, a local implementation team, large property owners, or nongovernmental organizations.

## Project Delivery

This section summarizes the planning steps that are generally consistent with standard project planning and development processes, as well as the ODOT project development process, which is detailed in the *Oregon Department of Transportation Project Delivery Guidebook* (ODOT 2017).

### Step 4. Develop Project Description, Goals, and Objectives

Following project selection, a detailed project description including project scope, goals, objectives, conceptual design, and project team must be developed.

### Step 5. Develop Partnerships Agreements (Partners/Agencies)

If a project is being developed by a multi-entity/multi-agency team, official agreements should be considered and may be required to specifically define the role and contributions (including financial) of each teaming entity/agency.

### Step 6. Identify and Apply for Funding

A variety of funding sources are available for the planning, design, and implementation of various connectivity enhancement tools. Funding may be available from state, federal, and tribal governments, as well as through nongovernmental organizations and the public. If a multi-entity/multi-agency team is partnering to develop a project, they may be able to use various funding types and sources to pool funds for a particular effort. See Chapter 6, *References and Resources*, *Case Studies,* for examples.

A list of potential funding and project support sources has been compiled and is provided in Appendix E.

Because this list can be maintained as a living document and updated as funding opportunities change over time, an electronic spreadsheet version of this list has been provided to the Tribe with a copy of this report.

### Step 7. Planning and Design

Project planning and design includes development of required project planning studies, including cultural and environmental studies, permitting, and approvals, as well as detailed project design plans, specifications, and cost estimates, which will be the final products used to construct/implement the project. During this phase, avoidance, minimization, and mitigation measures will be developed to avoid or reduce the project's potential impacts on cultural and environmental resources.

### Step 8. Project Construction, Implementation, and Operation

Once project planning and design have been finalized, the project may transition into the construction and implementation phases. Depending on the scope and scale of the project, these phases may last months to years, may require additional funding sources, and may need to adhere to construction programs and protocols required by the property owner or project proponent, such as the *Oregon Department of Transportation Construction Manual*. Avoidance, minimization, and mitigation measures are implemented during this phase to avoid/reduce the projects' potential impacts on cultural and environmental resources.

Once the project has been constructed and implemented, the operations (and maintenance) phase begins and may include long-term components, such as monitoring, community engagement, and adaptive management to ensure that the project meets the goals and objectives outlined in Step 4 above.

# Cost-Benefit Considerations

## Cost-Benefit Analysis

A cost-benefit analysis generally refers to the comparison of the benefits of projects and the costs associated with their implementation. This analysis may also be used to compare a variety of options and better understand the potential and relative costs, cost savings, and benefits. There are, however, limitations in the ability to accurately capture the true benefits of connectivity enhancement tools (e.g., due to limitations in quantifying the true economic value of individual animals or populations and experimental techniques and research); this continues to be an active area of research and development.

Importantly, demonstration of a return on investment is not always necessary to warrant investment into and/or development of connectivity enhancement tools, though it may be necessary for some funding opportunities or other programs (e.g., the ODOT All Roads Transportation Safety Program).

A growing body of research indicates that the benefits of properly designed wildlife connectivity tools, such as wildlife crossings paired with wildlife fencing, outweigh the cost of planning, constructing, and maintaining such projects. These benefits outweigh costs (i.e., result in returns on investments) due to the resulting reductions in WVCs, carcass removal, property damage, human injuries and deaths, impacts on wildlife populations, and loss of ecological processes.

Due to the range of connectivity enhancement tools available, their varying levels of effectiveness, benefits, and associated costs/cost savings, and the variety of scales they may be implemented in, the cost-benefits of connectivity enhancement tools must be approached on a project-by-project basis.

Several resources exist to support exploration of the costs and benefits of wildlife connectivity enhancement tools and are provided in Table 5-1.

**Table 5-1. Cost-Benefit Resources, Guidance, and Tools Related to Road Safety, WVC Reduction, and Connectivity Enhancement Tools**

| Resource Title | Description | Reference |
|---|---|---|
| Oregon Department of Transportation Highway Safety Improvement Program (HSIP) Guide | Provides an overview of the ODOT cost-benefit analysis approach and also includes an Excel workbook that can be used to calculate the benefit-cost ratio of a specific project. | https://fhwaapps.fhwa.dot.gov/hsip/Attachments/4d1ac21f-b42d-406b-88ea-cbc730070924_odot_safety_program_guide%5B1%5D.pdf |
| Cost–Benefit Analyses of Mitigation Measures Aimed at Reducing Collisions with Large | Provides estimated costs of WVCs with large mammals, estimated effectiveness of 13 connectivity enhancement tools, example cost- | Huijser, M.P., Duffield, J.W., Clevenger, A.P., Ament, R.J. and McGowen, P.T., 2009. Cost–benefit analyses of mitigation measures |

| Resource Title | Description | Reference |
|---|---|---|
| Ungulates in the United States and Canada: a Decision Support Tool | benefit analyses using 75-year horizons at various discount rates, and provide calculations, case studies, and decision support information for investigating the costs-benefits of mitigation aimed at reducing large mammal WVCs. | aimed at reducing collisions with large ungulates in the United States and Canada: a decision support tool. *Ecology and Society 14*(2). |
| Reducing Wildlife-Vehicle Collisions by Building Crossings: General Information, Cost Effectiveness, and Case Studies from the United States | A summary of general cost-benefit information related to WVC mitigation and examples of three case studies form western United States. | https://www.pewtrusts.org/-/media/assets/2020/02/reducing-wildlife-vehicle-collisions-by-building-crossingscllcpew-005.pdf |
| Wildlife-Vehicle Collision Reduction Study: Report to Congress | Details the causes and impacts of WVCs and identifies potential solutions to this growing safety problem. This report focuses on tools, methods, and other measures that reduce the number of collisions between vehicles and large wildlife, such as deer, because these accidents present the greatest safety danger to travelers and cause the most damage. The report also covers planning and design considerations and provides cost-benefit analyses for the mitigation methods that had sufficient data available to support these analyses. | https://www.fhwa.dot.gov/publications/research/safety/08034/ |
| Effectiveness of Wildlife Crossing Structures to Minimize Traffic Collisions with Mule Deer and Other Wildlife in Nevada | Nevada DOT evaluation of the effectiveness of wildlife crossing structures on Highway 93, between Wells and Contact, Nevada. We documented use of the crossing structures by mule deer as well as mortalities that occurred in that area associated with exclusionary structures. | https://www.dot.nv.gov/home/showdocument?id=6485 |
| Innovative Strategies to Reduce the Cost of Effective Wildlife Overpasses | This document compiles ideas and recommendations resulting from a facilitated workshop convened in October 2014, when prominent wildlife crossing practitioners from North America gathered to consider wildlife crossing structure planning, design and construction, with the goal of identifying ways to reduce costs in order to improve the feasibility of widespread implementation. | https://arc-solutions.org/wp-content/uploads/2017/04/ARC-Special-Pub-Design-Parameters.pdf |

# Effort versus Impact

Effort-versus-impact mapping provides a coarse-level tool to identify the relative effort (e.g., cost, timeframe, level of effort) and impact (e.g., magnitude of benefits), visualize the relative effort-impact of various projects, and build group consensus on the results. Effort-versus-impact mapping can facilitate differentiating low-hanging fruit and easy wins, prioritization of projects, project initiation approaches, and resources needed to achieve specific projects.

- During Workshop 3, workshop participants engaged in an effort-versus-impact activity, where potential projects were ranked collaboratively as a group discussion relative to the effort involved in implementing them (e.g., time, resources) versus the impact (e.g., the effect they would have on reducing WVCs or enhancing habitat connectivity for wildlife).

This activity was used to encourage discussion and understanding of the potential projects and what they would entail. The resulting effort versus impacts map (Figure 5-3) was generated by the workshop participants during this activity and Table 5-2 further summarizes the relative effort versus effectiveness (impacts) of each of the feasible connectivity enhancement tools.

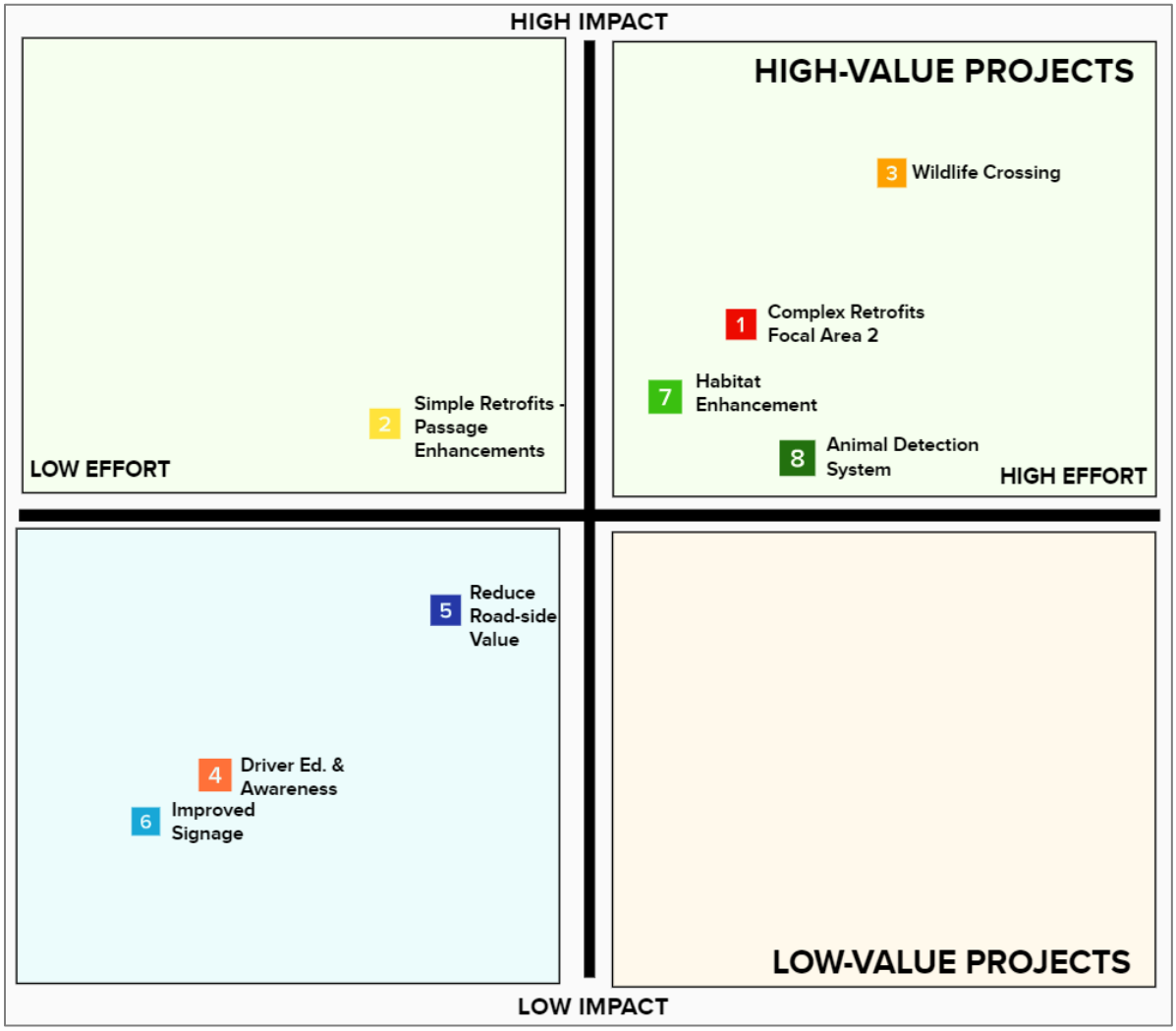


**Figure 5-3. Effort-versus-Impact Mapping Developed by Workshop Participants of Feasible Connectivity Enhancement Tools**

**Table 5-2. Relative Cost, Effectiveness, and Planning Timeframes for Each Connectivity Enhancement Measure**

| Mitigation Toolbox: | Price Range | Effectiveness at Reducing WVCs | Planning Timeframe |
|---|---|---|---|
| Public education and awareness | $ | Low | Short |
| Signage | $ | Low | Short |
| Traffic control | $ | Low | Medium |
| Experimental techniques | $$ | Unknown[a] | Medium |
| Reduce roadside value | $ | Medium | Short |
| Retrofit | $$ | Medium - high | Medium |
| Wildlife crossings | $$$ | High[b] | Long |
| Wildlife fencing | $$ | High | Medium |
| Habitat enhancement | $$ | Unknown | Medium |

Key:
Price Range: $ (tens of thousands); $$ (hundreds of thousands); $$$ (millions)
Effectiveness: High, medium, low, unknown
Planning Timeframe: short (1–3 years); medium (4–9 years); long (10+ years)
[a] – Limited number of available applications/studies
[b] – High effectiveness when coupled with wildlife fencing

# Wildlife Crossing Structure Placement and Design

Details on wildlife crossing structure, wildlife fencing, and wildlife escape ramp placement and design guidance is provided in Appendix F. Using the following guidance, to identify potential locations within the focal areas that may be suitable for new Wildlife Crossing Structures, the focal areas were analyzed based on the following methodology:

**Step 1** – Identify Locations within focal areas with approximately 1 mile or greater between existing crossing structures

- Note: existing structures are assumed to be retrofitted in future to enhance passage ability for mule deer and other species.
- Resulting nine (9) locations are Connectivity Enhancement Opportunity Areas

**Step 2** – Filter above locations based on potential feasibility for WCS (underpass/overpass).

- Are there any landscape conditions that may prohibit a WCS? Example: Is the road in this area located immediately adjacent to the river?
- If not, there may be other connectivity enhancement measures that may be applicable in this location. See Chapter 4 for a complete list of feasible measures.
- Note - these areas could be reviewed further with an engineer and could also be candidates for other connectivity enhancement measures e.g., Animal Detection Systems

**Step 3** – Identify Wildlife Crossing Structure Opportunity Areas based on the following criteria and prioritize based on quality/suitability of criteria in each location:

- Suitable habitat on either side of roadway
- Compatible land ownership
- WVC/Crossing hot spot
- Suitable topography and hydrology

A map of the resulting opportunity areas in provided below followed by results of the analysis.

This page was intentionally left blank.

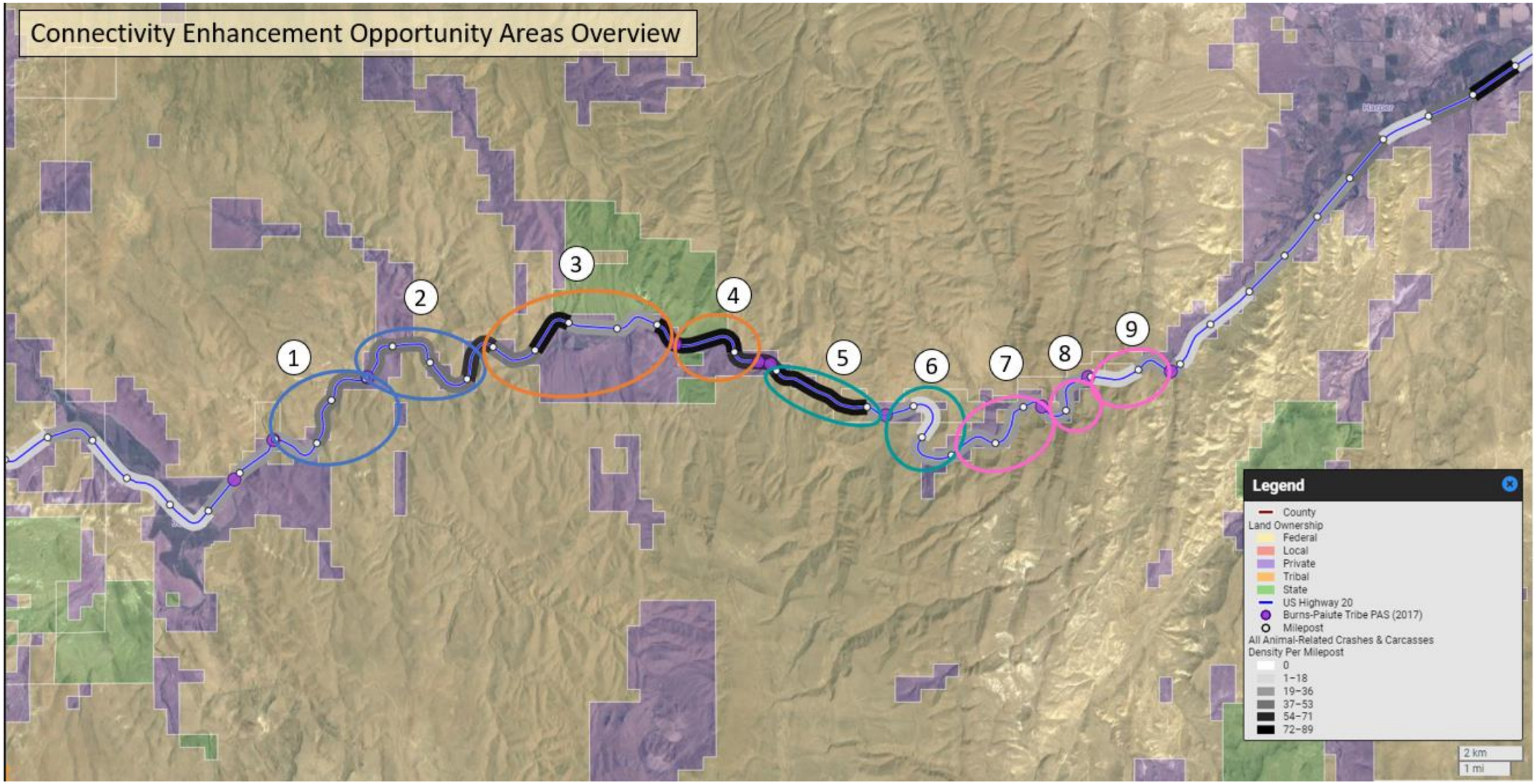



**Figure 5-4 Connectivity Enhancement Opportunity Areas Overview. Color corresponds to each focal area (focal areas 1-4)**

This page was intentionally left blank.

# Results

## Most Feasible

Most feasible and high priority location eligible for a WCS is Area #3 (meets all 4 criteria above).

An overpass is recommended at this location.

## Possibly Feasible

Other areas that *may* be candidates include Area #2, Area #4, and Area #7 though their feasibility and priority will depend on landowner details (adjacent landownership is currently unknown) *and* engineering input due to the roadway' s proximity to the river.

## Least Feasible

Areas that are unlikely to be feasible for WCS include Areas #1, #5, #6, #8, #9. These areas are likely unfeasible for WCS due to the roadway's proximity to the river. These conditions will make it much more challenging and expensive to construct a WCS. If considered, input from ODOT engineering will be imperative very early in the planning phase.

Details on wildlife crossing structure, wildlife fencing, and wildlife escape ramp placement and design guidance is provided in Appendix F.

Chapter 6
# References and Resources

# Case Studies

## Lava Butte Highway Expansion

Mule deer herd utilizing the dedicated underpass

Between 2011-2012, the Oregon Department of Transportation expanded U.S. Route 97 with two additional lanes. Part of this expansion included incorporating wildlife crossing structures and wildlife crossing-related elements with a focus on increasing mule deer connectivity between summer and winter ranges. This included adding 4 miles of 8-foot-tall wildlife fencing on both sides of the road, 4 jump-outs (escape ramps) designed to allow animals that venture onto the roadway to exit the roadway, Electromats™ at fence ends to keep wildlife from entering the roadway at intersections, a wildlife undercrossing, and a second multi-use wildlife-human underpass alongside a seasonally closed road. The total cost for creating this wildlife passage program was $3.03 million, or 16% of the $18.9 million project (ODOT 2021). Costs for the various wildlife crossing-related elements totaled $3,030,000 and included:

- Wildlife Fencing (4 miles): $430,000
- Wildlife Jump-outs (4): $15,000
- ElectromatsTM (6): $380,000
- Dedicated undercrossing (1): $755,000
- Multi-Use Wildlife Underpass at the Crawford Rd, wildlife portion (1): $1,450,000

After construction, the 4-mile fenced area encompassing the new wildlife crossings and wildlife crossing-related elements had an approximately 86% decrease in deer-vehicle collisions compared to the adjacent unfenced stretches following the completion of the wildlife crossing structures (Thompson et al. 2018; ODOT 2021). The wildlife underpass structures do appear to be mitigating the risk of collisions to both wildlife and drivers within the fenced areas. However, it is worth noting that although it was not statistically significant there appeared to be an increase in deer-vehicle collisions within 0.5 mile of fence ends post-completion of the wildlife crossing structures (Thompson et al. 2018). This was most pronounced on the south end and exemplifies the importance of post-construction monitoring and adaptive management and carefully designing fences and fence ends.

Mule deer were documented utilizing both the standalone wildlife underpass and the multi-use wildlife-human underpass alongside Crawford Road (Bliss-Ketchum and Parker 2015, Thompson et

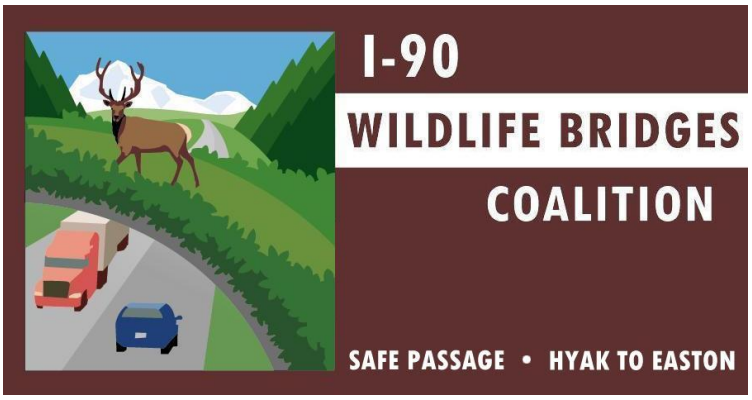
al. 2018). In the first couple of years, the Electromats™ had limited utility at keeping deer off the roadways as they did not consistently function. Snow and gravel accumulated on these mats in the winter months, and gaps were left between the fence ends and the Electromats™ (Bliss-Ketchum and Parker 2015). However, their utility has been greatly improved via road crew clearing and maintenance prior to migration season (ODOT 2021). Although mule deer were getting onto the roadway, they did not appear to be using the jump-outs to exit the roadway with much frequency. In 2013-2014, mule deer successfully used the jump-outs 3% of the time and attempted to use or investigate them an additional 16% of the time (Bliss-Ketchum and Parker 2015). There was no successful use of the jump-outs by mule deer documented in 2015-2017 (Thompson et al. 2018). Bliss-Ketchum and Parker (2015) and Thompson et al. (2018) blamed the low rates of use of the jump-outs primarily on the height of the jump-outs and a lack of stability at the edge. This information further stresses the importance of post-construction monitoring, adaptive management, and careful design practices.

The wildlife crossing structures on U.S. Route 97 do provide safe passage for wildlife under the highway and have reduced deer-vehicle collisions within the fenced area. However, better siting and configuration of the fence ends, as well as improvements to the jump-outs design would likely improve the efficacy of this four-mile stretch for wildlife connectivity and driver safety (Thompson et al. 2018).

Links to additional case study information:

- Oregon Conservation Strategy Spotlight: https://oregonconservationstrategy.org/success-story/us-97-wildlife-crossing/
- Lava Butte wildlife crossing effectiveness report: https://www.oregon.gov/odot/GeoEnvironmental/Documents/Wildlife-Crossing-Report_Lava-Butte.pdf
- Lava Butte Wildlife Crossing Monitoring Project Report: https://digital.osl.state.or.us/islandora/object/osl%3A8192/datastream/OBJ/view

## I-90 Wildlife Bridges Coalition




The I-90 Snoqualmie Pass East Project is a highway expansion occurring along a 15-mile stretch of Interstate 90 in Washington State, between Hyak and Easton. The area is undergoing construction, which started in 2009, to expand the current four-lane highway into a six-lane highway over a 20-year timeline. This area has historically suffered from dilapidated roadway conditions, traffic congestion, high levels of WVCs, and avalanche exposure resulting in road closures. These challenges along with the economic importance of I-90 prompted the highway expansion project.

Formed in 2004, the I-90 Wildlife Bridges Coalition brought diverse stakeholders together to advocate for and ultimately support the high-quality final design for the I-90 Snoqualmie Pass East Project. The I-90 Bridges Coalition emerged from efforts made by The Cascades Conservation Partnership to preserve and acquire up to 45,000 acres of forest land across the project area from 2000 to 2004. From there, the I-90 Wildlife Bridges Coalition emerged to further protect resources for both terrestrial and aquatic wildlife attempting to cross through the interstate barrier. The coalition succeeded in attracting a wide range of support from citizens, organizations, state representatives, and even from the U.S. senator representing Washington State, Patty Murray. These key figures helped elevate the issue such that conservationists and roadworkers alike worked together to garner support for the coalition from 2004 through April 2018 when the coalition finally disbanded. The administrating organization for the I-90 Bridges Coalition was the non-profit Conservation Northwest, who continue to work with partnerships and other endorsing organizations for the remaining construction efforts along the highway to this day.

The I-90 Snoqualmie Pass East Project successfully included high-quality wildlife connectivity measures including multiple wildlife crossings into the project design that was ultimately made possible through the I-90 Wildlife Bridges Coalition collaborations, the project's transportation planners, engineers, and biologists, and through greater outreach to the public in the form of environmental education. The I-90 Wildlife Bridges Coalition held programs teaching kids of the importance of wildlife connectivity and wildlife crossings and Washington State Department of Transportation (WSDOT) held public meetings to open a public and community forum in discussing the importance of creating wildlife crossings for both conservation and road safety.

The I-90 Wildlife Bridges Coalition supported studies on wildlife movement across the highway via snow tracking, automatic camera surveys, small mammal trapping, and GPS monitoring helped inform the science behind wildlife crossing development and identifying "connectivity emphasis areas" to inform engineering decisions. The project's engineering accomplishments have been incredible and include over 20 wildlife undercrossings and two iconic wildlife overcrossing structures. Habitat restoration including wetland restoration was also included into project design to improve the availability of natural habitat within the region and support use of the new wildlife crossings and has been very sucessful. Multiple undercrossings and the first wildlife overpass have already been constructed and after two years since construction are already being used regularly by a wide variety of wildlife including deer, elk, bear, mountain lion, and many others. Through July 2021 nearly 14,000 animals have been documented successfully moving through the crossing structures. Since wildlife fencing was installed, only one WVC has been documented in the fenced portion of the project area. To date, 7.5 more miles of the project are slated for additional highway improvements along with additional wildlife crossings slated to be installed.


Deer utilizing the wildlife undercrossing at Gold Creek.
Photo Credit: Conservation Northwest

The story of the I-90 Snoqualmie Pass East Project, the I-90 Wildlife Bridges Coalition, and the astounding successes of their collaborations can be seen in the documentary film Cascade Crossroads (linked below). The I-90 Snoqualmie Pass East Project, represents incredible achievements in engineering and connectivity and is testament to the importance of diverse collaborations and community education and outreach. This project serves as a beacon for similar transportation projects demonstrating that we can successfully harmonize infrastructure with the natural world.

Links to additional case study information:

- Cascade Crossroads Documentary (https://vimeo.com/248393286)
- Documentary highlighting the success and monitoring results of the project (https://www.youtube.com/watch?v=Cf5nMLrlgW4)
- I-90 Wildlife Bridges Coalition (i90wildlifebridges.org)
- I-90 Wildlife Corridor Campaign (https://www.conservationnw.org/our-work/habitat/i-90/)
- WSDOT I-90 - Snoqualmie Pass East project information (https://wsdot.wa.gov/Projects/I90/SnoqualmiePassEast/Default.htm)

## Highway 89 Stewardship Team

The Highway 89 Stewardship Team is a collaboration initiated in 2002 comprised of a multi-faceted group of individuals stemming from various agencies and institutions (including Sierra County Fish and Wildlife Commission [FWC], Sierra County Board of Supervisors [BoS], USDA Forest Service: Tahoe National Forest & Pacific Southwest Research Station, California Department of Fish and Game, California Department of Transportation, University of California Berkeley: Sagehen Creek Field Station, University of California, Davis, and more) coming together with the same concern: to minimize the increasing number of animal-vehicle collisions while simultaneously improving habitat connectivity along Highway 89 in California.

The Highway 89 Stewardship Team formed in 2002 because of increasing deer-vehicle collisions along Highway 89 in the area north of Lake Tahoe in the Sierra Nevada Mountain range from the town of Truckee to Sierraville in the Tahoe National Forest. Like many other highways, Highway 89 poses a threat to wildlife by acting as a barrier to wildlife movement and connectivity. The I-89 Stewardship Team's main objectives were constructed around these core issues: to reduce WVCs, to increase traveler safety, and to maintain wildlife habitat connectivity using research, education, and collaboration.

This Highway 89 Stewardship Team's unique approach to addressing and achieving these objectives is based on a using a combination of applying research, targeted outreach and education, and implementation of mitigation strategies. All of these were put into action at the Kyburz Flat area, which involved conducting wildlife movement studies, WVC studies, and subsequent design and construction of a new wildlife underpass and wildlife fencing to facilitate wildlife movement and connectivity. The Kyburz Flat project was funded by Caltrans enhancement funds, and the area was selected after data analysis revealed it was deer-vehicle collision "hotspot" and warranted mitigation. The applied research conducted in the Kyburz Flat area included radio-collaring and monitoring herds of deer which facilitated the siting and construction of the wildlife underpass and wildlife fencing.

The Sagehen Twin Underpass was a similar project that was initiated by the Highway 89 Stewardship Team. This project was also developed using available data on wildlife movement and WVCs. The project entailed twin underpasses which would not only facilitate safe wildlife movement under Highway 89 but also would serve as an opportunity to conduct controlled experimental research on wildlife use of underpasses, with the idea that one underpass may serve as a control to experimental conditions imposed on the second "twin" underpass. Sagehen Twin Underpass project was built in 2017 and constitutes another major success of the Highway 89 Stewardship Team.

The Highway 89 Stewardship Team also implemented important education and outreach to the community at large. The educational and outreach components is varied and ranges from summer youth programs (i.e., teaching youth how to extrapolate data from motion-detector cameras) to public presentations like the Sagehen Summer Speaker series to better inform the community of the need for wildlife crossings. There are also University-level professional courses regarding these management techniques that are taught nationwide and are in part based on knowledge and data gained by the I-89 Stewardship Team.

Although WVC data are not available for the Kyburz Flatproject and Sagehen Twin Underpass areas, it has been reported that only one WVC of a mule deer has been documented in the area over 5 years post construction.

Costs for the various wildlife crossing and construction-related elements at the Sagehen Twin Underpass project totaled $2,078,000 and included:

- Wildlife Fencing (2.7 miles): $213,000
- Wildlife Jump-outs (4): $20,000
- Dedicated undercrossings (two 12' x 10'box culverts): $200,000

The unique projects like the Kyburz Flat project and Sagehen Twin Underpass project help define I-89 as a model for human-wildlife research and for future roadway developments across wildlife corridors. Further developments in creating warning devices or retrofitting structures for mammal passage are expected from the Highway 89 Stewardship Team. Through increased research and through community education and outreach, this area will serve to be one of the leading examples for collaborative approaches to experimental design in wildlife crossings and roadway safety that can inform future infrastructure developments nationwide.

Viewing the old structure adjacent to the newly constructed Kyburz Flat underpass. Photo Credit: US Forest Service

Links to additional case study information:

- Sagehen Creek Field Station – Hwy-89 Road Ecology: https://sagehen.ucnrs.org/research/hwy-89-road-ecology/
- Wildlife Crossings Toolkit - Tahoe National Forest: Highway 89 Stewardship Team: https://www.fs.fed.us/wildlifecrossings/case-histories/public-lands/Highway89StewardshipTeam.php
- Highway 89 Stewardship Team Presentation: https://sierranevadaalliance.org/wp-content/uploads/Sandra-Jacobson.pdf
- Sierraville (California) Highway 89 Stewardship Team: Ahead of The Curve: https://escholarship.org/uc/item/4t926516
- USDA: Wildlife Underpass to Benefit Animals, Drivers: https://www.fs.usda.gov/features/wildlife-underpass-benefit-animals-drivers

# Planning and Development Resources

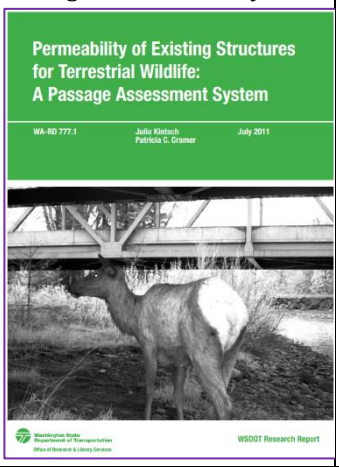
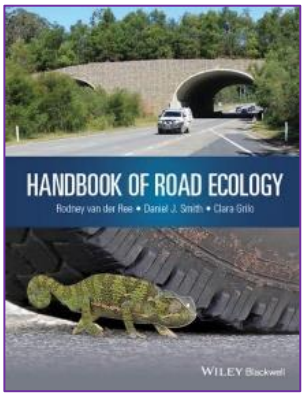
## Online Resources

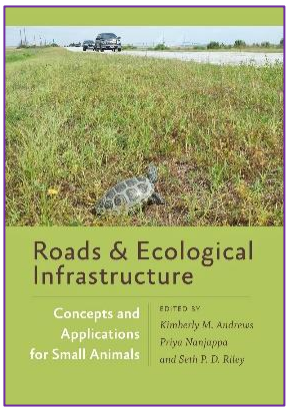
| Resource | Description | Link |
|---|---|---|
| ARC Solutions | The homepage for ARC (*Animal Road Crossing*) that provides background on the organization's work towards improving coexistence between humans and wildlife through innovative wildlife crossing solutions. Provides many resources and links for case studies and ongoing wildlife crossing developments. | https://arc-solutions.org/ |
| ARC Solutions Wildlife Crossing FAQs | FAQs on wildlife crossings regarding their design, societal benefits, necessity, and outreach/further education on the topic. | https://arc-solutions.org/wp-content/uploads/2021/01/ARC-Special-Pub-FAQs-online.pdf |
| ARC Solutions: Wildlife Crossing Success Stories in the Western States | A webpage by ARC that outlines numerous case studies and successful implementations of wildlife crossing structures throughout eleven western states. | https://arc-solutions.org/wp-content/uploads/2021/01/ARC-Solutions-Success-Stories-online.pdf |
| Safe Passage: The I-40 Pigeon River Gorge Wildlife Crossing Project | Detailing the current efforts to reduce wildlife mortality along I-40 throughout the Southern Appalachian Mountains. Provides a detailed background of the diverse coalition fronting the effort and the resources of similar ongoing projects attempting to reduce WVCs. | https://smokiessafepassage.org/ Habitat Connectivity & the Pigeon River Gorge (arcgis.com) (storyboard) |
| US 93 North Wildlife Passages – People's Way Partnership | Discusses the importance and need for further wildlife crossing structures along U.S. Highway 93 North on the Flathead Indian Reservation and beyond. Additionally provides resources detailing the research, history, and ongoing education about Montana's existing and future wildlife crossing structures. | People's Way Partnership – The Western Transportation Institute |
| US State DOT Wildlife Crossing Structures | This website functions as an expansive library containing case studies, manuals, and guides relevant to wildlife crossing designs and implementations throughout the United States and internationally. | Home - US State DOT Wildlife Crossing Structures - LibGuides at National Transportation Library |
| Oregon State Government Wildlife Crossings Site | Provides links to data, brochures, public outreach and educational information and materials, and government contacts on wildlife crossings in Oregon. | https://www.oregon.gov/odot/GeoEnvironmental/Pages/Wildlife.aspx |

| Resource | Description | Link |
|---|---|---|
| USDA Forest Service Wildlife Crossings Toolkit | The Wildlife Crossings Toolkit provides information for terrestrial biologists, engineers, and transportation professionals to assist in maintaining or restoring habitat connectivity across transportation infrastructure on public lands. | https://www.fs.fed.us/wildlifecrossings/ |
| Effectiveness of Seasonal Deer Advisories on Changeable Message Signs as a Deer Crash Reduction Tool | 2018 Virginia DOT study investigated the effectiveness of seasonal deer advisory messages as a Deer-Vehicle Collison mitigation option and provides findings and recommendations. | https://www.virginiadot.org/vtrc/main/online_reports/pdf/19-r8.pdf |
| Wildlife Crossing Structures Transportation Library | This LibGuide was created in response to a request for information and resources used by state DOTs for the design of wildlife mitigation structures. It has since grown through the contribution of many transportation librarians, researchers and others throughout the United States and Canada. | https://transportation.libguides.com/WildlifeCrossing |
| Oregon Department of Fish and Wildlife Management Plans<br>Mule Deer and Elk | Management plans including management objectives as well as habitat enhancement and restoration opportunities and priorities for various species native to the region, including mule deer and elk. | https://www.dfw.state.or.us/resources/hunting/big_game/mule_deer/docs/Mule_Deer_Mgmt_Plan_Final.pdf |

# Guidebooks and Manuals

| Resource | Description | Link |
|---|---|---|
| Wildlife Crossing Structure Handbook, Design and Evaluation in North America | A handbook that functions to educate about the history of human-wildlife interaction issues and offers solutions to design and maintain wildlife crossings for effective methods preserving safe animal passage through human corridors. | https://www.researchgate.net/publication/277003400_Wildlife_Crossing_Structure_Handbook_Design_and_Evaluation_in_North_America |
| Construction Guidelines for Wildlife Fencing and Associated Escape and Lateral Access Control Measures | This report summarizes the breadth of research regarding wildlife fencing/jumpout measures and further develops how these tools function as forms of mitigation and weighs their benefits through cost-benefit analyses. | http://onlinepubs.trb.org/onlinepubs/nchrp/docs/NCHRP25-25(84)_FR.pdf |
| Arizona Game and Fish Guidelines for Wildlife Compatible Fencing | The Arizona Game and Fish Department (Department) developed these guidelines to assist the landowner, project manager, land management agency, and others in designing wildlife compatible fences. The focus is on fence design rather than detailed fence construction specifications. The goal is to provide guidance in designing a fence that will achieve its objective with minimum impact to wildlife. | https://s3.amazonaws.com/azgfd-portal-wordpress/PortalImages/files/wildlife/planningFor/wildlifeFriendlyGuidelines/110125_AGFD_fencing_guidelines.pdf |
| Montana Fish Wildlife and Parks: A Landowner's | The Montana Department of Fish, Wildlife and Parks 2012 second edition, the material has been revised and updated, benefitting from the | https://myfwp.mt.gov/getRepositoryFile?objectID=34461 |

| Resource | Description | Link |
|---|---|---|
| Guide to Wildlife Friendly Fences | creative ideas and practical experience of landowners and resource professionals who have adopted a wildlife friendly approach to their<br>Operations. This guide will help you construct and modify fences and crossings that are friendlier to wildlife while still meeting fencing needs | |
| Wildlife-Vehicle Collision Reduction Study: Report to Congress | This study details the causes and impacts of WVCs and identifies potential solutions to this growing safety problem. The report focuses on mitigation methods that reduce the number of collisions between vehicles and large wildlife, such as deer, because these accidents present the greatest safety danger to travelers and cause the most damage. | https://www.fhwa.dot.gov/publications/research/safety/08034/08034.pdf |
| Permeability of Existing Structures for Terrestrial Wildlife: Developing a Passage Assessment System<br>  | The Passage Assessment System (PAS) was developed to help the Washington State Department of Transportation (WSDOT) evaluate existing transportation infrastructure for its ability to facilitate terrestrial wildlife movement from one side of a roadway to the other. The outcomes of this research provide mechanisms to allow transportation agencies to identify both opportunities and barriers to wildlife passage along roads. | https://wsdot.wa.gov/Research/Reports/700/777.1.htm |
| The Handbook of Road Ecology<br>  | This book presents a wide expanse of knowledge on road design with respect to wildlife movement, taking into account the planning, funding, design, construction, and maintenance requirements necessary for a successful wildlife crossing structure, including retrofitting existing structures. | Handbook of Road Ecology \| Ensuring tomorrow's linear infrastructure is as green as possible |
| Roads and Ecological Infrastructure – Concepts | This book offers insight from both transportation and ecological perspectives about the importance in designing roads such | Project MUSE - Roads and Ecological Infrastructure (jhu.edu) |

| Resource | Description | Link |
|---|---|---|
| and Applications for Small Animals   | that there's reduced conflict between humans and small animals attempting to cross. The book delves into animal behavior in relation to roads and offers solutions for roadway engineers to mitigate for such conflicts. | |
| Wildlife Crossings<br>Rethinking Road Design to Improve Safety and Reconnect Habitat<br>Portland State University Planning Workshop<br>June 2003 | Metro's Green Streets handbook presents methodologies and design solutions for minimizing the impact of roads on the natural environment in the Portland metropolitan region. Green Streets includes wildlife crossings as part of its toolkit of options. This guidebook, Wildlife Crossings: Rethinking Road Design to Improve Safety and Reconnect Habitat, expands on Metro's previous work and provides guidance on how to develop wildlife crossings in this region. | https://www.fws.gov/oregonfwo/toolsforlandowners/urbanconservation/greenspaces/Documents/Projects/2002/6505.0204/Wildlife%20Crossings_final.pdf |

# Chapter 7
# References


Bliss-Ketchum, L., and C. Parker. 2015. Lava Butte wildlife crossing monitoring project. Final report, Portland State University, Portland, Oregon, USA.

Burns Paiute Tribe. 2016. Mule Deer-Vehicle Collisions in Eastern Oregon: A Case for Mitigation Strategies. Available: https://www.arcgis.com/apps/MapJournal/index.html?appid=a5edb30ef896495fa849cbe5690d455c%20.

Charry, B., and J. Kintsch. 2015. Maine Terrestrial Wildlife Crossings Survey Report: Potential for Retrofitting Transportation Infrastructure to Benefit Movement of Terrestrial Wildlife. Maine Audubon.

Donaldson, B.M., and N.W. Lafon. 2008. Testing an integrated PDA-GPS system to collect standardized animal carcass removal data on Virginia roadways (No. FHWA/VTRC 08-CR10). Virginia Transportation Research Council.

Fischer, J., and D.B. Lindenmayer. 2007. Landscape modification and habitat fragmentation: a synthesis. *Global Ecology and Biogeography* 16(3):265–280.

Huijser, M.P., Duffield, J.W., Clevenger, A.P., Ament, R.J. and McGowen, P.T., 2009. Cost–benefit analyses of mitigation measures aimed at reducing collisions with large ungulates in the United States and Canada: a decision support tool. Ecology and Society, 14(2).

Huijser, M.P., P. McGowan, A.P. Clevenger, R. Ament, and L. Berger. 2008. Wildlife-Vehicle Collision Reduction Study: Best Practices Manual: Report to Congress.

Kintsch, J., and P. Cramer. 2011. Permeability of existing structures for terrestrial wildlife: a passage assessment system (No. WA-RD 777.1). Washington (State). Dept. of Transportation. Office of Research and Library Services.

Olson, D.D., J.A. Bissonette, P.C. Cramer, A.D. Green, S.T. Davis, P.J. Jackson, and D.C. Coster. 2014. Monitoring wildlife-vehicle collisions in the information age: how smartphones can improve data collection. *PloS one* 9(6):98613.

Oregon Department of Fish and Wildlife (ODFW). 2020. Big Game Population Survey Data. Mule Deer Population Estimates, Composition, and Over-Winter Fawn Survival 2015-2019. February 25, 2020. Available: https://www.dfw.state.or.us/resources/hunting/big_game/controlled_hunts/docs/hunt_statistics/19/Mule%20Deer%20Population%20Estimates,%20Composition,%20and%20Over-Winter%20Fawn%20Survival%202015%20-%202019.pdf. Accessed: December 2020.

Oregon Department of Transportation (ODOT), 2020. 2019 OREGON MILEAGE REPORT. Transportation Data Section Road Inventory & Classification Services. August 2020. Available: https://www.oregon.gov/odot/Data/Documents/OMR_2019.pdf. Accessed: December 2020.

Oregon Department of Transportation 2021 personal communication Cidney.N.BOWMAN@odot.state.or.us.

Oregon Department of Transportation. 2017. Project Delivery Guidebook. Available: https://www.oregon.gov/odot/ProjectDel/Documents/SBS-Guidebook.pdf

Shilling, F., Waetjen, D., and Harrold, K., 2017. Impact of Wildlife-Vehicle Conflict on California Drivers and Animals. Road Ecology Center, UC Davis.

Soule, M. E., & Gilpin, M. E. (1991). The theory of wildlife corridor capability. In A. Denis, & J. H. Richard (Eds.), Nature conservation 2: The role of corridors. Surrey Beatty & Sons.

Thompson, J., B. Moser, and L. A. Starcevich. 2018. Lava butte wildlife crossing effectiveness. Final Report 2015-2017. WEST Inc. Corvallis, Oregon, USA.

Appendix A

# Highway 20 Wildlife Passage Assessment

# Eastern Oregon Large-Structure Generalist Crossings Survey Report: Potential for retrofitting transportation infrastructure to benefit movement of all Crossing Guilds (with a focus on large-structure generalists)

**Calla Hagle**
**Burns Paiute Tribe Wildlife Biologist**

**Ben Cate**
**Burns Paiute Tribe Wildlife Program Manager**

**Jason Kesling**
**Burns Paiute Tribe Natural Resources Program Director**

**January 2017**

**In Collaboration with:**
**Oregon Department of Transportation, Ken Patterson**
**Oregon Department of Transportation, Cidney Bowman**
**Oregon Department of Fish and Wildlife, Simon Wray**
**Oregon Department of Fish and Wildlife, Scott Torland**

## Table of Contents

# I. Passage Assessment System Introduction

During the winter of 2017, the Burns Paiute Tribe and its partners — the Oregon Department of Transportation, Oregon Department of Fish and Wildlife— conducted a pilot project to survey and evaluate existing road crossings for retrofit potential. This project used a modified versions of the "Permeability of Existing Structures for Terrestrial Wildlife: A Passage Assessment System (PAS)" developed for the Washington State Department of Transportation in cooperation with the U.S. Department of Transportation, Federal Highway Administration (Kintsch and Cramer 2011) and the Maine Terrestrial Wildlife Crossings Survey Report: Potential for Retrofitting Transportation Infrastructure to Benefit Movement of Terrestrial Wildlife (Charry and Kintsh 2015). The PAS was modified to only assess the retrofit potential of structures for large structure generalists like Rocky Mountain elk and mule deer.

## Project Goals

The goals of this pilot project were to investigate the following:

- What types of bridges and culverts are present in the Juntura-Harper area?
- Can existing road crossing structures be retrofitted for large-structure generalist wildlife passage?
- What types of retrofit solutions are possible for Juntura-Harper existing bridges and culverts?
- Can this survey method be used to inform opportunities for integrating connectivity for Large-Structure Generalists into already planned bridge and culvert replacement projects?

## Study Areas

The PAS was applied to 33 miles of Highway 20 between Juntura, OR and Harper, OR, in the Malheur River Basin of Eastern Oregon. The region is rural and sparsely developed with few public roads. Highway 20, which follows the Malheur River, is the main artery to the Eastern Oregon region. This landscape is primarily composed of sagebrush-steppe rangelands with few perennial streams. The mainly seasonal streams are flashy due to short periods of rainfall and steep slopes. Much of the highway-adjoined area at the river-valley bottom is relatively flat and sparsely vegetated, however there are sections of riparian vegetation adjacent to the Malheur River. In some sections, steep talus slopes or smaller hills abut the highway.

Wide ranging species such as mule deer and elk occur in this region. The study section of highway 20 has been identified as a potential habitat barrier, to mule deer in particular as highway 20 bisects the winter range of this species. Mule deer, in addition to other species, are highly susceptible to road mortality. Passage routes through this section of highway needs to be maintained to proactively preserve wildlife movement. Wildlife use the north side of the highway, which is preferred habitat to many species throughout the year, as well as the south side of the highway where the Malheur River, and its adjacent riparian cover, is a primary water and cover source.

## Methods

We used a modified PAS to conduct 2 day-long surveys in teams of 2 in January 2017. Only those structures with retrofit potential for Large-Structure Generalists and Cover Obligates were surveyed. We took multiple photographs at all survey sites. We entered survey results into a Microsoft Access database.

