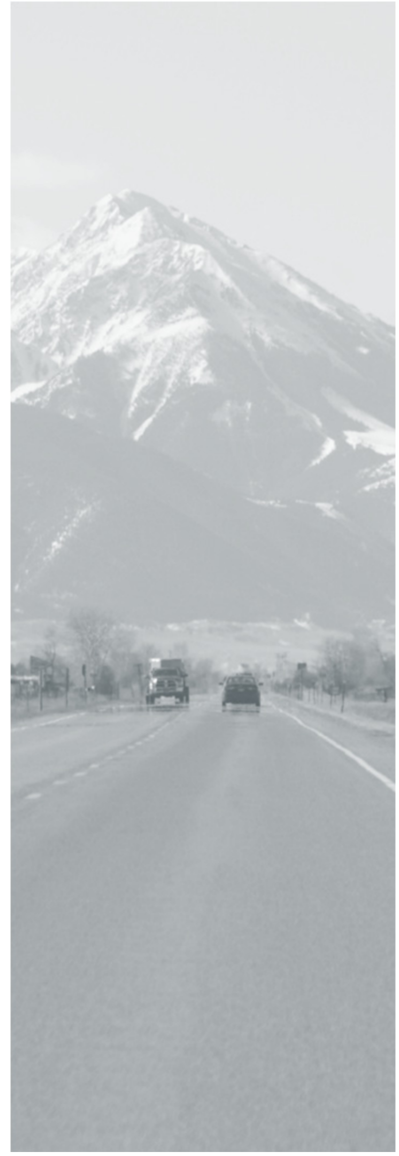

IMPROVEMENT OPTIONS REPORT

Paradise Valley Corridor Planning Study
US 89 (Gardiner to Livingston)

FINAL

Prepared for:
MONTANA DEPARTMENT OF TRANSPORTATION

December 24, 2013

Prepared by:
ROBERT PECCIA & ASSOCIATES
Helena, Montana

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ABBREVIATIONS/ACRONYMS

LOS	Level of Service
MDT	Montana Department of Transportation
RHRS	Rockfall Hazard Rating System
RP	Reference Post
TA	Transportation Alternatives Program
TWLTL	Two-Way Left-Turn Lane
YNP	Yellowstone National Park

IMPROVEMENT OPTIONS REPORT

1.0 INTRODUCTION

The US Highway 89 corridor provides the primary surface transportation link between Livingston and Yellowstone National Park (YNP) in Park County. US 89 is one of the major routes in Montana used to access YNP through Gardiner. The highway passes through "Paradise Valley," which lies between Livingston and Yankee Jim Canyon. The roadway generally parallels the Yellowstone River over the length of the corridor. **Figure 1** shows the study area.

Recommended improvement options considered in this report reflect input from stakeholders and the public, as well as a thorough evaluation of the existing conditions of US 89 within the study area. Three steps are applied to develop improvement options:

1. Identify roadway issues and areas of concern based on field review, engineering analysis of as-built drawings, crash data analysis, consultation with resource agencies, and information provided by the public.
2. Identify overall corridor needs and objectives.
3. Analyze the information gathered to develop a range of improvement options that address the roadway issues and areas of concern, as well as satisfying corridor needs and objectives.

The purpose of this memorandum is to describe and evaluate each improvement option considered and to highlight potential benefits and drawbacks. This, in turns, enables assessing whether an improvement option will receive further consideration.

Implementation of improvement options depends on available personnel resources, funding availability, right-of-way needs, and other project delivery elements. Recommended timeframes for implementation are defined as follows:

- Short-term: Implementation is recommended within a 0- to 5-year period.
- Mid-term: Implementation is recommended within a 5- to 10-year period.
- Long-term: Implementation is recommended within a 10- to 20-year period.
- As needed: Implementation could occur based on observed need throughout the planning horizon.

Planning level cost estimates are listed in 2013 dollars for each improvement option. The planning level costs include estimates for right-of-way, preliminary engineering, construction engineering, construction, and indirect and incidental costs (IDIC). In addition, an inflationary factor of 3 percent per year was applied to the planning level costs to account for estimated year of expenditure. Cost ranges are provided in some cases, indicating unknown factors at the particular planning level stage. **Appendix A** contains planning level cost estimates, including all assumptions.

The following sections discuss general strategies explored, recommended improvement options (and associated planning level cost estimates), potential implementation timeframes, benefits, limitations, and drawbacks.