# II. Summary Findings

## Overview

We inventoried a total of 10 structures along 33 miles of Highway 20 (Table 1). Of these, we identified 8 as retrofittable, and 2 as having limited retrofit opportunity. All of the inventoried structures have some retrofit opportunity. The remaining 18 culverts offered no retrofit opportunities for large-structure generalists.

**Table 1. Structures Inventoried**

| Structure Type | Total |
|---|---|
| Small Culvert (<5' width x height) | 18 |
| Medium Culvert (5' to <8' width x height) | 0 |
| Large Culvert (≥ 8' x 8' width x height) | 0 |
| Bridge | 10 |

All of the bridge structures we inventoried have some opportunity for retrofit, although the degree of opportunity varied (Table 2).

**Table 2. Retrofit potential for inventoried road segments**. Length refers to the length of the road segment; # is the number of structures inventoried in that segment. Retrofit potential at each location was categorized as 'yes', 'yes-limited', or 'no'. Percent retrofittable is the number of structures in a road segment that were identified as having some retrofit opportunity (i.e. either 'yes' or 'yes-limited').

| Name | Length (miles) | # | Retrofit – Yes | Retrofit – Yes, Limited | Retrofit – No | % Retrofittable |
|---|---|---|---|---|---|---|
| Juntura-Harper: US Hwy 20 | 33 | 10 | 9 | 1 | 0 | 100% |

## Aquatic Crossings

Many of the structures we surveyed have an aquatic component, which may preclude or inhibit passage by terrestrial wildlife. We identified seventy-nine sites, or 100%, as having an aquatic component that may interrupt passage use (i.e. either intermittent or perennial flows).

Culverts and bridges are typically installed to channel ephemeral and permanent water flows under the road without damaging the roadbed itself and are not designed to accommodate terrestrial wildlife passage. Structures with intermittent water flows may be functional for terrestrial wildlife passage where the timing of wildlife movements does not overlap with spring run-off or seasonal storms. Structures with perennial flows require dry pathways, such as stream banks, through the structure to allow wildlife passage. In some cases, wildlife may be willing to walk through shallow water where no dry pathway is present.

Issues encountered in surveys include:

- Lack of stream banks through the bridge to provide a dry pathway;
- Extensive stream bed material around structure entrances and along stream banks, which can

inhibit wildlife from entering into or traveling through the structure.

Some culverts and bridges may be retrofit to enhance passage by terrestrial wildlife. In the future, we hope that stream crossing replacement projects will consider terrestrial wildlife passage needs during planning and design so terrestrial passage can be integrated with goals of restoring stream geomorphology and reducing stormwater impacts. Designing and constructing road-stream crossings to meet all these needs from the outset offers much higher potential for being cost effective in meeting crossing needs for the full range of wildlife moving through the area.

Figure 1. Extensive stream bed material under bridge

Figure 2. Narrow bank through structure

# III. Retrofit Solutions

This section discusses retrofit opportunities for common issues identified during the survey. These concepts provide general guidance for improving passage for terrestrial wildlife at locations identified in Section IV. Further site assessments will be required for creating engineering designs of any improvements. Ultimately, determining whether or not to retrofit a given location will depend on several factors:

- What is the condition of the bridge or culvert – is it structurally sound or is it degraded?
- What is the value of the location for the species for which it can be retrofit, and is good quality habitat present on both sides of the structure? Is that habitat likely to remain somewhat intact?
- What is the potential for a retrofit to increase wildlife passage, decrease road mortality, and reduce safety hazards to motorists?
- What is the cost-effectiveness of retrofitting at the location as a temporary or permanent solution for improved wildlife passage?

For each road segment we inventoried, Table 4 summarizes the common types of retrofits we recommend at different structure locations for improving terrestrial wildlife passage. At a given structure location there may be more than one retrofit recommendation (e.g. create a dry pathway and add wildlife guide fencing). Detailed retrofit recommendations for each location are provided in Section IV.

**Table 4. General classes of retrofit opportunities for each road segment we inventoried**. Numbers are the number of structure locations in that road segment where a particular type of retrofit is recommended.

| Name | Number of locations with recommended retrofit |
|---|---|
| Add guide fencing | 10 |
| Create pathway | 8 |
| Remove blockage fencing | 3 |
| Remove debris (improve line-of-sight) | 3 |
| Add riparian cover | 1 |
| Heighten bridge | 1 |

## **Wildlife Guide Fencing** (10 sites)

Many of the surveyed bridges and culverts have the potential to function as passages for wildlife with the addition of limited stretches of wildlife fencing designed to guide animals to the structure entrances. The design and length of fencing is species- specific, and must be tailored to the needs of the target species. We recommend considering the addition of wildlife guide fencing at all potential retrofit sites, and fence designs should address the array of wildlife present at each site. However, while a structure may be retrofit for some types of species, it is possible that it will still be impassible for others. In these situations, wildlife fencing should be designed to funnel the target wildlife towards the structure while not creating an additional barrier for other species that cannot use the structure. Plans for fencing maintenance and abutting landowner access should be part of the project design. Where appropriate think about how structures are in the landscape and how fencing can tie them in as a system rather than isolated crossings. Large mammal fencing is typically

eight feet high, with four-inch mesh. Shorter segments of wildlife guide fencing can be used to direct wildlife to a single crossing opportunity whereas longer stretches of wildlife guide fencing incorporate multiple wildlife crossings.

Figure 3. Eight-foot high large mammal exclusion fencing, CO.© J. Kintsch

## **Create Pathways** (8 sites)

A number of sites could provide improved passage for terrestrial wildlife with the creation of dry, level pathways through a bridge or culvert. For example, at sites with a bridge over a waterway, the banks and support slopes are commonly lined with extensive riprap to protect the bridge footings from scour. However, this riprap is impassible for many species of wildlife. By creating a three-foot wide pathway through the riprap, many of these bridges can be navigated by deer and other species. At sites that do not regularly flood above the path elevation, topdressing the path or bench created under the bridges with soil or sand can increase the likelihood of use.

Figure 4. Pathway through rip rap

Figure 5. Pathway through rip rap

**Remove blockage fencing** (3 sites)

**Remove debris (improve line-of-sight)** (3 sites)

**Add Riparian Cover Elements** (1 site)

Protective cover is an important feature, particularly for species that are prey and are hesitant to expose themselves through the length of a crossing structure. The primary element of this retrofit is restoring native riparian vegetation.

**Heighten bridge** (1 site)

**Retrofit Design Resources:**

Wildlife Crossing Structure Handbook: Design and Evaluation in North America. 2011. [Refer to hot sheets] http://flh.fhwa.dot.gov/innovation/td/wildlife/

Ministry of Natural Resources and Forestry Guidelines for Mitigation of Road Impacts on Amphibians and Reptiles in Ontario. 2015. Available from the Ontario Ministry of Natural Resources guidance and resources library for species at risk in 2016 https://www.ontario.ca/environment-and- energy/species-risk-guides-and-resources

Reptile and Amphibian Exclusion Fencing: Best Practices. 2013. http://files.ontario.ca/environment-and-energy/species-at- risk/mnr_sar_tx_rptl_amp_fnc_en.pdf

# IV. Recommendations:

**Juntura to Harper: US Highway 20**

*Description*: Starting in Juntura running west- east ending at Harper

*Length*: 33 miles

*Roadway and Site Description*
Two-lane paved road. Surveyors recorded moderate mid-day traffic volume (<2,000 seasonal average daily traffic (ADT))

*Figure 6. Typical road profile on Highway 20*

The roadbed is level or raised relative to the surrounding topography through this segment. Vegetation cover consists of riparian, and upland habitats with some agricultural and residential development.

*Structures Inventory*

| Structure ID | Structure Type* | Retrofit Potential | Wildlife Use** | Retrofit Notes** |
|---|---|---|---|---|
| 19908 | Bridge (Stringer/Girder) | Yes | Yes | • Install let down fence at inlet side of structure, and remove fencing at east and west sides of railroad bridge<br>• Install wildlife fencing to guide animals towards bridge |
| 19909 | Bridge (Stringer/Girder) | Yes | Yes | • Already highly functional<br>• Restore riparian vegetation |
| 19910 | Bridge (Box Beam) | Yes | Yes | • Create dry, level pathways on both edges |
| 04347A | Bridge (slab) | Yes, limited | No | • Create pathways through stream bed material on both sides of stream<br>• Increase height from bridge floor to ground<br>• Remove debris and vegetative over-growth |
| 19911 | Bridge (Multiple Box Beam) | Yes | Yes | • Create dry, level pathways on both edges, particularly east edge |
| 19912 | Bridge (slab) | Yes | No | • Create dry, level pathways through stream bed material on both edges<br>• Provide a clearer line-of-sight under the structure |
| 19914 | Bridge (slab) | Yes | No | • Create dry, level pathways through stream bed material on both edges |
| 19915 | Bridge (Stringer/Girder) | Yes | Yes | • Create dry, level pathways on both edges |

| | | | | |
|---|---|---|---|---|
| 19916 | Bridge (Multiple Box Beam) | Yes | No | • Create dry, level pathways through stream bed material on both edges<br>• Install let down fence or remove fence at outlet side of structure |
| 19917 | Bridge (Slab) | Yes | No | • Create dry, level pathways through stream bed material on both edges |

**Species-specific wildlife fencing should be considered at all retrofit locations, taking into account potential barrier impacts to other species for which the structure is an unsuitable passageway and whose movements the fencing may block. See Section III for discussion of wildlife guide fencing.*

***Documented large structure generalist wildlife-use of structure, either in-field sighting or by game-camera. Indicates an acceptance of the structure as a movement corridor and which suggests retrofit actions (especially fencing) may increase wildlife use of the structure.*

*Summary Findings*

All of the structures inventoried were constructed at road-stream crossings and were designed primarily to accommodate perennial water flows under the road. Several of the bridges offer an excellent opportunity for retrofitting to improve passage for large structure generalists. Several of the bridges in this segment have a limited span across the riparian banks and could be improved with the installation of a level pathway connecting to the adjacent habitat. Other large span bridges do span across the stream banks, but wildlife passage is largely blocked by stream bed material on moderate to steep slopes. In these instances, creating pathways across the stream bed material slopes above high water to avoid scour of the new pathway, and restoring riparian banks, where possible, would enhance passage for a variety of species. Installing wildlife fencing at each of these sites (and connecting to nearby, passable structures, depending on spacing) would help in guiding animals towards the structures and keeping them out of the right-of-way and off the road surface.

Figure 7. Mule deer using bank under bridge 19915 as passage


Figure 8. Mule deer using frozen river under bridge 19911 as passage

| Retrofit Priorities | |
|---|---|
| **19908 (High)** | |
| • Bridge with concrete vertical abutments spanning the North Fork of the Malheur River<br>• Continuous dry pathway along east side of structure under all conditions.<br>• Offers functionality for Large-Structure Generalists with installation of a let-down fence. Wire strand fence blocks inlet side of structure. Wire stand fence blocks outlet side at railroad bridge | |
| Retrofit Recommendation | |
| • Investigate whether it would be possible to install let down fence at inlet side of structure, and remove fencing at east and west sides of railroad bridge<br>• Install wildlife fencing to guide animals towards bridge | |
|  |  |
| *Photo 1*. 19908: Eastern edge of inlet side. Note large dry pathway interrupted by wire strand fence. | *Photo 2*. 19908: Outlet side facing railroad bridge. Note wire strand fences block wildlife passage. |
| | |
| **19909 (High)** | |
| • Bridge with stream bed material vertical abutments spanning the Malheur River (Horseshoe Bend)<br>• Continuous dry pathway along west side of structure under all conditions. | |
| Retrofit Recommendation | |
| • Install wildlife fencing to guide animals towards bridge<br>• Restore riparian vegetation | |
|  |  |
| *Photo 3.* 19909: Inlet side. Large bridge very suitable for large structure generalists. | *Photo 4.* 19909: Outlet side. Dry, mostly-level pathway on west side. |

**19910 (High)**

- Bridge with concrete vertical abutments spanning Malheur River (<40’ wide by 8 to <12’ high by 65’ to < 100’ long)
- Structure is not wide enough to span stream banks during high water so there is no dry, level pathway on either edge

Retrofit Recommendation

- Create dry, level pathways on both edges
- Install wildlife fencing to guide animals towards bridge

*Photo 5*. 19910: Outlet, east-side. During high flow no pathway is available.

*Photo 6.* 19910: Inside structure, west-side. During high flow no pathway is available.

**04347A (Limited)**

- Multi-span bridge with concrete vertical abutments spanning Black Canyon Creek, an intermittent creek (<40’ wide by 8 to <12’ high by 65’ to < 100’ long)
- Structure has three spans, with two having intermittent water flow during high flow periods
- Bridge is not currently high enough to allow large structure generalists passage
- Vegetation and debris have obstructed the western-most span of the bridge

Retrofit Recommendation

- Create pathways through stream bed material on both sides of stream
- Investigate whether it would be possible to increase height from bridge floor to ground
- Remove debris to create a better line-of-sight in the western-most span
- Install wildlife fencing to guide animals towards bridge

| | |
|---|---|
| *Photo 7*. 04347A: Inflow. Height of structure is not adequate for large structure generalists. | *Photo 8*. 04347A: Inside structure, outflow, central span. Stream bed material floor consistent throughout all spans. During high flow no pathway |

**19911 (High)**

- Bridge with concrete vertical abutments spanning Malheur River (<40’ wide by 8 to <12’ high by 65’ to < 100’ long)
- Continuous dry pathway along west side of structure under all conditions
- Offers functionality for Large-Structure Generalists on west side
- No pathway available on east side of structure during high flow conditions

Retrofit Recommendation

- Create dry, level pathways on both edges
- Install wildlife fencing to guide animals towards bridge

| | |
|---|---|
|  |  |
| *Photo 9.* 19910: Outflow, east side of structure has steep embankment limiting function as passage | *Photo 10*. 19910: Inside structure, west-side. Slope could be graded and leveled to create dry, ice-free passage. |

**19912 (High)**

- Bridge with concrete vertical abutments spanning Sperry Creek, an intermittent creek (<40’ wide by 8 to <12’ high by 65’ to < 100’ long)
- Offers some functionality for Large-Structure Generalists during low flow conditions
- No pathway available on during high flow conditions

Retrofit Recommendation

- Create dry, level pathways through stream bed material on both edges
- Install wildlife fencing to guide animals towards bridge
- Level inlet to provide a clearer line-of-sight under the structure

*Photo 11*. 19912: Outflow, underpass lacks clear line of sight decreasing likelihood of use by large structure generalists

*Photo 12.* 19912: Inside structure, west-side. Slope could be graded and leveled to create dry, rip rap free passage.

**19914 (High)**

- Bridge with concrete vertical abutments spanning Gold Creek, a perennial creek (<40’ wide by 8 to <12’ high by 65’ to < 100’ long)
- Offers some functionality for Large-Structure Generalists during low flow conditions
- West side available on during high flow conditions, however, floor is continuous rip rap

Retrofit Recommendation

- Create dry, level pathways through stream bed material on both edges
- Install wildlife fencing to guide animals towards bridge

*Photo 13*. 19914: Outflow, underpass has clear line of sight and some riparian cover

*Photo 14.* 19914: Inside structure, west-side. Slope could be graded and leveled to create dry, rip rap free passage.

**19915 (High)**

- Bridge with rip rap vertical abutments spanning the Malheur River (<40’ wide by 8 to <12’ high by 65’ to < 100’ long)
- Offers functionality for Large-Structure Generalists with installation of a let-down fence, or removal of existing fence.
- Both sides of structure are available on during high flow conditions, however, path slope is fairly steep

Retrofit Recommendation

- Create dry, level pathways on both edges
- Install wildlife fencing to guide animals towards bridge
- Remove fence or install let-down fence

*Photo 15*. 19915: West-side pathway inside structure. Note: steepness of bank and fence interrupting pathway

*Photo 16.* 19915: Outflow.

**19916 (High)**

- Bridge with concrete vertical abutments spanning Malheur River (<40’ wide by 8 to <12’ high by 65’ to < 100’ long)
- Offers some functionality for Large-Structure Generalists during all flow conditions
- West side available on during high flow conditions, however, floor is not level
- East side is very steep and mainly rip rap

Retrofit Recommendation

- Create dry, level pathways through stream bed material on both edges
- Install wildlife fencing to guide animals towards bridge
- Investigate whether it would be possible to install let down or remove fence at outlet side of structure

*Photo 17*. 19916: Outflow

*Photo 18.* 19916: Inside structure, west-side. Slope could be graded and leveled to create dry, rip rap free passage.

**19917 (High)**

- Bridge with concrete vertical abutments spanning Squaw Creek an intermittent stream (<40’ wide by 8 to <12’ high by 65’ to < 100’ long)
- Offers some functionality for Large-Structure Generalists during low flow conditions, however, floor consists entirely of rip rap

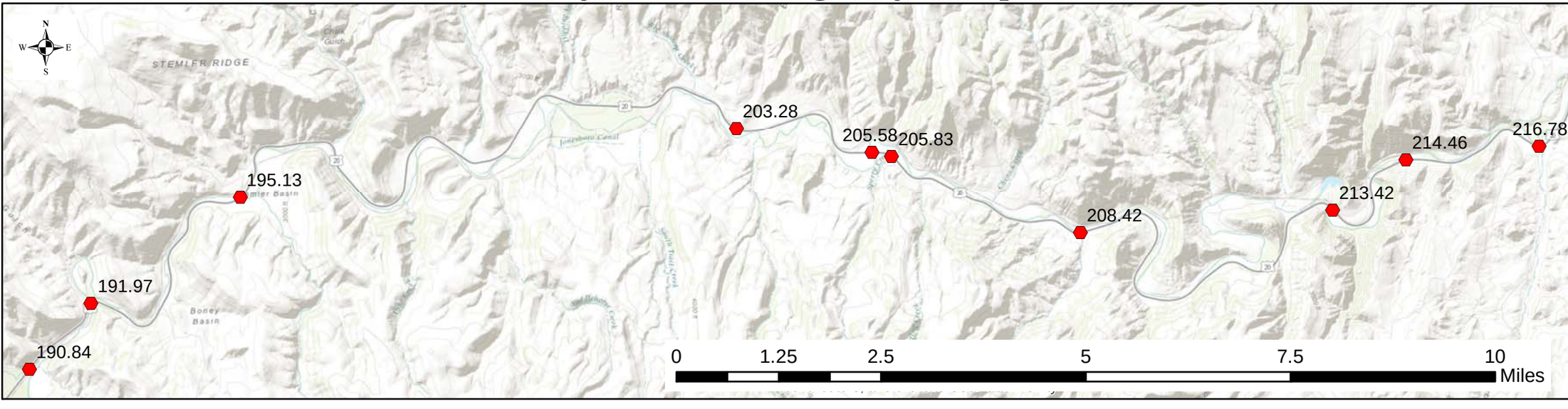
| Retrofit Recommendation | |
|---|---|
| • Create dry, level pathways through stream bed material on both edges<br>• Install wildlife fencing to guide animals towards bridge | |
|  |  |
| *Photo 17*. 19916: Outflow | *Photo 18.* 19916: Inside structure, west-side. Slope could be graded and leveled to create dry, rip rap free passage. |

## Appendix A. Target Species and Associated Wildlife Crossing Guilds

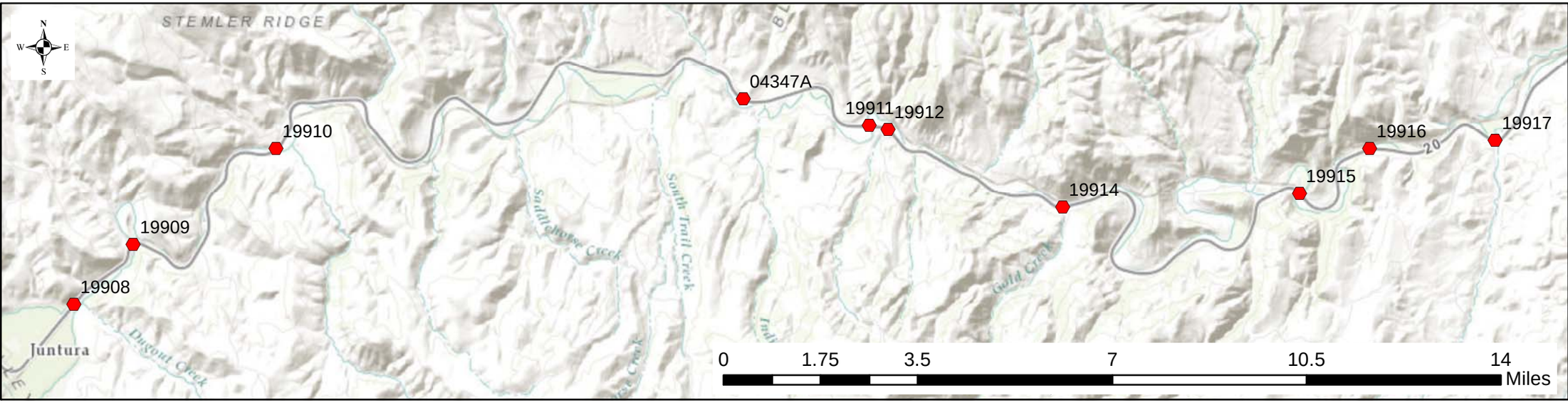
Guild classes and descriptions derived from Kintsch, Cramer and Jacobson (in progress…)

| WILDLIFE CROSSING GUILD | SPECIES |
|---|---|
| ***Cover Obligates*** – | pygmy rabbit (Species of concern, vulnerable)<br>small mammals (e.g., gopher, mice, mole, shrew, vole)<br>white-tailed jack rabbit<br>sagebrush lizard<br>pygmy short-horned lizard<br>western skink<br>Great Basin whiptail |
| ***Semi-Aquatic Obligates*** –<br>Species that live in or close to fresh water and riparian habitat. | beaver<br>mink<br>river Otter |
| ***Medium-Structure Generalists*** –<br>Small and medium-sized, fauna that tolerate or prefer some enclosure but do not have specific cover requirements. | black bear<br>cougar<br>bobcat<br>coyote<br>raccoon<br>weasels<br>striped skunk<br>porcupine |
| ***Large-Structure Generalists*** –<br>Medium and large-sized fauna that are adaptive to a variety of crossing structure types so long as they meet minimum size and openness requirements. | Rocky Mountain elk<br>mule deer<br>pronghorn<br>California bighorn sheep |
| ***Conditions Specialists*** –<br>Extremely low mobility species; permeable-skinned species; other habitat specialists; or species with unique movement considerations. | Columbia spotted frog (species of concern, vulnerable)<br>Western toad(vulnerable)<br>Great Basin spadefoot toad<br>Pacific tree frog |

# Hwy 20 PAS Bridges by Milepost




# Hwy 20 PAS Bridges by Bridge ID



Appendix B
# Workshop Summaries

# Highway 20 Connectivity Feasibility Study: Workshop 1 Summary

**Calla Hagle (Burns Paiute Tribe), Carter Crouch (Burns Paiute Tribe), Shannon Crossen (ICF), Sarah Horwath (ICF, Erika Britney (ICF), Jennifer Cathcart (ICF)**

**12/04/20**

# Context

### Wildlife-Vehicle Collisions

Substantial levels of wildlife-vehicle collisions (WVCs) occur along the US 20 corridor in the study area. Cumulative costs since 2007 are estimated to be ***at least $24 million*** in property damage, human injuries/fatalities, and wildlife mortality (Burns Paiute Tribe 2020).

### Habitat Fragmentation

US 20 bisects important habitat and ecological resources for a wide variety of species, interrupting ecological connectivity and access to resources.

### Motorist Safety

Vehicle collisions with large animals are an important safety concern for motorists traveling through the region.

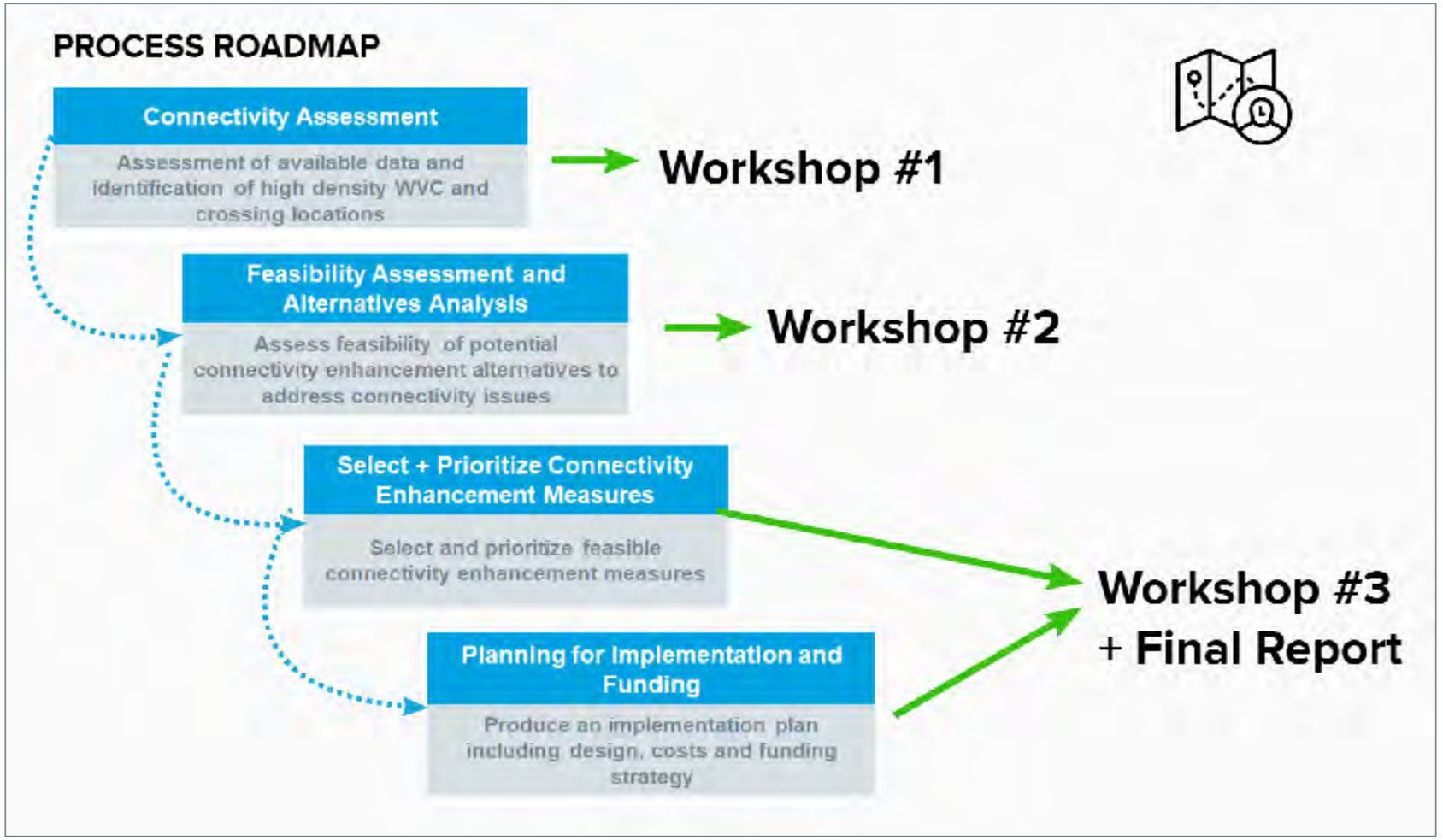
### Winter Range

US 20 bisects ecologically important winter range for mule deer, elk, pronghorn, and other native wildlife where animals are abundant during the cold season.

# Study Objectives

1. Assess the state of WVCs, habitat connectivity, and wildlife movement and identify focal areas based on with high levels of WVCs and wildlife road crossings
2. Collaboratively prioritize focal areas for reducing WVCs and facilitating safer wildlife movement in partnership with agencies and stakeholders
3. Identify feasible connectivity enhancement measures through facilitated discussions with local and regional partners
4. Develop an implementation plan for connectivity enhancement measures that will protect wildlife, connect habitats, and create a safer highway

# Project Approach



# Workshop 1 Contributors

*The Burns Paiute Tribe would like to thank the following contributors for their participation in the first workshop.*

- **Paul Woodworth** (Oregon Department of Transportation)
- **Ken Patterson** (Oregon Department of Transportation)
- **Cidney Bowman** (Oregon Department of Transportation)
- **Sara Gregory** (Oregon Department of Fish and Wildlife)
- **Rachel Wheat** (Oregon Department of Fish and Wildlife)
- **Tom Segal** (Oregon Department of Fish and Wildlife)
- **Mike Schmeiske** (Oregon State Lands)
- **Jake Ferguson** (Bureau of Land Management)
- **Megan McGuire** (Bureau of Land Management)
- **Jackie Cupples** (U.S. Fish and Wildlife Service)
- **Skyler Vold** (U.S. Geological Survey)
- **Mark Owens** (Oregon House District 60)
- **Linda Rowe** (Malheur County Soil and Water Conservation District)
- **Bret Cleaver**, (Malheur County Soil and Water Conservation District)
- **Dallas Hall Defrees**, (Baker sage-grouse Local Implementation Team)
- **Amy Patrick** (Oregon Hunters Association)
- **Jeremy Austin** (Oregon Natural Desert Association)
- **Michael O'Casey** (Theodore Roosevelt Conservation Partnership)
- **Bill Richardson** (Rocky Mountain Elk Foundation)
- **Julie Unfried** (Pheasants Forever)
- **Kalei Augustine** (Oregon Wildlife Foundation)
- **Laurel Williams** (Pew Charitable Trusts)
- **Sandra Jacobson** (ARC Solutions)
- **Kevin MacKay** (ICF)
- **Tessa Artuc** (ICF)
- **Annika Sullivan** (ICF)

# Vision Statement

*The Workshop 1 participants cooperatively developed a vision statement in Mural.*

**In 15 years, we will have reduced wildlife vehicle collisions on Highway 20 by 75% by collaborating to implement wildlife crossing structures and other measures that improve habitat connectivity and quality for wildlife species, road safety, and driver awareness.**

See Workshop 1 Mural board, Panel 2 for original post-it note comments.
https://app.mural.co/t/icfeei4168/m/icfsparklabs0658/1603829155367/9d044bb03d8f880aae4ed05beca3878afa4fc9d1

# Themes/Issues Raised Related to the Connectivity Analysis

## Observations

- WVC hotspots correlate with GPS collar data and show a clear problem of WVC/safety concerns in Malheur County that need to be addressed.
- The hotspots seem to be located where the river runs right next to the highway - highways in winter range (esp. river bottoms) are known to be WVC hotspots.
- Forage quality is higher within the riparian areas along the river.
- Increased fall and winter WVC may be in part due to a combination of visibility issues (darker days) and the influx of deer to the winter habitat.
- Reducing the speed limit has not been shown to be as effective at reducing WVCs as crossing structure/barrier solutions. People still speed and the curviness of the roads also limit slow down time.

## Follow-up Items

- Investigate potential influence of changes in speed limits WVCs in Malheur County e.g. speed limit went from 55 to 65 MPH in 2017).
- How many collared animals were evaluated when looking for crossing hotspots? Collars were not stratified across the project area... just in places where ODFW knew deer were wintering.

## Additional Information Sources

- Getting the ODFW estimate of deer that may be struck but not recovered (i.e., they do not die on the road) may be helpful in estimating true cost of WVCs.
- A new report is coming within a few months that evaluates cost-benefit to mitigate WVCs.
- ODFW habitat modeling/connectivity study is in progress.
- Additional background information on wildlife movement/migration may be useful for the group.

# Themes/Issues Raised Related to the Connectivity Analysis

## Potential Mitigation Measures

1. Signage:
    - Standard wildlife crossing signs are ineffective at reducing WVCs
    - Fixed message signs deployed in John Day Valley, didn't result in a noticeable change in WVCs
    - Improved effectiveness of non-standard signs may occur when only deployed at certain times of year
    - Signs may be effective for visitors, locals may habituate them
2. Crossing structures and wildlife fencing are highly effective at reducing WVCs. They take time to plan and construct, require major funding, and require maintenance over their lifecycle. Other measures that also reduce animals/vehicles interactions should be considered that can be implemented while crossings and fencing are planned.
3. Multiple/a combination of mitigation measures are needed. Some ideas include: drive during the day, reduce speed limit at night, reader board that alerts drivers to high deer densities near the road, improving visibility, wildlife crossings and fencing.
4. Rocky Mountain Elk Foundation funded collars in Washington that trip flashing lights on highway (Roadside Animal Detection System) as elk approached highway, this effort is considered to be hugely successful.

# Themes/Issues Raised Related to the Connectivity Analysis

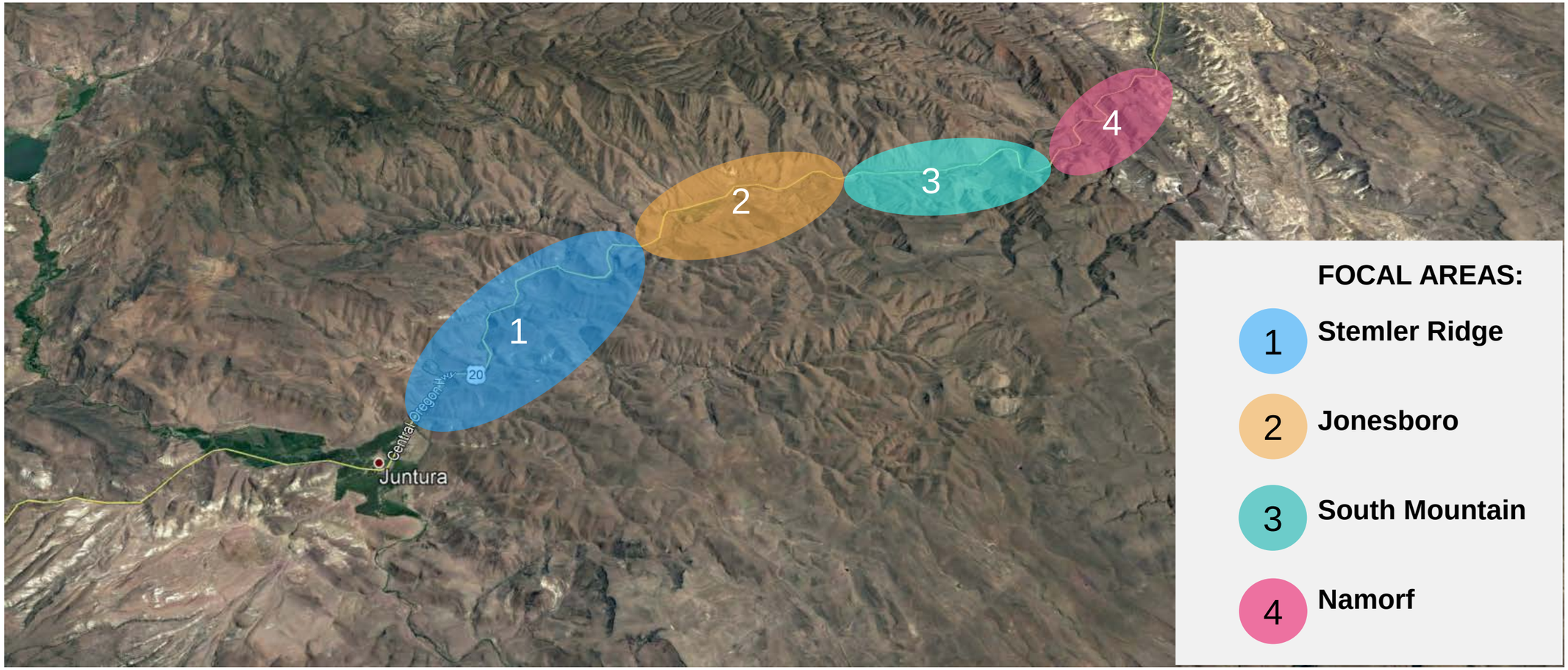
## Planning Mitigation and Important Considerations

- Unique challenges within each focal area and reaches within each focal area.
- Need to incorporate wildlife crossing needs as highway upgrades/projects are planned and incorporate into upcoming projects.
- All WVC reduction and connectivity enhancement options should be considered.
- Consider habitat enhancements and enhancing access to resources near good forage. Consider whether this may reduce road crossings.
- Both Long-term and short-term solutions should be considered. Long term solutions are going to take a long time to implement. In the meantime, short term issues need to be addressed, i.e. variable message boards installed during peak migration and winter to notify out-of-area motorists of wildlife.
- Barriers to crossing, i.e. dilapidated fencing along the railroad corridor needs to be removed to facilitate wildlife movement.
- Funding is going to be important to explore and identify for each mitigation measure.
- Wildlife highway mortality is not the only wildlife impact; avoidance of crossing the highway (i.e., a barrier effect) is also a potential population-limiting impact for some species because it restricts movement and access to resources.
- Hotspots for mule deer and antelope are different, different strategies may be needed.
- Deer, elk, pronghorn, and other species may require different design considerations and mitigation approaches. Consider species-specific needs in design of mitigation measures.

# Focal Area Overview

**We identified four focal areas* with high density of animal movement and wildlife vehicle collisions. The stakeholder workshop focused on these four areas.**

*Focal areas were selected based on density of wildlife-vehicle collisions and jurisdiction of collaborators to implement improvements.




The presentation of the ICF analysis is appended to the end of this summary. It shows data supporting selection of focal areas.

# Focal Area Data Summary: Deer Crossings and WVCs

| Focal Area | Mile Posts | Mule deer crossings[1] | | Reported Carcasses[2] | | Animal-related crashes[3] | | Total WVCs[4] | | Annual Estimated Total WVCs Cost[6] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Number | Density[5] | Number | Density[5] | Number | Density[5] | Number | Density[5] | |
| 1 - Stemler Ridge | 190-199 | 83 | 9.2 | 363 | 40.3 | 11 | 1.2 | 374 | 41.6 | $253,642 - $338,190 |
| 2 - Jonesboro | 199-206 | 651 | 93 | 319 | 45.6 | 16 | 2.3 | 335 | 47.9 | $227,566 - $303,422 |
| 3 - South Mountain | 206-211 | 62 | 12.4 | 121 | 24.2 | 4 | 0.8 | 125 | 25 | $84,780 - $113,040 |
| 4 - Namorf | 211-217 | 257 | 42.8 | 133 | 22.2 | 12 | 2 | 145 | 24.2 | $98,284 - $131,045 |

**Notes:**
[1]ODFW collar data
[2]ODOT carcass data, 2010-2019
[3]ODOT crashes data, 2007-2018
[4]Total Wildlife Vehicle Collisions = Carcasses + Animal-related Crashes
[5]Density calculated per mile within each focal area
[6]Annual estimated total WVCs cost is based on reported carcasses and animal-related crashes, thus likely underestimates total cost from WVCs per focal area.

# Focal Area 1: Stemler Ridge

## Descriptors

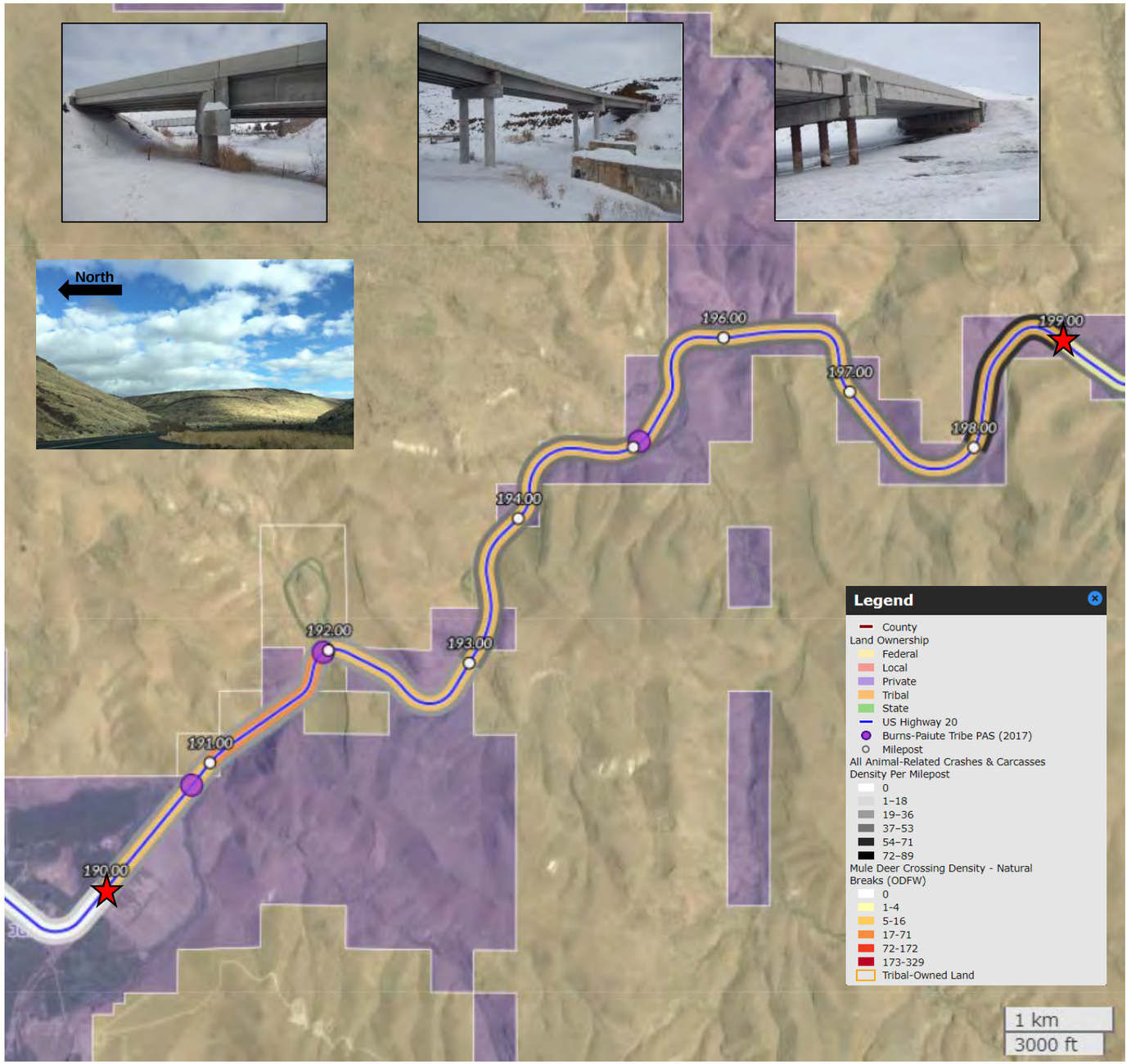
- Location: approx. MP 190-199 (red stars = boundaries)
- Land ownership = Private and Federal Govt. (DOE & BLM)

## Key Issues (see Focal Area Data Summary slide)

- High WVC densities and high estimated WVC costs
- Moderate-high mule deer crossing densities

## Discussion Results

- Topography in study area is steep and rocky, and may limit movement and/or funnel wildlife to certain areas
- Area is prone to flash floods; two major tributaries enter the Malheur River along this reach.
- There have been multiple fires in the area that reduced vegetative cover that provides good forage (shrubs).
- ODFW-funded Mule Deer Initiative Habitat Improvement Project, in conjunction with BLM, planted 200,000 sagebrush and bitterbrush seedlings in the Currey Canyon Fire scar in 2020.Mostly private land adjacent to highway corridor.
- Existing structures (e.g., bridges and/or underpasses) may be enhanced for wildlife movement, potentially with fencing. Bridges have been evaluated by BPT for retrofit potential.
- Fencing may be difficult to install and would need to be maintained by a responsible party.
- It will be challenging to provide crossings/improve connectivity for this entire zone: the area is in winter range, where animals are living for 4 + months are going to need to cross multiple times.



# Focal Area 2: Jonesboro

## Descriptors

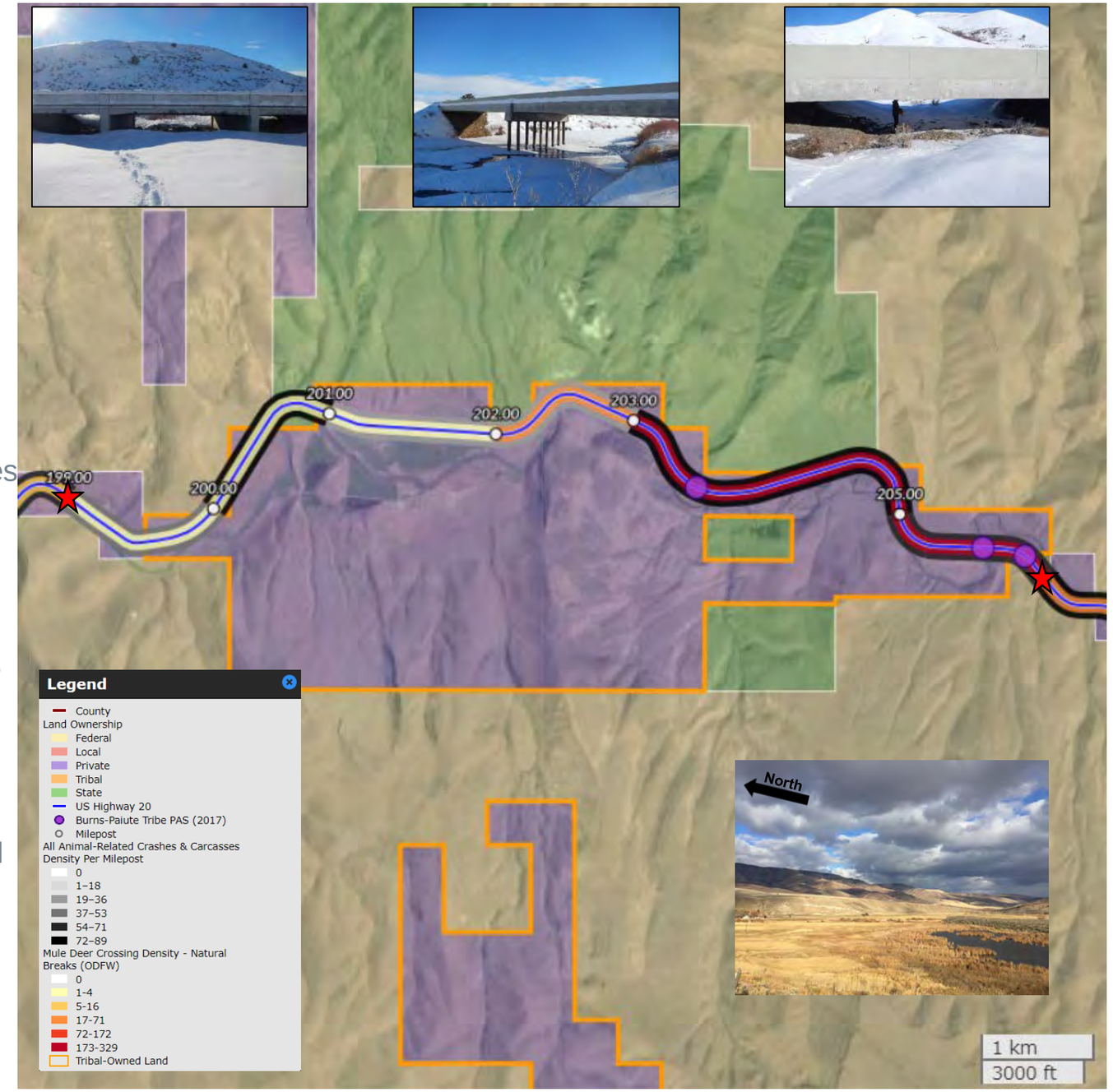
- Location: approx. MP 199-206
- Land ownership = Tribal, State, and Federal Govt. (BLM)

## Key issues (see Focal Area Data Summary slide)

- Highest WVC densities of study area, high estimated WVC costs
- Highest mule deer crossing densities of study area

## Discussion Results

- Area is within the footprint of the Indian Creek fire (2020) and a smaller fire on State land (2018)→ increase of invasive annual grasses
- Adjacent landownership combination of BPT and BLM/State may be conducive for crossing solutions.
- Existing structures (e.g., bridges/underpasses) may be enhanced for wildlife movement, potentially with fencing – fencing would need maintained. Bridges have been evaluated by BPT for retrofit potential.
- Some bridges seem lower to ground and less inviting for connectivity, but excavation under or around most bridges will compromise the foundation of the structure
- ODFW-funded Mule Deer Initiative Habitat Improvement project (with State Lands): conducting ongoing fire recovery work, including annual grass treatments and native seeding. Mostly focused on north side of the river: 2,300+ acres of herbicide treatments. BPT has started annual grass treatments and seeding on tribal-owned land.



# Focal Area 3: South Mountain

## Descriptors

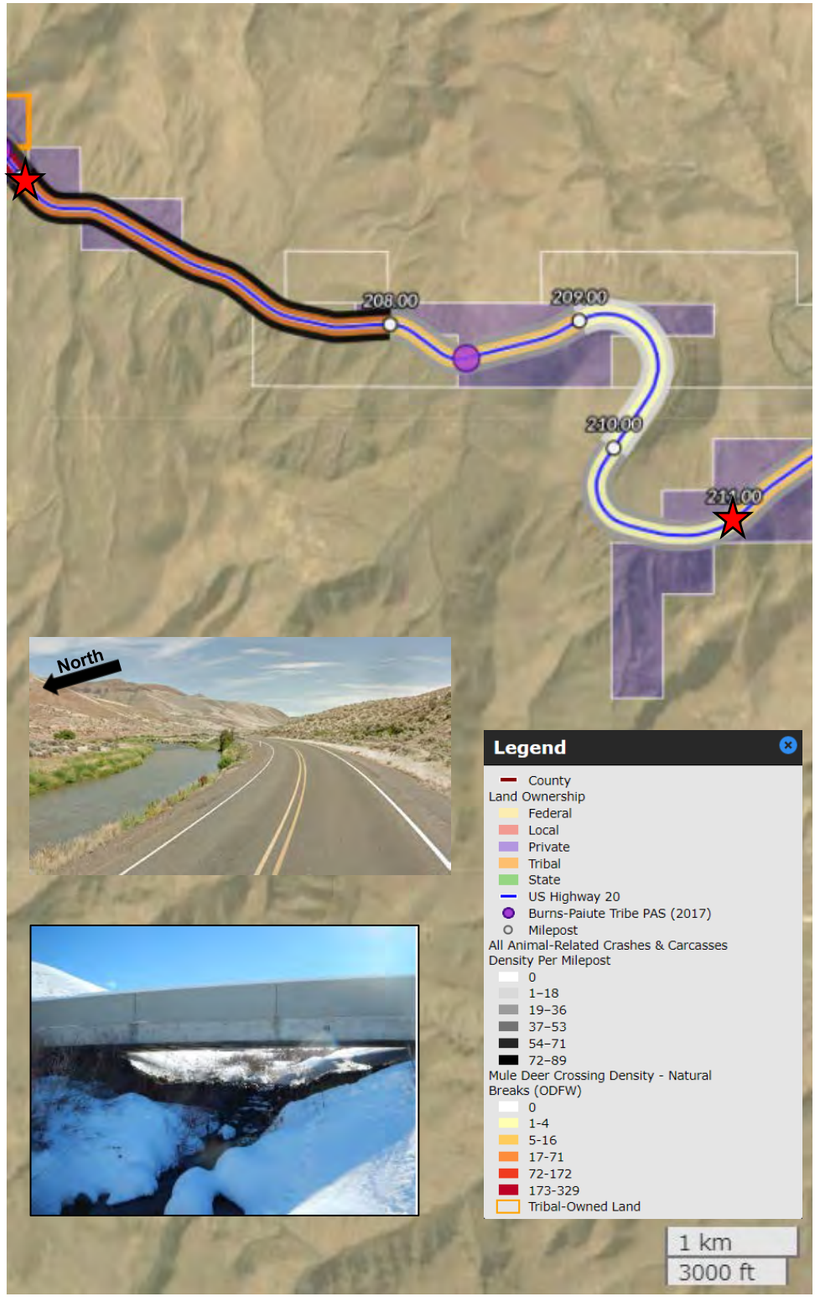
- Location: approx. MP 206-211
- Land ownership = Private and Federal Govt. (DOE & BLM)

## Key issues (see Focal Area Data Summary slide)

- Moderate-high WVC densities
- Moderate-high mule deer crossing densities
- Intermediate estimated WVC costs

## Discussion Results

- Terrain is relatively steeper than other focal areas and road hugs the river more.
- Area can be prone to flash floods.
- Fencing maintenance is a concern.
- One bridge that occurs within focal area has been evaluated by BPT for retrofit potential, and it occurs on a tributary to the Malheur River.
- This is by far the most challenging section because of the river/road position.
- Guardrails were discussed as potential safety and WVC reduction measure, though input was mixed regarding the potential effectiveness for reducing/preventing wildlife road crossings and further discussion and consideration of modified design is warranted.
- No current or planned projects were discussed.



# Focal Area 4: Namorf

## Descriptors

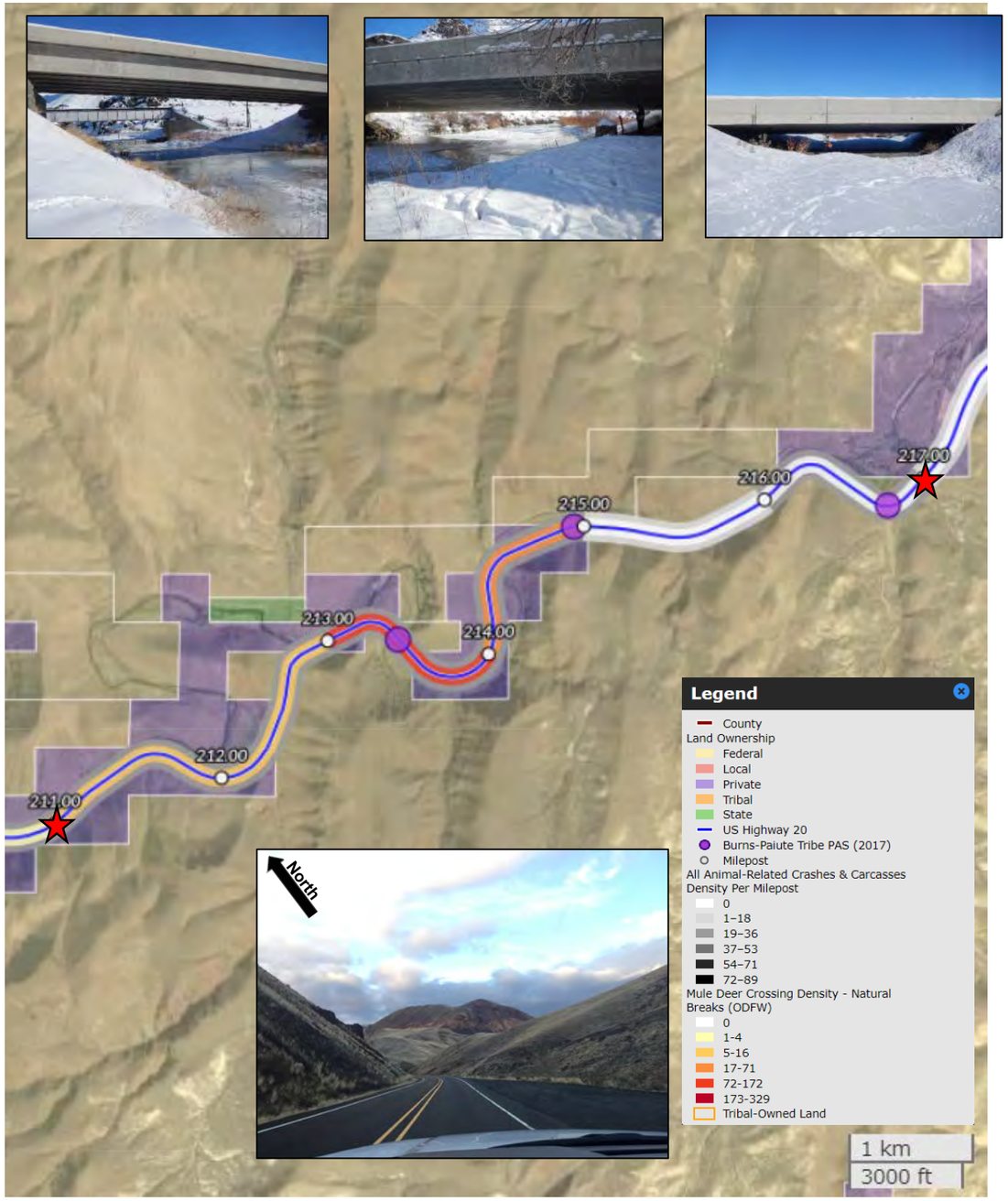
- Location: approx. MP 211-217
- Land ownership = Private and Federal Govt. (BLM & BOR)

## Key issues (see Focal Area Data Summary slide)

- Moderate WVC densities; intermediate estimated WVC costs
- High mule deer crossing densities

## Discussion Results

- Some steep terrain, flash flood and debris flow prone area, and high occurrences of rockfalls.
- Line of sight constrained by steep slopes next to highway in some areas
- More eastern area has wider valley floor with good sight distances and lower densities of crossings and WVCs.
- Topography may provide more opportunities for overpass than other focal areas.
- Bridges provide opportunities for crossing enhancements have been evaluated by BPT for retrofit potential.
- Bureau of Land Management jurisdiction adjacent may warrant exploration of SO 3362 on big game habitat and winter range.
- Need to further discuss how wildlife fence could be designed, installed, and maintained in this challenging terrain.
- On guardrails: depending on adjacent topography/slope animals may or may not be able or reluctant to jump up or down from slope-roadway or roadway-slope. Guardrails are not a complete barrier, though could discourage some road crossings. A modified design may also increase effectiveness.



# Next Steps

- **Workshop #2**: Early January – assessment of feasibility of potential connectivity enhancement alternatives
  - ☑ **Save-the-date:** Coming soon (next week)

- **Workshop #3**: Late-January/early February – select and prioritize connectivity enhancement measures; contribute to an implementation plan
  - ☑ **New:** Workshop 3 Doodle Poll: **https://doodle.com/poll/qnutz4mz52r9pcsg?utm_source=poll&utm_medium=link**

Point of contact for workshop process: **Erika Britney** - erika.britney@icf.com - (206) 801-2802

Thank you!

# Highway 20 Connectivity Feasibility Study

## Workshop 2 Lightning Talk

**Calla Hagle (Burns Paiute Tribe), Shannon Crossen (ICF),Sarah Horwath (ICF) Erika Britney (ICF), Jennifer Cathcart (ICF)**

**11/19/20**

# Context

**Wildlife-Vehicle Collisions**
US 20 in the study area experiences substantial levels of wildlife-vehicle collisions (WVCs) estimated costing ***at least*** $24 million in property damage, human injuries/fatalities, and wildlife mortality since 2007 (Burns Paiute Tribe 2020).

**Motorist Safety**
Vehicle collisions with large animals are an important safety concern for motorists traveling through the region.

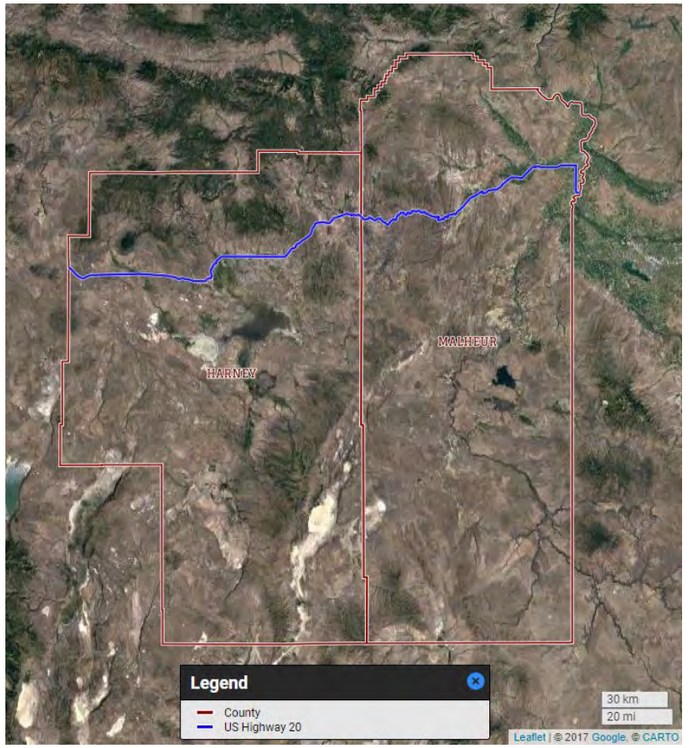
**Habitat Fragmentation**
US 20 bisects important habitat and ecological resources for a wide variety of species interrupting ecological connectivity and access to resources.

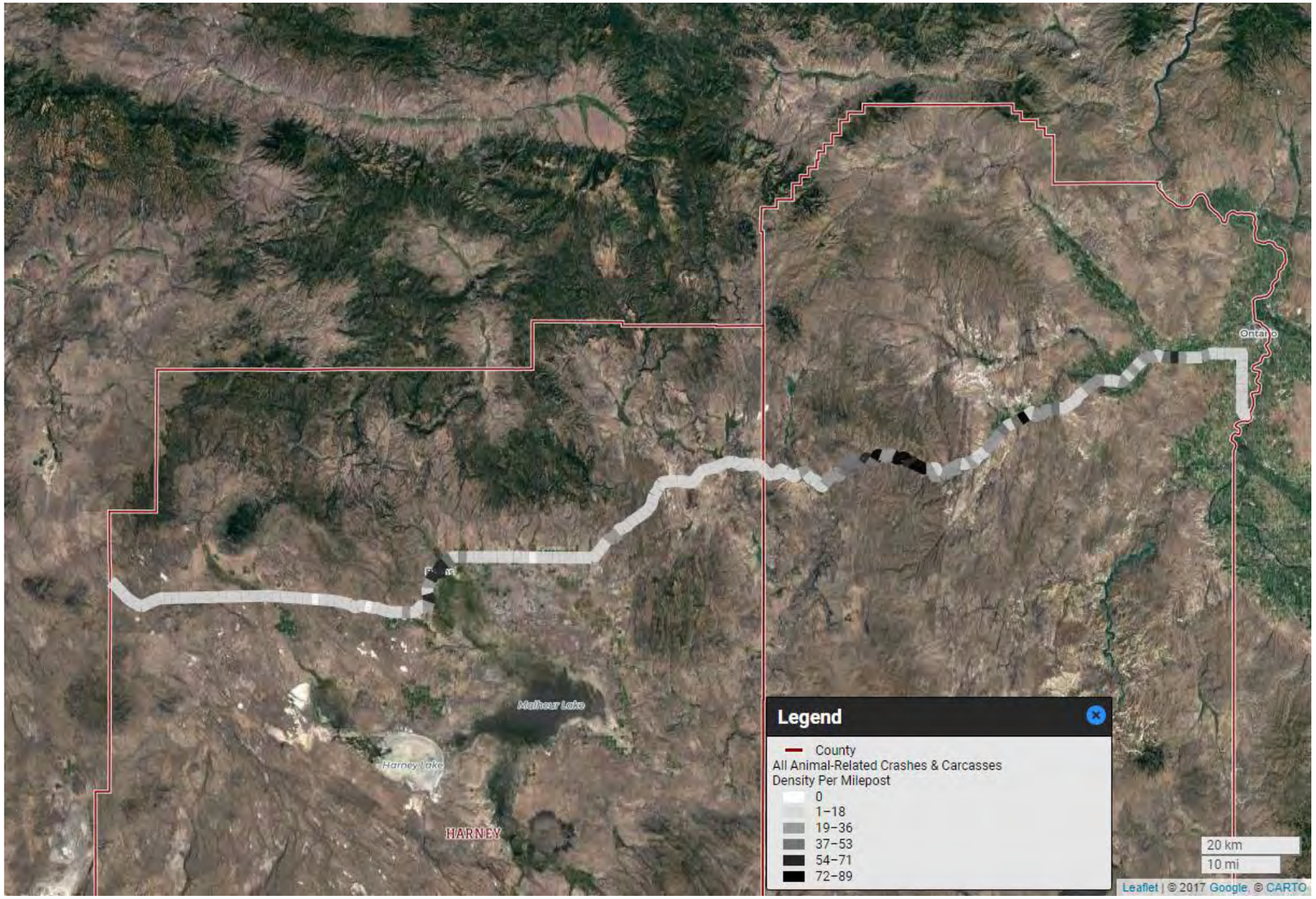
**Winter Range**
US 20 bisects ecologically important winter range for mule deer, elk, pronghorn, and other native wildlife where animals are abundant during the cold season.

# Connectivity Assessment: Methods

Analysis based on wildlife/vehicle crossing, ecological and land use data in Harney & Malheur Counties.

| Data Type | Source |
|---|---|
| WVCs, carcass removals (2010-2019) | ODOT |
| WVCs, crash reports(2007-2018) | ODOT |
| Mule deer and antelope collar data | ODFW |
| Mule deer collar data | Burns Paiute Tribe |
| Ecological, connectivity, and land use/ownership datasets | Various Sources |

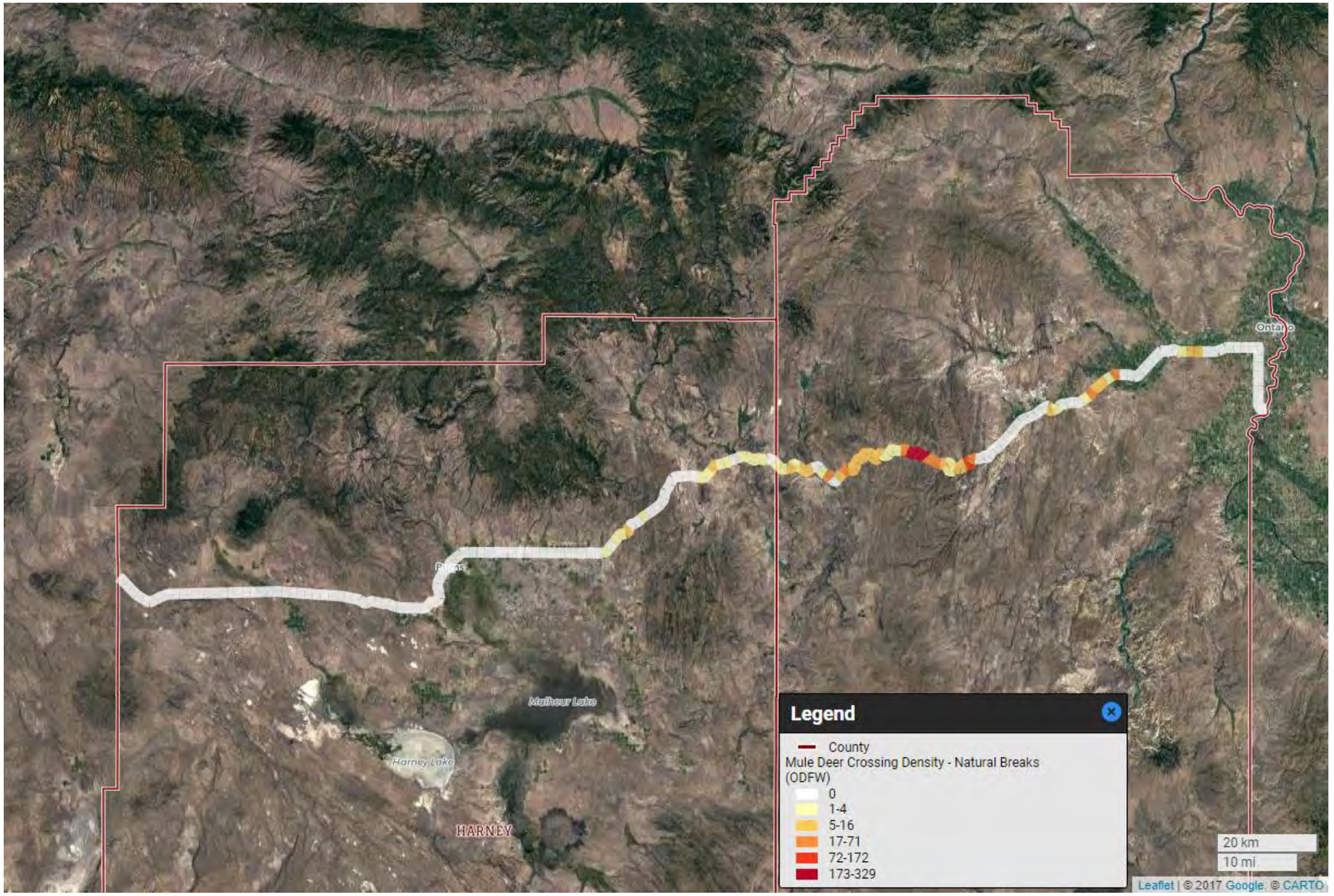





# WVC Density

The connectivity analysis revealed a high density of wildlife vehicle collisions in the study area, particularly through the Highway 20 corridor in Malheur County.

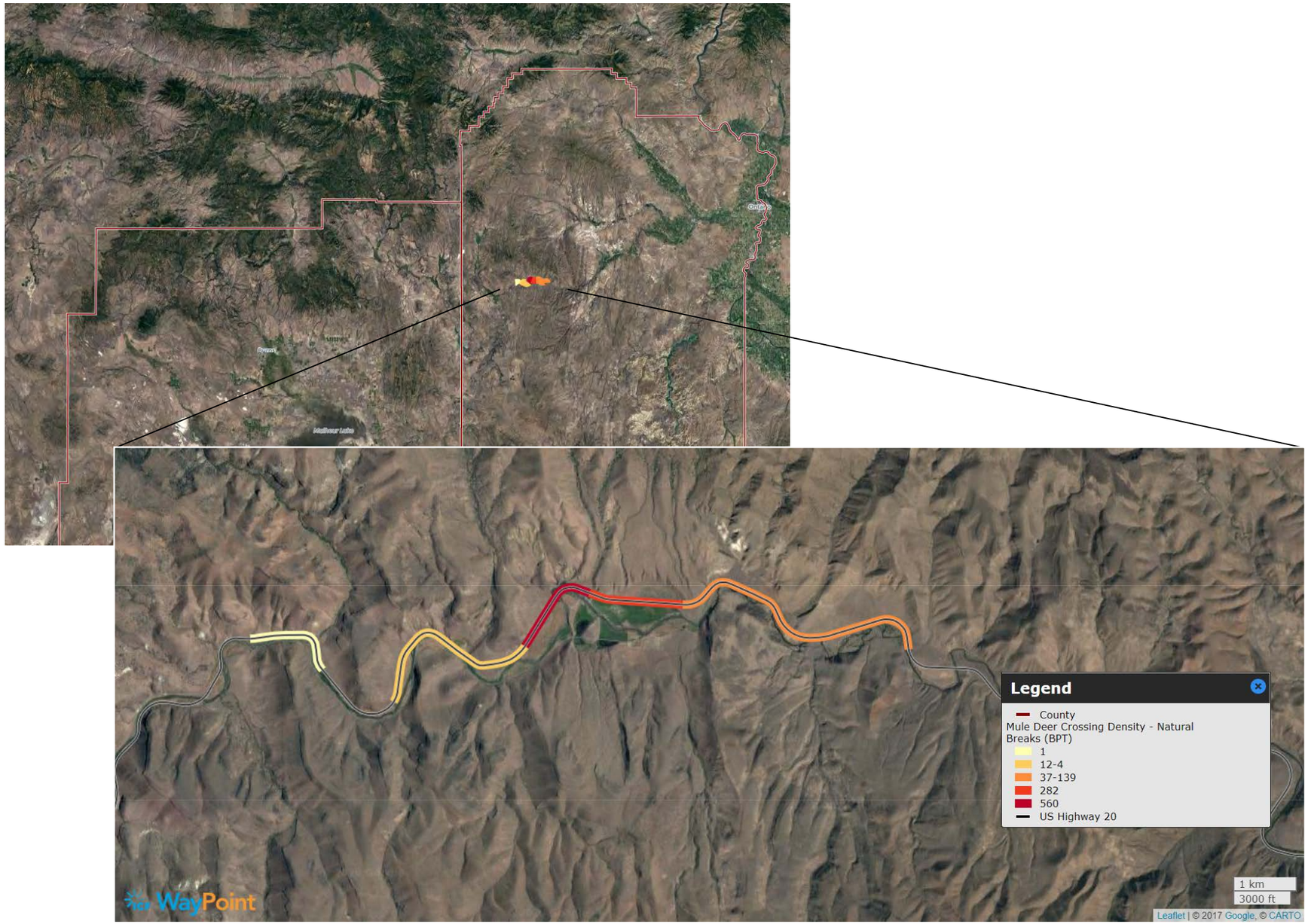
**Source: ODOT Carcass + Crash Data**




# Mule Deer Crossing Density

Along this same stretch of Highway 20, you'll see that there's a very high concentration of mule deer crossings.

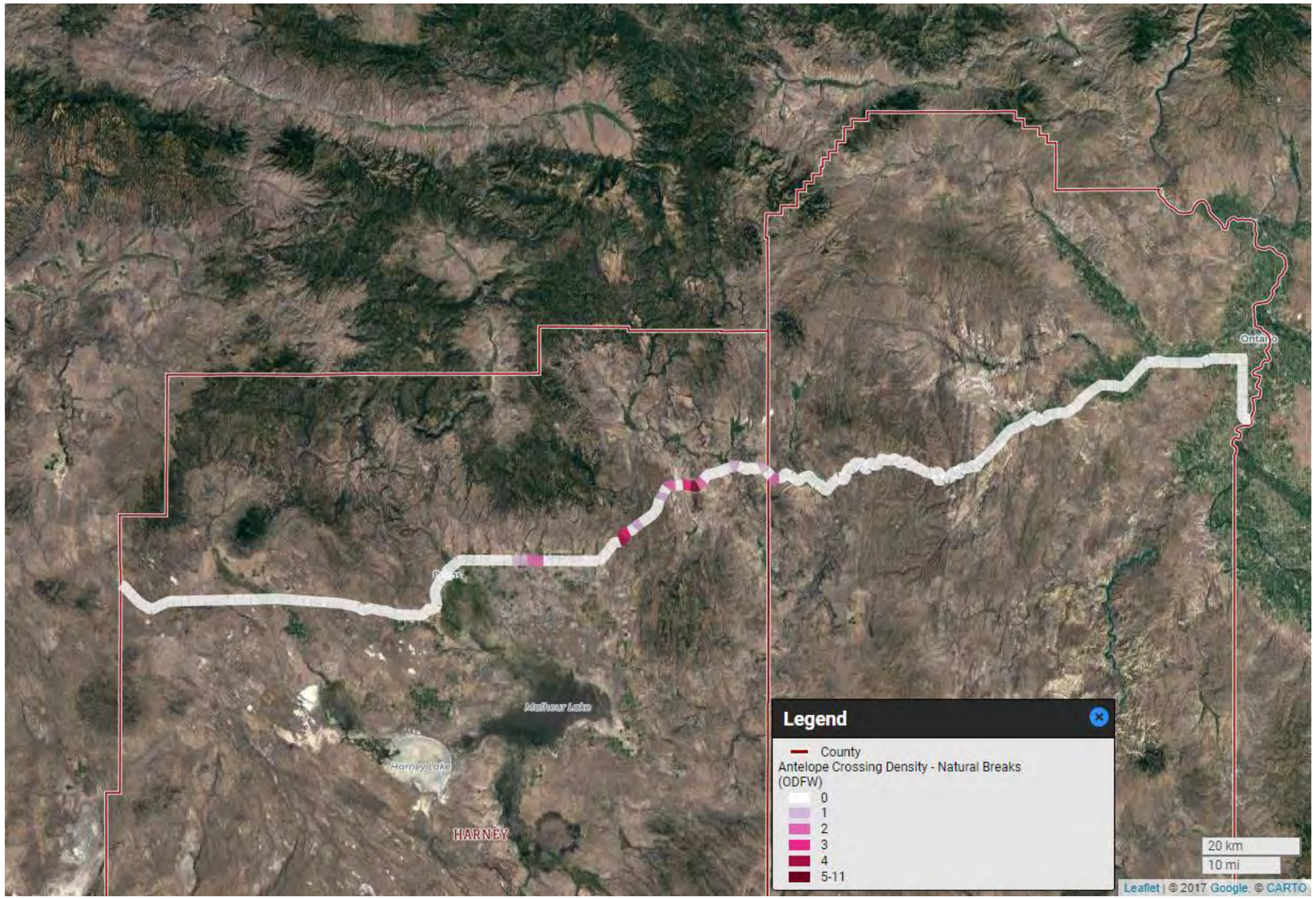
**Source: ODFW Data**




# Mule Deer Crossing Density

BPT data also shows a concentration of mule deer crossings in this section of the Highway 20 corridor in Malheur County.

**Source: BPT Data**



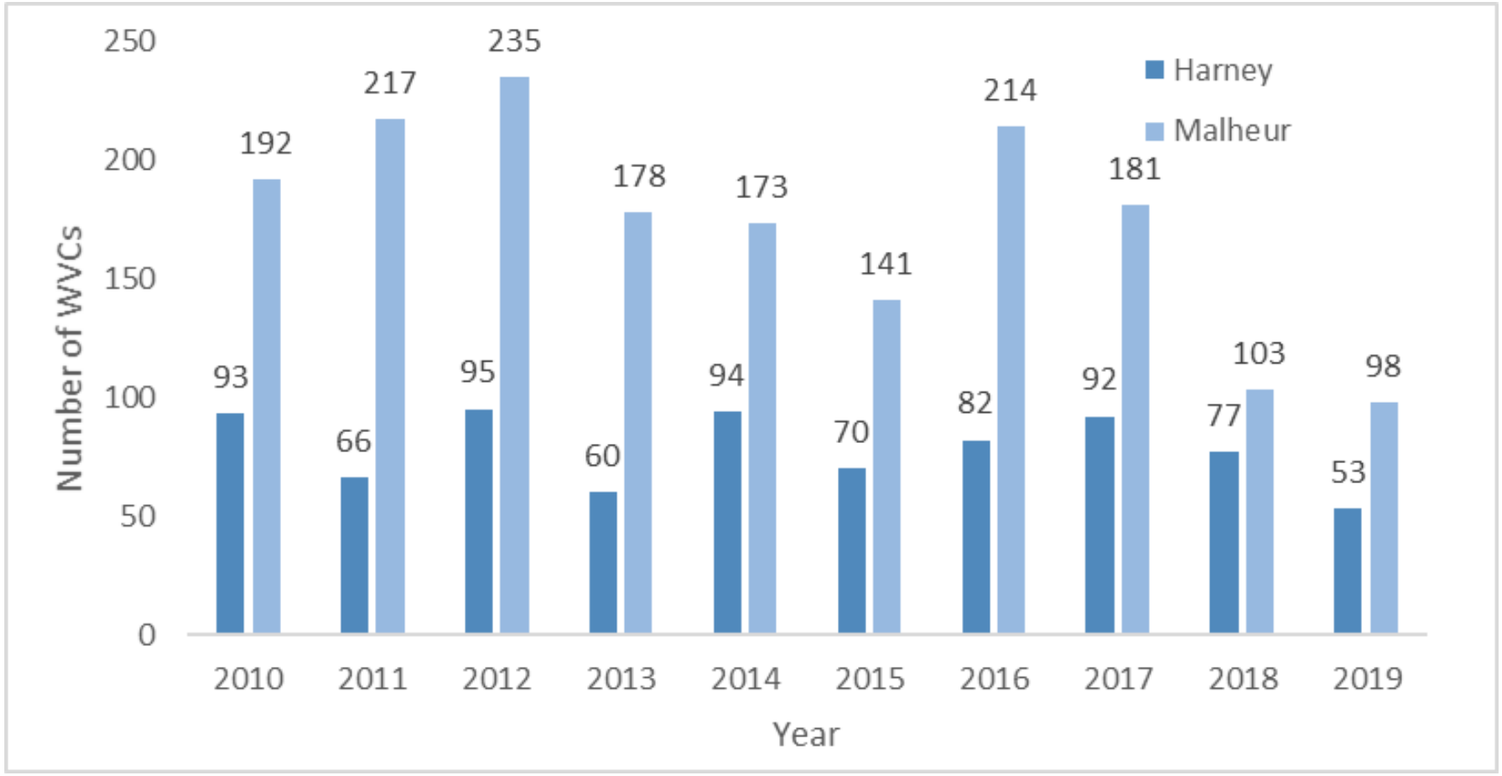

# Antelope Crossing Density

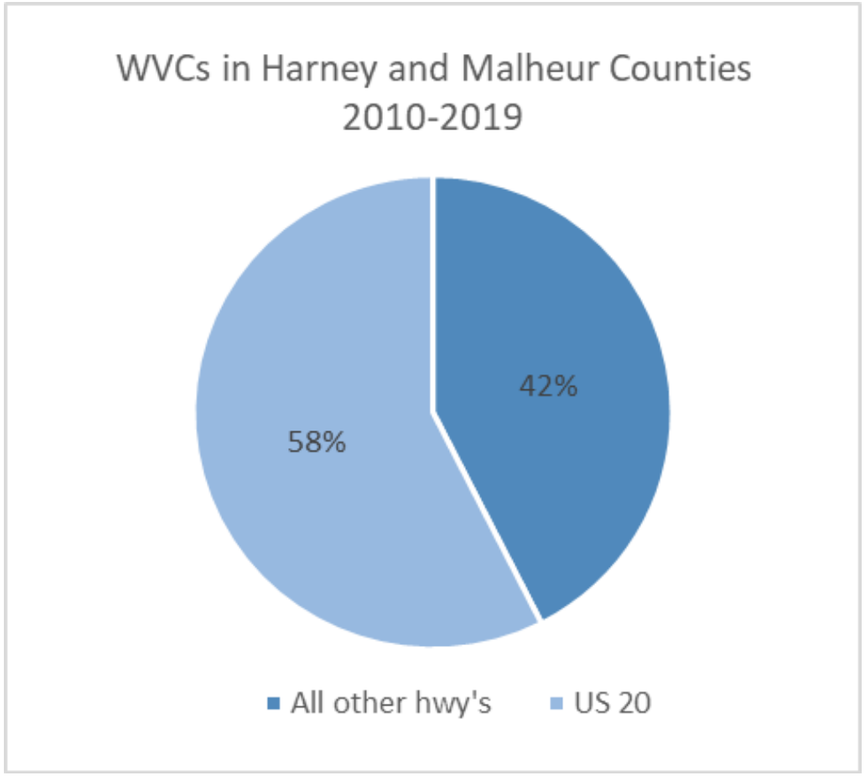
Collar data also shows antelope road crossings in the study area with highest crossing densities occurring in Harney County. Antelope road crossing densities are substantially lower in magnitude than for mule deer.

**Source: ODFW Data**

# Study Findings

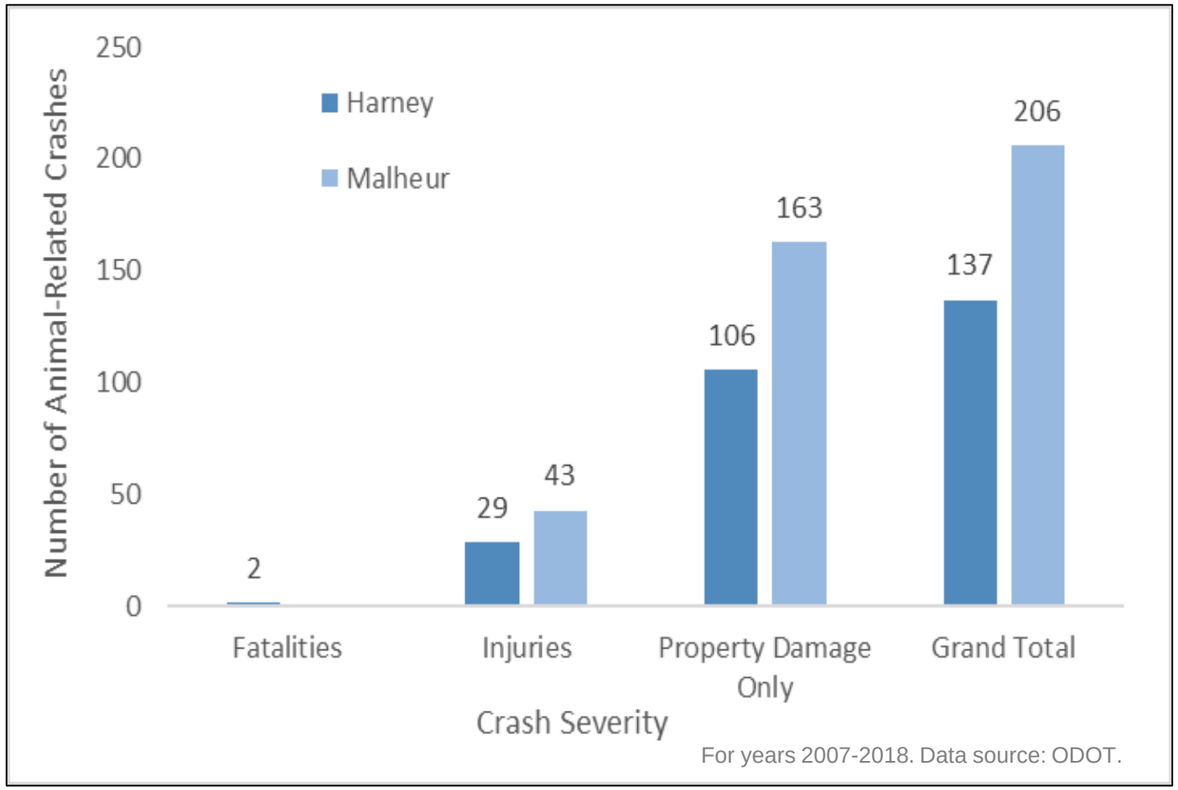
- More WVCs are documented on US 20 than any other highway in Harney and Malheur Counties.
- US Highway 20 is a substantial source of wildlife mortality, particularly in Malheur County
- Mule deer account for most carcasses, 92% in Harney County and 97% in Malheur County.



# Study Findings

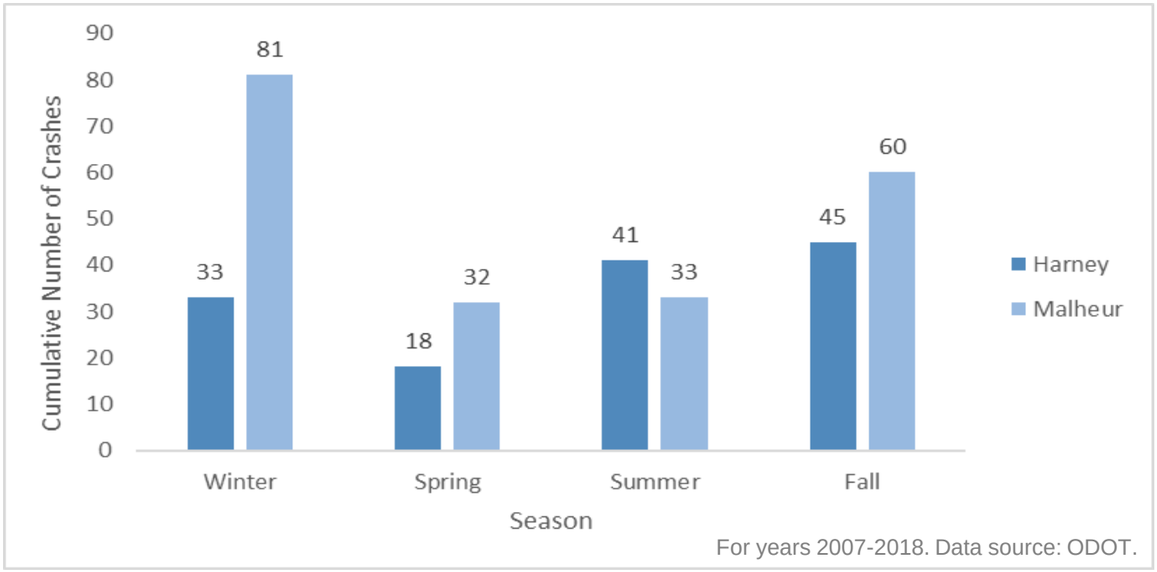
- Since 2010, animal-related crashes on US Highway 20 have resulted in 2 fatalities and 73 injuries
- 12-15% of all crashes in Harney and Malheur Counties are animal-related collisions. National average is 5%.
- Costs associated with wildlife/animal-vehicle collisions in Harney and Malheur County are estimated to be ~$2M annually (Burns Paiute Tribe 2020)
- Other species involved in collisions include elk, antelope, cougar, livestock, pets, and small wildlife species such as birds.



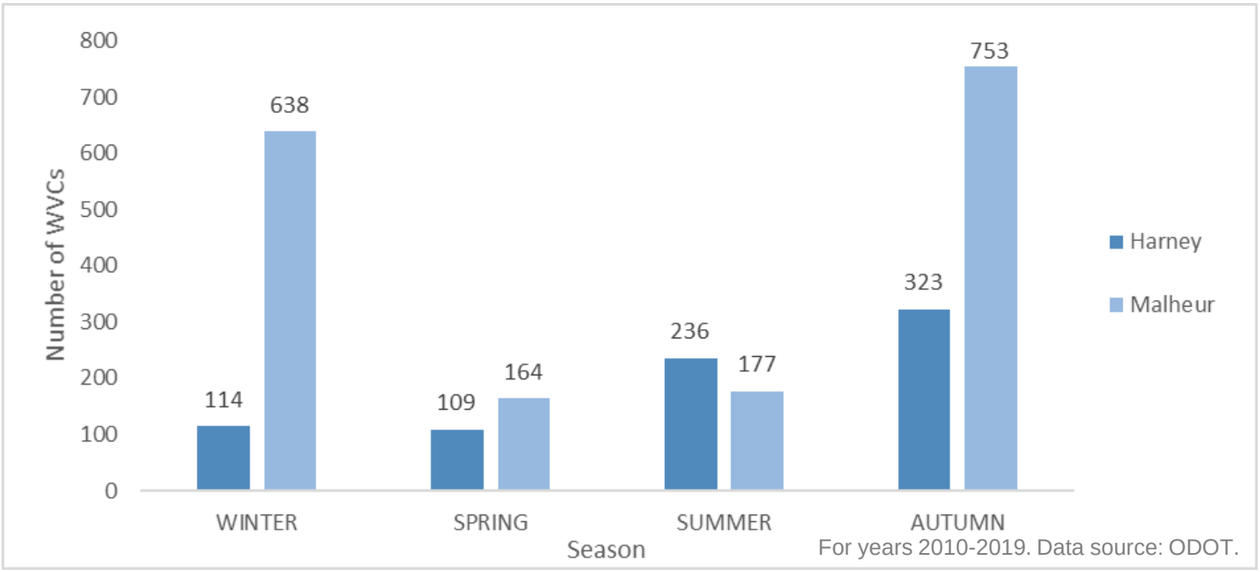
For years 2007-2018. Data source: ODOT.

# Study Findings

- Within Harney County, most WVCs were recorded in Fall, followed by in Summer, with substantially less recorded in Winter and Spring; most crashes occurred in the Fall and Summer.
- Within Malheur County the highest numbers of WVCs were recorded in the Fall and Winter; most crashes occurred in the Winter and Fall.
- Overall, WVCs substantially highest in Fall and Winter, followed by Summer and Spring
- Overall, crashes highest in Winter and Fall, followed by Summer and Spring.



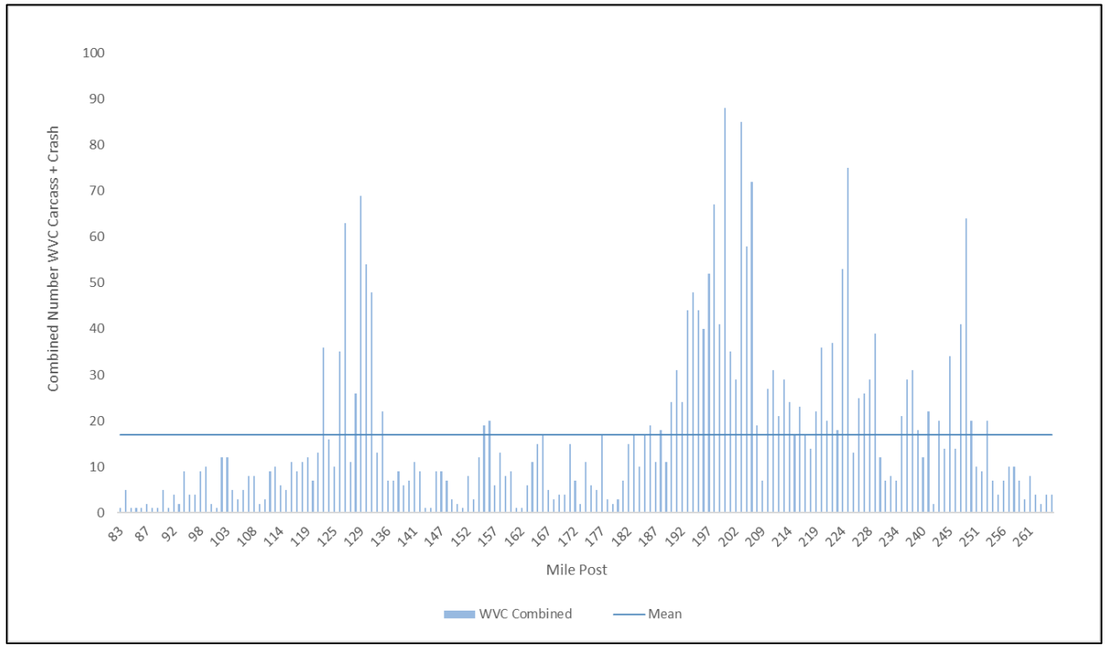
For years 2007-2018. Data source: ODOT.

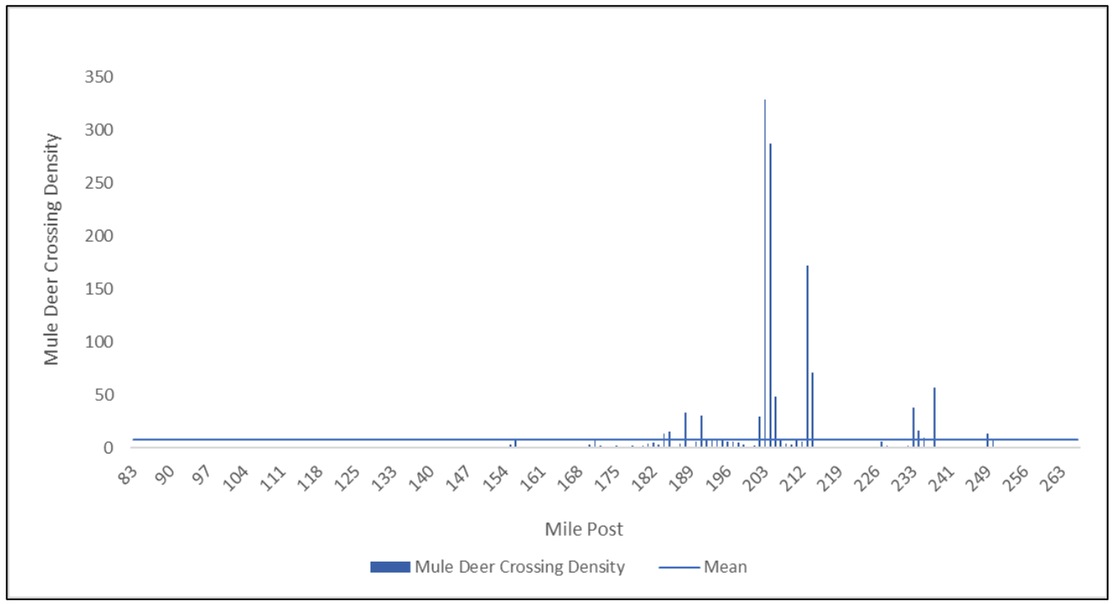


For years 2010-2019. Data source: ODOT.