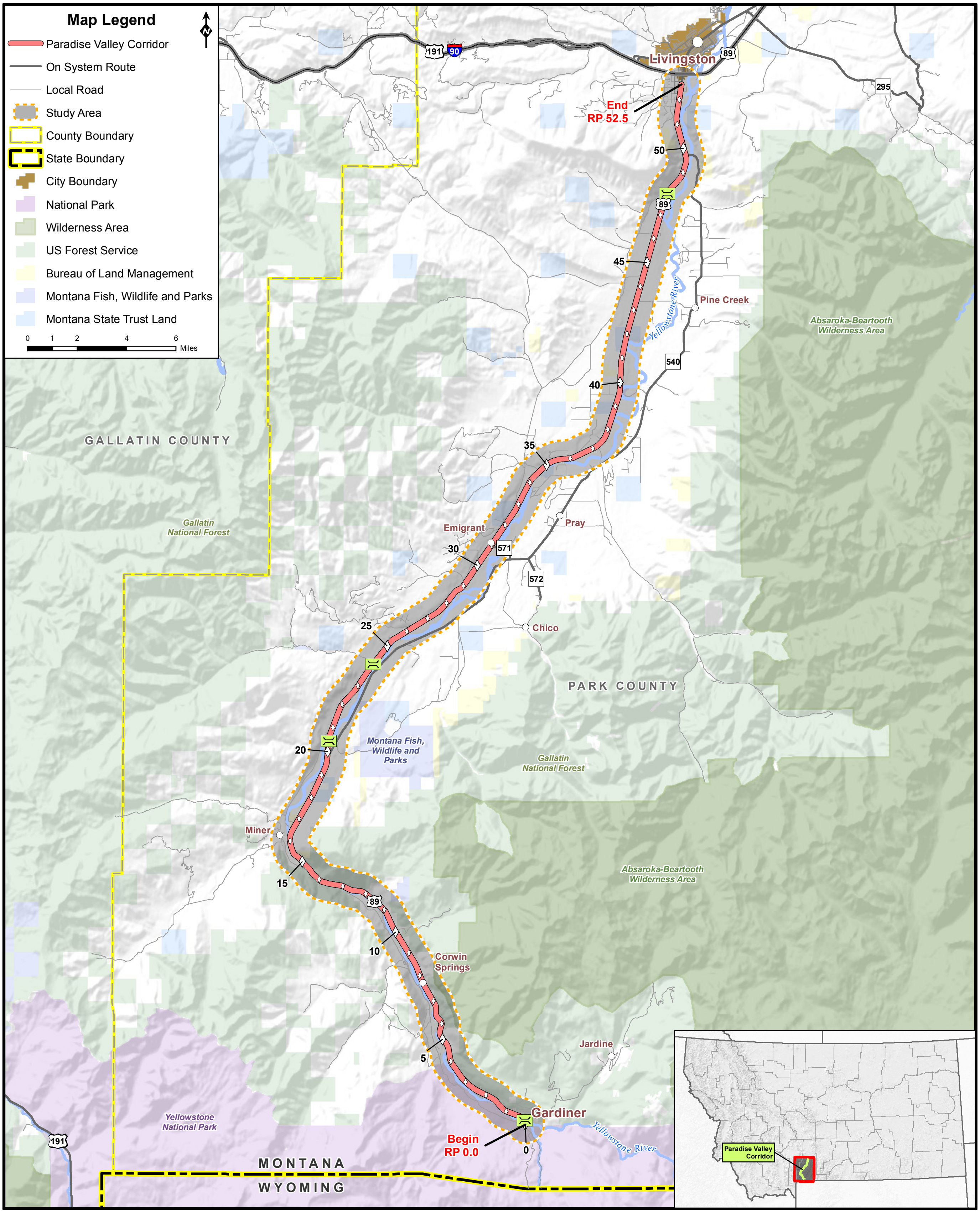


Figure 1: Study Area

2.0 IMPROVEMENT OPTIONS CONSIDERED

This section contains descriptions of the improvement options developed for the US 89 corridor, their potential benefits, limitations/drawbacks, and recommendations regarding whether the improvement options should be advanced for further consideration. The improvement options address previously defined issues or areas of concern and are intended to satisfy the corridor needs and objectives. For ease of identification, the improvement options receive unique identifiers via a numbering scheme.

Five general strategies for developing improvement options were identified in response to previously defined areas of concern. The various improvement options based on each general strategy are discussed in the following sections. The strategies explored were derived from a full assessment of the previously developed needs and objectives for the corridor, which are as follows:

Need 1 – Improve the safety of US 89 in the study area for all users.

- Improve roadway elements to meet current design standards.
- Review signing and passing opportunities based on current design standards.
- Evaluate best practice mitigation strategies as appropriate to reduce potential animal-vehicle conflicts.
- Evaluate existing access density impacts.

Need 2 – Improve the operations of US 89 within the study area.

- Accommodate existing and future capacity demands within the corridor.
- Minimize future access density impacts.
- Consider access to recreational sites in the corridor.