# Study Findings

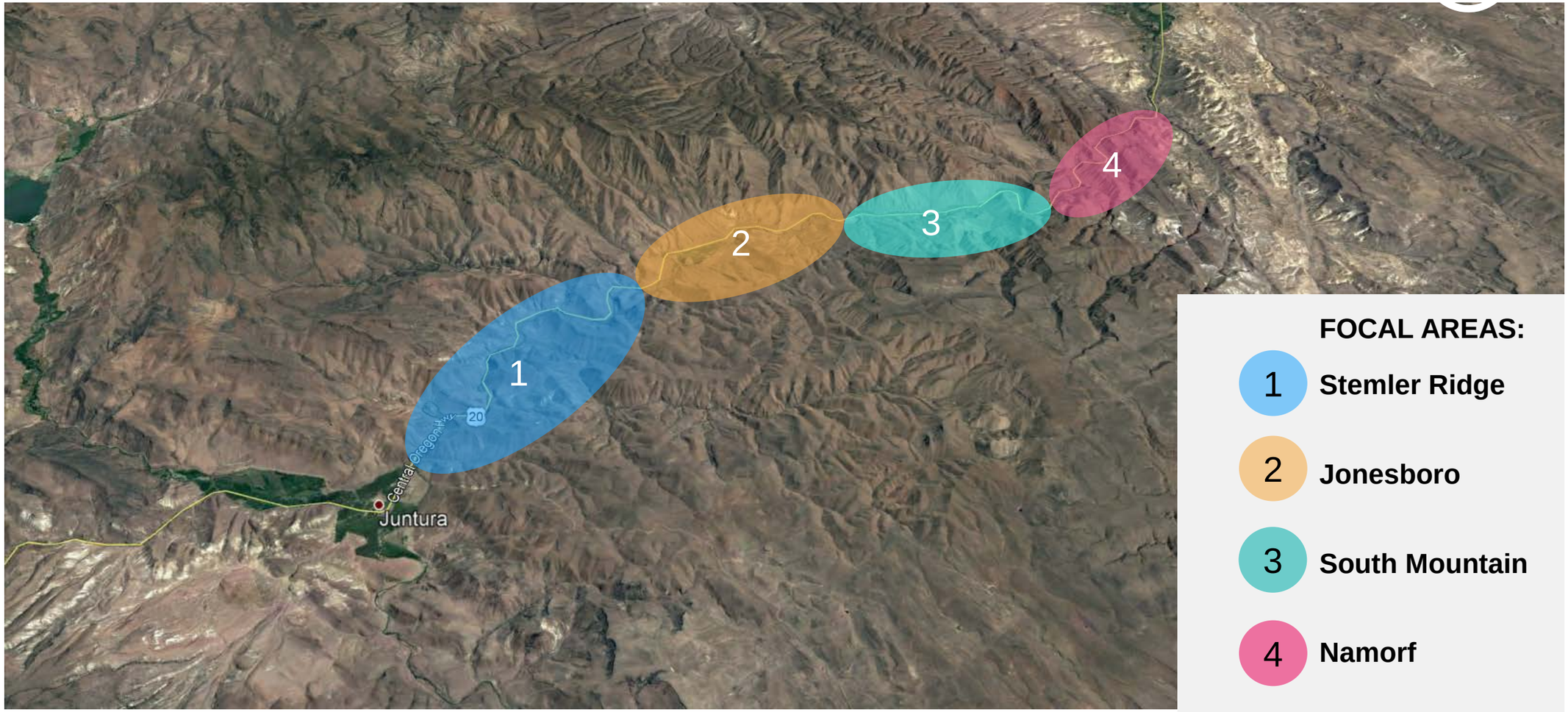
- Combined WVC + Crash data by mile post indicate regions experiencing high carcass + crash densities.
- Mule deer road crossings also indicate regions experiencing high crossing densities.
- Locations experiencing high WVCs, road crossings, and with unique land ownership context were identified and advanced as focal areas for detailed assessment.



# Focal Area Overview

**Via the data analysis, we homed in on areas with high density of animal movement and wildlife vehicle collisions. We'll focus on these four areas in the stakeholder workshop.**



# Focal Area 1: Stemler Ridge

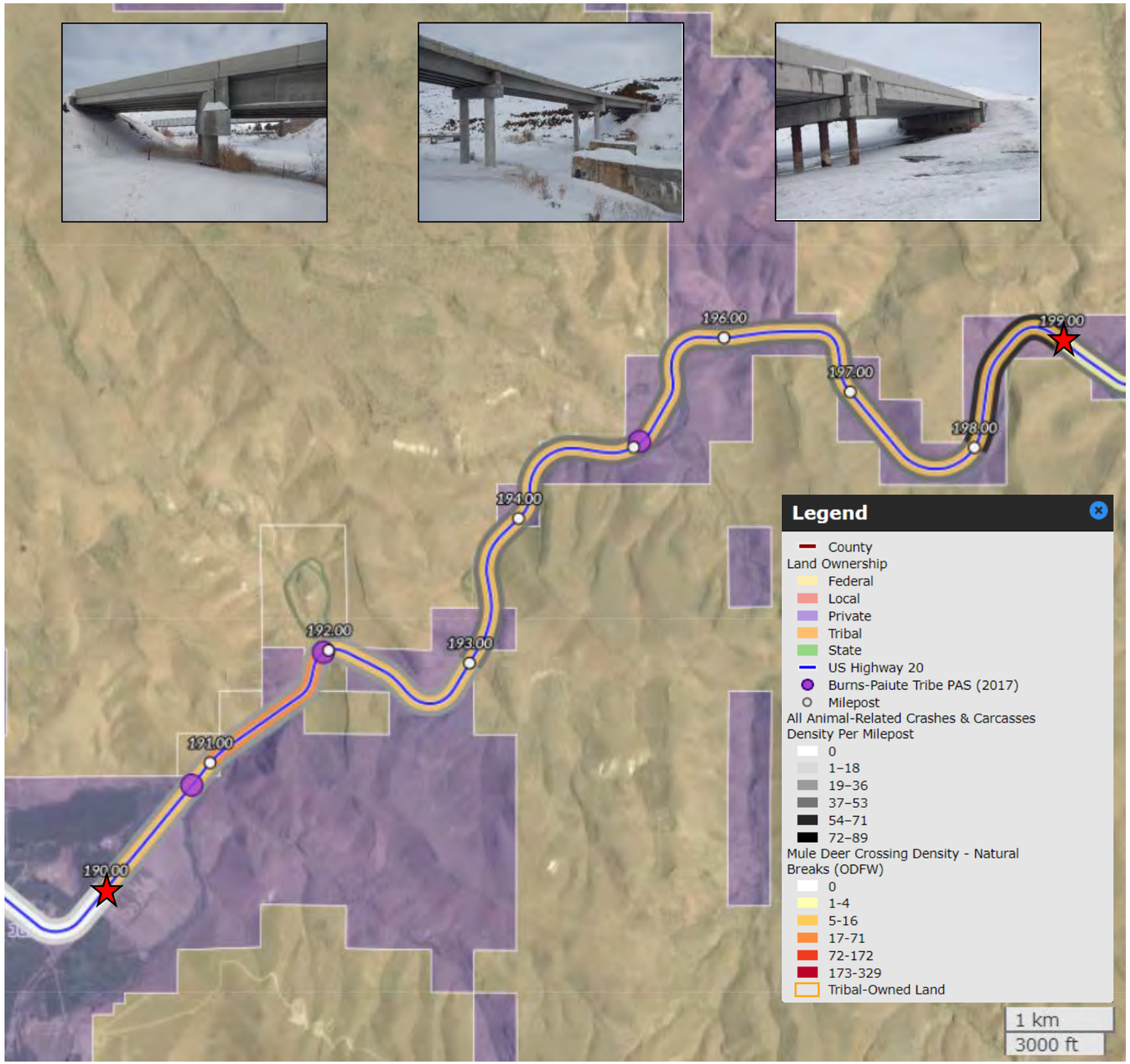
## Descriptors

- Location: approx. MP 190-199 (red stars = boundaries)
- Land ownership = Private and Federal Govt.

## Key issues

- Moderate WVC densities
  - Total carcasses[1] = 363, or 40.3/mi
  - Total animal-related crashes[2] = 11, or 1.2/mi
  - Total WVCs (both datasets) = 374, or 41.6/mi
- High-moderate mule deer crossing densities
  - Total deer crossings[3] = 83, or 9.2/mi
- Estimated costs
  - Total estimated WVCs cost per year range: $253,642 - $338,190

*[1] (ODOT, 2010-2019)  [2] (ODOT, 2007-2018)  [3] (ODFW collar data)*

# Focal Area 2: Jonesboro

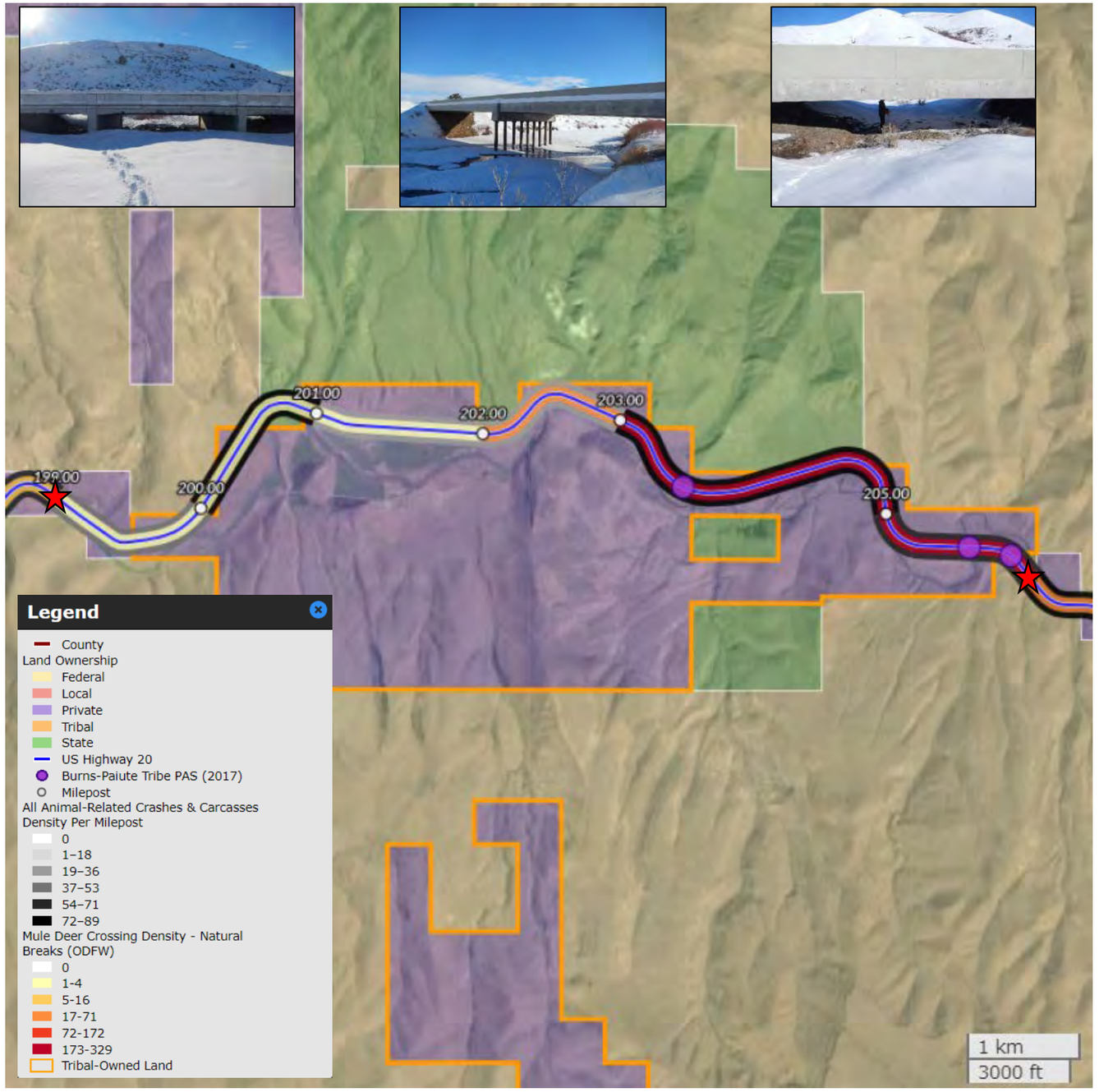
## Descriptors

- Location: approx. MP 199-206
- Land ownership = Tribal, State, and Federal Govt.

## Key issues

- Highest WVC densities of study area
  - Total carcasses[1] = 319, or 45.6/mi
  - Total animal-related crashes[2] = 16, or 2.3/mi
  - Total WVCs (both datasets) = 335, or 47.9/mi
- Highest mule deer crossing densities of study area
  - Total deer crossings[3] = 651, or 93/mi
- Estimated costs
  - Total estimated WVCs cost per year range: $227,566 - $303,422

*[1] (ODOT, 2010-2019)  [2] (ODOT, 2007-2018)  [3] (ODFW collar data)*

# Focal Area 3: South Mountain

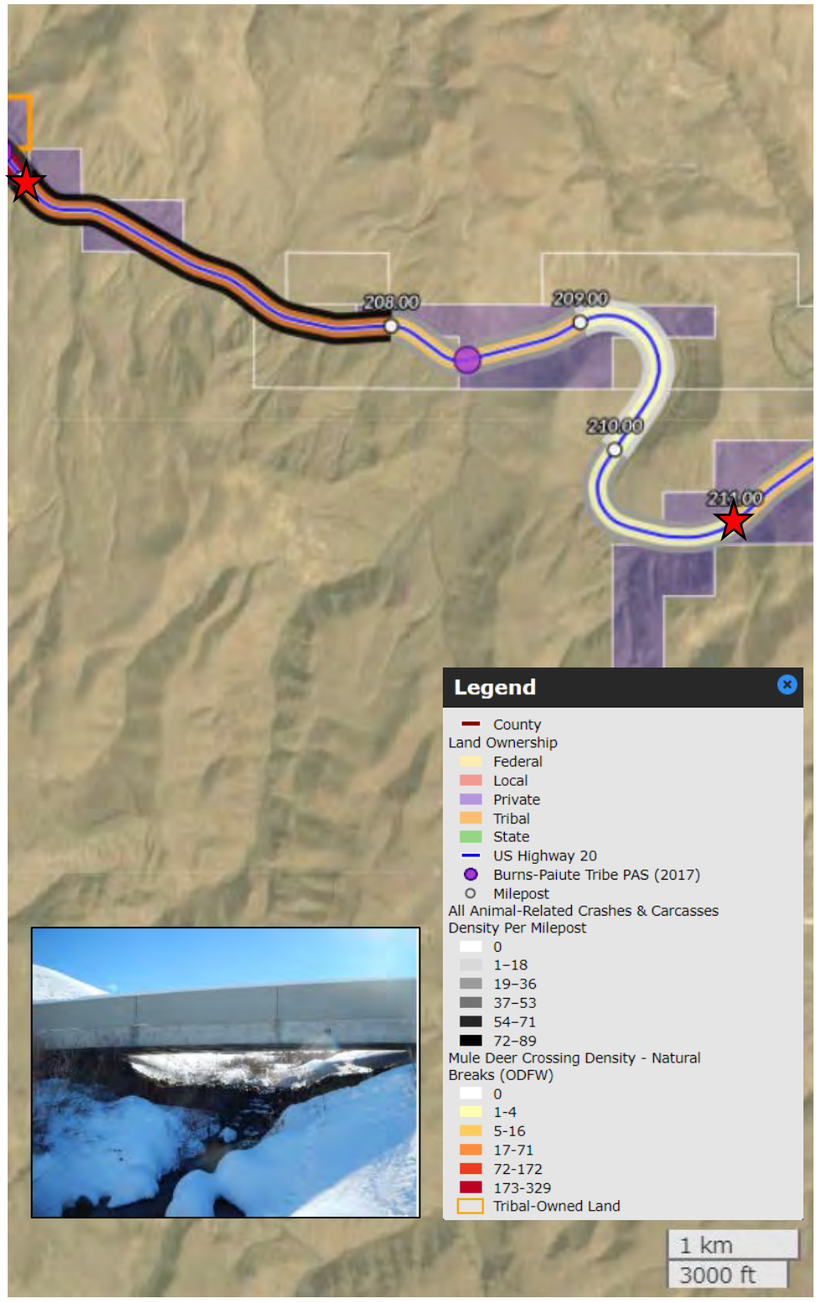
## Descriptors

- Location: approx. MP 206-211
- Land ownership = Private and Federal Govt.

## Key issues

- High WVC densities
  - Total carcasses[1] = 121, or 24.2/mi
  - Total animal-related crashes[2] = 4, or 0.8/mi
  - Total WVCs (both datasets) = 125, or 25.0/mi
- High mule deer crossing densities for study area
  - Total deer crossings[3] = 62, or 12.4/mi
- Estimated costs
  - Total estimated WVCs cost per year range: $84,780 - $113,040

*[1] (ODOT, 2010-2019)* *[2] (ODOT, 2007-2018)* *[3] (ODFW collar data)*

# Focal Area 4: Namorf

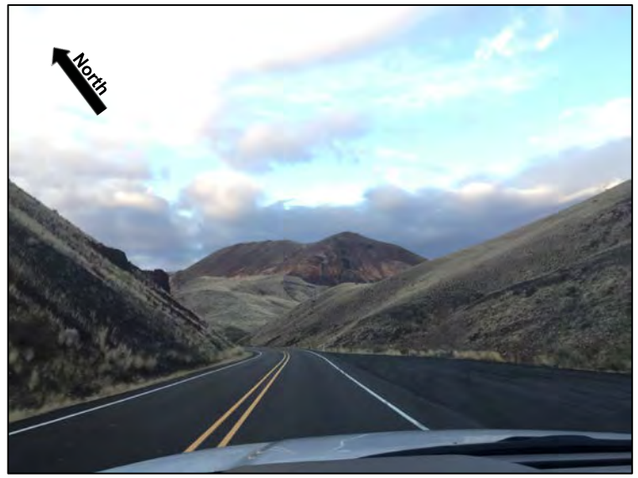
## Descriptors

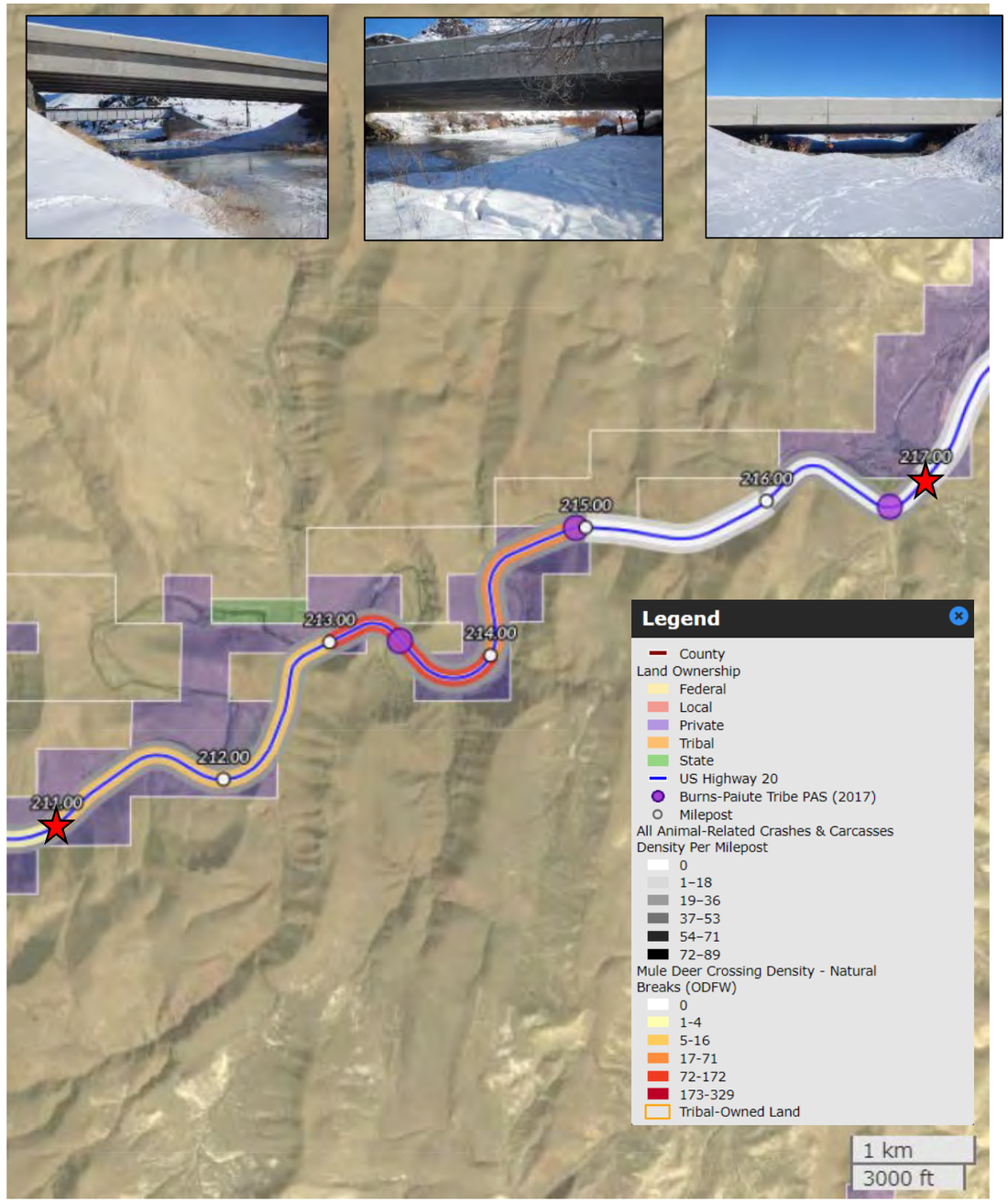
- Location: approx. MP 211-217
- Land ownership = Private and Federal Govt.

## Key issues

- Moderate WVC densities
  - Total carcasses[1] = 133, or 22.2/mile
  - Total animal-related crashes[2] = 12, or 2.0/mile
  - Total WVCs (both datasets) = 145, or 24.2/mile
- High mule deer crossing densities
  - Total deer crossings[3] = 257, or 42.8/mile
- Estimated costs
  - Total estimated WVCs cost per year range: $98,284 - $131,045

*[1] (ODOT, 2010-2019)  [2] (ODOT, 2007-2018)  [3] (ODFW collar data)*



# Highway 20 Connectivity Feasibility Study: Workshop 2 Summary

**Calla Hagle (Burns Paiute Tribe), Carter Crouch (Burns Paiute Tribe), Shannon Crossen (ICF), Erika Britney (ICF), Vicki Heron (ICF), Jennifer Cathcart (ICF)**

**01/19/21**

# Background

- Highway 20 bisects important winter range for a variety of species, including mule deer
- High levels of wildlife-vehicle collisions (WVCs) in study area resulting in substantial wildlife mortality and human safety risks
- Malheur River mule deer population: 25% decline over 4 years; Beulah population 42% decline in 4 years
- This project: analyze data, collaboratively identify feasible habitat connectivity mitigation, develop implementation plan

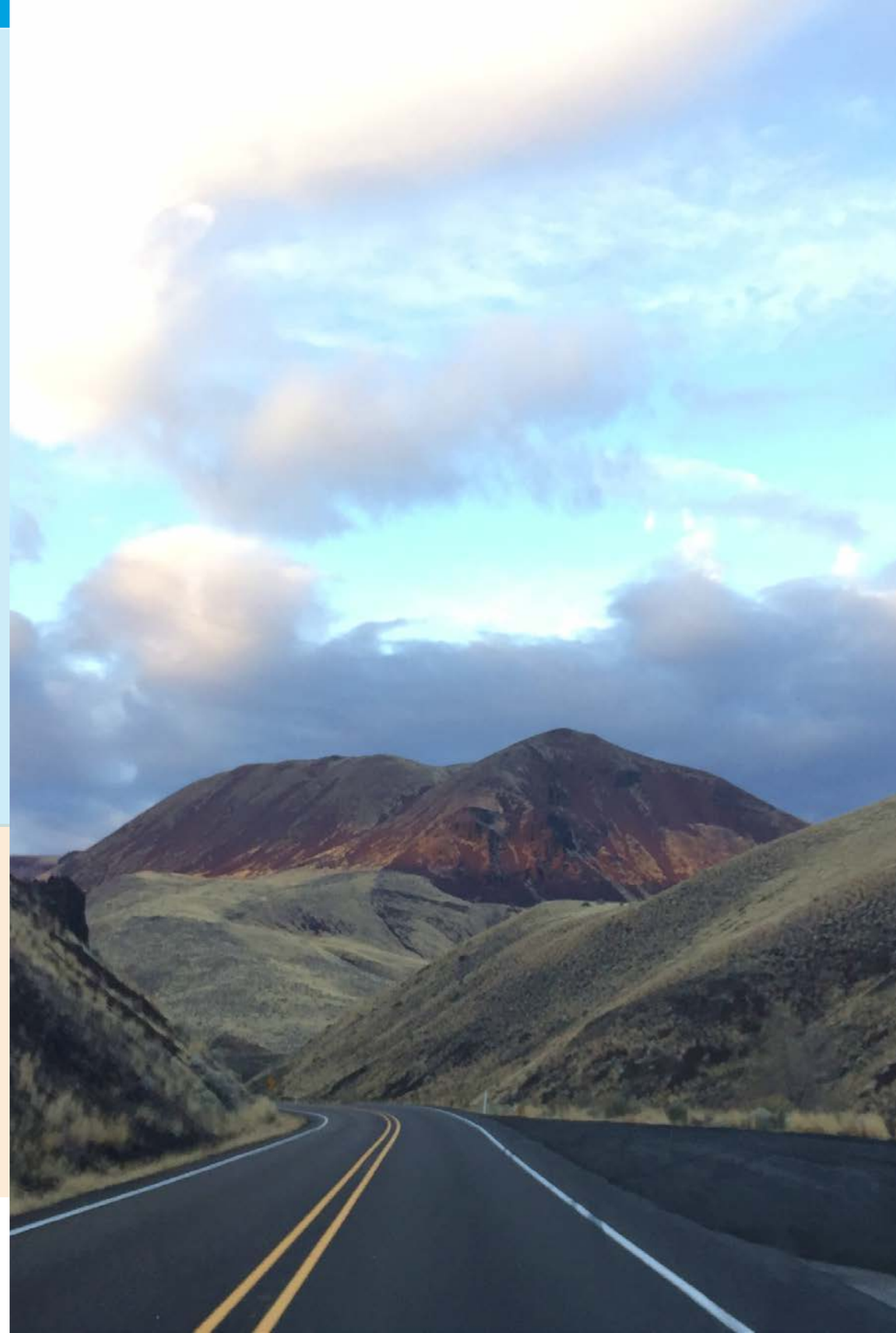
# Workshop Objective

Identify feasible connectivity enhancement measures through facilitated discussions with local and regional partners

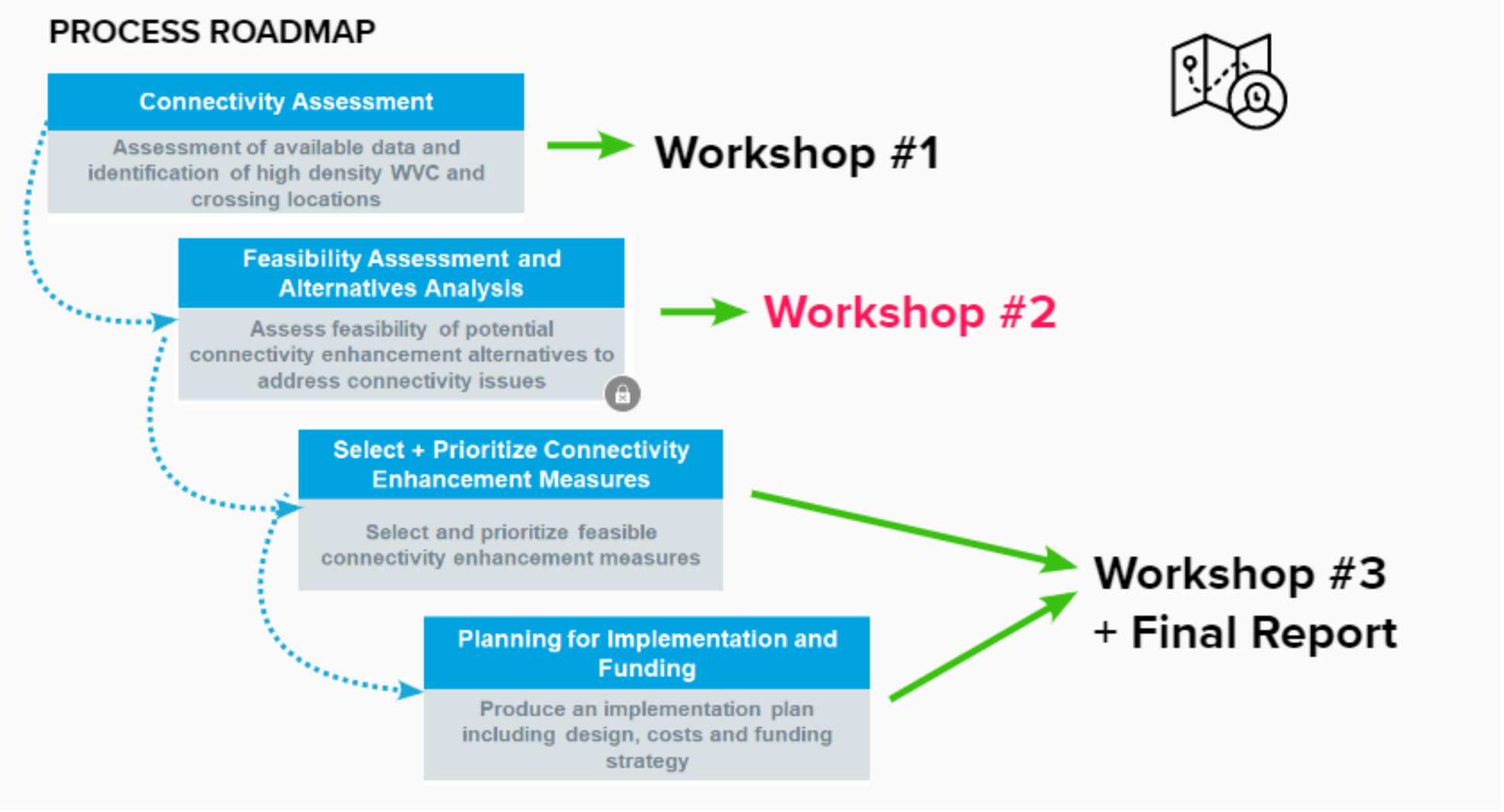
# Workshop Process Vision Statement

***In 15 years, we will have reduced wildlife vehicle collisions on Highway 20 by 75% by collaborating to implement wildlife crossing structures and other measures that improve habitat connectivity and quality for wildlife species, road safety, and driver awareness***

Developed collaboratively during Workshop 1



# Project Approach



# Workshop 2 Contributors

*The Burns Paiute Tribe would like to thank the following contributors for their participation in the second workshop.*

- **Paul Woodworth** (Oregon Department of Transportation)
- **Cidney Bowman** (Oregon Department of Transportation)
- **Rachel Wheat** (Oregon Department of Fish and Wildlife)
- **Tom Segal** (Oregon Department of Fish and Wildlife)
- **Randy Wiest** (Oregon State Lands)
- **Mike Schmeiske** (Oregon State Lands)
- **Jake Ferguson** (Bureau of Land Management)
- **Megan McGuire** (Bureau of Land Management)
- **Mark Penninger** (U.S. Fish and Wildlife Service)
- **Calla Hagle** Burns Paiute Tribe)
- **Jessica Keys (**US Senator Jeff Merkley Office)
- **Kathleen Cathey** (US Senator Ron Wyden Office)
- **Ken McCall** (Oregon Hunters Association)
- **Jeremy Austin** (Oregon Natural Desert Association)
- **Michael O'Casey** (Theodore Roosevelt Conservation Partnership)
- **Bill Richardson** (Rocky Mountain Elk Foundation)
- **Julie Unfried** (Pheasants Forever)
- **Tim Greseth** (Oregon Wildlife Foundation)
- **Sandra Jacobson** (ARC Solutions)
- **Renee Callahan** (ARC Solutions)
- **Tessa Artuc** (ICF)
- **Annika Sullivan** (ICF)

See Workshop 2 Mural Board Here:
https://app.mural.co/t/icfeei4168/m/icfeei4168/1607362026976/e740f3133903e22b2bec1b629f95dbbea32d3a13?sender=bb40abff-4e9f-46b4-be6e-215b11a66aeb

# Stakeholder Additions and Clarifications on the Mitigation Tool Kit

## MITIGATION TOOL KIT


## STAKEHOLDER COMMENTS

**Combining Tools:**

- All measures can be used together. They aren't mutually exclusive.
- When measures are coupled, we can see more benefit and effectiveness

**Education:**

- Need public education at the local level
- Recognition that studies have not been conducted to determine what the 'best approach' is to influence driver behavioral change

**Traffic Calming Measures:**

- Consideration of slow zones, using signage, ripples/speed bumps on roadway, graphics on the roadway that increase as the driver approaches the red zone area
- It would be good to have a feel for implementation costs of traffic calming measures

**Habitat Improvements**:

- Enhance/improve habitat quality away from roadsides to attract wildlife away from highway
- Relocate highway to a landscape setting that is less impactful to wildlife. Expensive, but should be considered

**Management & Monitoring:**

- What should be the frequency and duration of monitoring - what's the funding source look like?
- How will livestock management be handled?

The presentation on the Mitigation Tool Kit is appended to the end of this summary. See Mural board, Panel 3 for post-it note comments

*Each tool in the Connectivity Tool Kit has the potential to reduce Wildlife Vehicle Collisions (WVCs) in different ways and are associated with differing levels of cost and effectiveness and require different planning time horizons. The following information was used to inform break-out session discussions.*

# COMPARISON OF COST, EFFECTIVENESS AND PLANNING TIMEFRAME OF CONNECTIVITY TOOLS

| Mitigation Toolbox: | Price Range | Effectiveness at Reducing WVCs | Planning Timeframe |
|---|---|---|---|
| Public education and awareness | $ | low | short |
| Signage | $ | low | short |
| Traffic control | $ | low | medium |
| Experimental techniques | $$ | unknown[1] | medium |
| Reduce roadside value | $ | medium | short |
| Retrofit | $$ | medium - high | medium |
| Wildlife crossings | $$$ | high[2] | long |
| Wildlife fencing | $$ | high | medium |
| Habitat Enhancement | $$ | unknown | medium |

**Key:**

**Price Range:** $ (tens of thousands); $$ (hundreds of thousands); $$$ (millions)

**Effectiveness:** high, medium, low, unknown

**Planning timeframe**: short (1-3 years); medium (4-9 years); long (10+ years)

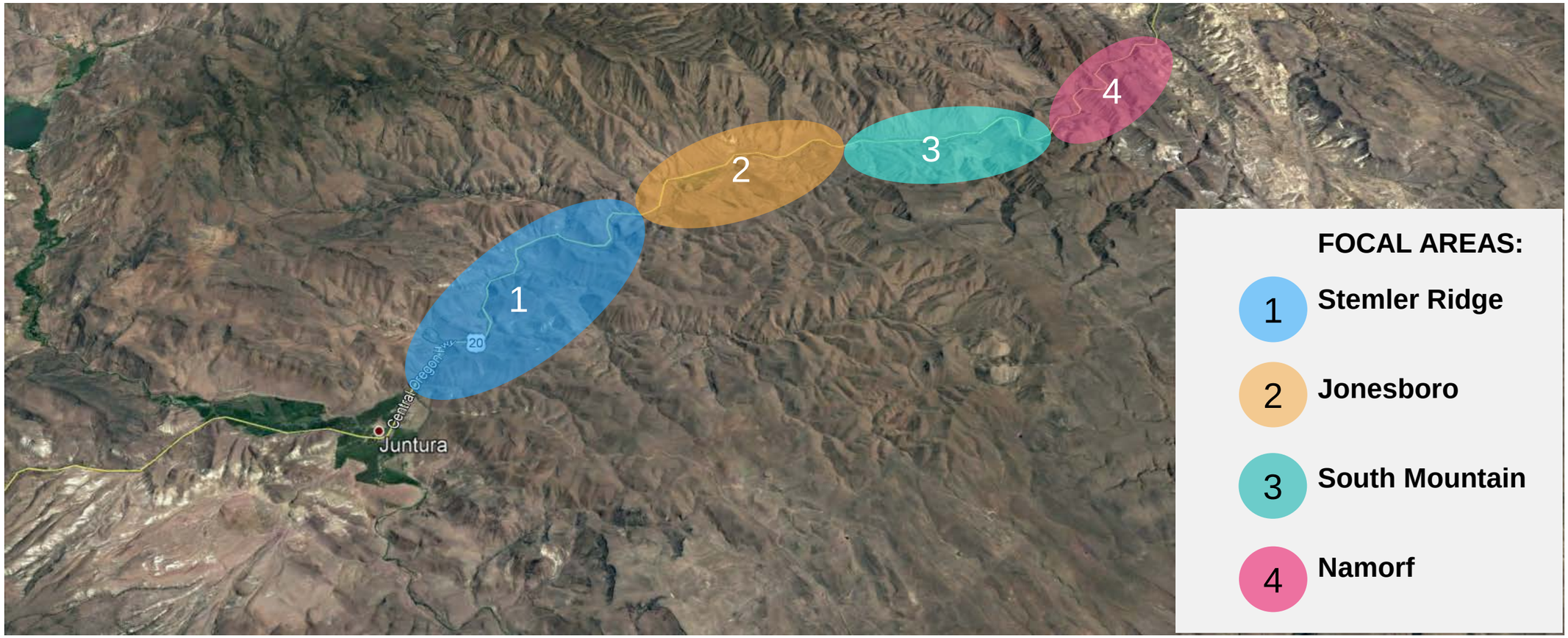
[1] Limited numbers of applications/studies

[2] High effectiveness only if coupled with fencing

# Focal Area Overview

**In workshop 1 we presented and vetted four focal areas* within the study area with highest density of animal movement and wildlife-vehicle collisions. Workshop 2 focused on these four areas.**

*Focal areas were selected based on density of wildlife-vehicle collisions and wildlife road crossings in the study area outside of incorporated municipalities.




The presentation of the ICF analysis is appended to the end of the workshop 1 summary. It shows data supporting selection of focal areas.

# Focal Area 1: Stemler Ridge

## Land Uses

- Primarily undeveloped
- Extensive agriculture at MP 190-191

## Vegetation Cover

- Primarily surrounded by shrubland
- Narrow riparian/wetlands corridor along Malheur River, few trees

## Recent Wildfires

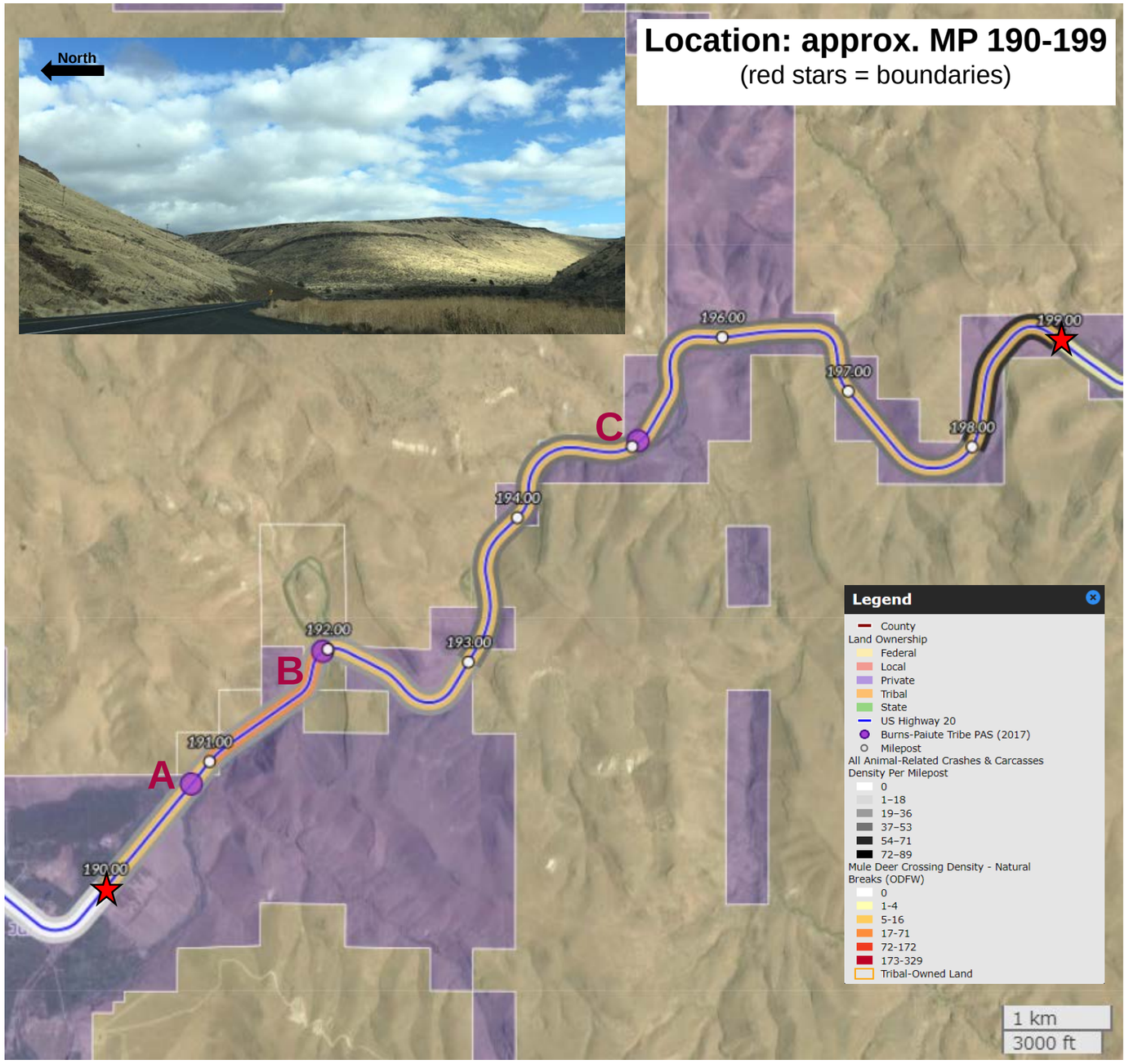
- Multiple fires adjacent to north side of Hwy 20 from MP 191-197
- “Currey Canyon” (2018), “Stemler Ridge” (2006 & 2016), “Stemler” (2014), “Juniper Reservoir” (2007)

## Notable Topography/Features

- Open valley on western end between MP 190-191
- Highway mostly adjacent to river through most of focal area
- Highway is confined at steep slopes/river bends near MP 192-195, 197, and 199
- Highway crosses rivers at three large bridges
- Three large culverts in focal area

## Bridges Assessed for Retrofit by BPT using PAS (listed west to east)

A. North Fork Malheur River bridge
B. Malheur River ("Horseshoe Bend") bridge
C. Malheur River ("Gwynn") bridge



# Focal Area 2: Jonesboro

## Land Uses

- Primarily undeveloped, few structures at MP 201
- Agriculture at MP 201-202

## Vegetation Cover

- Primarily surrounded by shrubland
- Narrow riparian/wetland corridor along Malheur River, few trees
- Some grassland habitat on river valley floor/floodplain terrace along US20

## Recent Wildfires

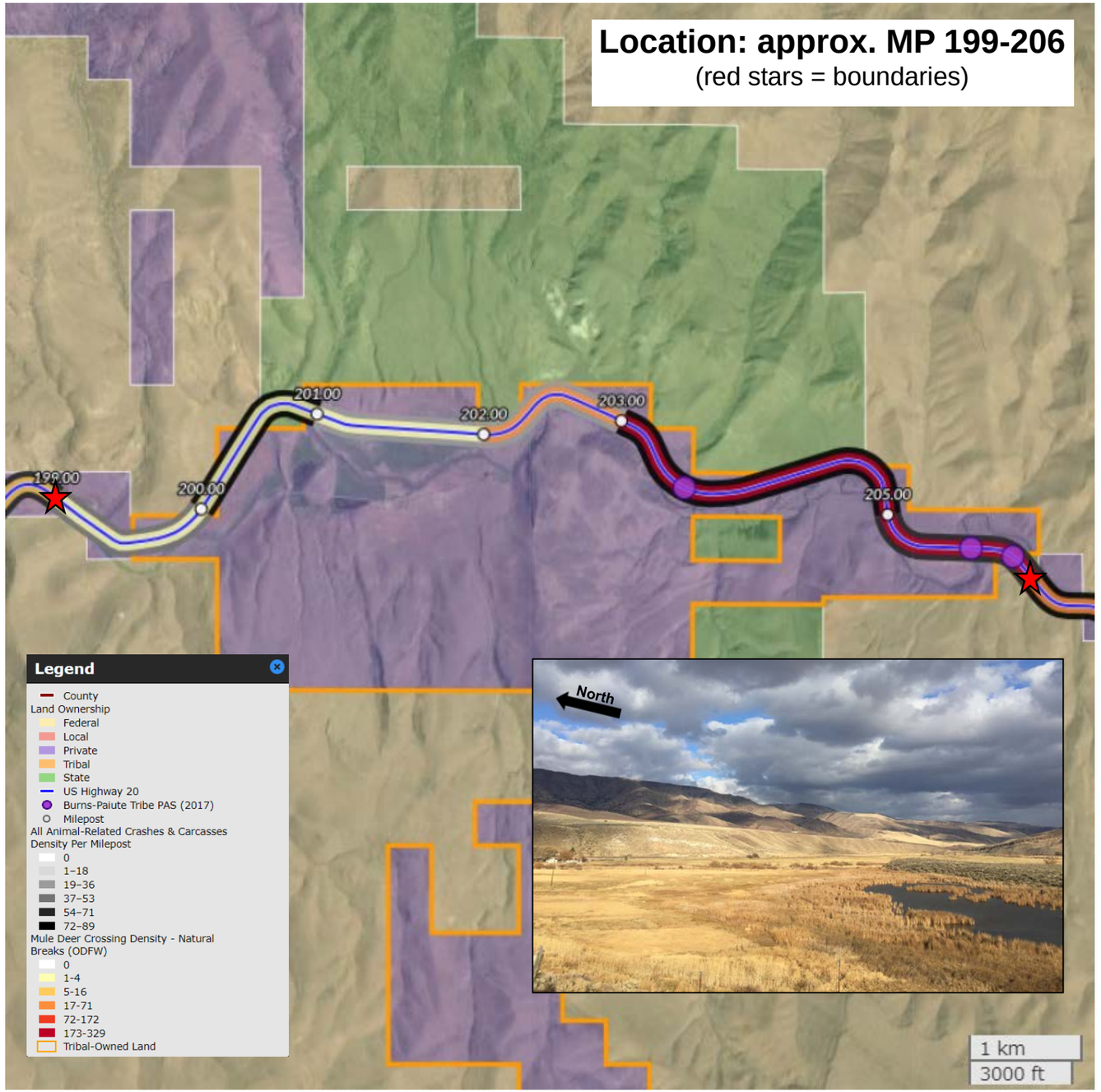
- “Indian Creek” (2020) adjacent to north side of Hwy 20 between MP 200-205

## Notable Topography/Features

- Generally, more open river valley compared to other focal areas
- Highway occasionally adjacent to river, often separated by floodplain
- Highway crosses streams at three large bridges, including Malheur River once and at two major tributaries
- Area can be prone to flash flooding
- Potentially 8 large culverts in focal area

## Bridges Assessed for Retrofit by BPT using PAS (listed west to east)

- Black Canyon Creek bridge
- Malheur River bridge
- Sperry Creek bridge



# Focal Area 3: South Mountain

## Land Uses

- Nearly entirely undeveloped
- A few structures west of MP 211

## Vegetation Cover

- Primarily surrounded by shrubland
- Minimal riparian/wetlands corridor along Malheur River, few trees

## Recent Wildfires

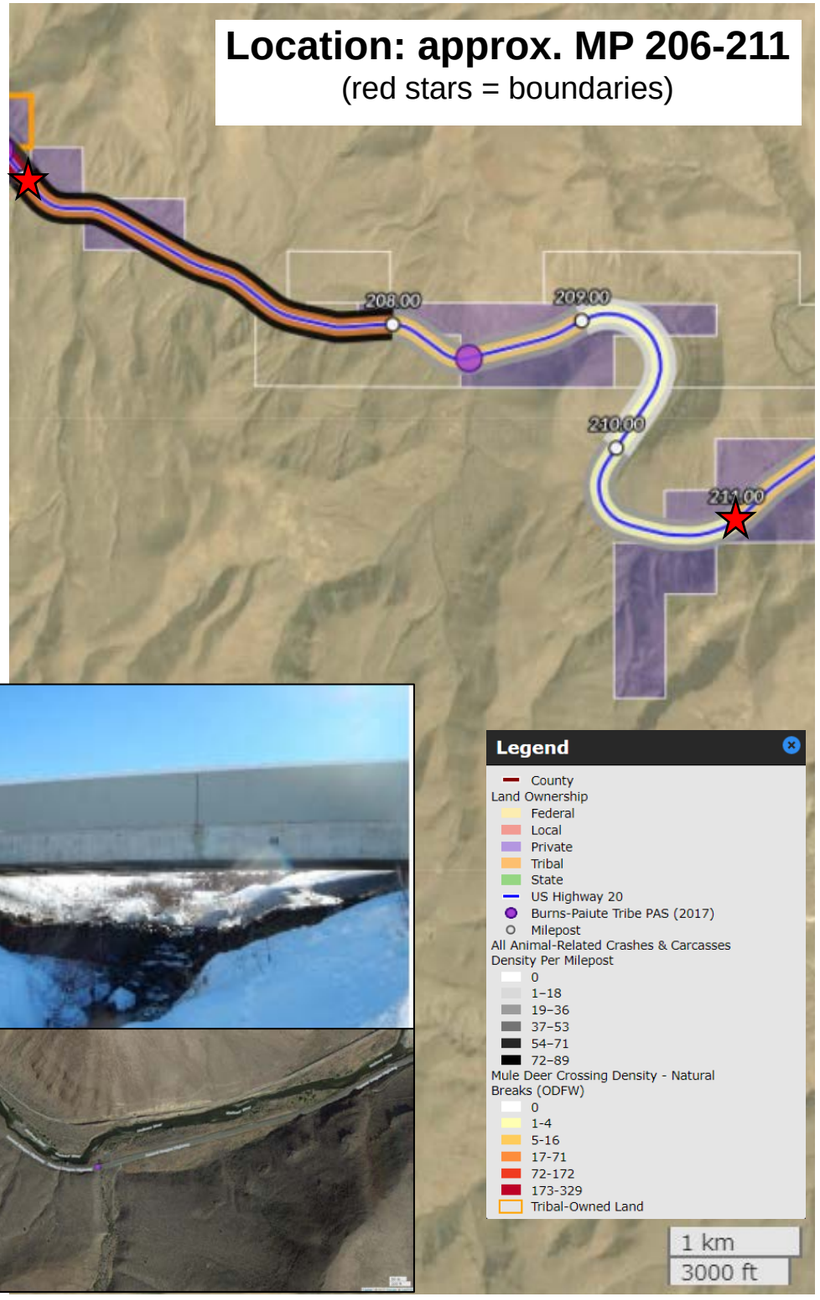
- None since 2000

## Notable Topography/Features

- Highway mostly adjacent to river through most of focal area
- Fairly narrow river/floodplain corridor between steep terrain and slopes
- Highway is confined at steep slopes/river near MP 206-208, and MP 211
- Pond/wetland present adjacent to south side of Hwy 20 west of MP 208
- Highway crosses one major tributary
- Area can be prone to flash flooding
- Potentially 2 large culverts in focal area

## Bridges Assessed for Retrofit by BPT using PAS (listed west to east)

- Gold Creek bridge

# Focal Area 4: Namorf

## Land Uses

- Primarily undeveloped
- Agriculture near Hwy 20 approximately at MP 212 and 217
- Some structures west of MP 212 and 213

## Vegetation Cover

- Primarily surrounded by shrubland; some grassland within floodplain/river valley
- Narrow riparian/wetlands corridor along Malheur River, more trees east of MP 215

## Recent Wildfires

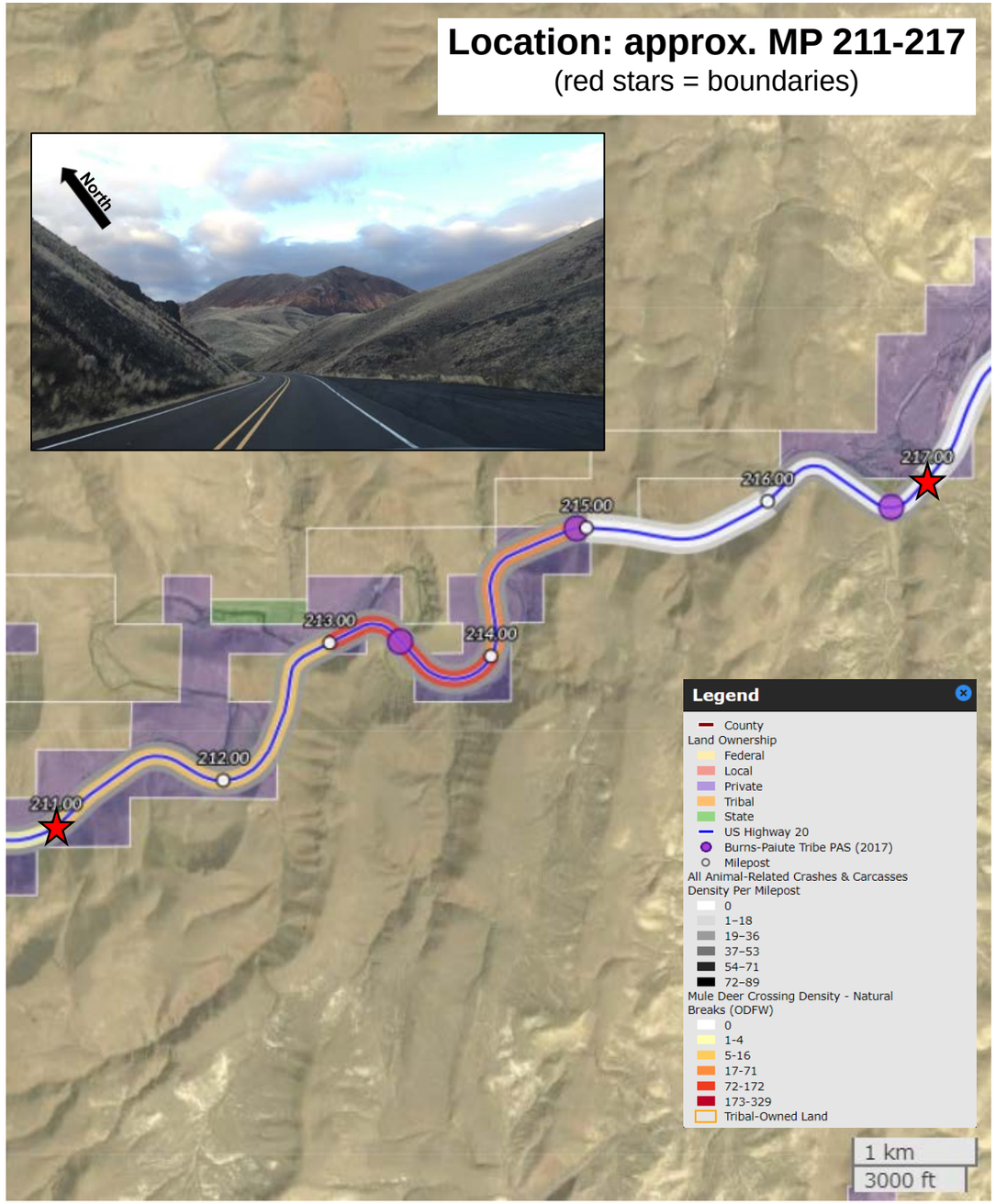
- “Simmons Gulch” fire (2016) adjacent to southside of Hwy 20 from MP 211-212

## Notable Topography/Features

- Extremely narrow river/floodplain corridor between steep hillsides and slopes, though valley opens at eastern end of focal area
- Highway is often off-channel or across floodplain, occasionally adjacent to river
- Highway confined by steep slopes/river near MP 211 and 213, west of MP 215, and near MP 216; many curves within steep canyon
- Crosses rivers at three large bridges, including at one major tributary
- Area can be prone to flash flooding
- Potentially 1 large culvert in focal area

## Bridges Assessed for Retrofit by BPT using PAS (listed west to east)

- Malheur River “Diversion” bridge
- Malheur River “Namorf” bridge
- “Squaw Creek” (aka Yapaa Creek) bridge



# Summary of Feasible Connectivity Enhancement Measures Identified across the Focal Areas

*(summary across all four focal areas – Mural Panel 4B and 4D)*

| | APPLIES? | WHERE TO IMPLEMENT THE TOOL (GENERAL) | GROUPING WITH OTHER MEASURES |
|---|---|---|---|
| Public Education/ Awareness | ✓ | Whole corridor; local and targeted education | Combine with **Signage** |
| Signage | ✓ | Whole corridor and in specific areas (areas with High WVCs, curves, riparian areas) | Combine with **Public Education/Awareness** |
| Traffic Control | ✗ | Not supported with consensus; limited applicability - highway a high priority for moving freight. (See Slide 15) | N/A |
| Experimental Techniques | ✓ ? | Animal Detection Systems ***may apply***; very location-specific and situations-specific | Combine with **Wildlife Fencing** |
| Reduce roadside value | ✓ ? | ***May apply.*** Carcass removal: whole corridor; weed maintenance, reduce road salts in limited sight areas | None |
| Retrofit | ✓ | Existing bridges and culverts when feasible (passage and engineering) | Combine with **Wildlife Fencing** and **Habitat Enhancement** |
| Wildlife Crossings | ✓ | Areas with high WVCs, high density of wildlife movement across Highway and no retrofit opportunities | Combine with **Wildlife Fencing** and **Habitat Enhancement** |
| Wildlife Fencing | ✓ | Areas with existing safe crossing opportunities, high WVCs, high density of wildlife movement across Highway | Combine with **Retrofit** and/or **Wildlife Crossings** and **Habitat Enhancement** |
| Habitat Enhancement | ✓ | Whole corridor; targeted at Retrofit locations (e.g., riparian enhancement) | Combine with **Retrofit** and/or **Wildlife Crossings** and **Wildlife Fencing** |

**Note: Any tool implemented will require additional research and coordination**
**"Other measures not shown here may also apply, depends on cost and outcomes of specific analysis"**

# Public Education & Awareness

**DESCRIBE**

Targeted messaging/outreach campaign for the "Malheur corridor", cohesive logos, messages, etc.

Target specific types of drivers:

- Out-of-state/out-of town drivers (RVs, hikers/mountain bikers).
- Big transport trucks (work with trucking companies)
- Local residents

Placement:

- Have information at local trails and info centers
- Radio spots near east and west ends of Juntura/Vale section
- Need best practice ideas

**PROS**

- Low cost
- Address inherent human component
- Engages community and may facilitate public support etc.

**CONS**

- Unknown effectiveness
- Challenges determining who to target for public education and how (what will work)
- This stretch of HWY receives use from a large number of out-of-area truckers...would be difficult to educate unless done roadside or at the project site
- Hard for large vehicles. Don't want to slow down, big trucks very big. Truckers outfit trucks so that vehicle not damaged by WVCs

**PLANNING/DESIGN CONSIDERATIONS**

Semis – Large Commercial Vehicles:

- This is a high priority highway for moving freight - target freight industry
- Need to figure out what's in it for them?
- Stopping Distance for Semi-Trucks (60 mph) ~ 400-500 feet

Public education:

- Need to target educational messages to different audiences (very difficult)
- Locals tend to learn where "hot spots" are, but they also travel local routes more frequently
- Out of towners often have no idea of hazards on highways that they have never or rarely travel

Educate on value of mitigation options

Target various demographics, age groups, and media sources

# Signage

**DESCRIBE**

Type:

- Variable message signs and/or signs that are only up or only display a message during a certain times or seasons
- More detailed/specific signage
- Add flashing lights
- On-the-road graphic signage
- “Possible Stop” sign
- Non-static signage

Placement:

- Variable messaging signs near Juntura and near Vale and/or Harper
- Variable message “reminder” signs in the core of high-density WVC areas

**PROS**

- Low cost
- People do not ignore variable message signs or signs only up some of the time.
- Apply to all drivers on the road without bias

**CONS**

- Low effectiveness
- More specific signage may require policy changes re: signage (Oregon state policies)
- People don't pay attention to signs because they know where they are going
- People may ignore signs they are unfamiliar with
- Variable message signs – there may be language barriers (EB)

**PLANNING/DESIGN CONSIDERATIONS**

- Look at current state of science and best practices
- ***Place making*** e.g., take a corridor approach, "named wildlife corridor“
- Have a local "***logo***" to personalize and increase recognition
- Need multiple signs to grab attention of distracted drivers
- Consider anamorphosis signage

# Traffic Control

not recommended

## DESCRIBE

- ***Cannot*** restrict of load, time or speed of travel
- ***Rumble strips may be opposed by truckers*** these could undo the good done by semi truck drive education/outreach

Type:

- Appearance of on-road graphics increases as approach to red zone increases

Placement:

- Corridor approach, focus on high density areas and areas near curves and riparian areas

## PROS

- Low cost

## CONS

- Difficult to get compliance
- Effectiveness of traffic calming [varies] on seasonal basis, i.e., Ice/snow vs dry sunny
- Even at 45 mph only about half of cars can stop in time to avoid WVC
- Can be problematic where operational speed of highway is higher, plus cost/need for enforcement

## PLANNING/DESIGN CONSIDERATIONS

- Rely on signage
- Corridor specific logo - corridor approach and theme
- This is a high priority highway for moving freight

# Experimental Techniques

? limited application

**DESCRIBE**

Type:

- Motion sensor /animal detection system in high wildlife usage zones
- Electronic pads/mats and warning light
- Anamorphosis graphics

Placement:

- Could be added at fence ends

**PROS**

- Real time notifications for drivers
- high visibility

**CONS**

- Relatively expensive
- Require long-term maintenance
- Need electricity
- Requires more collaboration to determine what techniques to use
- May get public pushback for "unproven" techniques

**PLANNING/DESIGN CONSIDERATIONS**

- Need to evaluate for feasibility relative to species and movement
- Requires monitoring

# Reduce Roadside Value

? may apply

**DESCRIBE**

Type:

- Frequent carcass removal (instead of “drag ‘n drop” technique currently used)
- Vegetation maintenance
- Reduce road salts

Placement:

- Corridor wide
- Near riparian corridors and curves and/or where there are limited sight distances
- Areas where with high wildlife crossing/use

**PROS**

- Discourages road/roadside attraction, reduces roadside foraging
- Reducing WVCs would reduce overall cost of carcass disposal
- Carcass removal would decrease subsidization of predators (e.g., crows) that that prey on sage grouse and other species by reducing food availability and scavenging opportunities.
- Tools with sage grouse benefits could create partnership opportunity with sage grouse conservation interests.

**CONS**

- Carcass removal expensive – need a way to dispose of them (compost or incinerate)
- Staffing issue for carcass removal
- Maintenance costs

**PLANNING/DESIGN CONSIDERATIONS**

- Requires analysis to evaluate how this can be cost-effectively applied.
- If/when wolves colonize this area, drag and drop of carcasses needs to consider avoiding attractants near areas with livestock, potential wolf-vehicle collisions, and the very large home range sizes of wolves.
- Identify cost effective method for carcass disposal
- Interface with sage grouse and other species conservation programs to partner/collaborate and identify possible funding opportunities
- Avoid negative impacts on plants and geomorphology

# Existing Infrastructure Retrofit

## DESCRIBE

- Retrofit where there are existing bridges or culverts that are feasible for retrofit (e.g., higher bridges)
- Potentially enlarge culverts (e.g., those with adequate flow capacity)
- Couple with riparian restoration and fencing to encourage wildlife use
- In Namorf Focal Area, would need to provide passage under the bridge because the canyon is steep

## PROS

- Retrofits are low hanging fruit that provides biggest bang for buck
- High effectiveness
- Shorter planning phase than new wildlife crossing
- Provides safe road crossing opportunity for wildlife
- Works within existing developed area
- Burns Paiute Tribe has already completed a high-level assessment of bridges and retrofit opportunities within each focal area

## CONS

- Current structures not functional for pronghorn even if retrofitted – they require overpasses
- May be more expensive than some other measures
- Potential environmental impacts due to construction
- Some locations may have limited ability to provide best function (e.g., low clearance bridges)

## PLANNING/DESIGN CONSIDERATIONS

- Structures would need to be evaluated by ODOT engineers (structural and geotechnical engineers)
- Need to assess hydraulic capability of culverts and bridges to handle flood flows
- Make sure retrofit costs less than structure cost
- Use Passage Assessment System (WSDOT 2011) to facilitate decision making
- Primarily mule deer and elk in focal areas

# Wildlife Crossings

## DESCRIBE

- Could site where collaring studies and WVC data show high density of wildlife movement across road
- Consider overpass if topography allows, also depending on targeted species use (overpasses are more appropriate elk and pronghorn)
- Couple with riparian restoration and fencing to increase effectiveness
- There are geographic opportunities for an overpass in the Namorf Focal area, at approx. mile 212-213 on public lands, in combo with retrofits to 3 existing bridges in this Focal Area

## PROS

- *Highly* effective
- Structures also allow for habitat connectivity not only WVC reduction
- Cost-benefit break-even for crossings + fencing approximately 5 deer-vehicle collisions/miles/year
- There may be more land-bridge (overpass) opportunities in Namorf focal area

## CONS

- Expensive
- A crossing structure requires perpetual maintenance over the lifecycle (Workshop 1)
- Prescriptive capital improvements seem to preclude other measures that might be effective in reducing WVCs (Workshop 1)

## PLANNING/DESIGN

- Consider design options that help as many species as possible
- Careful evaluation of locations that are appropriate for an overpass
- May face design challenge where river is close to road with little space to "land" crossing
- Consider optimal spacing for crossings (depending on target species)
- Livestock management considerations
- Need to consider property ownership when siting new crossing structures

# Wildlife Fencing

## DESCRIBE

- Site where collaring studies and WVC data show high density of wildlife movement across road and where safe crossing exists or where barrier is intended
- Adjacent to agriculture lands, funneling to crossing locations
- Combine with wildlife crossings and/or retrofits
- Could run fencing from existing bridges/structures (if/when retrofitted)
- Implement with care, need to be site specific

## PROS

- Effective when designed and implemented correctly

## CONS

- High cost
- Very steep and rugged topography throughout the Namorf Focal Area
- Lots of private land in this area. Fencing will need to account for private entryways onto the highway. Would be costly to add numerous cattle guards or other measures to keep wildlife off highway across numerous private driveways. May also need easements on private land
- High maintenance cost. Who will be tasked with maintenance?
- Deceases habitat connectivity unless coupled with crossing structures or retrofits

## PLANNING/DESIGN

- Include livestock management considerations
- What design features will fence ends have to prevent deer from being trapped within the fence and against the HWY?
- Consider escape ramp sites according to use and terrain
- Need to consider topography, especially where the topography is steep on either side of the highway, e.g., Stemler Ridge, South Mountain and Namorf focal areas (Workshop 1)

# Habitat Enhancement

## DESCRIBE

- The entire project area from Vale to Juntura is degraded mule deer winter range and can all benefit from upland habitat restoration outside of the riparian corridor
- Shrubs continue to be lost throughout the project area due to fire
- Riparian restoration near retrofit bridges and wildlife crossings.
- Shrub plantings, willow, etc. inside draws
- Emphasis on improving habitat outside fencing/crossing, provide alternative forage outside riparian strip
- Providing habitat on adjacent lands away from the roadway
- Water development – place water tanks (guzzlers) so that wildlife can access water without crossing the road to the river
- Address lack of riparian vegetation in the South Mountain Focal Area (Workshop 1)

## PROS

- Provides alternative forage option
- Could reduce number of crossings or time near roadway

## CONS

- Expensive
- Success and effectiveness can be slow and low
- Cost effectiveness and survival of plantings, perhaps focus on dryland grass forbs, and native grasses

## PLANNING/DESIGN CONSIDERATIONS

- Should be done, no matter the outcome of other actions
- It seems that if there were measures that reduced the need for animals and vehicles to meet, such as water availability, foraging habitat, etc. those types of measures might be more achievable sooner and more sustainable [e.g., require less maintenance] (Workshop 1)

# Stakeholder Input on Measures/Actions that Apply Throughout the Project Area

**Corridor Approach:** Need a corridor approach for several of these measures (e.g., application across entire highway corridor)

**Education and Engagement to Find Solutions:**

- Oregon trucking association - outreach and include them in the process for buy-in and support
- Determine how to engage freight industry to be supportive of mitigation measures. They may oppose rumble strips, though may support wildlife crossing structures and other measures
- Understand economic impacts of reduced speed on freight
- How can we engage some "partners" in a public awareness campaign engagement?
- Public ed probably will be excellent to gain support from locals

**Branding:**

- Create corridor brand or identity (e.g., place making, logo, or named corridor). Identifying a theme and name for the corridor-chosen by local partners-will help engage their support
- Keep corridor an appropriate length for best driver engagement

**Signage:**

- Seasonal/variable message signs to warn of seasonal movement + non-local drivers who may be unaware of heightened WVC risk

**Retrofit:**

- Identify retrofit needs and plan fencing and or animal detection system. Fencing and structure are more location/focal area specific
- Retrofit existing structures with wildlife fencing along with education/outreach will likely be the best approach for the whole area
- Many retrofit opportunities to make bridges more effective for wildlife use. Need an interdisciplinary team including engineers to deicide on options

**Design:**

- Checking the design life of culverts 9and when they are due for maintenance/replacement) may provide opportunities in the future to design new structures for better wildlife/aquatics use
- Need to get to the river [for water] is a key factor that influences wildlife crossing the road

**Wildlife Movement:**

- Consider placement of pronghorn and elk overpasses outside of focal areas
- Identify specifically where road crossings are needed and possible
- Upland habitat improvement throughout region
- Could water provisions (guzzlers) reduce wildlife road conflict?

# Final Words, Questions, Thoughts

**Data/Information Needs to Support Planning**

- What is the Annual Average Daily Traffic of commercial trucks
- Percentage of freight vehicles is useful data
- How many/percentage of WVCs are attributed to trucks/freight?
- Higher traffic volume tends to reduce collisions because many species begin to avoid crossing
- Is there any data on time of day when most truck traffic occurs?

**Partners**

- Consider partnering with local universities for monitoring studies or research
- Role of communications (e.g., film, local PSAs, infographics, etc.)

**Signage:**

- Consider seasonal/variable message signs to warn of seasonal movement of wildlife + non-local drivers who may be unaware of heightened WVC risk

**Responses to Questions (where available)**

- Average annual daily traffic (AADT) along this portion of Hwy 20 is ~1500
- Salt and deicers are a documented to be roadside attractants, even though some are toxic
- For information on WVCs by species, deer, elk, and pronghorn – see the Workshop 1 Summary for the analysis presented

# Next Steps

- **Workshop #3**: Early February – prioritize connectivity enhancement measures; contribute to an implementation plan
  - ☑ **Save-the-date:** Coming soon (this week)

- Point of contact for workshop process: **Erika Britney** - erika.britney@icf.com - (206) 801-2802

Thank you!

# Highway 20 Connectivity Feasibility Study

## Workshop 2 Lightning Talk

Calla Hagle (Burns Paiute Tribe), Carter Couch (Burns Paiute Tribe), Shannon Crossen (ICF), Sarah Horwath (ICF), Erika Britney (ICF), Vicki Heron (ICF), Jennifer Cathcart (ICF), Sandra Jacobson (ARC Solutions)

01/07/21

# Background

- Highway 20 bisects important winter range for a variety of species, including mule deer
- High levels of wildlife-vehicle collisions (WVCs) in study area resulting in substantial wildlife mortality and human safety risks
- Malheur River mule deer population: 25% decline over 4 years; Beulah population 42% decline in 4 years
- This project: analyze data, collaboratively identify feasible habitat connectivity mitigation, develop implementation plan

# Wildlife Connectivity Mitigation Toolbox

- Transportation and environmental professionals have developed methods for reducing wildlife-vehicle collisions, improving habitat and wildlife connectivity, and improving road safety
- Recent advancement and ongoing development of approaches, technology, and designs
- Best practice to incorporate wildlife connectivity measures into roadway design, infrastructure, operations, and maintenance, and increasingly required
- Increasing legal and regulatory requirements


Public education and awareness


Signage


Traffic control


Experimental techniques

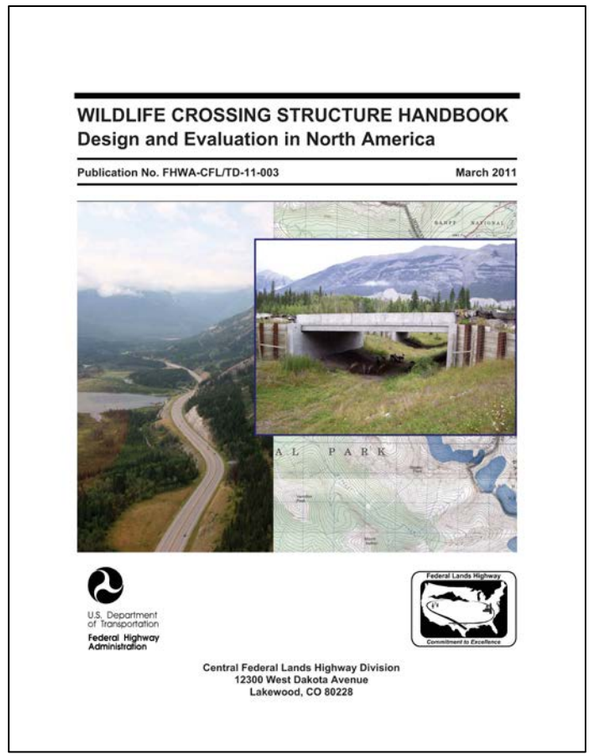

Reduce roadside value

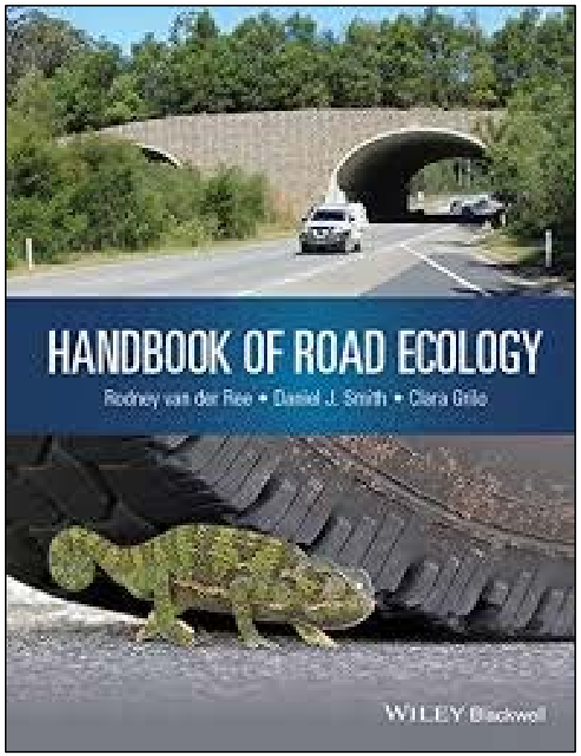

Wildlife crossings

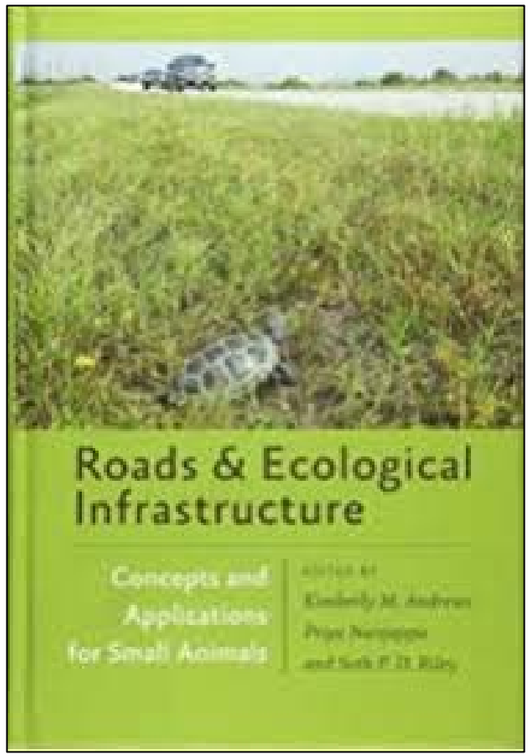

Wildlife fencing

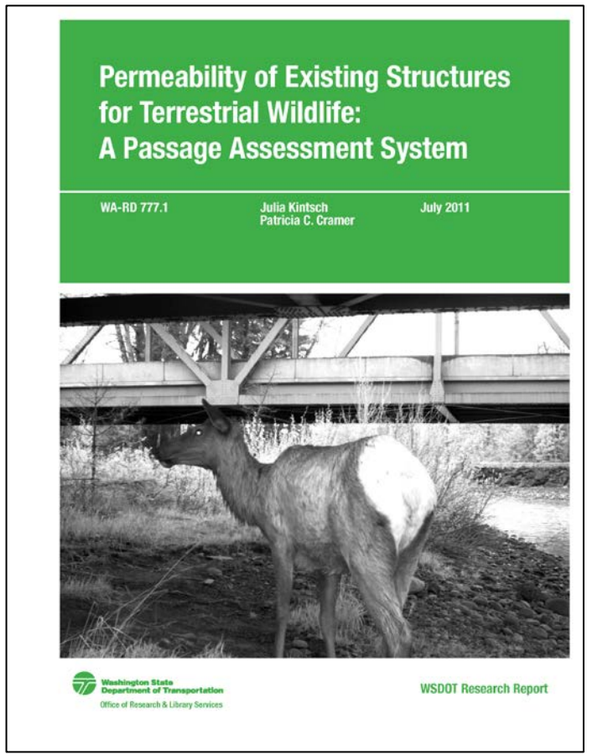

Habitat Enhancement

# Guidance, Manuals, and Handbooks



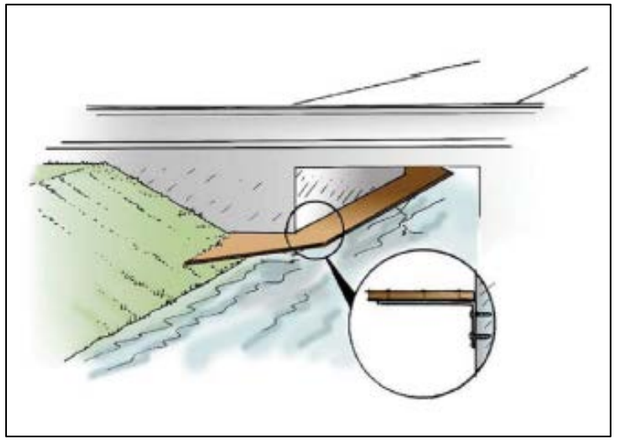



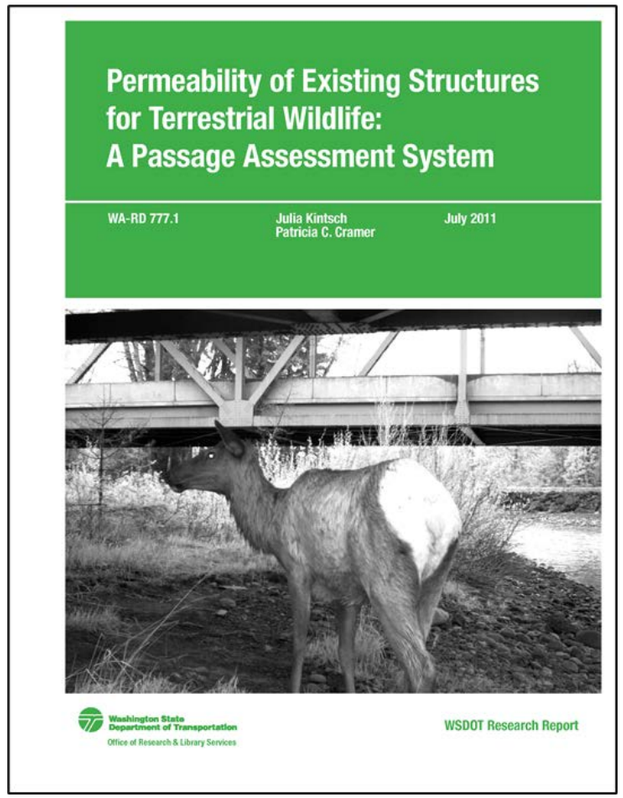



# Existing Infrastructure Retrofit

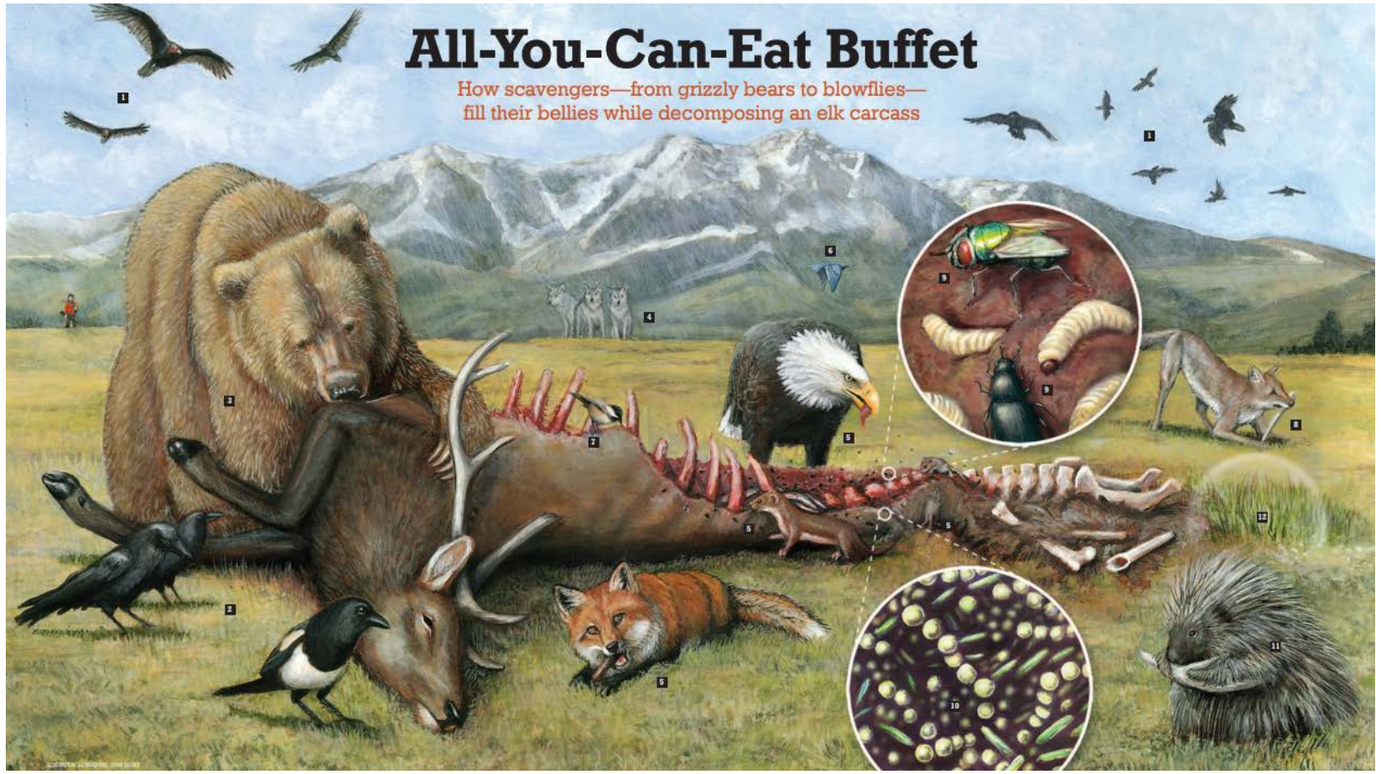
- Millions of existing bridges, culverts, and other structures
- Vast majority not designed to facilitate wildlife use
- Many can be enhanced for wildlife with several types of improvements at *lower cost than new structure*
- Passage assessment system designed to evaluate feasibility for improvement and to suggest options





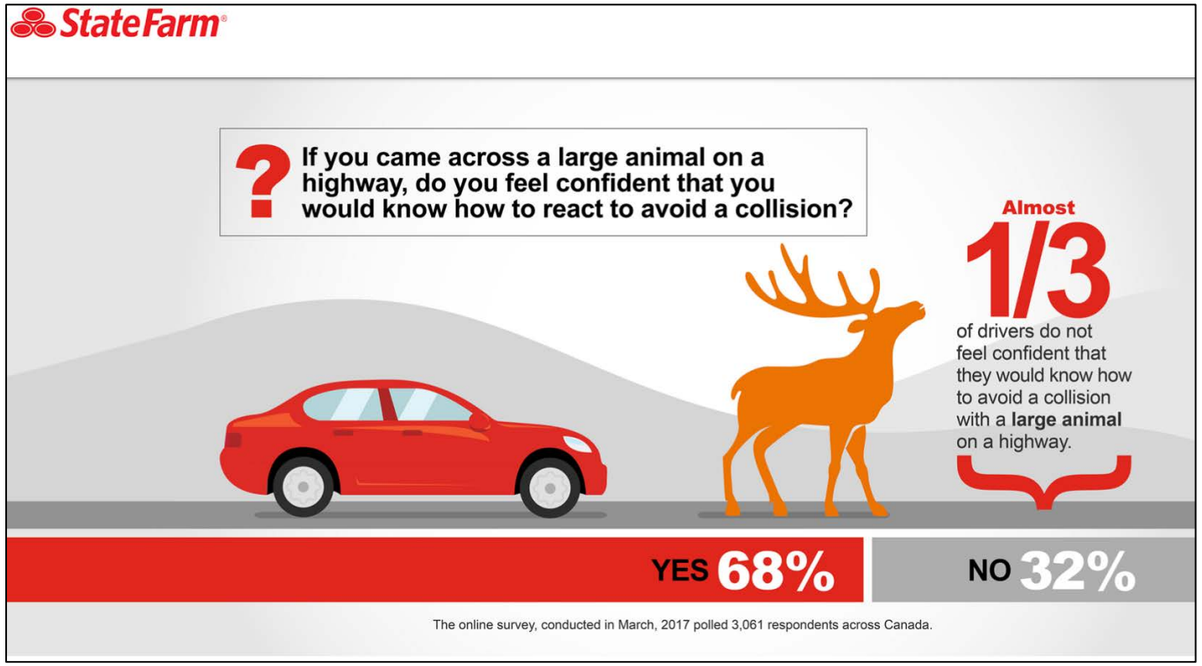
# Reduce Roadside Value

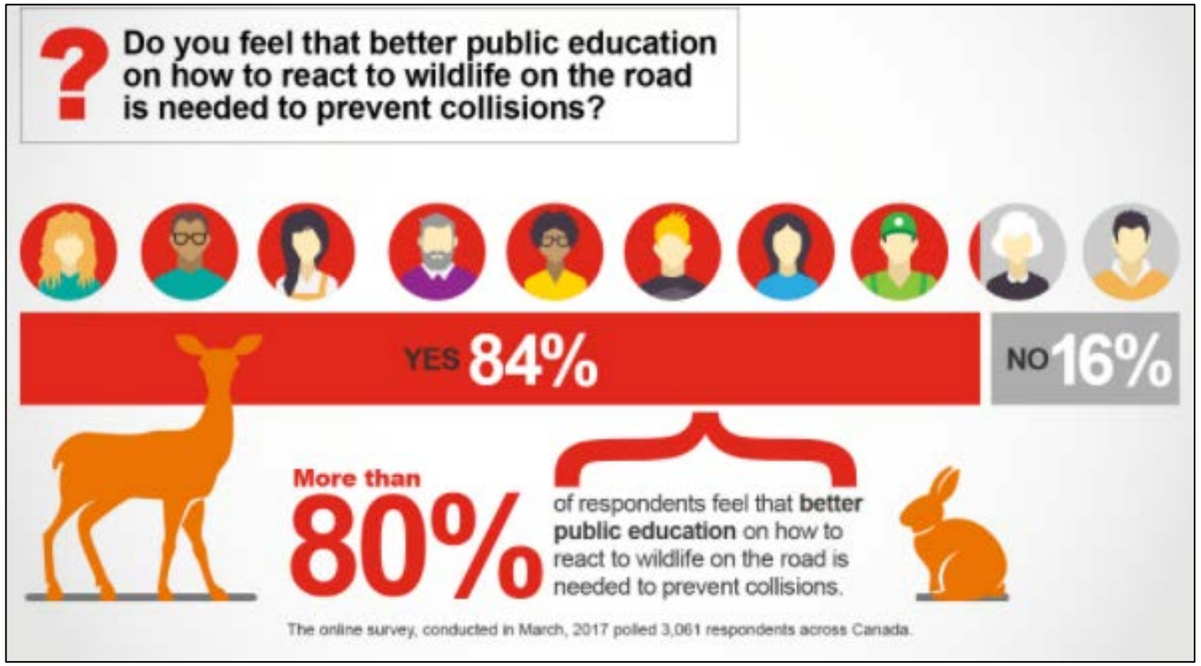
- Reduce resources/food availability at roadside
- E.g., reduce/remove forage, carcasses, road salt
- Some deicing agents may be less attractive though are toxic to wildlife




# Public Education & Awareness

- Many drivers are not confident that they could avoid a large animal collision.
- Most drivers feel collision prevention education is needed.
- Tools: Public Service Announcements (PSAs), advertisements, drivers' education

# Signage

- Standard signs not effective
- Drivers do not know what sign means or how to respond
- Changeable Message Signs or “active” message signs may be more effective because they can provide specific information and guidance on response
- Best to couple with other measures


# Traffic Control

- Aware of speed limit non-compliance on Hwy 20.
- Modified speed limits:
  - Reduction - may reduce collision severity (decreased stopping distance)
  - Seasonal
  - Day/night
  - Advisory limits
- Traffic calming in hot spots






# Wildlife Crossings

- Examples: Underpass, Overpass, Culverts
- Facilitate safe connectivity
- Not as effective at reducing WVCs unless coupled with fencing
- When coupled with fencing, highly effective at reducing WVCs (up to 90%)


# Wildlife Fencing

- *Highly* effective at reducing WVCs
- Complete barrier to movement/connectivity
- Guide/funnel animals to safe crossings
- Fence ends strategically located

**CONSTRUCTION GUIDELINES FOR WILDLIFE FENCING AND ASSOCIATED ESCAPE AND LATERAL ACCESS CONTROL MEASURES**

*Requested by:*

American Association of State Highway and Transportation Officials (AASHTO)

Standing Committee on the Environment

*Prepared by:*

Marcel P. Huijser, Angela V. Kociolek, Tiffany D.H. Allen, Patrick McGowen
Western Transportation Institute – Montana State University
PO Box 174250
Bozeman, MT 59717-4250

Patricia C. Cramer
264 E 100 North, Logan, Utah 84321

Marie Venner
Lakewood, CO 80232

April 2015

The information contained in this report was prepared as part of NCHRP Project 25-25, Task 84, National Cooperative Highway Research Program, Transportation Research Board.

**SPECIAL NOTE:** This report **IS NOT** an official publication of the National Cooperative Highway Research Program, Transportation Research Board, National Research Council, or The National Academies.

# Habitat Enhancement

**Before**

**After**

- Habitat enhancements may be beneficial at or near existing bridges to augment vegetative cover and increase species use of structures
- Habitat enhancement may be implemented on the landscape to strategically increase habitat value and support species conservation

# Experimental Techniques

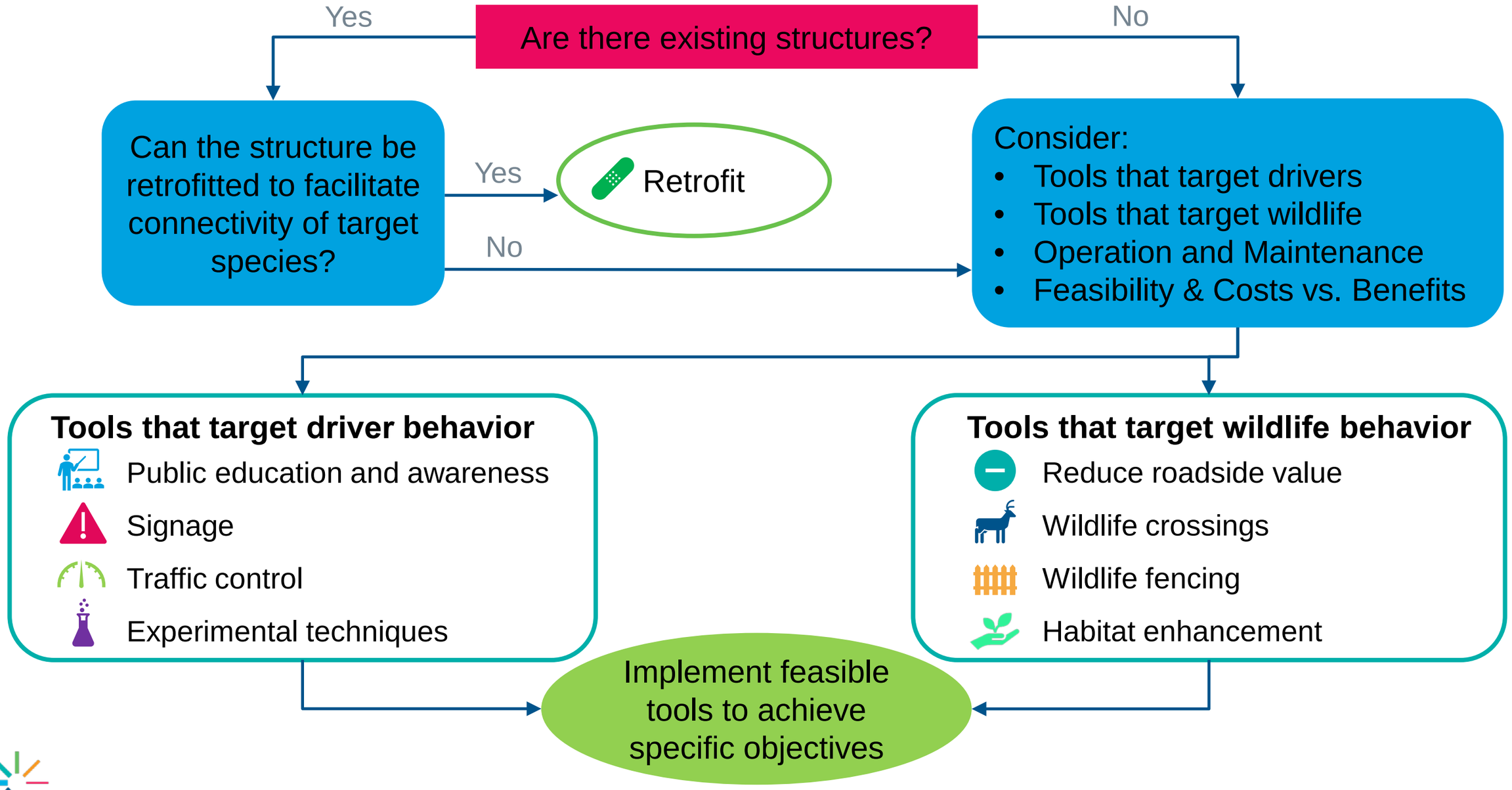
- Roadside Animal Detection Systems (ADS)
- ADS with at-grade crossings



# Monitoring and Adaptive Management

- Important component of mitigation, esp. experimental approaches (required)
- Supports ensuring approaches are both effective and meeting goals and needs of various partners/stakeholders
- Allows for approaches to be refined or replaced if not working as intended

# Decision-Making Framework



# Conclusions

- A variety of *highly effective* and *cost-effective* tools are available to reduce WVCs and facilitate safe wildlife movement across roadways
- Such tools are becoming (and in many places are) part of the new normal in transportation planning, design, operation, and maintenance (do expect to see a lot more in years to come)
- Many options can be modified and adapted to meet specific needs of DOTs and stakeholders
- Solutions should be feasible and work for both wildlife and people

# Highway 20 Connectivity Feasibility Study: Workshop 3 Summary

**Calla Hagle (Burns Paiute Tribe), Carter Crouch (Burns Paiute Tribe), Shannon Crossen (ICF), Erika Britney (ICF), Michelle Hobbs (ICF)**

**02/22/21**

# Workshop Objective

Develop a shared vision for an action plan for key next steps, priorities and considerations and major milestones for improving Wildlife Connectivity along Hwy 20.

# Outcome – what we were aiming for…

By the end of the workshop participants are excited and inspired to help improve wildlife connectivity along Hwy 20 and have a clear understanding of the critical next steps  they can take to make the shared vision a reality.