2.1 Geometrics

Roadway geometrics were compared to current Montana Department of Transportation (MDT) standards. A list of areas that do not meet current standards was developed previously in the *Existing and Projected Conditions Report.* The analysis identified potential strategies that correct some of the identified issues and may minimize potential effects. In some circumstances, it may not be cost-effective to address minor geometric issues unless there are safety concerns directly attributable to roadway geometry. Some of the strategies examined are listed below:

- Expand roadway widths via shoulder widening.
- Modify sub-standard curves with future improvements to meet current standards.
- Install advisory signs at sub-standard horizontal curves.
- Improve intersections by adding turn bays and enhanced signage.
- Improve clear zones.

Improvement options that arise from this strategy tie directly to ***Need 1 – Improve the safety of US 89 in the study area for all users***.

2.1.1 Improvement Options – Geometrics

1. Shoulder Widening

The corridor generally consists of 12-foot travel lanes with 4-foot shoulders. Recreational and bicycle tourist traffic commonly occurs along the corridor. Widening roadway shoulders to 8 feet would increase both available space for bicyclists and roadside clear zones. A recent safety project resulted in installation of rumble strips along the shoulders of the corridor, which reduced the available shoulder space for bicyclists.

Recommendation:

- Consider constructing 8-foot shoulders incrementally as projects develop along the corridor.

Benefits:

- Would improve accommodations for bicyclists.
- Would improve geometrics and safety.

Limitations/Drawbacks:

- Would create potential for increased vehicle speeds.
- Land constraints may prohibit widening in some areas.

Estimated Cost:

- $910,000 per mile

Recommended Action:

- **ADVANCE** – Consider during project-level design.

Implementation Timeframe:

- Implement as needed, depending on future project development and location limitations. Can be assessed on a case-by-case basis during project-level design.

2. Maiden Basin Road Intersection (Reference Post [RP] 5.15)

The intersection of Maiden Basin Road with US 89, located at RP 5.15, serves local residents and the Yellowstone Basin Inn. The intersection currently has poor sight distance for northbound motorists on US 89 due to intersection geometrics and a hillside along the east side of the highway. A pull-off area just south of the intersection serves a mailbox facility and is a local bus stop, both of which add to the potential for conflicts with through traffic.

2(a). Advance Warning Signs (RP 5.15)

This improvement option would result in the installation of advance intersection warning signs in both directions along US 89 at the intersection with Maiden Basin Road.

Recommendation:

- Install advance intersection warning signs along US 89.

Benefits:

- Would increase driver awareness of the intersection.
- Would improve safety.

Limitations/Drawbacks:

- Would not address intersection geometrics and sight distance limitations.

Estimated Cost:

- $600 EA

Recommended Action:

- **ADVANCE**

Implementation Timeframe:

- Short-term

2(b). Right-turn Lane (RP 5.15)

A northbound right-turn lane at this intersection would allow turning vehicles to exit from the traffic stream.

Recommendation:

- Construct a northbound right-turn lane along US 89 when appropriate warrants are met.

Benefits:

- Would separate turning vehicles from traffic stream.
- Would improve safety.

Limitations/Drawbacks:

- None were identified.

Estimated Cost:

- $270,000

Recommended Action:

- **ADVANCE**

Implementation Timeframe:

- Mid-term

2(c). Slope Flattening (RP 5.15)

Sight distance is limited from Maiden Basin Road looking north along US 89 due to cut slopes on the east side of the highway.

Recommendation:

- Flatten the slopes on the east side of US 89 north of the intersection with Maiden Basin Road to increase sight distances.

Benefits:

- Would increase sight distances.
- Would improve safety.

Limitations/Drawbacks:

- May impact adjacent roadway at top of cut slope.
- Topographical constraints may prohibit viability of flattening slopes.

Estimated Cost:

- $70,000

Recommended Action:

- **DO NOT ADVANCE** – It is not recommended that this improvement option be advanced for further consideration. It is unlikely that sight distances could feasibly be increased to meet existing standards given existing topography and roadway geometrics.

3. Rockfall Hazards (RP 13.3 to RP 14.6)

Rockfall hazard sites were identified in the *Rockfall Hazard Classification and Mitigation System* research project administered by MDT. The report identified 12 rockfall hazard sites along the corridor that were incorporated into MDT's Rockfall Hazard Rating System (RHRS) database. Three of the sites along the corridor were included in the top 100 rockfall hazard sites for Montana.

3(a). Rockfall Hazard Section #307 (RP 13.32 to RP 13.66)

Identified mitigation would include excavating using controlled blasting, installing guardrail and rockfall barrier, and construction of a Mechanically Stabilized Earth (MSE) wall.

Recommendation:

- Implement the recommendations contained in the *Rockfall Hazard Classification and Mitigation System*.

Benefits:

- Would improve roadside safety.