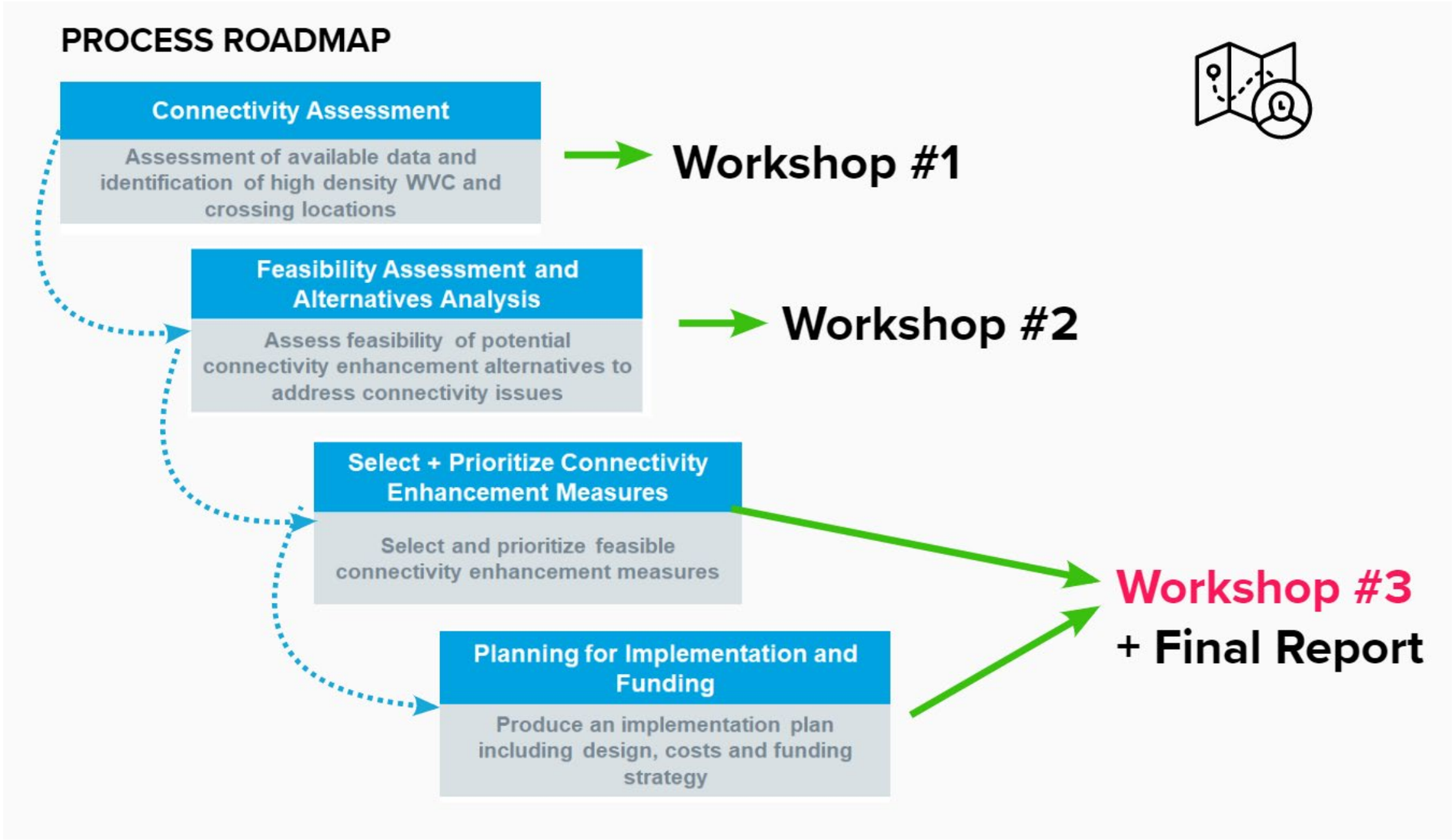
# Workshop Process Vision Statement

***In 15 years, we will have reduced wildlife vehicle collisions on Highway 20 by 75% by collaborating to implement wildlife crossing structures and other measures that improve habitat connectivity and quality for wildlife species, road safety, and driver awareness***

Developed collaboratively during Workshop 1

**Workshop 3 Mural Board:**
https://app.mural.co/t/icfeei4168/m/icfeei4168/1612809980979/23e3440368b31d3b1d47c21e39697571a1922d91

# Project Approach



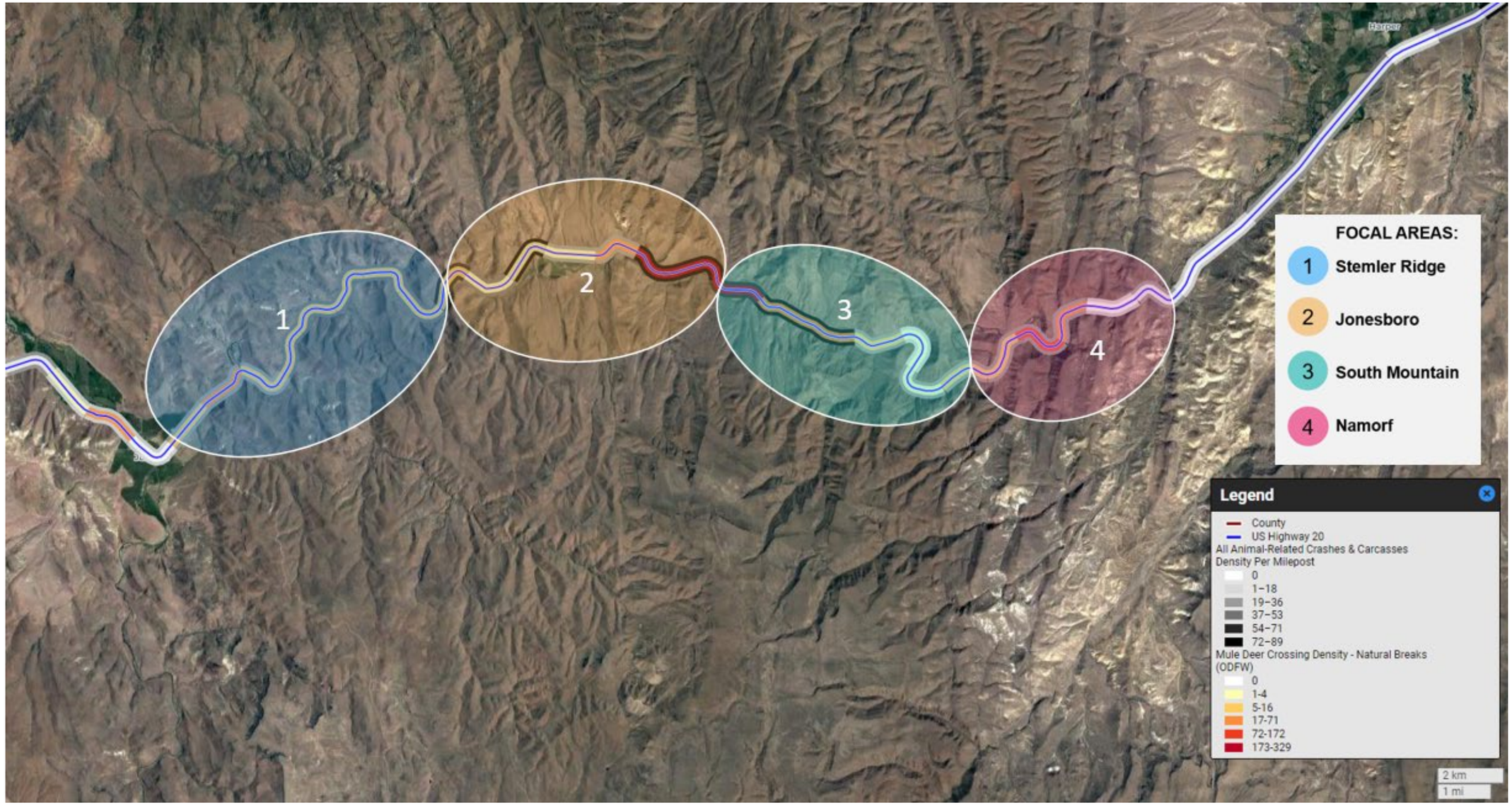
# Workshop 3 Contributors

*The Burns Paiute Tribe would like to thank the following contributors for their participation in the second workshop.*

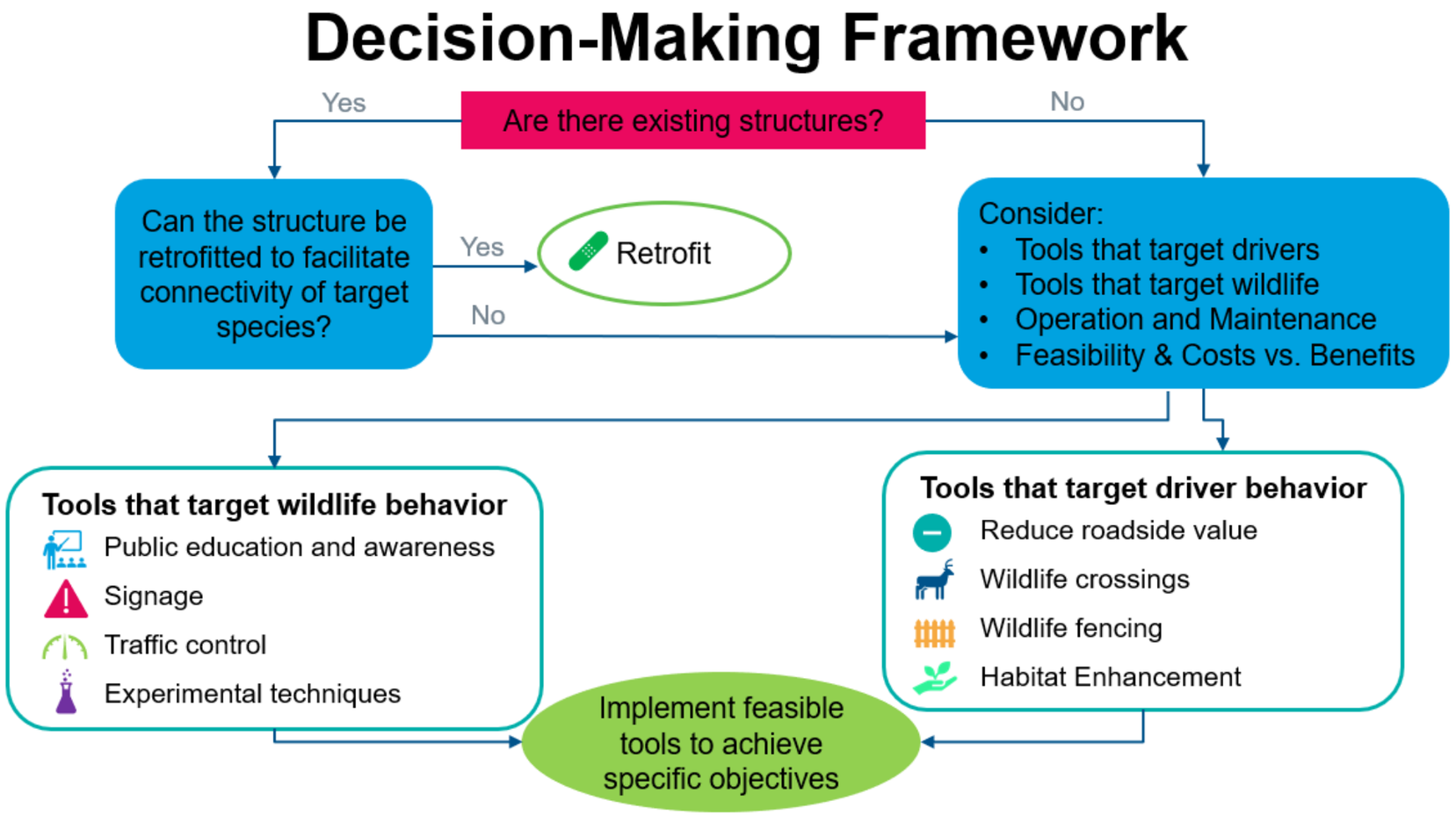
- **Paul Woodworth** (Oregon Department of Transportation)
- **Cidney Bowman** (Oregon Department of Transportation)
- **Tom Segal** (Oregon Department of Fish and Wildlife)
- **Randy Wiest** (Oregon State Lands)
- **Mike Schmeiske** (Oregon State Lands)
- **Jake Ferguson** (Bureau of Land Management)
- **Megan McGuire** (Bureau of Land Management)
- **Mark Penninger** (U.S. Fish and Wildlife Service)
- **Calla Hagle (**Burns Paiute Tribe)
- **Carter Crouch** (Burns Paiute Tribe)
- **Jessica Keys (**US Senator Jeff Merkley Office)
- **Kathleen Cathey** (US Senator Ron Wyden Office)
- **Ken McCall** (Oregon Hunters Association)
- **Bill Richardson** (Rocky Mountain Elk Foundation)
- **Tim Greseth** (Oregon Wildlife Foundation)
- **Suzanne Linford** (Protect Animal Migration)
- **Laurel Williams** (Pew Charitable Trusts)
- **Sandra Jacobson** (ARC Solutions)
- **Renee Callahan** (ARC Solutions)
- **Tessa Artuc** (ICF)
- **Annika Sullivan** (ICF)

# Summary of Workshop 1 & 2 Materials: WVC and Wildlife Crossing Data

# Summary of Workshop 1 & 2 Materials: Focal Areas



# Summary of Workshop 1 & 2 Materials

# Potential Connectivity Projects

*This list of potential projects was developed before the workshop. It is composed of connectivity tools and ideas discussed during Workshop 2. Projects are intended to represent the range of potential projects that could be undertaken.*

**Common Element Across All Projects –Public Education/Awareness**

Landowner/community education, outreach and engagement around overall effort to improve Wildlife Connectivity along the Hwy 20 corridor. This would be a foundational component of any and all efforts to improve wildlife connectivity, aimed at gaining community support and participation.

1 **Complex Retrofits - Focal Area 2**

Integrated retrofit of 3 bridges in highest WVC and crossing Focal Area, includes fencing, openness, and habitat enhancement within the vicinity to facilitate wildlife use.

2 **Simple Retrofits - Passage Enhancements**

Create a pathway for wildlife under and existing bridge without modifying the structure. This may include removal of derelict fencing, addressing steep grades and/or increasing riparian vegetation cover, etc.

3 **Wildlife Crossing**

New crossing project within one of the focal areas that includes fencing design and installation, and riparian habitat enhancement within the vicinity of the structure to facilitate wildlife use.

4 **Driver Education/Awareness**

Targeted public education and outreach aimed at changing driver behavior. This would include outreach to freight transport and tourism office; and development of signage, roadway markings, and other outreach materials (e.g., for posting at campsites and trailheads).

5 **Reduce Roadside Value**

Develop a sustainable program for carcass removal and disposal along the Highway 20 corridor in Malheur and Harney counties (ODOT District 14).

6 **Improved Signage**

Improved road signage across the whole corridor, particularly in starting at the western side of Focal Area 1 and the eastern side of Focal Area 4, e.g., specific information and direction to drivers, seasonal signage, variable message.

7 **Habitat Enhancement**

Habitat restoration of recent burn areas. Habitat enhancement to remove annual invasive grasses, spraying invasive plants, and seeding planting palatable vegetation. This could include installation of guzzlers to provide water sources away from the highway corridor.

8 **Animal Detection System**

Monitor WVCs and crossing following retrofit or new crossing installation. Install animal detection system where monitoring indicated a concentration of animals crossing the road at fence ends.

***Project 1, 2 and 3:*** *This combination of tools could potentially be replicated in multiple places along the corridor, partners, funding sources and implementation plan would be similar for other potential locations.*

# Potential Connectivity Projects - Examples

**1 Focal Area 2 - Existing Bridges**

Black Canyon Creek Bridge (#04347A)

Malheur River Bridge (#19911)

Sperry Creek Bridge (#19912)

*For Project 1, 2 and 3, the following examples were provided to illustrate possible locations of each type of project because these tools could potentially be implemented in multiple places along the highway corridor.*

**2 Focal Area 4 - Possible Passage Enhancement**

Malheur River "Diversion" Bridge (#19915)

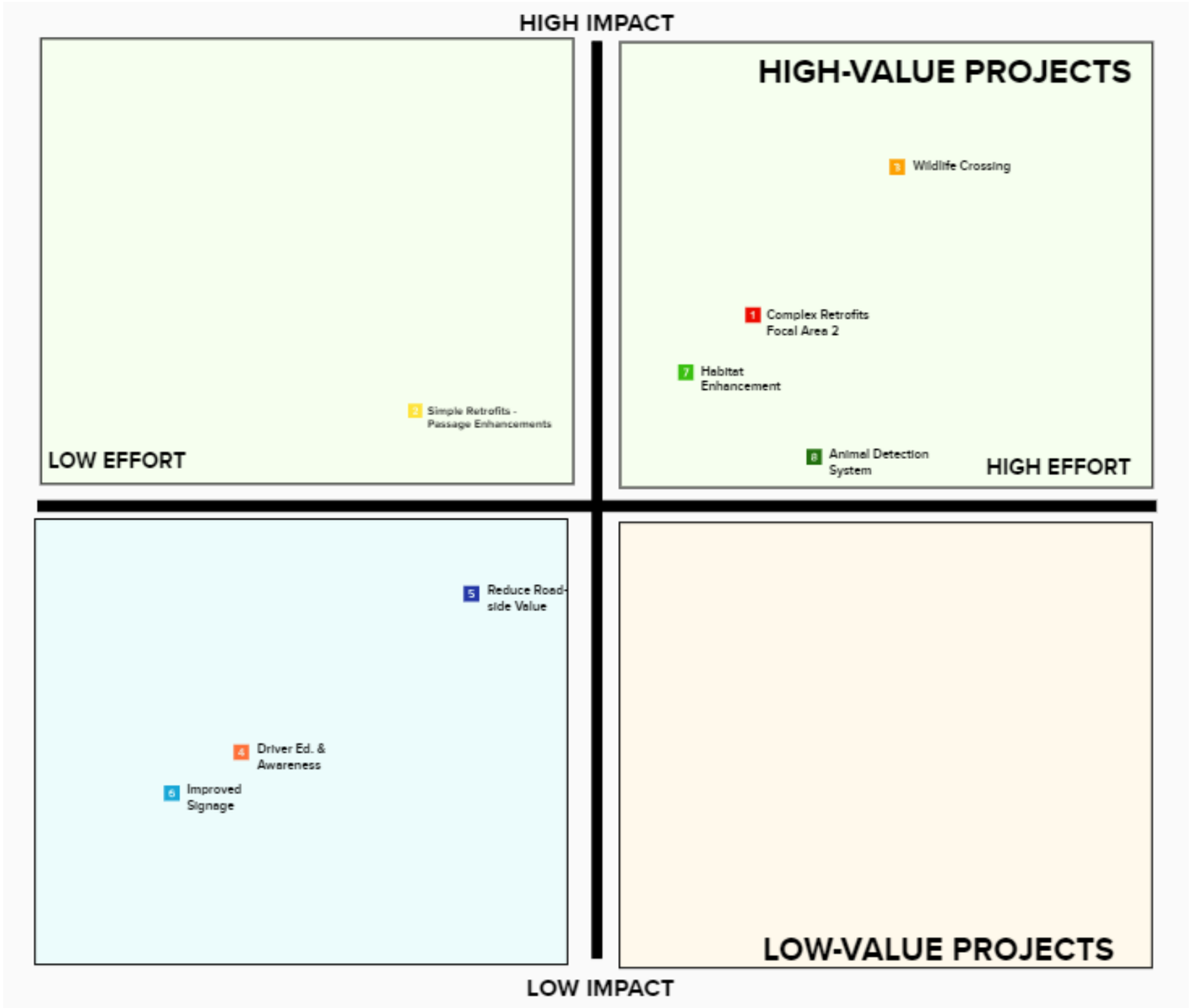
**3 Possible Wildlife Crossing Location**

# Potential Connectivity Projects – Effort vs. Impact

*Potential Projects were ranked collaboratively as a group discussion relative to:*

- *Effort involved in implementing them (e.g., time, resources) vs.*
- *Impact (e.g., the effect they would have on reducing WVCs or enhancing habitat connectivity for wildlife.*

*This activity was used to encourage discussion and understanding of the potential projects and what they would entail.*



# Top-Ranked Connectivity Projects

- *Two voting sessions were held to select the highest priority projects.*
- *These are projects participants thought should be implemented first and were the focus of the action planning for the remainder of the workshop.*
- *The first vote clearly identified the top two priority projects.*
- *The second vote resolved a tie for 3rd place between:*
  - *Project 1 (Complex Retrofit – Focal Area 2) and*
  - *Project 7 (Habitat Enhancement)*

## #1st Place – Highest Priority

2 **Simple Retrofits - Passage Enhancements**

Create a pathway for wildlife under and existing bridge without modifying the structure. This may include removal of derelict fencing, addressing steep grades and/or increasing riparian vegetation cover, etc.

## #2nd Place – Second Priority

3 **Wildlife Crossing**

New crossing project within one of the focal areas that includes fencing design and installation, and riparian habitat enhancement within the vicinity of the structure to facilitate wildlife use.

## #3rd Place – Third Priority

1 **Complex Retrofits - Focal Area 2**

Integrated retrofit of 3 bridges in highest WVC and crossing Focal Area, includes fencing, openness, and habitat enhancement within the vicinity to facilitate wildlife use.

***Public Education/Awareness:*** *Landowner/community education, outreach and engagement around overall effort to improve Wildlife Connectivity along the Hwy 20 corridor. This would be a foundational component of any and all efforts to improve wildlife connectivity, aimed at gaining community support and participation.*

# PARTNERS

Participants were asked to indicate how they could be involved in each project and identify other groups or types of individuals or groups who would need to or should be involved.

| PARTNER TYPE | DESCRIPTION | 1st Place SIMPLE RETROFITS – PASSAGE ENHANCEMENT | 2nd Place WILDLIFE CROSSING | 3rd Place COMPLEX RETROFITS – FOCAL AREA 2 |
|---|---|---|---|---|
| DRIVER/ CHAMPION | Group(s) who rally, engage, and organize partners | Oregon Action Team on Ungulates and Migration (**OAT***), Burns Paiute Tribe (**BPT**), Theodor Roosevelt Conservation Partnership (**TRCP**) | Need a local champion, a coalition group could be very helpful, invite/engage local government | Mostly the same as last two, except a greater need to gain acceptance from local government* and tribal entities due to higher cost |
| SPONSOR | Entity that provides high-level support & advocacy | Oregon Wildlife Foundation (**OWF**), TRCP | OWF, Protect Animal Migration (**PAM**)* | OWF, PAM, OHA, TRCP, local NGO's |
| OWNER | Owner of the physical asset or resource | ODOT, BLM, BPT, DSL, adjacent landowners* (very important), Cattlemen's' groups* | ODOT, BLM, BPT, DSL, USFS, adjacent private property owners* | ODOT (must be included in planning), DSL, BPT, private property owners. Very important to get local government and tribe involvement and support |
| COLLABOR-ATOR | Contributor of time, expertise, resources | OWF, BPT, TRCP, USFWS, Pew Charitable Trusts (**Pew**), hunter or wildlife advocacy groups*, landowners* | Private property owners*, Oregon Hunters Association (**OHA**), Pew, Rocky Mountain Elk Foundation (**RMEF**), OWF, BPT, USFS, PAM* | OWF, BPT, TRCP, USFWS, Pew, PAM* |
| FUNDER | Entity that provides financial resources | OWF, USFWS, ODFW, Oregon Conservation and Recreation Fund (**OCRF**)*, ODOT (maybe), may only require volunteer labor | OWF, USFWS (SO 3362), ODFW, OCRF*, ODOT (limited), OWEB, BPT | OWF, USFWS, ODFW, NFWF, ODOT** |
| TECHNICAL RESOURCE | Contributor of expertise, may require funding | ODOT, ODFW, BLM, USFWS, Arc Solutions, ICF | ODOT, ODFW, BLM, PAM, Arc Solutions, ICF | ODOT, ODFW, USFWS, BLM, Resource agency Biologists, Arc Solutions, ICF |
| OTHER PARTNERS | | OAT (some overlaps with groups listed), Local universities* (opportunity for research / long-term monitoring) | OAT, Mule Deer Foundation*, Local universities*, participants in the Oregon Connectivity Assessment and Mapping Project (OCAMP)* | OAT, Local universities*, other state wildlife resource agencies and groups* |

* These groups/organizations would need to be approached/invited to participate as they were not involved in this workshop

** Funding for complex retrofit projects are almost always borne by the DOT as a part of a larger transportation project. ODOT has very limited ability to fund these types of projects.

*Common themes:*

- *Issue an invitation for participants, particularly local participants and local champion(s); projects need a local champion*
- *Invite/engage the local governments and community*
- *Local universities may be able to support research and long-term monitoring*

# FUNDING AND IN-KIND RESOURCES

Participants were asked to brainstorm potential funding and in-kind resources for each project.

| FUNDING TYPE | 1st Place<br>SIMPLE RETROFITS – PASSAGE ENHANCEMENT | 2nd Place<br>WILDLIFE CROSSING | 3rd Place<br>COMPLEX RETROFITS – FOCAL AREA 2 |
|---|---|---|---|
| **FEDERAL/STATE PLANNING FUNDING** | ODOT, Oregon Conservation & Recreation Fund, OWEB, Federal Transportation bills<br>BLM RAC Grants | OWEB, State Transportation Improvement Program (**STIP**), Federal DOT, ODOT (very limited) | OWEB, STIP, RAWA legislations, ODOT (very limited) |
| **FEDERAL/STATE DESIGN/CONSTRUCTION** | ODOT, USFWS (SO 3362), Pittman-Roberts, Partners for Fish & Wildlife (private lands) | Pittman-Roberts, ARC may also be able to assemble technical/design crossing experts | USFWS (SO 3362), ODOT (couple with planned ODOT projects*), Arc |
| **NGO FUNDING/NON-PROFIT** | OWF, Mule Deer Foundation, Grant Funding | OWF, Grant Funding, Arc may be able to help identify funding | OWF, Grant Funding, Arc may be able to help identify funding |
| **PRIVATE FUNDING (COMPANIES)** | Car Insurer, Local companies or service organizations | Car Insurer | Car Insurer |
| **MATCHING IN-KIND DONATIONS** | Oregon Natural Desert Association (ONDA), ODOT (labor/equipment), volunteer labor (e.g., removing fences), other Federal Land Management Agencies partners | OCRF, On Ground Volunteers | NGO Volunteers |
| **OTHER** | | Oregon license plate campaign | Oregon license plate campaign<br>Local govt transportation dept: could contribute a token amount in support |
| **PRIVATE FUNDING (DONORS/KICKSTARTER)** | • Call for supporters to "put your $ where you mouth is"<br>• Need a brainstorm session on Private funding and Kick-starters | | |

- On Hwy 97 - ODOT had plans to do lane widening which created an opportunity to identify and incorporate opportunities to improved wildlife passage
- Voluntary Wildlife Crossing Donation – Wyoming statutes provide for a voluntary donation to be utilized for wildlife conservation efforts related to the transportation system in Wyoming. See page 20 of the following doc: https://wgfd.wyo.gov/hunting/wgfd_appnarrative.pdf

*Other Considerations:*

- *Bridge replacement and other projects can fold in wildlife passage*
- *Available funding often comes and goes, need to be ready for opportunities that come and go given the potentially long time horizons for these projects*

# Highway 20 Coalition Group

*The concept of a Highway 20 Coalition Group was introduced at the beginning of the discussion to build-out project details around Partners and Funding. As the discussion progressed, participants shared the following thoughts about the functions and benefits of a Coalition.*

## DESCRIBE

- Potential overarching organization for planning, overall community outreach and securing funding
- A coalition would be an inter-agency team to lead mitigation development across highway 20 corridor
- Function of a coalition would be advocate with ODOT to plan project that could also integrate funding from other sources
- Brainstorm innovated funding sources e.g., Corporate sponsorship, private funding and kick-starter campaign, etc.

## ADVANTAGES

- Available funding often comes and goes, need to be ready for opportunities that come and go given the long-time scale of a new crossing project or a complex retrofit
- Coalition could propose to ODOT to add a project addressing wildlife connectivity

## PLANNING/DESIGN CONSIDERATIONS

- U.S. Rep. Peter Defazio role as an advocate

# Action Planning:
# Key First Steps in the Implementation Process for All Projects

*Participants identified the steps in the project implementation process (see Workshop 3 pre-read) that would need to be started first in order to assure project success. Once these critical first steps were identified the remainder of the workshop was spent brainstorming critical tasks, actions and partners that could be involved for the first 3 (see bold) .*

1. **Community Outreach (general, not project specific)**
2. **Identify opportunities to combine projects (tool or tool-project combining)**
3. **Private landowner/public engagement plan (project specific)**
4. Develop project description, goals, objective
5. Develop cooperative agreements (Partners/Agencies)
6. Identify and apply funding
7. Planning and Design
8. Project Implementation and construction

# 1. Community Outreach (general, not project specific)

**INITIAL PARTNERS**

- Burns Paiute Tribe (BPT)
- Oregon Hunters Association (OHA)
- Rocky Mountain Elk Foundation (RMEF)
- Oregon Department of Fish and Wildlife (ODFW)
    - Tom Segal, ODFW was mentioned as having many private land contacts/relationships

**KEY FIRST CONTACTS/STRATEGIC PARTNERS**

- Local reporter/community paper: Larry Meyer, Matt Caldwell
- Senator Lynn Finley, Senator Merkey,  State Representative, Mark Owens
- Dan Joyce, Malheur County Judge
- A county commissioner would be an important voice and link between us and the landowners
- High Dessert Museum
- Social media (Facebook groups, other)

**ACTIONS**

- Use OHA chapter to elevate the issue locally
- ID potential influencers and be inclusive
- Outreach and education to Local representatives (County, State, Federal
- Write or provide information for initial articles or series of articles
- Community outreach meeting/ workshop/open house
- Plan a field trip, outdoor activity to engage and educate
- Prepare and distribute a well-penned letter to prospective supporters

**HOW TO CONNECT**

- Local journalists – newspaper/newsletter articles
- Elkhorn media group - Coffee chat
- Zoom call? Other platforms

# 2. Identify Opportunities to Combine Projects

**ACTIONS**

1. Identify list of planned/proposed projects
    - Check for Fish Passage Obstructions (ODOT)
    - Where does ODOT already have plans to upgrade or perform maintenance?
2. Collect and review available resources such as passage assessment results, hotspots, land ownership overlays
    - ODOT, Arc Solutions, ICF, Technical experts
3. Get ODOT engineer review of proposed enhancements
4. Identify opportunities for integrating mitigation tools into planned/proposed projects
5. Identify opportunities for coupling mitigation efforts

# 3. Private Landowner/Public Engagement Plan

**NOTE:** Need to start general Community Outreach (public education and engagement) first, before project-specific efforts begin.

## ACTIONS

1. Identify landowners and public stakeholders
    - Need to identify a Local Champion to help act as support
    - If you don't bring landowners in early the conversation becomes much more difficult
2. Develop landowner and public stakeholder engagement approach
3. Engage and identify relevant issues
4. Collaborate to develop solutions
5. Integrate solutions into Project

## POTENTIAL CANDIDATES FOR LOCAL CHAMPION

- Local Implementation Team
- County Representatives,
- Large property owners (local fire dep is the place to meet-up)
- Oregon Hunters Association (OHA)
- Rocky Mountain Elk Foundation (RMEF)

# Final Reflections

**I LIKE…**

- The willingness to develop a coalition to champion these efforts!!!
- Willingness for collaboration!
- That ARC has so many resources and services that they are willing to provide pro-bono
- The collective wisdom of this group is incredible!!!!
- The enthusiasm for engaging locals ASAP

**I WISH…**

- We could create a 90 sec video
- A group from this working group would volunteer to spearhead outreach program
- That this process will cultivate a Highway 20 coalition
- ~~People/groups would indicate willingness to work on outreach~~

**I WONDER…**

- ~~What the action items are for moving forward for this group?~~
- How we can keep this group engaged with one another?
- How to start interactions during COVID

**OTHER RESOURCES** (provided via Zoom chat):

- **ARC Wildlife Crossing FAQs**: https://arc-solutions.org/wp-content/uploads/2021/01/ARC-Special-Pub-FAQs-online.pdf
- **Western Success Stories** (includes a short write-up on this project!): https://arc-solutions.org/wp-content/uploads/2021/01/ARC-Solutions-Success-Stories-online.pdf

# Next Steps

- **Final Project Report**: will be distributed via email once completed
- **Community Outreach:** More to follow
- **Coalition Group:** More to follow
- Points of contact at Burns Paiute Tribe:

  Carter Crouch office: 541-573-8086 email: carter.crouch@burnspaiute-nsn.gov

  Jason Fenton office: 541-573-8020 email: jason.fenton@burnspaiute-nsn.gov

Thank you!

Appendix C

# Connectivity Enhancement Tool Concepts

Appendix C

# Mitigation Tool Resources: Descriptions, Concepts, and Examples

## Reduce Roadside Value

Animals may be attracted to roads for a wide variety of reasons including roadside vegetation foraging, utilizing roadside for cover using roadside vegetation or other cover, warming up on warm/hot pavement, desire to consume road minerals (e.g., salt and sand), access to roadside water (i.e., roadside ditches/wetlands), and some animals may feed on roadkill carcasses found on/near roadways.

Reducing roadside value involves removing suitable conditions for foraging, feeding, or other desirable resources that might attract animals to roadways and their vicinities. Examples of this practice include regular roadkill carcass removal, routine vegetation maintenance, and reducing applications of road salt. This can be a useful tool particularly in areas with high wildlife use or where adjacent to active wildlife or riparian corridors so that incentives to forage closer to the roadway are reduced thereby reducing wildlife-roadway interactions and risks of wildlife-vehicle collisions (WVCs). Actions considered to reduce roadside value should be assessed alongside careful consideration of any additional costs needed to implement as well as consideration of staffing and maintenance needs. Some examples are provided below (Figures 1 – 3).

**Figure 1. Deer Foraging along Roadside in the Salmon River Valley, Idaho**

Photo from May 2007 FHWA Report "Wildlife-Vehicle Collision and Crossing Mitigation Measures: A Toolbox for The Montana Department of Transportation". Photo by Marcel Huijser, Western Transportation Institute. Final Report Available at: https://www.mdt.mt.gov/other/webdata/external/research/docs/research_proj/wildlife_crossing_mitigation/final_report.pdf

## Winter Maintenance And Deicing Compounds

Roadside areas where deicing materials, such as salt and sand, accumulate also are known to attract ungulates but represent a somewhat different phenomenon from naturally occurring mineral deposits. Although deicing materials theoretically could contribute to salt accumulations in muck licks, natural seepage areas act as an attractant even where deicing is not practiced.

One distinction between muck licks and roadside accumulations of deicing materials is important in this context. Simply moving away from chloride-based deicing compounds (like salt and sand) may help diminish animal-vehicle collisions in accumulation areas, whereas "fixing" the muck lick problem may be more complicated. It is still unclear whether it is mineral content, soil type, soil particle size, water, or other factors that draw animals like moose to licks.

Many States, including Montana, are studying alternative strategies for winter road maintenance, such as applying liquid chemical deicers instead of abrasive salt and sand. For more information, see the white paper "Past and Current Practices of Winter Maintenance at the Montana Department of Transportation (MDT)" at www.mdt.state.mt.us/departments/maintenance/docs/wintmaint_whitepaper.pdf.


This mountain sheep is licking minerals from the soft shoulder along the side of a rural highway.

**Figure 2. Excerpt from a 2005 FHWA Public Roads Magazine Article titled "Of Moose and Mud"**

Notes: Written by Roy V. Rea and Roy V. Rea Sr. explores the causes, implications, alternatives to mineral deicing agents, and countermeasures to reduce wildlife-vehicle collisions. Article available at: https://www.fhwa.dot.gov/publications/publicroads/05sep/05.cfm

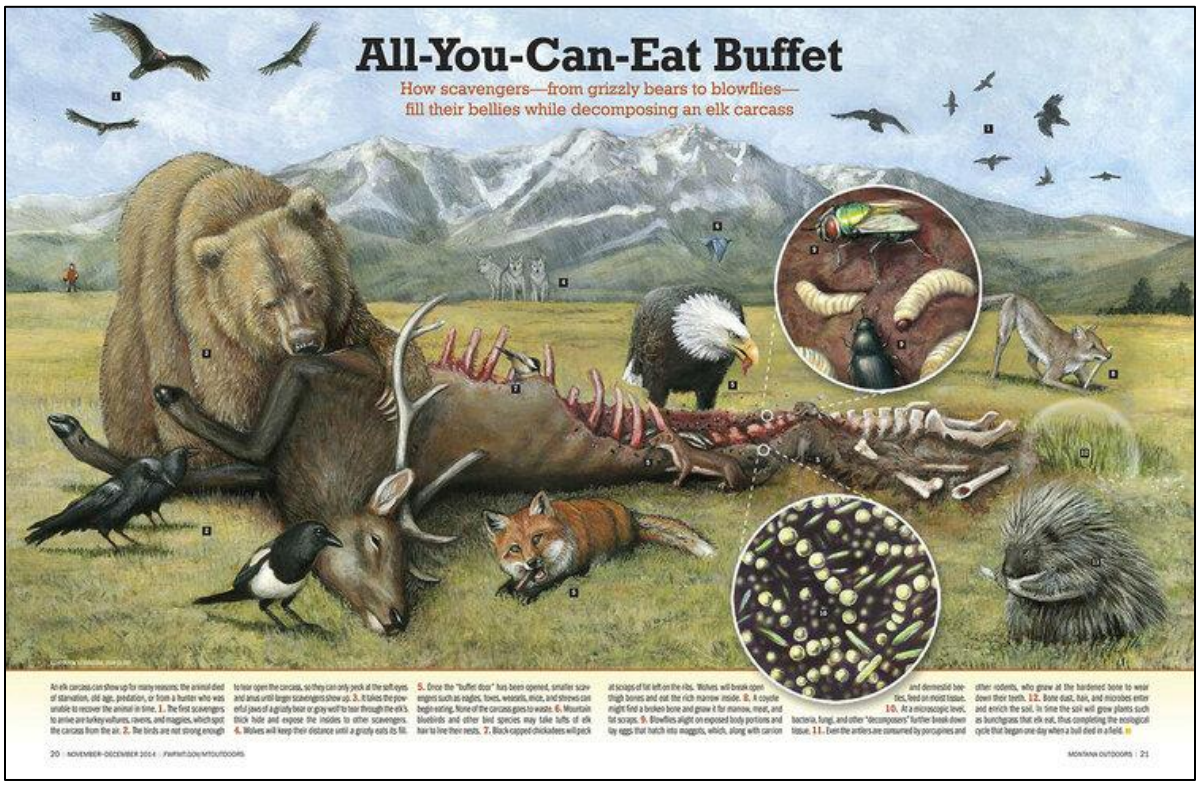



**Figure 3. Illustration from the November-December 2014 Issue of Montana Outdoors (A Bi-Monthly Publication Of Montana Fish, Wildlife and Parks) Depicting the Variety of Wildlife Scavenging on an Elk Carcass**

Notes: Provides an example of the species attracted to carcasses on/near roadsides and the additional wildlife-vehicle collision risk posed due to this behavior.

# Public Education and Awareness

Part of the greater issue in wildlife-vehicle collisions stems from the lack of proper public/driver education and instructions about roadway safety associated with risks of hitting wildlife. A significant number of drivers are not trained to properly maintain awareness or react appropriately when avoiding animal-vehicle collisions. A large number of people desire some form of additional education about collision prevention. Through Public Safety Announcements (PSAs), advertisements, and driver's education courses, the general public could have a greater awareness about the possibility of wildlife collisions and can be properly prepared when reacting to potential scenarios involving wildlife crossing roadways. In addition to every day drivers, those potentially unfamiliar with the risks in high wildlife-use areas (i.e., out-of-state visitors, young drivers, semitruck drivers) also make the ideal targets for these awareness campaigns and having additional signage at local trails or public information centers could provide warnings of the risks. Below are several examples of public education and outreach materials (Figures 4 – 7) including a driver educational brochure from the Oregon Department of Transportation highlighting seven points to watch for when driving in wildlife areas (Figure 4).

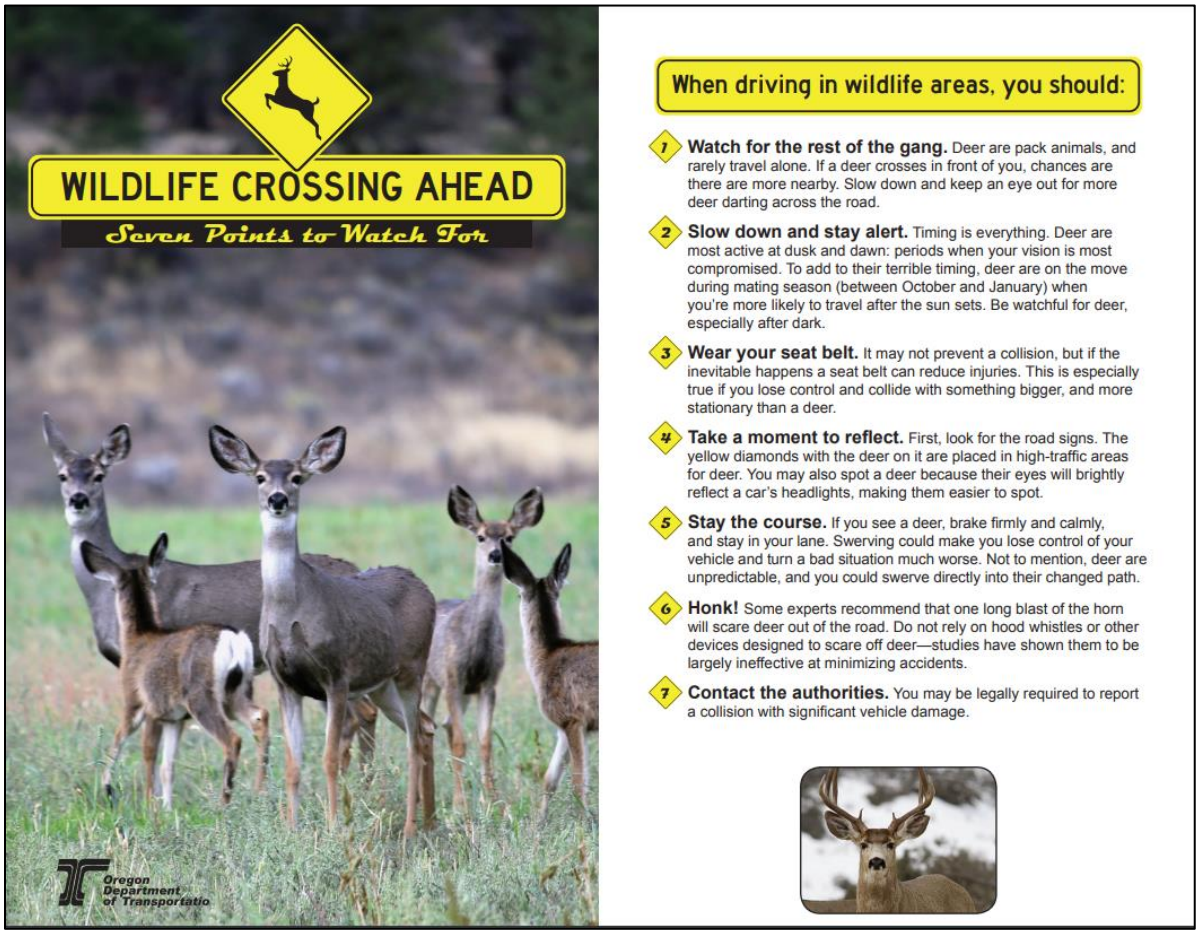



**Figure 4. Driver Educational Brochure From the Oregon Department Of Transportation**

Note: Available for download in brochure or poster format at: https://www.oregon.gov/odot/GeoEnvironmental/Pages/Wildlife.aspx

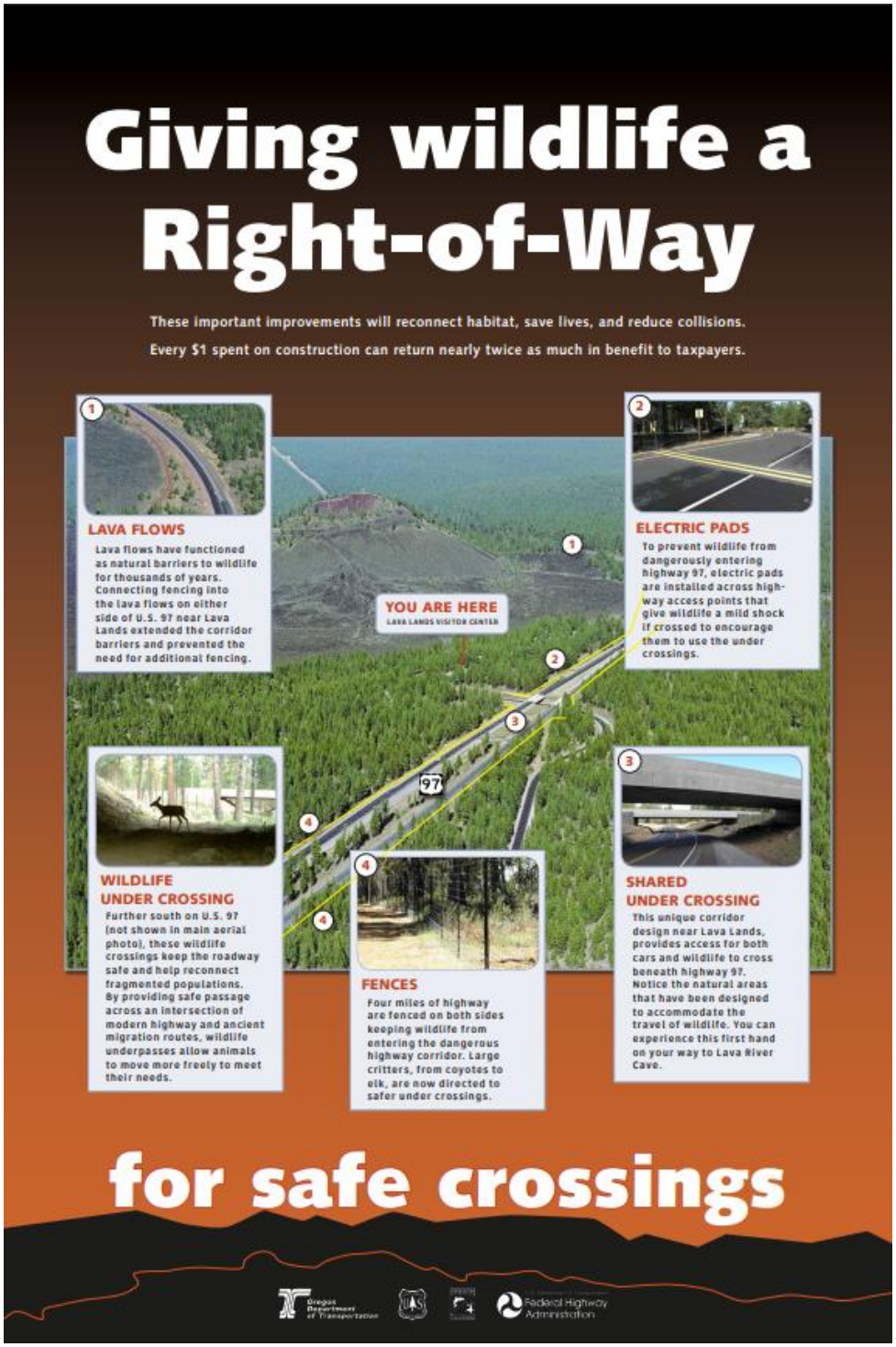



**Figure 5. Educational Poster from the Oregon Department Of Transportation, U.S. Forest Service, Oregon Department Of Fish And Wildlife, And Federal Highway Administration Highlighting Various Projects Undertaken in Oregon's Deschutes National Forest And Newberry National Volcanic Monument to Improve Road Safety and Wildlife Connectivity in the Region**

Notes: Available for download at: https://www.oregon.gov/odot/GeoEnvironmental/Pages/Wildlife.aspx

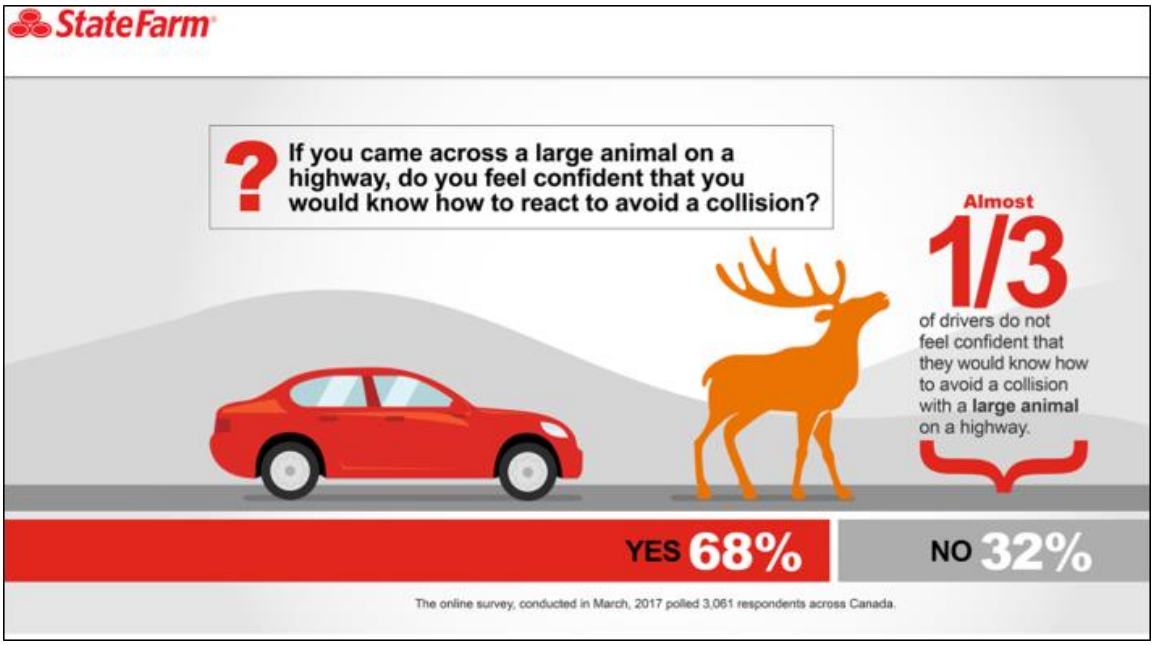



**Figure 6. State Farm, A Leading Insurance Provider, Conducted An Online Survey in Canada in 2017. Their Research Identified That Most Drivers Do Not Feel Confident in What They Should Do if Encountering A Large Animal on a Roadway.**

Notes: Additional details and infographics available at: http://www.multivu.com/players/English/8209251-state-farm-wildlife/

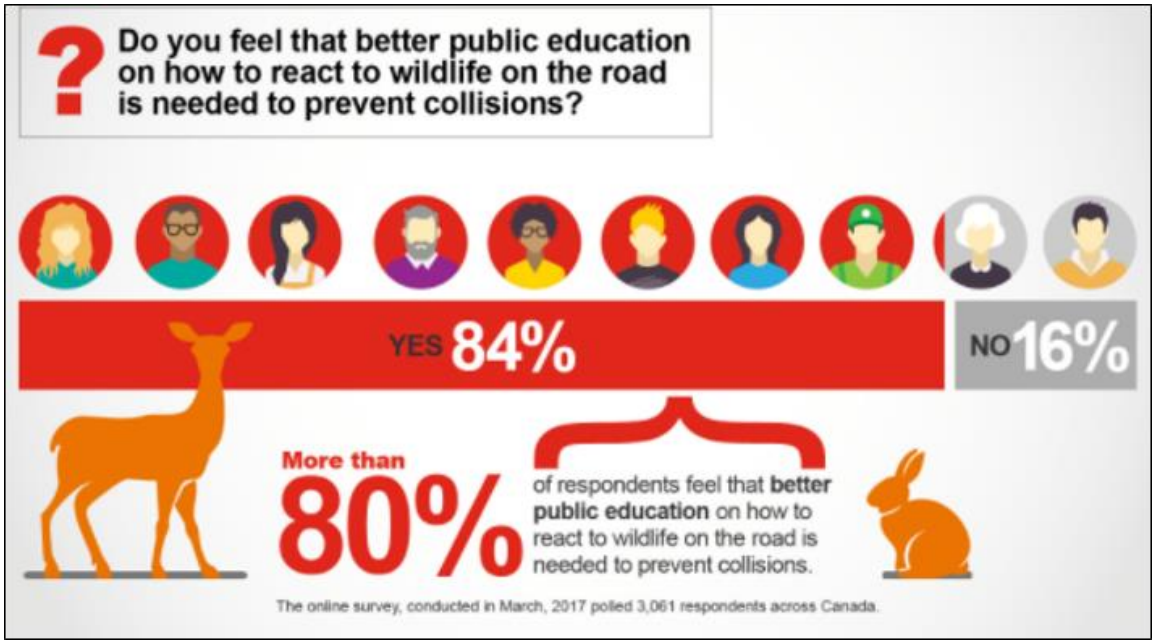



**Figure 7. State Farm, a Leading Insurance Provider, Conducted an Online Survey in Canada in 2017. Their Research Identified that Over 80% of Respondents Feel That Better Public Education Is Needed**

Notes: Additional details and infographics available at: http://www.multivu.com/players/English/8209251-state-farm-wildlife/


**Figure 8. Example social media messaging form the British Columbia Conservation Foundation's Wildlife Collision Prevention Program who regularly shares social media posts aimed at educating drivers on how to reduce WVCs**

Notes: Additional information can be found at https://www.instagram.com/wcpp.bc/ and https://www.wildlifecollisions.ca/

# Signage

Standard wildlife warning signs (such as the standard deer crossing road sign) are NOT effective in reducing wildlife-vehicle collisions. Wildlife-specific roadway signage could potentially be effective in reducing or avoiding wildlife-vehicle collisions if the signage is highly visible, provides specific messaging and/or instructions to drivers, and has elements to reduce driver habituation. Having such messaging posted in in high-risk areas could easily grab a passerby's attention and posting repeated messages in certain areas could reinforce the message that drivers should exercise greater caution and specific actions in such areas. Utilizing flashing lights or more personal, localized information and graphics on signs could prove more effective at communicating and preparing drivers for any potential risks.


Photo from the FHWA report titled "Wildlife-Vehicle Collision Reduction Study: Report to Congress" (Huijser et al., 2008). Source: Marcel Huijser

**Figure 9. Permanent Flashing Florida Black Bear Warning Sign in the Ocala National Forest, Florida**

Notes: Report available from: https://www.fhwa.dot.gov/publications/research/safety/08034/exec.cfm


**Figure 10. Example of a Changeable Message Sign with Deer Advisories To Alert And Educate Drivers which Have Been Found to Be Effective Deer-Vehicle Collision Reduction Tools. Example from a 2018 Virginia Transportation Research Council Report Titled "Effectiveness of Seasonal Deer Advisories on Changeable Message Signs as a Deer Crash Reduction Tool"**

Notes: Available from: https://www.virginiadot.org/vtrc/main/online_reports/pdf/19-r8.pdf

# Wildlife Crossings

Wildlife crossings are used to facilitate safe wildlife passage across roads/highway and other areas by providing passages through culverts, underpasses, or via overpasses designed to guide wildlife under/over traffic. Wildlife crossing structures have proven to be highly effective when coupled with wildlife fencing and when both are properly designed. Whenever possible, wildlife crossings should be designed to accommodate a wide variety of species and ecological processes. The location, type, and specific design of wildlife crossings are dependent on the context, species, and goals and objectives of a given project.

Below are general examples of several types of wildlife crossing structures (Figures 10 – 12). A number of resources exist to inform the placement and design of wildlife crossing structures, see the References and Resources section of this report for details.

Source: Shannon Crossen

**Figure 11. Examples of a Wildlife Underpass Facilitating Wildlife Movement And Habitat Connectivity under Interstate 90 in Washington State**


Source: Washington State Department of Transportation

**Figure 12. Wildlife Underpass at an Aquatic Culvert Crossing Facilitating Both Fish and Wildlife Movement**

Source: Washington State Department of Transportation

**Figure 13. Wildlife Overpass Facilitating Wildlife Movement and Habitat Connectivity over Interstate 90 in Washington State**

# Wildlife Fencing

Properly designed wildlife fencing is highly effective at reducing wildlife-vehicle collisions. Wildlife fencing may be used to exclude wildlife access to particular areas and/or to guide wildlife movement toward safe crossings such as wildlife crossing structures. Wildlife fencing should almost always be used in conjunction with existing, safe crossings or suitable underpasses/overpasses to help guide wildlife towards safe crossing areas and fence ends must be carefully chosen and designed to prevent fencing end effects (e.g., high numbers of wildlife-vehicle collisions at fence ends). Fencing should always be site-specific with a design considering target specific species, topography, public assess, and land ownership. Care should be taken to ensure that fencing design considers measures required to withstand various wildlife breech methods including jumping, climbing, pushing, and digging. Longer stretches of fencing may require measures to facilitate escape for animals trapped inside the fenced area of the roadway such as jump-out ramps. Longer fencing stretches may also have gaps in fencing which can lead to animals having access to the roadway. Fending gaps may be treated with a variety of treatments to prevent animal access into the roadway such as cattle guards or electromats which can deter animals away from unsafe access points.

Below are several general examples of several types of wildlife fencing, escape ramps, and fence gap treatments (See Figures 13 – 18). A number of resources exist to inform the placement and design of wildlife fencing and associated elements. see the References and Resources section of this report for details.

Photo from Arizona Game and Fish Guidelines for Wildlife Compatible Fencing.
Source: Christine Paige

**Figure 14. 8-Foot-Tall Woven Wire Wildlife Fencing Targeting Deer**

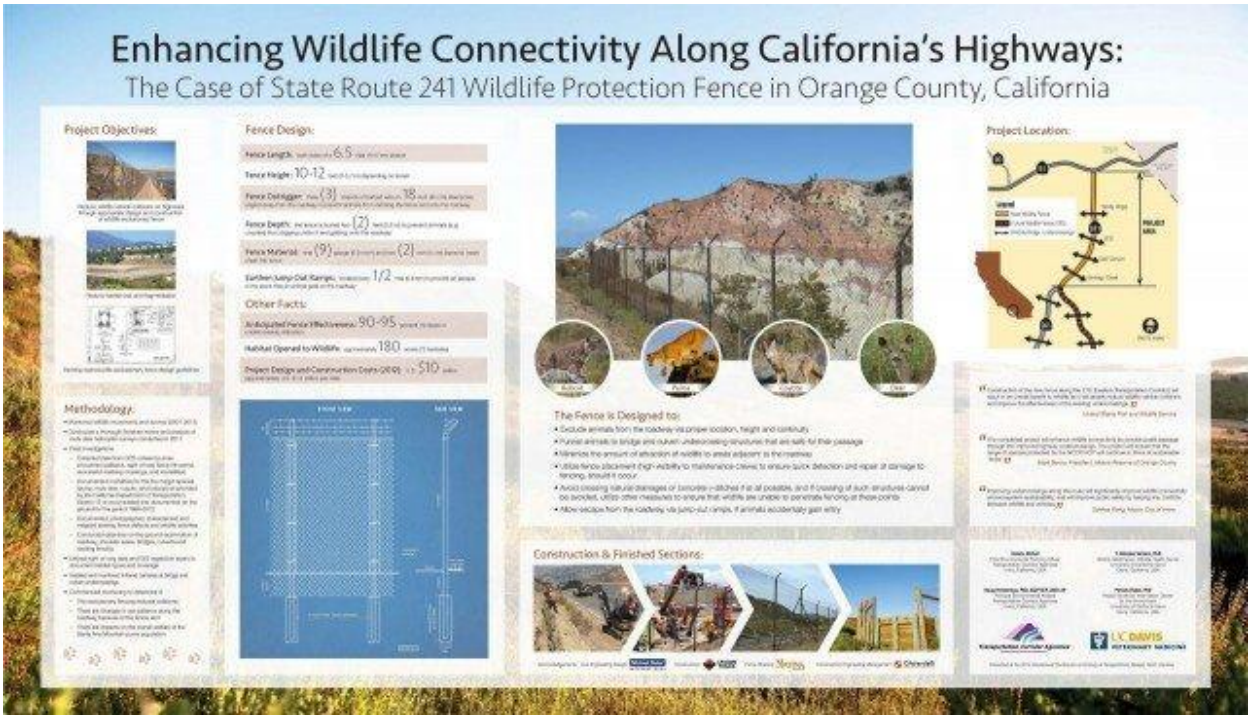



**Figure 15. Poster for a Wildlife Fencing Project Led by the Transportation Corridors Agency along Southern California's State Route 241**

Notes: Fencing includes 10-12-foot-tall wildlife fencing, angled barbed wire, a buried, angles apron, to prevent fence breeching by wildlife including climbers (e.g., mountain lion), jumpers (e.g., mountain lion and deer), diggers (e.g., coyote and deer). It also features a patina treatment to ensure it blend sin with the surrounding landscape aesthetically.

Source: Toll Roads Blog

**Figure 16. Wildlife Fencing Installed along California State Route 241**

Source: Clevenger and Huijser 2011

**Figure 17. Wildlife Escape (i.e., jump-out) Ramp from Appendix C, Hot Sheet 14 of the Wildlife Crossing Structure Handbook, Design and Evaluation in North America**

Source: Wyoming Department of Transportation. Photo Credit: Tony Clevenger.

**Figure 18. Double Cattle Guard Used to Prevent Wildlife Highway Access**

**Figure 19. CrossTek™ Electric Wildlife Mat™ at a Highway Crossing in Utah**

Notes: Such electromats prevent animals form breeching gaps in wildlife fencing and prevent wildlife from accessing roadways. Photo Credit: CrossTek™. More information including product details and specifications can be found at www.crosstekco.com.

# Habitat Enhancement

Habitat restoration and enhancement in areas that are degraded may prove beneficial in drawing and supporting animals into areas away from roadways. Restoration efforts would be concentrated near retrofits or suitable wildlife crossings and may consist of shrub and willow plantings within draws, enhancement of grassland and other forage habitat, and restoration/creation of wetlands or other water sources. Strategic placement of water tanks could also help wildlife by providing a source of water that decreases the need to cross roadways. These efforts can prove to be time intensive and not always 100% effective; however, habitat enhancement and restoration is still a practice that should be carried out regardless of the outcome as it provides a net benefit to wildlife and the greater ecosystem. There are a variety of habitat enhancement opportunities throughout the study area including grassland, shrubland, riparian, and wetland habitat enhancement and restoration opportunities. Below are some examples of habitat enhancement and restoration that may support wildlife connectivity in the study area (Figure 19 – 20).

**Figure 20. Overview of the Jonesboro Ranch Restoration Site Facing Downstream**

Notes: Additional information on habitat enhancement and restoration opportunities and priorities to benefit species native to the region, including mule deer and elk, can be found in the Oregon Department of Fish and Wildlife Management Plan website:
https://www.dfw.state.or.us/resources/hunting/big_game/mule_deer/docs/Mule_Deer_Mgmt_Plan_Final.pdf


**Figure 21. Example of Habitat Enhancement within A Wildlife Corridor and How Vegetative Structure Can Augment Cover and Support Species Movement**

# Existing Infrastructure Retrofit

Utilizing existing structures such as bridges or culverts to support wildlife movement can be a relatively fast and cost-effective way of facilitating safe wildlife movement. Retrofitting culverts and bridges, coupled with proper wildlife fencing and habitat restoration efforts, can improve wildlife use and movement function of existing structures. Like with new infrastructure, retrofits can be expensive or may create environmental impacts associated with construction, but the benefit of having an effective solution opposed to the longer process of installing a new wildlife crossing structure or taking no action may prove worthwhile given the resources available. Retrofits may be able to be implemented on a faster time-horizon than new infrastructure, allowing them to serve as a supplemental or interim solution while dedicated wildlife crossing structures are being planning, designed, and build, often a multi-year process. An example of an existing bridge in the study area and potential bridge retrofit opportunities is provided below (see Figures 21 and 22).

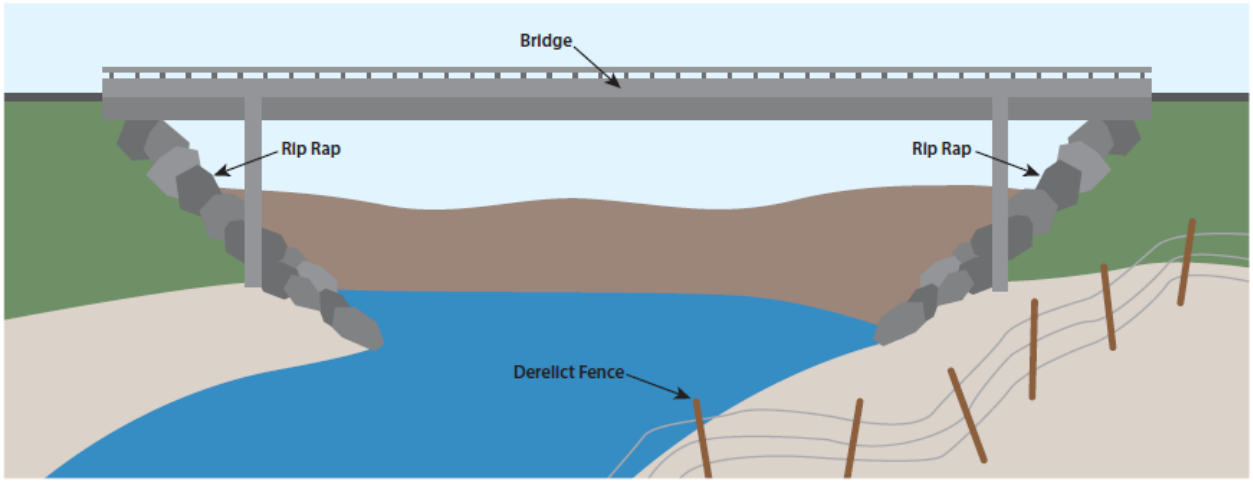



**Figure 22. Before Retrofits Graphic Depicting an Existing Bridge with Obstructive Riprap, Derelict Fencing, and Lacking in Developed Vegetation Structure That Are Barriers to Wildlife Movement**

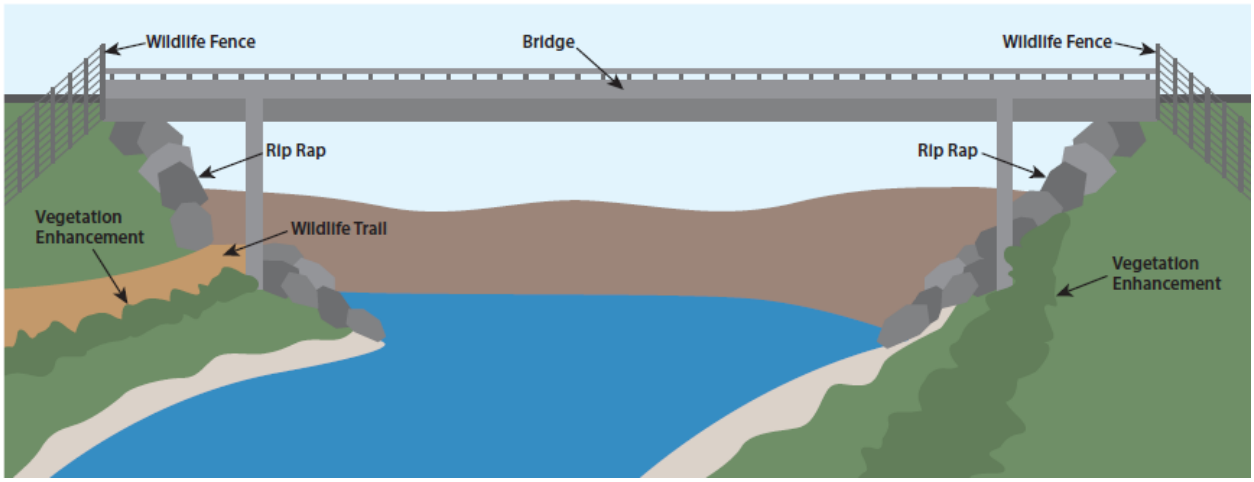



**Figure 23. After Retrofits Graphic Depicting A Bridge With Retrofits To Enhance Wildlife Movement Including Adding A Pathway Through Obstructive Riprap, Removing Derelict Fencing, And Adding Wildlife Fencing And Vegetation Enhancements To Facilitate And Support Movement**

# Experimental Techniques

The science behind deterring wildlife from entering and crossing roadways is still in development, and as such, there are still new and undeveloped ideas that could potentially be adapted for reducing WVCs. Installation of wildlife motion sensors and alert systems (i.e. flashing lights) could be used to alert drivers approaching a section of roadway with crossing wildlife. These methods are still under research and development, which could be perceived as "unproven" by the general public, though it should be noted that even at this experimental they have value in facilitating research and adaptive management and further development and refinement of such technologies. Further studies on a particular experimental technique's effectiveness are generally encouraged as well as

careful consideration of feasible locations and species these techniques may target. Below is an example of an animal detection system, one the foremost experimental techniques in development to reduce WVCs (Figure 23).


**Figure 24. Photo of a CrossTek$_{TM}$ Animal Detection System At-Grade Crosswalk**

Notes: Such systems are designed to detect the presence of animals approaching a road/highway, actively warning motorists of the oncoming hazard so that they can slow down/stop and allow safe movement of the animals over the roadway. Photo Credit: CrossTek$_{TM.}$ More information including product details and specifications can be found at www.crosstekco.com.

Appendix D

# Priority Project Information Sheets

# Appendix D
# Priority Connectivity Project Information Sheets

## Priority Connectivity Tool Project Details and Guidance

The following are general project overview information, locations, cost estimates, and tasks involved in the planning, design, and construction/implementation of the three highest priority feasible connectivity enhancement tool projects identified and prioritized during Workshop 3 (Detailed in Chapter 5). The top three highest priority connectivity enhancement projects were (in order of highest to lowest priority):

1. simple retrofits,
2. new wildlife crossing/s, and
3. complex retrofits.

Additionally, during Workshop 3, workshop participants agreed that prior to conducting *any* action planning or project development efforts, community outreach should be developed and implemented. Therefore, a project overview and cost estimates are also provided for a community outreach project.

The below project overviews, cost estimates, and guidance are intended to provide general guidance on the primary tasks and costs involved in the planning, design, and construction/ implementation phases and are intended to provide order of magnitude information, not exact costs. This information may not be all-inclusive of the tasks, steps, and costs involved in initiating, developing, planning, designing, and constructing/implementing the priority connectivity enhancement projects. Specific tasks, design details, and costs for each project will vary depending on the type of and level of involvement from project proponents/partners, specific project locations, engineering, hydrology, and other environmental constraints and details, project design details, regulatory and other requirements, and project-specific context. All project tasks and costs associated with each project should be confirmed with the Oregon Department of Transportation and any other property owners overlapping with the project area.

For details on the project implementation process, see Chapter 5. For details on project references and resources including case studies, wildlife crossing manuals and handbooks, and other resources, See Chapter 6. For additional concepts of connectivity enhancement tools see Appendix C. A comprehensive list of project funding opportunities is provided in Appendix E. Guidance on the placement and design of wildlife crossing structure, wildlife fencing, and wildlife escape ramp are provided in Appendix F.

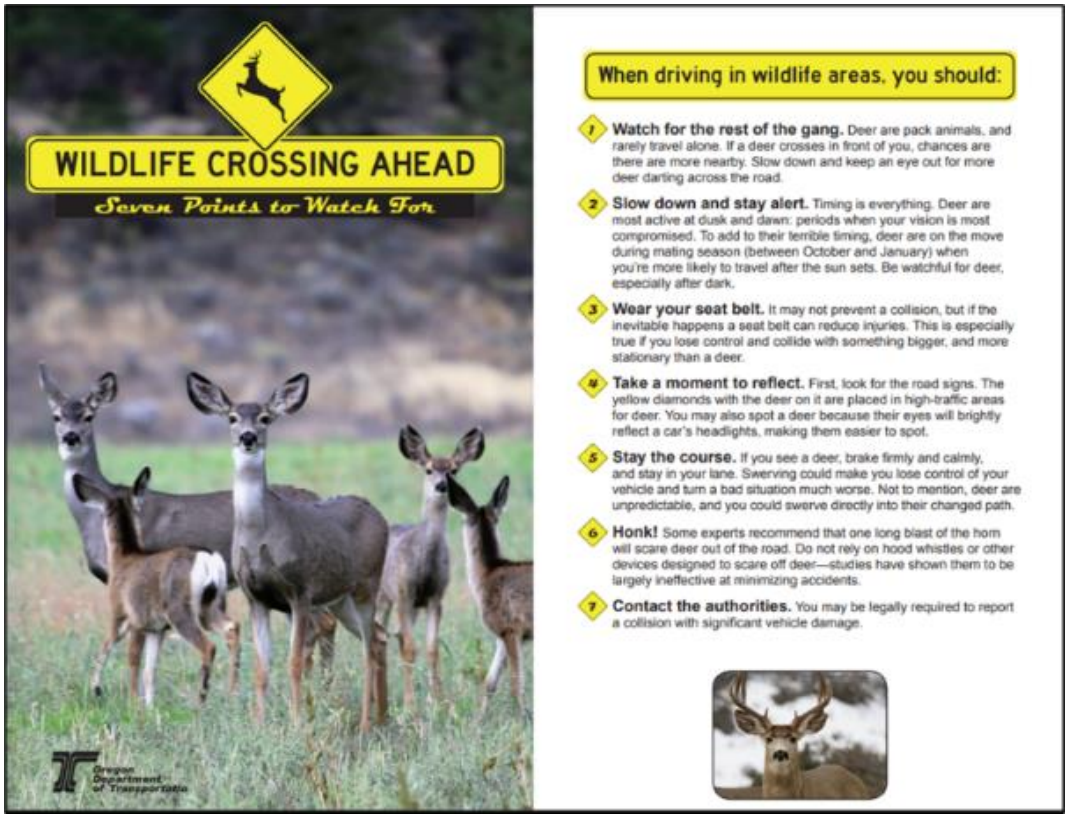
**Community Engagement and Outreach – Planning and Implementation**

**Location:** TBD (Examples: Eastern Oregon, Harney and/or Malheur County)

**Project Overview:**

- Identify audiences, prepare schedule, outline outreach tactics
- Develop a project website and digital media
- Develop informational materials to share with audiences (presentation, fact sheet, key messages)
- Coordinate/facilitate/document/follow-up of an informational meeting (virtual via Zoom or Webex)
- Continued messaging, engagement, and coordination
- One-on-one briefings with up to five (5) landowners - (includes prep, meeting, follow-up for one-hour briefing)

| **Community Engagement and Outreach** | |
|---|---|
| Task | Cost |
| Develop Outreach/Engagement Plan | $20,000 |
| Develop Project Website and Digital Media | $15,000 |
| Develop Informational Materials & Messaging | $15,000 |
| Facilitation, Coordination, Meetings, Follow up | $15,000 |
| One-On-One Briefings with Landowners | $15,000 |
| Ongoing Messaging and Engagement | $15,000 |
| Project Management, Travel, Administrative Duties, Other Expenses | $20,000 |
| Total | $115,000 |




**Example Media Concept: Driver educational brochure on wildlife road crossings from the Oregon Department of Transportation.**

This page was intentionally left blank.

**Priority Project # 1 – Simple Retrofits – Planning, Design, Construction Information Sheet**

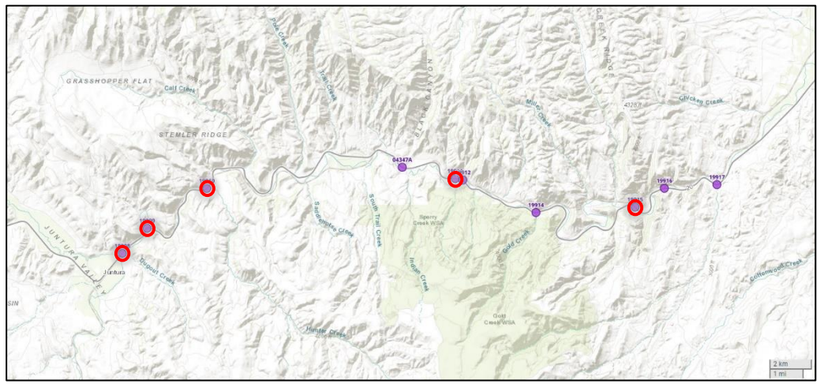
**Location:** Malheur County**, Specific Bridges:** 19908, 19909, 19910, 19911, 19915

**Project Overview:**

- Create an unobstructed pathway under existing bridge/culvert (may entail light earthwork, removal of rip-rap, light grading)
- Removal of derelict fencing and debris
- Vegetation enhancement (plant installation, and establishment)

**Simple Retrofits Estimate (5 Bridges Total)**

| Task | Cost Estimate |
|---|---|
| Project Initiation, Development, and Planning | $20,000 |
| ODOT Planning Coordination and Approvals | $20,000 |
| Project Studies and Reviews | $75,000 |
| Permitting and Regulatory Approvals | $25,000 |
| Prepare Design, Specifications, and Cost Estimates | $50,000 |
| ODOT Design Coordination and Approvals | $15,000 |
| Final Bid package: Plans, Specifications and Cost Estimates | $25,000 |
| Construction ($175,000 per site) | $875,000 |
| 10% Contingency | $110,500 |
| **Total** | **$1,215,000** |



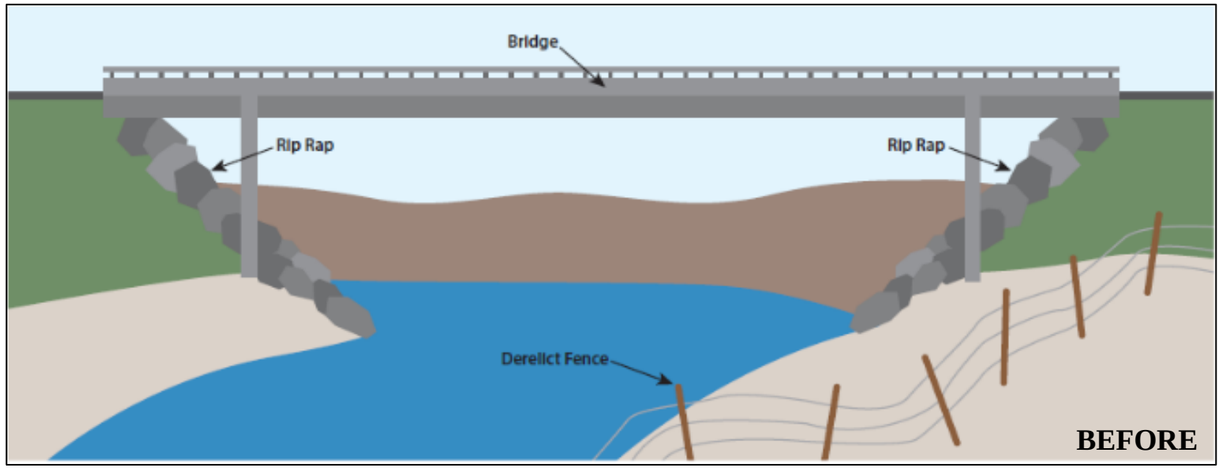




**Figure 1. Before.**
Existing Conditions Before retrofits graphic depicting an existing bridge with obstructive riprap, derelict fencing, and lacking in developed vegetation structure that are barriers to wildlife movement.

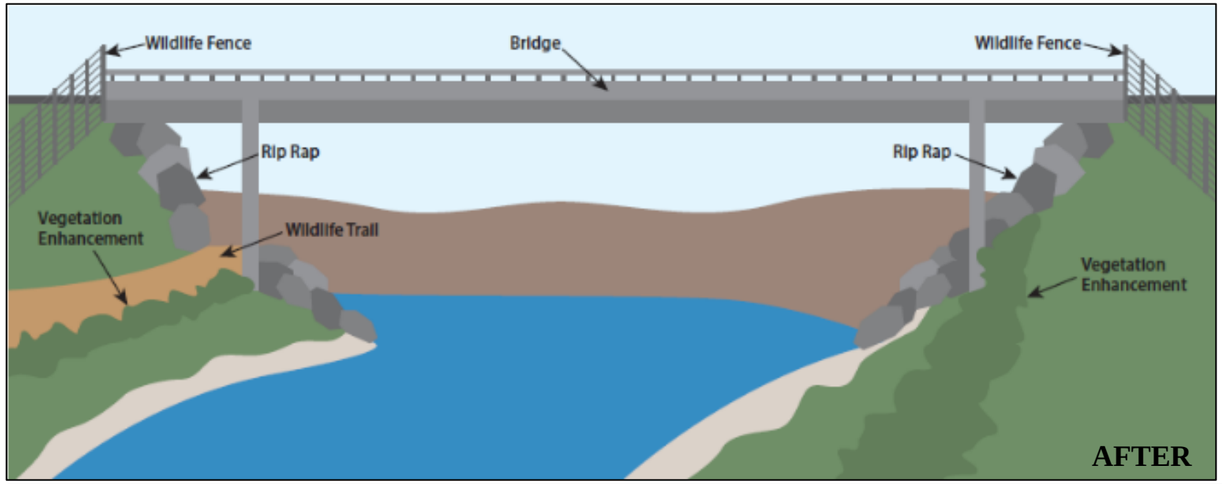



**Figure 2. After.**
After retrofits graphic depicting a bridge with retrofits to enhance wildlife movement including adding a pathway through obstructive riprap, removing derelict fencing, and adding wildlife fencing and vegetation enhancements to facilitate and support movement.

Assumptions:

- No Structural modifications and minimal grading
- Planning and PS&E price assumes all five (5) sites bid together in same bid package. If Planning and PS&E are conducted individually, all costs will increase.
- Cost does not include fencing
- Project studies will not include any hydrology modeling or advanced analyses and reporting
- Each project area includes two (2) acres around each bridge
- No irrigation installation

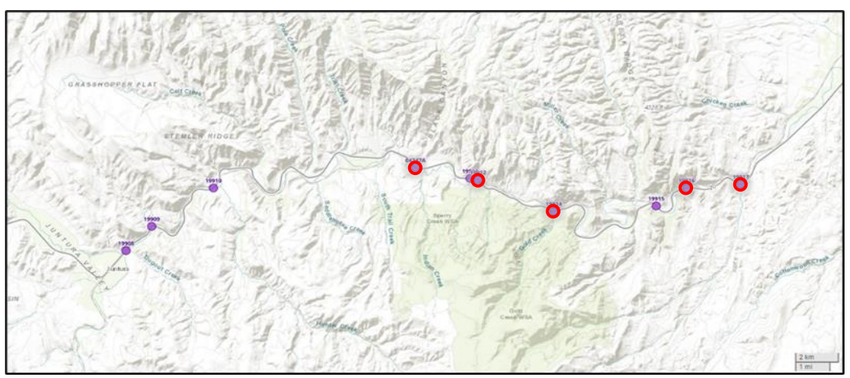
**Priority Project #3 – Complex Retrofits– Planning, Design, Construction Planning, Design, Construction Information Sheet**

**Location:** Malheur County, **Specific Bridges:** 04374A, 19912, 19914, 19916, 19917

**Project Overview:**

- Conduct grading (or other methods) to increase freeboard (height between bottom of bridge deck and ground), improve openness, and increase line of sight
- Create an unobstructed pathway under existing bridge/culvert (may entail light earthwork, removal of rip rap, light grading)
- Removal of derelict fencing and debris
- Vegetation enhancement (plant installation, and establishment)

| Complex Retrofits Estimate (5 total) | |
|---|---|
| **Task** | **Cost** |
| Project Initiation, Development, and Planning | $20,000 |
| ODOT Planning Coordination and Approvals | $20,000 |
| Project Studies and Reviews | $300,000 |
| Permitting and Regulatory Approvals | $30,000 |
| Prepare Design, Specifications, and Cost Estimates | $100,000 |
| Geotechnical Engineering | $50,000 |
| Structural Engineering | $50,000 |
| ODOT Design Coordination and Approvals | $20,000 |
| Final Bid package: Plans, Specifications and Cost estimates | $15,000 |
| Construction ($2 million per site) | 10,000,000 |
| 10% Contingency | 1,040,500 |
| **Total** | **$11,445,500** |



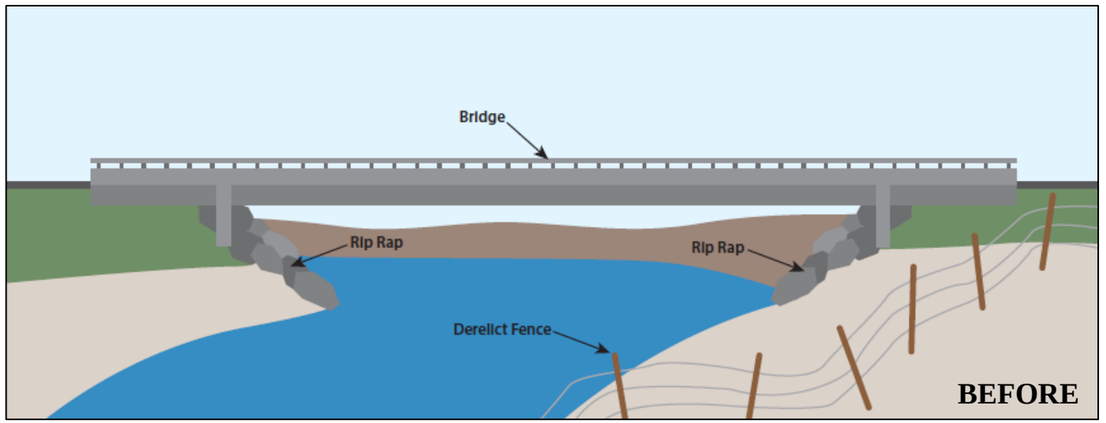




**Figure 1. Before.**
Existing Conditions Before retrofits graphic depicting an existing bridge with very low clearance, obstructive riprap, derelict fencing, and lacking in developed vegetation structure that are barriers to wildlife movement.

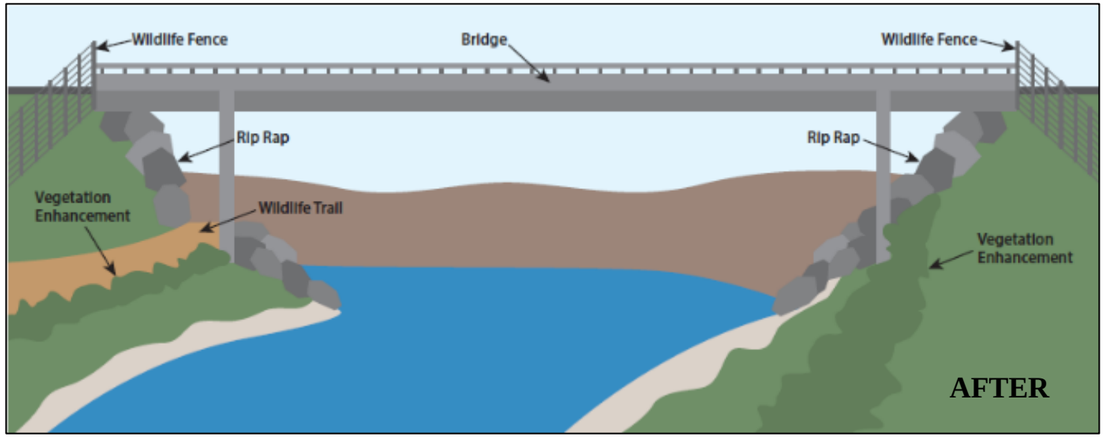



**Figure 2. After.**
After retrofits graphic depicting a bridge with retrofits to enhance wildlife movement including adding a pathway through obstructive riprap, removing derelict fencing, and adding wildlife fencing and vegetation enhancements to facilitate and support movement.

Assumptions:

- Includes structural and road modifications (e.g., increased elevation, bridge replacement), traffic control, detours, road restoration, fill/cut hauling
- Hydrologic assessment and modeling and other environmental studies required
- Planning and PS&E price assumes all five (5) sites bid together in same bid package. If Planning and PS&E are conducted individually, all costs will increase.
- Cost does not include fencing
- Each project area includes two (2) acres around each bridge
- No irrigation installation

**Priority Project #2 – New Wildlife Crossing Structure– Planning, Design, Construction**

**Location:** Malheur County, Focal Area 2 (Jonesboro)

**Project Overview**

- Project Initiation, Planning and Coordination, Permitting and Regulatory Approvals, Plans, Specification, and Cost Estimates, Construction.

**Assumptions**

- Includes traffic control, detours, fill/cut hauling
- Overpass Construction approximate cost - $2- 4 million
- Fencing length: $107,500 per mile. Assume 10 miles totaling $ 1,750,000
- Escape/Jump-Out Ramps: $3,750 each. Assume 10 totaling $37,000
- Engineering and design work includes wildlife crossing structure, fencing, and jump-outs

**Additional Notes**

- Modular bridge systems, such as provided by Contech Engineered Solutions LLC, may reduce the planning, engineering, and construction costs outlined below
- Underpass Construction not included - approximate cost - $1+ million

| **Generic Wildlife Crossing Estimate** | |
|---|---|
| Task | Cost |
| Project Initiation, Development, and Planning | $30,000 |
| ODOT Planning Coordination and Approvals | $30,000 |
| Project Studies and Reviews | $150,000 |
| Permitting and Regulatory Approvals | $50,000 |
| Prepare Design, Specifications, and Cost Estimates | $150,000 |
| Geotechnical Engineering | $75,000 |
| Structural Engineering | $75,000 |
| ODOT Design Coordination and Approvals | $30,000 |
| Final Bid package: Plans, Specifications and Cost estimates | $75,000 |
| Construction (Overpass) | $1-4 million |
| Fencing | $1,750,000 |
| Jump Outs | $37,000 |
| 10% Contingency | $360,200 – 645,200 |
| Total | $3,962,200 – $7,097,200 |

Appendix E
# Funding Opportunities

| Funding/Support Source | Government Level/Type | State | Agency/ Organization | Summary | Web Link | Private Landowner Incentive (Yes/Maybe) |
|---|---|---|---|---|---|---|
| **Bridge Investment Program** | Federal | All | U.S. DOT | The Bridge Investment Act bill provides $12.5 billion to fund a bridge investment program that will award competitive grants to governmental entities for projects that improve the condition of bridges. Bridges of all sizes qualify. | https://www.congress.gov/bill/117th-congress/senate-bill/1817?s=1&r=51 | |
| **Wildlife Crossings Pilot Program** | Federal | All | U.S. DOT | New competitive grant program offering $350 million over 5 years for wildlife crossing projects. Counties can apply directly to USDOT for this new competitive grant program to carry out eligible projects that reduce collisions and/or improve habitat connectivity. As this is a new program, no official website or program mechanism are available. | https://arc-solutions.org/wp-content/uploads/2021/11/Wildlife-Crossings-Pilot-Program-Summary.pdf | |
| **Nationally Significant Freight and Highway Projects** | Federal | All | U.S. DOT | This program was recently expanded to include increased funding and eligibility of wildlife crossing projects | https://www.transportation.gov/sites/dot.gov/files/docs/NSFHP%20Fact%20Sheets%20with%20Letterhead_v2.pdf | |
| **BUILD Discretionary Grant** | Federal | All | U.S. DOT | Better Utilizing Investments to Leverage Development (BUILD) invest in road, rail, transit, and port projects that promise to achieve national objectives | https://www.transportation.gov/BUILDgrants | |
| **Surface Transportation Block Grant Program (STBG)** | Federal | All | FHWA | The STBG promotes flexibility in State and local transportation decisions and provides flexible funding to best address State and local transportation needs. | https://www.fhwa.dot.gov/specialfunding/stp/160307.cfm#a | |
| **Accelerated Innovative Deployment (AID) Program** | Federal | All | FHWA | The AID Demonstration program provides funding as an incentive for eligible entities to accelerate the implementation and adoption of innovation in highway transportation. | https://www.fhwa.dot.gov/innovation/grants/ | |
| **Highway Safety Improvement Program** | Federal | All | FHWA | The Highway Safety Improvement Program (HSIP) is a core Federal-aid program with the purpose to achieve a significant reduction in traffic fatalities and serious injuries on all public roads, including non-State-owned roads and roads on tribal land. The HSIP requires a data-driven, strategic approach to improving highway safety on all public roads with a focus on performance. | https://safety.fhwa.dot.gov/hsip/ | |
| **Federal Lands Transportation Program (FLTP)** | Federal | All | FHWA | The Federal Lands Transportation Program (FLTP) was established in 23 U.S.C. 203 to improve the transportation infrastructure owned and maintained by the following Federal Lands Management Agencies: National Park Service (NPS), US Fish and Wildlife Service (FWS), USDA Forest Service (Forest Service), Bureau of Land Management (BLM), US Army Corps of Engineers (USACE), Bureau of Reclamation and independent Federal agencies with land and natural resource management responsibilities. | https://highways.dot.gov/federal-lands/programs/transportation | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Federal Lands Access Program (FLAP)** | Federal | All | FHWA | The Federal Lands Access Program (Access Program) was established in 23 U.S.C. 204 to improve transportation facilities that provide access to, are adjacent to, or are located within Federal lands. | https://highways.dot.gov/federal-lands/programs-access/or/ | |
| **Partners for Fish and Wildlife** | Federal | All | USFWS | The Partners for Fish and Wildlife Program provides technical and financial assistance to landowners interested in restoring and enhancing wildlife habitat on their land. Projects are custom designed to meet landowners' needs. Since the program's start in 1987, some 50,000 landowners have worked with Partners staff to complete 60,000 habitat restoration projects on 6 million acres. Partners projects are voluntary. Participating landowners continue to own and manage their land to serve their needs while they improve conditions for wildlife. | https://www.fws.gov/partners/ | Yes |
| **State Wildlife Grant Program** | Federal | All | USFWS | The State Wildlife Grant (SWG) Program provides Federal grant funds to State fish and wildlife agencies for developing and implementing programs that benefit wildlife and their habitats, including species that are not hunted or fished.<br><br>Grant funds may be used to address a variety of conservation needs--such as research, fish and wildlife surveys, species restoration, habitat management, and monitoring—that are identified within a State's Wildlife Action Plan. These funds may also be used to update, revise, or modify a State's Plan. | https://www.fws.gov/wsfrprograms/subpages/grantprograms/swg/swg.htm | |
| **Tribal Transportation Program (TTP)** | Federal | All | FHWA | The purpose of the TTP is to provide safe and adequate transportation and public road access to and within Indian reservations, Indian lands, and Alaska Native Village communities. A prime objective of the TTP is to contribute to the economic development, self-determination, and employment of Indians and Native Americans. Through mutual respect and understanding, enhance the quality of life in Tribal communities by supporting the Tribes' delivery of transportation programs. | https://highways.dot.gov/federal-lands/programs-tribal | |
| **Tribal Transportation Safety Fund (TTSF)** | Federal | All | FHWA | TTPSF grants are available to federally recognized Indian tribes through a competitive, discretionary program. Awarded annually, projects are chosen whose outcomes will address the prevention and reduction of death or serious injuries in transportation related incidents, such as motor vehicle crashes. | https://highways.dot.gov/federal-lands/programs-tribal/safety/funds | |
| **Tribal Transportation Bridge Program** | Federal | All | FHWA | The Tribal Transportation Bridge Program is focused on improving the number of declining structurally deficient bridges. This information has been created to assist our partners working to improve the condition of non-BIA owned and BIA/tribally owned bridges. | https://highways.dot.gov/federal-lands/programs-tribal/bridge | |
| **Cooperative Endangered Species Conservation Fund (Section 6 of the ESA)** | Federal | All | USFWS | Provides financial assistance to States and Territories to implement conservation projects for listed species and at-risk species. Funded activities include habitat restoration, species status surveys, public education and outreach, captive propagation and reintroduction, nesting surveys, genetic studies, and development of management plans. | https://www.fws.gov/endangered/grants/ | |
| **Tribal Wildlife Grants** | Federal | All | USFWS | Goal of the Tribal Wildlife Grant Program: Provide a competitive funding opportunity for Federally recognized Tribal governments to develop and implement programs for the benefit of wildlife and their habitat, including species of Native American cultural or traditional importance and species that are not hunted or fished. | https://www.fws.gov/nativeamerican/grants.html | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Wildlife Restoration Act (Pittman-Robertson Act)** | Federal | All | USFWS | The Wildlife Restoration Act provides grant funds generated form excise taxes on firearms, ammunition, and archery equipment to states, the District of Columbia, and insular areas that have passed assent legislation. The Wildlife Restoration Act authorizes annual distributions from the Wildlife Restoration Account for the following:<br>- Administration of the Wildlife Restoration Program<br>- Multistate Conservation Grant Program<br>- Hunter Education Enhancements - Section 10 apportionments<br>- Hunter Education - Section 4 (c) (1/2 taxes collected on pistols, revolvers, bows, arrows and archer accessories) apportionments<br>- Remaining Funds in Wildlife Restoration Account are apportioned to states/DC/insular areas<br>- Reversions in the WR Account are transferred to Migratory Birds. | https://www.fws.gov/wsfrprograms/subpages/grantprograms/wr/WR_Act.htm | |
| **Landowner Incentive Program (Non-Tribal Portion)** | Federal | All | USFWS | The Landowner Incentive Program (LIP) provides federal grant funds to grant funds to the states, the District of Columbia and insular areas to protect and restore habitats on private lands, to benefit Federally listed, proposed or candidate species or other species determined to be at-risk.<br><br>Grant funds must be used to establish or supplement State landowner incentive programs to benefit species identified in the State's Comprehensive Wildlife Conservation Strategy (State Wildlife Action Plan) or classified as Special Concern by the State, or Federally listed, proposed, or candidate species or other species determined to be at-risk. These grant funds may also be used to provide technical and financial assistance to private landowners for habitat protection and restoration | https://www.fws.gov/wsfrprograms/Subpages/GrantPrograms/LIP/lip.htm | Yes |
| **Tribal Landowner Incentive Grant Program** | Federal | All | USFWS | A percentage of the Land and Water Conservation funds made available for the Landowner Incentive Program (LIP) are distributed to Federally recognized tribal governments through a competitive grant program.<br><br>These funds may be used for projects to "provide for the protection, restoration and management of habitat to benefit species at risk, including Federally-listed endangered or threatened species, as well as proposed or candidate species." Funds can be used for salaries, equipment, consultant services, subcontracts, acquisitions and travel. Proposals are evaluated by their Resource Benefit, Performance Measures, Work Plan, Budget, Capacity Building and their Partnerships and Contributions. | https://www.fws.gov/wsfrprograms/Subpages/GrantPrograms/TLIP/TLIP.htm | |
| **Multistate Conservation Grant Program** | Federal | All | Association of Fish & Wildlife Agencies and U.S. Fish and Wildlife Service (USFWS) | Funds projects that address regional or national priorities and undertaken by state fish and wildlife agencies. | https://www.fishwildlife.org/afwa-informs/multi-state-conservation-grants-program | |
| **Resource Advisory Council (RAC) Grants** | Federal | All | BLM | The BLM maintains chartered advisory councils primarily located in the West. These include statewide and regional Resource Advisory Councils (RACs), advisory committees affiliated with specific sites on the BLM's National Conservation Lands, and the National Wild Horse and Burro Advisory Board.<br><br>RACs and advisory committees are sounding boards for BLM initiatives, regulatory proposals, and policy changes. Each citizen-based council generally consists of 10 to 15 members from diverse interests in local communities, including ranchers, environmental groups, tribes, state and local government officials, academics, and other public land users. | https://www.blm.gov/get-involved/resource-advisory-council/about-rac | Maybe |
| **Cooperative Endangered Species Conservation Fund: Conservation Grants** | Federal | All | USFWS | Supports implementation of conservation projects under Section 6.<br><br>Section 6 of the ESA authorizes the Service to provide federal financial assistance through the Cooperative Endangered Species Conservation Fund (CESCF) to states and territories (states) to support the development and implementation of conservation programs for the benefit of resident listed, candidate, and at-risk species on non-federal lands. This financial assistance, provided in the form of competitive grants and made available through four CESCF grant programs, contributes approximately $51.8 million toward species and habitat conservation annually. | https://www.fws.gov/endangered/grants/grant-programs.html | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Cooperative Endangered Species Conservation Fund: Recovery Land Acquisition** | Federal | All | USFWS | Supports Acquisition of habitat in support of approved recovery goals or objectives.<br><br>Section 6 of the ESA authorizes the Service to provide federal financial assistance through the Cooperative Endangered Species Conservation Fund (CESCF) to states and territories (states) to support the development and implementation of conservation programs for the benefit of resident listed, candidate, and at-risk species on non-federal lands. This financial assistance, provided in the form of competitive grants and made available through four CESCF grant programs, contributes approximately $51.8 million toward species and habitat conservation annually. | https://www.fws.gov/endangered/grants/grant-programs.html | |
| **Cooperative Endangered Species Conservation Fund: Habitat Conservation Planning Assistance** | Federal | All | USFWS | Supports development of Habitat Conservation Plans (HCPs)<br><br>Section 6 of the ESA authorizes the Service to provide federal financial assistance through the Cooperative Endangered Species Conservation Fund (CESCF) to states and territories (states) to support the development and implementation of conservation programs for the benefit of resident listed, candidate, and at-risk species on non-federal lands. This financial assistance, provided in the form of competitive grants and made available through four CESCF grant programs, contributes approximately $51.8 million toward species and habitat conservation annually. | https://www.fws.gov/endangered/grants/grant-programs.html | |
| **Cooperative Endangered Species Conservation Fund: Habitat Conservation Plan (HCP) Land Acquisition** | Federal | All | USFWS | Supports acquisition of land associated with approved HCPs.<br><br>Section 6 of the ESA authorizes the Service to provide federal financial assistance through the Cooperative Endangered Species Conservation Fund (CESCF) to states and territories (states) to support the development and implementation of conservation programs for the benefit of resident listed, candidate, and at-risk species on non-federal lands. This financial assistance, provided in the form of competitive grants and made available through four CESCF grant programs, contributes approximately $51.8 million toward species and habitat conservation annually. | https://www.fws.gov/endangered/grants/grant-programs.html | |
| **Ecological Effects of Sea Level Rise Program Grant** | Federal | All | NOAA | Funding to improve adaptation and planning in response to regional and local effects of sea level rise and coastal inundation through targeted research on key technologies, natural and nature-based infrastructure, physical and biological processes, and model evaluation. | https://coastalscience.noaa.gov/research/coastal-change/ecological-effects-sea-level-rise-program/#:~:text=The%20ESLR%20program%20awarded%20%244.6,%2C%20infrastructure%2C%20and%20surface%20transpor | |
| **Species Recovery Grants to States** | Federal | All | NOAA | Supports management, research, monitoring, and/or outreach activities that have direct conservation benefits for listed species under the Endangered Species Act within that state. Recently delisted species, proposed, and candidate species are also eligible. | https://www.fisheries.noaa.gov/grant/species-recovery-grants-states | |
| **The Coastal and Estuarine Land Conservation Program** | Federal | All | NOAA | Lands selected to be protected through the program are ecologically important or possess other coastal conservation values, such as historic features, scenic views, or recreational opportunities. | https://coast.noaa.gov/czm/landconservation/ | |
| **Agricultural Conservation Easement Program (ACEP)/ Wetland Reserve Easement (WRE)** | Federal | All | NRCS | Provides financial and technical assistance to help conserve agricultural lands and wetlands and their related benefits. Under the ACEP component, NRCS helps state and local governments protect working agricultural lands and limit non-agricultural uses of the land. Under the WRE component, NRCS helps to restore, protect, and enhance enrolled wetlands. | https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/acep/ | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Conservation Innovation Grants (CIG)** | Federal | All | NRCS | Through the NRCS CIG program, public and private grantees develop the tools, technologies, and strategies to support next-generation conservation efforts on working lands and develop market-based solutions to resource challenges. Grantees leverage the federal investment by at least matching it. | https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/cig/ | |
| **Environmental Quality Incentives Program (EQIP)** | Federal | All | NRCS | EQIP provides funding for solutions that conserve natural resources for the future while also improving agricultural operations. | https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/eqip/ | |
| **WaterSMART Cooperative Watershed Management Program (CWMP) Phase I** | Federal | All | USBR | Contributes to the WaterSMART strategy by providing funding to watershed groups to encourage diverse stakeholders to form local solutions to address their water management needs. For Phase I projects, Reclamation will award a successful applicant up to $50,000 per year for a period of up to 2 years with no non-Federal cost-share required. Reclamation will award up to $100,000 per project over a 2-year period. For Phase II projects, applicants must contribute at least 50% of the total project costs. | https://www.usbr.gov/watersmart/cwmp/ | |
| **Farmable Wetlands Program (FWP)** | Federal | All | USDA | Designed to restore previously farmed wetlands and wetland buffer to improve both vegetation and water flow. FWP is a voluntary program to restore up to one million acres of farmable wetlands and associated buffers. Participants must agree to restore the wetlands, establish plant cover, and to not use enrolled land for commercial purposes. Plant cover may include plants that are partially submerged or specific types of trees. | https://www.fsa.usda.gov/programs-and-services/conservation-programs/farmable-wetlands/index | |
| **Grassland Reserve Program** | Federal | All | USDA | Conservation program that emphasizes support for working grazing operations, enhancement of plant and animal biodiversity, and protection of grassland under threat of conversion to other uses. | https://www.nrcs.usda.gov/wps/portal/nrcs/detail/null/?cid=nrcs141p2_036530 | |
| **Community-Based Restoration Program (CRP)** | Federal | All | NOAA | NOAA is seeking proposals from non-federal partners for habitat restoration projects that will restore coastal ecosystems. The selected projects will support species recovery and help rebuild fish populations, and likely yield community and economic benefits. Since CRP began in 1996, roughly $162 million has been contributed to more than 2,000 projects. | https://www.fisheries.noaa.gov/national/habitat-conservation/community-based-habitat-restoration | |
| **Clean Water Act State Revolving Loan Fund** | Federal | All | EPA | The Clean Water State Revolving Fund (CWSRF) program is a federal-state partnership that provides communities low-cost financing for a wide range of water quality infrastructure projects. This program offers low-cost financing for a variety of water quality projects. The program has significant financial assets, capable of financing projects from <$1 million to >$100 million. | https://www.epa.gov/cwsrf | |
| **Regional Conservation Partnership Program** | Federal | All | NRCS | The Regional Conservation Partnership Program (RCPP) promotes coordination of NRCS conservation activities with partners that offer value-added contributions to expand our collective ability to address on-farm, watershed, and regional natural resource concerns. Through RCPP, NRCS seeks to co-invest with partners to implement projects that demonstrate innovative solutions to conservation challenges and provide measurable improvements and outcomes tied to the resource concerns they seek to address. | https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/rcpp/ | Yes |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Conservation Reserve Program** | Federal | All | USDA | The Conservation Reserve Program (CRP) is a voluntary program for agricultural landowners to receive rental payments when they convert marginal farmlands to vegetated cover. This reduces soil erosion, supports farmers, reduces sedimentation and pollution in water sources, and establishes wildlife habitat. The wetland enhancement, shoreline protection, and riparian buffer practices enhance resilience by reducing downstream flooding during storm events.<br><br>One effort of the CRP is the Floodplain Wetlands Initiative, which restores the functions and values of wetland ecosystems that had been devoted to agricultural use. Wetland restoration reverses the degradation of the wetland areas on what is often marginal soil. For farmers and landowners facing crop damage from flooding, restoring wetlands to receive floodwaters can also increase flood storage capacity—while significantly reducing farming risks. | https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/index | Yes, farm owner |
| **Disaster Assistance Program** | Federal | All | USDA | The Farm Service Agency provides several disaster assistance programs. These include the Emergency Conservation Program, Emergency Forest Restoration Program, Emergency Loan Program, and Tree Assistance Program, as well as a mix of other programs aimed at specific agricultural sectors. While focused on recovery, many of these programs provide funding for conservation practices that enhance resilience. | https://www.fsa.usda.gov/programs-and-services/disaster-assistance-program/index | Yes, farm owner |
| **Forest Legacy Program** | Federal | All | USFS | The Purpose of the Forest Legacy Program (FLP) is to identify and conserve environmentally important forest areas that are threatened by conversion to non-forest uses. Providing economic incentives to landowners to keep their land as forests encourages sustainable forest management and supports strong markets for forest products. Forest protection can be a valuable tool for natural resource conservation and can reduce flooding and hazard risk downstream within a watershed.<br>Landowners may participate in the FLP by either selling their property outright or by retaining ownership and selling only a portion of the property's development rights; both are held by state agencies or another unit of government. The use of a conservation easement, a legal agreement between a landowner and a nonprofit land trust or governmental agency, allows the land to remain in private ownership while ensuring that its environmental values are retained. | https://www.fs.fed.us/managing-land/private-land/forest-legacy/program | Yes, farm owner |
| **Coastal and Marine Habitat Restoration Grants** | Federal | All | NOAA | The National Oceanic and Atmospheric Administration (NOAA) Community-Based Restoration Program recognizes that habitat protection and restoration are essential elements of a strategy for sustainable commercial and recreational fisheries. Investing in habitat restoration projects leads to real, lasting differences for communities, businesses, and the environment. The program grants support restoration projects that use a habitat-based approach to rebuild productive and sustainable fisheries, contribute to the recovery and conservation of protected resources, and promote healthy ecosystems and resilient communities.<br><br>Restoration includes activities that return degraded or altered marine, estuarine, coastal, and freshwater, migratory fish habitats to functioning conditions, and techniques that return NOAA trust species to their historic habitats. These projects support economic recovery. They can also prevent future hazards and hazard losses by protecting natural resources in critical areas of the coastal floodplain. | https://www.fisheries.noaa.gov/grant/coastal-and-marine-habitat-restoration-grants | |
| **Coastal Resilience Grants** | Federal | All | NOAA | The National Oceanic and Atmospheric Administration (NOAA) Coastal Resilience Grants program, jointly administered by NOAA's National Ocean Service and NOAA Fisheries, implements projects that build resilient U.S. coastal communities and ecosystems.<br><br>Resilience is the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events such as extreme weather or long-term changing environmental conditions. This program is intended to build resilience through projects that conserve and restore sustainable ecosystem processes and functions and reduce the vulnerability of coastal communities and infrastructure from the impacts of extreme weather events, climate hazards, and changing ocean conditions. | https://www.fisheries.noaa.gov/grant/noaa-coastal-resilience-grants | |
| **Smart Growth Support** | Federal | All | EPA | The Environmental Protection Agency's (EPA) Office of Community Revitalization works on smart growth issues by:<br>• Conducting research.<br>• Producing reports and other publications.<br>• Providing examples of outstanding smart growth communities and projects.<br>• Working with tribes, states, regions, and communities through grants and technical assistance.<br>Smart growth can incorporate elements of green infrastructure and/or land preservation and can create more resilient communities | https://www.epa.gov/smartgrowth/about-smart-growth | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Flood Mitigation Assistance** | Federal | All | FEMA | FMA provides funding to states for projects and planning that reduces or eliminates long-term risk of flood damage to structures insured under the NFIP. FMA funding is also available for management costs. FEMA requires state and local governments to develop and adopt hazard mitigation plans as a condition for receiving certain types of non-emergency disaster assistance, including funding for FMA mitigation projects. | https://www.fema.gov/grants/mitigation/floods | |
| **Pre-Disaster Mitigation (PDM) and FMA grant programs** | Federal | All | FEMA | The goal is to reduce overall risk to the population and structures from future hazard events, while also reducing reliance on federal funding in future disasters. This program awards planning and project grants and provides opportunities for raising public awareness about reducing future losses before disaster strikes. Mitigation planning is a key process used to break the cycle of disaster damage, reconstruction, and repeated damage. PDM grants are funded annually by Congressional appropriations and are awarded on a nationally competitive basis. | https://www.fema.gov/grants/mitigation/pre-disaster | |
| **Rivers, Trails, and Conservation Assistance Program** | Federal | All | NPS | Supports community-led natural resource conservation and outdoor recreation projects across the nation. | https://www.nps.gov/orgs/rtca/index.htm | |
| **Environmental Education Grants Program** | Federal | All | EPA | Under the Environmental Education Grants Program, EPA seeks grant applications from eligible applicants to support environmental education projects that promote environmental awareness and stewardship and help provide people with the skills to take responsible actions to protect the environment. This grant program provides financial support for projects that design, demonstrate, and/or disseminate environmental education practices, methods, or techniques. | https://www.epa.gov/education/grants | |
| **Office of Wetlands, Oceans & Watersheds, Watershed Funding Resources** | Federal | All | EPA | Supports the Clean Water Act by promoting effective and responsible water use, wastewater treatment, and disposal and management and by encouraging the protection and restoration of watersheds. Provided are regulatory standards, voluntary management approaches, and financial and technical assistance to states, tribes, communities, and regulated entities to protect human health and aquatic ecosystems, reduce flooding, and protect the nation's infrastructure investment. | https://www.epa.gov/aboutepa/about-office-water#wetlands | |
| **National Coastal Wetlands Conservation Grant Program** | Federal | All | USFWS | Annually provides grants of up to $1 million to coastal and Great Lakes states, as well as U.S. territories to protect, restore, and enhance coastal wetland ecosystems and associated uplands. | https://www.fws.gov/coastal/coastalgrants/ | |
| **North American Wetlands Conservation Act (NAWCA) Small Grants Program** | Federal | All | USFWS | NAWCA grants increase bird populations and wetland habitat, while supporting local economies and American traditions such as hunting, fishing, bird watching, family farming, and cattle ranching. Wetlands protected by NAWCA provide valuable benefits such as flood control, reducing coastal erosion, improving water and air quality, and recharging groundwater. | https://www.fws.gov/birds/grants/north-american-wetland-conservation-act.php | |
| **North American Wetlands Conservation Act (NAWCA) Standard Grant** | Federal | All | USFWS | Grants made to increase bird populations and wetland habitat, while supporting local economies and American traditions such as hunting, fishing, bird watching, family farming, and cattle ranching. | https://www.fws.gov/birds/grants/north-american-wetland-conservation-act/standard-grants.php | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Recovery Implementation Fund Grants** | Federal | All | USFWS | Provides funding for projects that will contribute to the recovery of USFWS-managed endangered and threatened species and limited to projects carrying out actions described in a species approved recovery plan, in the implementation schedule of a species approved recovery plan, actions recommended in a completed 5-year status review of the species or in a spotlight species action plan, or projects documenting species response to climate change. | https://www.fws.gov/wafwo/articles.cfm?id=149489476 | Maybe |
| **National Estuarine Research Reserve System (NERRS) Land Acquisition and Construction Program for FY19** | Federal | All | NOAA | NOAA anticipates approximately $1.9 million in FY19 will be available to designated lead Reserve agencies or universities in coastal states for approximately 5–10 construction and acquisition projects. Awards are expected to range from approximately $20,000 to $800,000 per project, with project periods typically covering 12–36 months, depending on the availability of funds. | https://www.grants.gov/web/grants/view-opportunity.html?oppId=329645 | |
| **Acres for America** | NGO | All | NFWF and Walmart | Walmart's Acres for America priorities include:<br>- Conserve critical habitats for birds, fish, plants and wildlife;<br>- Connect existing protected lands to unify wild places and protect migration routes<br>- Provide access for people to enjoy the outdoors; and,<br>- Ensure the future of local economies that depend on forestry, ranching and recreation. | https://www.nfwf.org/programs/acres-america | |
| **Animal Road Crossing (ARC)** | NGO | All | ARC | ARC—Animal Road Crossing—is an interdisciplinary partnership working to facilitate new thinking, new methods, new materials and new solutions for wildlife crossing structures.<br><br>Our primary goal is to ensure safe passage for both humans and animals on and across our roads. We do this through supporting the study, design and construction of wildlife crossing structures throughout North America.<br><br>ARC builds bridges in other important ways: We reconnect landscapes and wildlife habitats that have been split apart by our road systems; we reacquaint people and wildlife, helping drivers to be aware of the habitats our roads interrupt and the animals that use these places; and through these strategies, we reaffirm the need for humans and animals to coexist in the landscapes we call home.<br><br>Situated at the intersection of science and design, ARC is a forum for creative collaborations and surprising synergies. | https://arc-solutions.org/ | |
| **California Flow Restoration Accounting Fund** | NGO | All | NFWF | Goals are to develop technical capacity and provide monitoring support for organizations, agencies, and funders to effectively account for the impacts of flow enhancement projects on stream discharge, habitat, water quality, and survival of native fish and wildlife. | https://www.nfwf.org/sites/default/files/wwp/Documents/freshwaterflow2019grantslate.pdf | |
| **Five Star and Urban Waters Restoration Grant Program** | NGO | All | NFWF | Projects include a variety of ecological improvements along with targeted community outreach, education, and stewardship. Approximately $1,700,000 is available nationwide for projects meeting program priorities. Awards range from $20,000 to $50,000 with an average size of $30,000, and 40–50 grants are awarded per year. Projects should span 12–18 months with a start date in July 2019; applicants requesting more than $30,000 should propose projects longer than 12 months. | nfwf.org/programs/five-star-and-urban-waters-restoration-grant-program | |
| **National Coastal Resilience Fund** | NGO | All | NFWF | Funding to advance identified priorities for restoring and strengthening natural systems so they can protect coastal communities from the impacts of storms and floods and enable them to recover more quickly, while also enhancing habitats for important fish and wildlife populations. | https://www.nfwf.org/programs/national-coastal-resilience-fund | |
| **Ducks Unlimited Grants** | NGO | All | Ducks Unlimited | Grant opportunities for restoring grasslands, replanting forests, restoring watersheds, working with landowners, working with partners, acquiring land, conservation easements, management agreements, and geographic information systems. | https://www.ducks.org/conservation/public-policy/federal-conservation-funding | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Research Projects** | NGO | All | EarthWatch Institute | Earthwatch's overarching goal is to support research projects that produce rigorous, relevant, and impactful science; address global change; and actively involve citizen-scientist participants. Annual budgets range between $20,000 and $80,000, with most of this covering participant expenses. All proposals must be submitted by a researcher with a PhD, who is planning to function as the project's principal investigator. | https://earthwatch.org/research/apply-for-research-funding | |
| **Hewlett Foundation Environment Program** | NGO | All | Hewlett Foundation | Funds grants to protect people and places threatened by a warming planet by addressing climate change globally, expanding clean energy, and conserving the North American West. | https://hewlett.org/programs/environment/ | |
| **SeaWorld & Busch Gardens Conservation Fund** | NGO | All | SeaWorld & Busch Gardens | The fund's areas of focus are species research, habitat protection, conservation education, animal rescue and rehabilitation. Although there is no limit to the size of the application request, most grants range between $10,000 and $25,000. Not accepting grant applications from 2021-2023. | https://swbg-conservationfund.org/grant-seekers/ | |
| **Temper of the Times Foundation Grants** | NGO | All | Temper of the Times | The foundation does not provide grants to individuals, for-profit organizations, or government agencies. Grants are typically between $5,000 and $15,000 and are awarded for projects that will lead to measurable outcomes for wildland ecosystem conservation and restoration. Grants may be used to fund the production of print, radio, or television ads, to pay for advertising space or airtime, or to produce or distribute pamphlets, books, videos, or press packets. | http://temperfund.org/ | |
| **Tiffany & Co. Foundation Grants** | NGO | All | Tiffany & Co. Foundation | Funding for organizations dedicated to the stewardship of natural resources in the areas of responsible mining and coral conservation. Specifically, the Foundation promotes responsible mining through remediation, land preservation and standards-setting efforts; and coral conservation through key research and targeted educational outreach. | http://www.tiffanyandcofoundation.org/about/ | |
| **Monarch Butterfly and Pollinators Conservation Fund** | NGO | All | NFWF | The Monarch Butterfly and Pollinators Conservation Fund supports work that advances the conservation of the monarch butterfly and other at-risk native insect pollinators. | https://www.nfwf.org/monarch/Pages/home.aspx | |
| **Conservation Acquisition Revolving Fund** | NGO | All | The Conservation Fund | We use our Revolving Fund to help our federal, state and local partners by acting quickly to save priority lands vulnerable to development or fragmentation. As immediate conservation opportunities arise, our conservation partners turn to us to deploy the ready capital of our Revolving Fund. When public and/or private funding later becomes available to secure long-term protection, the Revolving Fund is fully repaid so it can continue to serve future conservation investments. | https://www.conservationfund.org/our-work/conservation-acquisition/our-revolving-fund | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Climate Adaptation Fund** | NGO | All | Wildlife Conservation Society | The WCS Climate Adaptation Fund ("the Fund") strives to increase the pace and scale of impact in adaptation for wildlife and ecosystems by increasing innovation, accelerating learning, and mainstreaming proven adaptation approaches. | https://www.wcsclimateadaptationfund.org/program-information | Yes, farm owner |
| **Resilient Communities Program** | NGO | All | NFWF and Wells Fargo | The program focuses on water quality and quantity declines, forest health concerns, and sea level rise. The program will emphasize community inclusion and assistance to traditionally underserved populations in vulnerable areas. | https://www.nfwf.org/resilientcommunities/Pages/home.aspx | |
| **North American Partnership for Environmental Community Action** | NGO | All | Commission for Environmental Cooperation | Project types can include, but are not limited to, building capacity, pilot projects, transfer of innovative technologies, conducting outreach or education, sharing best practices, training environmental leaders, engaging youth on environmental activities, reducing risks to the environment, and many other types of non-regulatory efforts. | http://www.cec.org/about/north-american-partnership-for-environmental-community-action/ | |
| **Corporate Foundation for the Americas** | Private | All | Mitsubishi | Funds projects that promote biodiversity conservation, environmental education, environmental justice, and sustainable development | http://www.mcfamericas.org/ | |
| **Land Trust Bird Conservation Initiative** | Private | All | Cornell Lab of Ornithology | Grant program in 2019 will fund six grants—three each at $5,000 and $20,000. Grants will support land trusts and their partners in accomplishing bird conservation on private lands through activities such as strategic planning, outreach, habitat management, stewardship, and capacity building. In addition to funding, the Cornell Lab of Ornithology will provide technical support and advice to recipients. | https://www.birds.cornell.edu/landtrust/small-grants-program/ | |
| **Patagonia Environmental Grants** | Private | All | Patagonia | Supports innovative work that addresses the root causes of the environmental crisis and seeks to protect both the environment and affected communities. We focus on places where we've built connections through outdoor recreation and through our network of retail stores, nationally and internationally. Grants typically range between $2,500 and $15,000. | https://www.patagonia.com/how-we-fund/ | |
| **Long Range Transportation Plan, State Transportation Funding Program** | State | All | DOT | Each state has their own plan; there is a prioritization process for projects proposed for the plan.<br><br>Each state has their own program for prioritizing and selecting transportation projects for funding. Projects are submitted by locality, city, MPO, Planning District Commission. Environmental factors are one of the scoring criteria.<br><br>*For planned transportation projects where there may be opportunities to incorporated habitat connectivity measures.<br><br>To make a case for integrating habitat connectivity measures, contact DOT construction planner in relevant region. Outreach to Planning District Commission boards (i.e. a presentation at one of their meetings) and/or the local governments (staff & elected boards). May be helpful to identify a local group that is active in the area to get their help. | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **State Transportation Improvement Program (STIP)** | State | All | DOT | Each state is required under 49 U.S.C. 5304(g) to develop a statewide transportation improvement program (STIP) covering at least four years. The STIP is a staged, multi-year, statewide intermodal program of transportation projects, consistent with the statewide transportation plan and planning processes as well as metropolitan plans, transportation improvement programs (TIPs), and planning processes. The STIP must be developed in cooperation with the metropolitan planning organizations (MPOs), public transit providers, and any Regional Transportation Planning Organizations (RTPO) in the state, and must be compatible with the TIPs for the state's metropolitan areas. | | |
| **Oregon Wildlife Foundation (OWF)** | NGO | OR | Oregon Wildlife Foundation (OWF) | The Oregon Wildlife Foundation offer small grant awards to the Oregon Department of Fish and Wildlife (ODFW), tax-exempt organizations, volunteer groups with a fiscal sponsor, and qualified individuals for projects that fall within the following areas:<br><br>fish and/or wildlife habitat restoration<br>public access preservation, restoration, or improvement<br>natural resource or outdoor education<br>invasive species removal or control<br>studies that support improved fish/wildlife management | https://www.myowf.org/grants | Maybe |
| **Oregon Natural Desert Association** | NGO | OR | Oregon Natural Desert Association | ONDA partners with land management agencies, private landowners, and tribal entities to undertake long-term restoration projects to improve land, waterways, wildlife and communities in Oregon's high desert. | https://onda.org/about-us/ | Maybe |
| **All Roads Transportation Safety (ARTS)** | State | OR | ODOT | The ARTS Program is designed to address safety needs on all public roads in Oregon. Only by collaborating with local road jurisdictions can the Oregon Department of Transportation expect to:<br>- Increase awareness of safety on all roads.<br>- Increase awareness of safety on all roads.<br>- Promote best practices for infrastructure safety.<br>- Compliment behavioral safety efforts.<br>- Focus limited resources to reduce fatal and serious injury crashes in the state of Oregon. | https://www.oregon.gov/ODOT/Engineering/Pages/ARTS.aspx | |
| **Oregon Department of Fish and Wildlife (DFW) Access and Habitat (A&H) Grant** | State | OR | ODFW | A&H funding is allocated to projects that improve wildlife habitat, increase public hunting access to private lands, or solve a wildlife damage issue. Examples of funded projects include wetland habitat creation, noxious weed control, improving wildlife forage on private lands, developing water in arid regions, riparian fencing, seeding after wildfire, hunting leases, land acquisition, seasonal road management and hunter access through private lands to inaccessible public lands. Projects may be on private or public lands, through preference is given to projects on private lands. | https://www.dfw.state.or.us/lands/AH/grants/index.asp | |
| **Oregon DFW Bird Stamp Grant** | State | OR | ODFW | Grant Applications may be submitted for habitat development and improvement projects, equipment, surveys and/or research. | https://www.dfw.state.or.us/wildlife/grants/ | |
| **Wildlife Habitat Conservation and Management Program (WHCMP)** | State | OR | ODFW | The Wildlife Habitat Conservation and Management Program (WHCMP) is a cooperative effort involving state and local governments and other partners to incentivize private landowners to voluntarily conserve native wildlife habitat. The Oregon Legislature created the WHCMP to offer a property tax incentive to private landowners who want to provide wildlife habitat on their properties instead of, or in addition to, farming, growing timber or other land uses. Under the WHCMP, land subject to an approved wildlife habitat conservation and management plan receives a wildlife habitat special assessment, where property taxes are assessed at the relatively low value that would apply if the land were being farmed or used for commercial forestry. | https://www.dfw.state.or.us/lands/whcmp/index.asp | Yes |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Riparian Lands Tax Incentive (RLTIP)** | State | OR | ODFW | The Riparian Lands Tax Incentive Program (RLTIP) offers a property tax incentive to property owners for improving or maintaining qualifying riparian lands which can include up to 100 feet from a waterway. Under this program, property owners file a Riparian Management Plan with the Oregon Department of Fish and Wildlife and County to receive a complete property tax exemption for the qualifying riparian lands on their property, provided measures are implemented to protect, conserve, and restore the riparian land. | https://www.dfw.state.or.us/lands/tax_overview.asp | Yes |
| **Oregon Watershed Enhancement Board (OWEB)** | State | OR | OWEB | The Oregon Watershed Enhancement Board is a state agency that provides grants to help Oregonians take care of local streams, rivers, wetlands, and natural areas. Community members and landowners use scientific criteria to decide jointly what needs to be done to conserve and improve rivers and natural habitat in the places where they live. OWEB grants are funded from the Oregon Lottery, federal dollars, and salmon license plate revenue. The agency is led by an 18-member citizen board drawn from the public at large, tribes, and federal and state natural resource agency boards and commissions. | https://www.oregon.gov/oweb/Pages/index.aspx | |
| **ODFW Oregon Mule Deer Initiative (MDI)** | State | OR | ODFW | The Oregon Mule Deer Initiative (MDI) was created with the purpose of addressing the problems that are affecting mule deer populations. | https://www.dfw.state.or.us/resources/hunting/big_game/mule_deer/mdi.asp | |
| **Oregon Conservation and Recreation Fund** | State (OR) | OR | ODFW | The Oregon Conservation & Recreation Fund established din 2019 is a new way for Oregonians to support projects that protect and enhance the species and habitats identified in the Oregon Conservation Strategy and create new opportunities for wildlife watching, urban conservation, community science, and other wildlife-associated recreation. The Fund supports critically important conservation and recreation projects led by conservation organizations across the state. | https://www.dfw.state.or.us/conservationstrategy/OCRF/grants.asp | |
| **Secretarial Order 3362** | Federal | Western | DOI | This Order directs appropriate bureaus within the Department of the Interior (Department) to work in close partnership with the states of Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming to enhance and improve the quality of big-game winter range and migration corridor habitat on Federal lands under the management jurisdiction of this Department in a way that recognizes state authority to conserve and manage big-game species and respects private property rights. Through scientific endeavors and land management actions, wildlife such as Rocky Mountain Elk (elk), Mule Deer (deer), Pronghorn Antelope (pronghorn), and a host of other species will benefit. Additionally, this Order seeks to expand opportunities for big-game hunting by improving priority habitats to assist states in their efforts to increase and maintain sustainable big game populations across western states. | https://www.doi.gov/sites/doi.gov/files/uploads/so_3362_migration.pdf | No |
| **Mule Deer Foundation** | NGO | Western | Mule Deer Foundation | MDF is dedicated to the following goals:<br><br>To restore, improve, and protect mule deer habitat (including land and easement acquisitions) resulting in self-sustaining, healthy, free ranging, and huntable deer populations.<br>To encourage and support responsible wildlife management with government agencies, private organizations, and landowners.<br>To promote public education and scientific research related to mule deer and wildlife management.<br>To support and encourage responsible and ethical behavior and awareness of issues among those whose actions affect mule deer.<br>To support regulated hunting as a viable component of mule deer and black-tailed deer conservation.<br>To develop programs that focus on recruitment and retention of youth into the shooting sports and conservation. | https://muledeer.org/ | Maybe |

Appendix F

# Wildlife Crossing Structure, Wildlife Fencing, and Wildlife Escape Ramp Placement and Design Guidance

# Appendix F
# Placement and Design Guidance for Wildlife Crossing Structures and Wildlife Fencing

Resources such as the Handbook of Road Ecology (Van Der Ree et al., 2015), the Wildlife Crossing Structure Handbook Design and Evaluation in North America (Clevenger and Huijser 2011), the Portland Metro Wildlife Crossings Rethinking Road Design to Improve Safety and Reconnect Habitat Guidebook (Carr et al., 2003), and other resources listed Chapter 6 (Planning and Development Resources) provide guidance on the placement and design of Wildlife Crossing Structures (WCS) and associated components such as wildlife fencing and escape ramps. Below is a summary of key items to consider in the placement and design of WCSs and related components.

# Wildlife Crossing Structure Placement Considerations

## Location of historical/current wildlife movement, Suitable Habitat, Land Use and Ownership

- Is the area lacking an existing structure that can be used/modified for crossing?
- Are there historical and/or current target wildlife species presence and movement in the region and/or across the roadway? i.e., historical movement, road crossings, and/or roadkill present?
- Is sufficient suitable habitat available on both sides of the proposed crossing location? And/or a riparian corridor crossing the road?
- Has the region been identified as a wildlife linkage/corridor?
- If the WCS is built, will there be any potential negative effects of facilitating wildlife movement and access to a new area? E.g., consider potential source-sink dynamics, human-wildlife conflicts, depredation permits, etc.
- Would the WCS and associated elements interfere with livestock operations?
- Are there any developments planned or possible that may disrupt the function of the WCS and/or wildlife movement in the region/vicinity?
- Land use near the crossing location and across the landscape should be compatible with wildlife movement and use of the WCS.
- Community and Landowners (including private, agencies, NGOs, and others) input, conflict prevention, support.
- Locally adjacent and regional land ownership, zoning, and land use should be evaluated. Are these compatible with facilitating wildlife movement and placement of a WCS?
- Are there existing or potential future human disturbances in the area? How might these influence/interfere with wildlife movement?

## Adjacent Topography and Hydrology

- Topography (and hydrology) will influence the suitability of the location for wildlife movement. Riparian crossings, ridgelines, or valleys are usually more suitable than areas with steep slopes though species-specific ecological and movement needs must be considered.
- Topography (and hydrology) will influence the type of WCS (underpass vs overpass vs culvert/bridge) and other design details.
- Is the road in a cut, fill, level, raised? Is it going over a water body?

# Wildlife Crossing Structure Design Considerations

- The type, size, and other features of a WCS will ideally support the movement and use of a wide variety of species and support connectivity and flow of ecological processes to the maximum extent feasible.
- Ensure that the design facilitates and maximizes the movement and use of a wide variety of aquatic, terrestrial, and aerial species, as applicable.
- Aquatic crossings must have terrestrial crossing capability such as ensuring planning above banks, inclusion of raised earthen path, shelves above the OHWM.
- Ensure fencing is included and designed for focal/target species as this is an essential element to functional WCSs.
- Elements such as vegetation and cover in the form of rock/rubble piles, large woody debris, or other elements, should be provided to ensure heterogeneity and cover are provided to support a variety of species.
- Small animals, such as rodents, reptiles, and birds, prefer cover when using crossing structures, and sufficient vegetation or other cover should be provided. Examples may include small piles of cinderblocks/rocks/rubble arranged to provide cover, crevices, and spaced every few meters or as strips along one side of the structure.
- Noise, light, human access, and other disturbances should be minimized using berms, fencing, walls etc.
- Berms or sound walls may be placed between crossings and roads to limit noise disturbances at approaches to help prevent noise from deterring animals from using WCSs.
- Artificial lighting should be avoided in and adjacent to all crossing structures and wildlife corridors as it may deter animal use/passage.
- Human activity should be avoided whenever possible near crossing structures and wildlife corridors as it may deter animal use/passage.
- For aerial species, consider maintaining canopy cover and contiguity by ensuring WCS have sufficient clearance above the canopy consider aerial species diversion structures on underpasses and culverts to prevent WVCs with animals passing over the roadway, and consider other elements that focal/target species may require (such as ecological needs, behavioral traits, predator avoidance strategies) to move through the WCS.
- Openness and clear line of sight from end to end and on the horizontal plane should be maintained when possible.

- All crossings should have native earthen bottoms as some species are deterred by artificial surfaces.
- Providing vegetative cover adjacent to and near the entrances of crossings may facilitate use by species whose movement and predator avoidance behavior patterns depend on such cover. This vegetation should be heterogeneous and contiguous (where possible) with surrounding native habitat to help facilitate movement to the structures from surrounding landscapes. This can be especially important for species that require cover to move safely through their environment.
- Underpasses and culverts carrying flows or prone to flooding should have dry crossing opportunities such as an earthen bench or dry ledge to provide dry passage opportunities for wildlife.
- Culverts should not have grates, riprap, or other devices that would obstruct wildlife movement through structures.

# Wildlife Fencing

Wildlife fencing is necessary to ensure usage of WCSs and reduce wildlife-vehicle collisions because it directs and funnels wildlife towards desired crossing locations and prevents animals from accessing the roadway. Generally, wildlife fencing should be designed to prevent a variety of animals from accessing roads and should be designed consider jumpers (e.g., deer, elk), climbers (e.g., mountain lion), diggers (e.g., coyote, badger), pushers (e.g., elk), and, when possible, small animals (e.g., amphibians and small mammals) from breaching fencing.

The following fencing design recommendations will help direct animals to WCSs and culverts and will help to prevent animals from accessing the roadway. See Chapter 6 (Guidebooks and Manuals) for more recourses and details on fencing deign recommendations which include information about livestock considerations.

# General Fencing Recommendations

- Minimum eight – ten feet tall woven or chain-link type fencing is recommended along the length of the proposed project Section (see Huijser et al. 2015 and Clevenger and Huijser 2011 for details).
- Fencing may be topped with angled barbed wire to prevent jumpers and climbers from attempting to cross fencing.
- To prevent digging under the fencing, it is recommended that all fencing be buried 3.5 feet at 45-degree angle underneath the existing grade (Huijser et al. 2015 and Clevenger and Huijser 2011).
- In areas where fencing is located adjacent to trees, a high-tension protective cable may be placed atop fencing if to prevent fencing damage from felled trees (Huijser et al. 2015).
- For fencing targeting small animals, smaller mesh along lower 2 feet of fencing is recommended. This smaller meshed fencing should be buried at least 6-10 inches below existing grade and have a ¼ to ½ inch mesh size with an overhanging 90-degree lip/overhang (minimum 6 inches) to prevent climbing (Clevenger and Huijser 2011, Huijser et al 2015). Seams should be overlapping by at least 6 inches.
- If targeting fencing for small animals, various materials and design approaches are available and must be developed with target species in mind as materials and design specifications will differ

for small mammals versus amphibians, for example, and based on specific species. Animex® Wildlife Fencing and Mitigation Solutions, a private company specializing in small animal wildlife fencing, provides a wide variety of guidance and specifications for various species of small animals.

## Gates

- Concrete should be placed under any gates to prevent digging (Clevenger and Huijser 2011)
- Gates should be designed so that all gaps are minimized to the greatest extent feasible (no greater than 3 inches) and so that gates and associated fence ends are robust to warping.

## Fence Ends

- Fencing should be terminated in areas unsuitable for wildlife movement such as bad terrain or highly urbanized areas (as appropriate) to prevent wildlife from accessing the highway.
- In areas where fencing is terminated or contains gaps (i.e., access roads), use of cattle guards and/or electomats (or other deterrent devices) are recommended to prevent wildlife from accessing the roadway. Since cattle guards are primarily effective at discouraging ungulate crossings, electromats may be useful at discouraging other wildlife species and may be used with or in place of cattle guards.
- Cattle guards should be at least 12 feet wide with 20-22 feet wide being a preferred width for ungulates.
- Cattle guards should be equipped with escape opportunities for small animals that may become entrapped in the spaces underneath them.
- Near roadway crossings, roadway wildlife crossing warning signs should be installed to alert drivers of potential wildlife-roadway hazards

## Escape Opportunities

All wildlife fencing should be equipped with escape opportunities if an animal becomes entrapped in the highway right-of-way. Jump-out ramps are the recommended escape opportunity for entrapped animals. Jump-out ramps have been proven to be effective and worthwhile through research and cost benefit analyses (Huijser et al. 2015). One-way gates are *not* recommended because of their vulnerability to damage, have increased need for maintenance, lack proven effectiveness, and can potentially cause physical harm to animals.

- Jump-out ramps should be located near fence ends/gaps at a minimum (Clevenger and Huijser 2011). It is recommended that jump-out ramps are located every 0.25 miles on either side of the alignment (e.g., 4 total per mile, two on each side of the road), especial in areas adjacent to fencing ends or other potential wildlife entry points such as road crossings (Cramer et al 2014, AZDOT 2019). Ramps should be designed to be low enough for species to safely jump down onto soft and sloped landings made of loose sand which will prevent injury to animals jumping down and prevent animals from jumping up and into ROW (AZ DOT 2019).
- Jump out height is recommended at between 1.5-1.8 m tall due to black-tailed deer and elk being present in the project area (Bissonette & Hammer 2000, AZ DOT 2019).
- A bar/plank is recommended 40 cm above the top of the jump-out to prevent animals from jumping up (Huijser et al 2015).

- A smooth metal plate should be attached to the wall of the jump out to prevent climbers from entering the highway right-of-way.
- The materials, exact height, slope, and other design factors should be determined with consideration of other successful jump-out designs used in the region and elsewhere. The ODOT and other state DOTs can provide valuable lessons learned and design guidance.

**Table F-1. General Design Guidelines for Wildlife Crossing Structures as a function of Wildlife Crossing Guild.**

| | | | | Width[2] (Feet) | | Height[2] (Feet) | | |
|---|---|---|---|---|---|---|---|---|
| Species Movement Guild | Example Focal Species | Distance between Dedicated Crossings[1] (Miles) | Maximum Crossing Length (Feet) | Minimum | Recommended | Minimum | Recommended | Source |
| Low Mobility Small Fauna | Reptiles and Amphibians | 0.3 | 200 | 2 | 3 | 2 | 3 | Clevenger and Huijser 2011; Kirkland and Strohl 2011 |
| Moderate Mobility Small Fauna | American badger, Kangaroo rat | 0.6 | 260 | 2 | 3 | 2 | 3 | Clevenger and Huijser 2011; Klafki 2014 |
| Adaptive High Mobility Fauna | Bobcat | 1.2 | 260 | 3 | 4 | 3 | 5 | Caine et al. 2003; Clevenger and Huijser 2011; Ng et al. 2003 |
| High Openness High Mobility | Mountain lion | 1.2 | 260 | 20 | 30 | 10 | 15 | Clevenger and Huijser 2011 |
| Adaptive Ungulates | Mule deer | 1.2 | 260 | 20 | 30 | 8 | 15 | Clevenger and Huijser 2011; Gordon and Anderson 2003; Dodd et al. 2007 |
| Very High Openness Fauna[3] | Elk, Pronghorn | 2.2 | 260 | 20 | 30 | 10 | 15 | Clevenger and Huijser 2011; Dodd et al. 2007 |

1 – Dedicated species-specific crossings would be located within suitable habitat for the species. Due to the location of suitable habitat, topography, and other considerations, distance between crossings may be situated slightly less or greater than recommended. The total number of crossings recommended for a given area can be determined by dividing area's stance by the recommended distance between dedicated crossings.

2 – Diameter and height is inside diameter/height and is measured as distance from ground/grade to inside top of structure.

3 – Note that overpasses or viaducts are highly recommended for this Species Movement Guild.

# References

Arizona Department of Transportation (ADOT). 2019. Wildlife Escape Measures. Available at: https://azdot.gov/sites/default/files/2019/06/wildlife-escape-measures.pdf

Bissonette, J.A. & M. Hammer. 2000. Effectiveness or earthen return ramps in reducing big game highway mortality in Utah. UTCFWRU Report Series 2000 (1): 1-29.

Cain, A. T., Tuovila, V. R., Hewitt, D. G., & Tewes, M. E. (2003). Effects of a highway and mitigation projects on bobcats in Southern Texas. Biological Conservation, 114(2), 189-197.

Carr, T., Dacanay, R., Drake, K., Everson, C., Sperry, A. and Sullivan, K., 2003. Wildlife Crossings: Rethinking Road Design to Improve Safety and Reconnect Habitat.

Clevenger, A. P., & Huijser, M. P. (2011). Wildlife crossing structure handbook: design and evaluation in North America (No. FHWA-CFL/TD-11-003).

Cramer, Patricia C., Suzanne Gifford, Benjamin Crabb, Christopher McGinty, Douglas Ramsey, Fraser Shilling, Julia Kintsch, Kari Gunson, and Sandra Jacobson 2014. Methodology for prioritizing appropriate mitigation actions to reduce wildlife-vehicle collisions on idaho highways. No. FHWA-ID-14-229.

Dodd, NL, Gagnon JW, Manco AL, Schweinsburg RE. 2007. Video surveillance to assess highway underpass use by elk in Arizona. Journal of Wildlife Management 71:637-645.

Gordon, K. M., & Anderson, S. H. (2003). Mule deer use of underpasses in western and southeastern Wyoming. Road Ecology Center.

Huijser, M. P., Kociolek, A. V., Allen, T. D., McGowen, P., Cramer, P. C., & Venner, M. (2015). Construction guidelines for wildlife fencing and associated escape and lateral access control measures. Prepared for the American Association of State Highway and Transportation Officials (AASHTO) Standing Committee on the Environment, 218.

Kirkland, S., Strohl, V. 2011. Highway Undercrossing Design for the California Tiger Salamander (Ambystoma californiense) in Santa Barbara County, California. Poster Presented at ICOET 2011

Klafki, R.W., Road Ecology of a Northern population of Badgers (*Taxidea taxus*) in British Columbia, Canada. Master's Thesis. 2014.

Ng, S. J., Dole, J. W., Sauvajot, R. M., Riley, S. P., & Valone, T. J. (2004). Use of highway undercrossings by wildlife in southern California. Biological Conservation, 115(3), 499-507.

Van Der Ree, R., Smith, D.J. and Grilo, C., 2015. Handbook of Road Ecology. John Wiley & Sons.