Limitations/Drawbacks:

- Would require excavation along US 89.

Estimated Cost:

- $4,000,000

Recommended Action:

- **DO NOT ADVANCE** – This improvement option was not advanced for further consideration. The high cost of this mitigation is disproportionate to the likely safety benefits. MDT normal maintenance practices respond to any ongoing rockfall concerns at this location. Crash characteristics pointing to safety concerns were not identified at this location.

3(b). Rockfall Hazard Section #309 (RP 13.84 to RP 13.96)

Identified mitigation would include slope scaling, draped cable nets, and rock bolts.

Recommendation:

- Implement the recommendations contained in the *Rockfall Hazard Classification and Mitigation System*.

Benefits:

- Would improve roadside safety.

Limitations/Drawbacks:

- None were identified.

Estimated Cost:

- $2,200,000

Recommended Action:

- **DO NOT ADVANCE** – This improvement option was not advanced for further consideration. The high cost of this mitigation is disproportionate to the likely safety benefits. MDT normal maintenance practices respond to any ongoing rockfall concerns at this location. Crash characteristics pointing to safety concerns were not identified at this location.

3(c). Rockfall Hazard Section #310 (RP 13.96 to RP 14.61)

Identified mitigation would include installing draped mesh with a catch fence.

Recommendation:

- Implement the recommendations contained in the *Rockfall Hazard Classification and Mitigation System*.

Benefits:

- Would improve roadside safety.

Limitations/Drawbacks:

- None were identified.

Estimated Cost:

- $3,000,000

Recommended Action:

- **DO NOT ADVANCE** – This improvement option was not advanced for further consideration. The high cost of this mitigation is disproportionate to the likely safety benefits. MDT normal maintenance practices respond to any ongoing rockfall concerns at this location. Crash characteristics pointing to safety concerns were not identified at this location.

4. East River Road Intersection – Turn Lanes (RP 19.8)

East River Road (S-540) serves as a parallel route to US 89, and provides access to recreational areas and local residences. The intersection of East River Road with US 89, located at RP 19.8, was reconstructed recently to eliminate the skewed approach where East River Road joins US 89. There are currently no dedicated turn lanes at this intersection. A southbound left-turn lane and northbound right-turn lane at this intersection would allow turning vehicles to exit from the traffic stream. The two turn lanes could be constructed at the same time or separately, depending on traffic volumes and when turn lane warrants are met.

Recommendation:

- Construct a southbound left-turn lane and northbound right-turn lane along US 89 when appropriate warrants are met.

Benefits:

- Would separate turning vehicles from traffic stream.
- Would improve safety.

Limitations/Drawbacks:

- May require additional right-of-way.

Estimated Cost:

- $650,000 (both turn lanes)
  - $370,000 (southbound left-turn lane only)
  - $280,000 (northbound right-turn lane only)

Recommended Action:

- **ADVANCE**

Implementation Timeframe:

- Mid-term

5. Mill Creek Road Intersection – Right-turn Lane (RP 37.2)

The intersection of Mill Creek Road with US 89, located at RP 37.2, serves local residents, provides access to recreational areas, and connects to East River Road (S-540). The intersection currently has a southbound left-turn lane. A northbound right-turn lane at this intersection would allow turning vehicles to exit from the traffic stream.

Recommendation:

- Construct a northbound right-turn lane along US 89 when appropriate warrants are met.

Benefits:

- Would separate turning vehicles from traffic stream.
- Would improve safety.

Limitations/Drawbacks:

- May require additional right-of-way.

Estimated Cost:

- $280,000

Recommended Action:

- **ADVANCE**

Implementation Timeframe:

- Mid-term

6. Geometric Improvements (RP 49.0 to RP 49.8)

This location consists of two horizontal curves and a vertical curve that do not meet current standards. Substandard roadway elements may pose safety concerns if left unaddressed.

6(a). Advance Warning Signs (RP 49.10 and RP 49.35)

Horizontal curves at RP 49.10 and RP 49.35 were identified as having radii that do not meet current MDT design standards. Currently there are no advance warning signs for the curves.

Recommendation:

- Install horizontal curve warning signs for the horizontal curves located at RP 49.10 and RP 49.35.

Benefits:

- Inform drivers to reduce speed along the curves.
- Would increase driver awareness.
- Would increase safety.

Limitations/Drawbacks:

- Does not address the geometric issues.

Estimated Cost:

- $600 EA

Recommended Action:

- **ADVANCE**

Implementation Timeframe:

- Short-term

6(b). Geometric Reconstruction (RP 49.0 to RP 49.8)

Two existing horizontal curves do not meet standards based on curve radii. In addition, the vertical curve at RP 49.2 does not meet standards for both stopping sight distance and rate of curvature.

Recommendation:

- Reconstruct the roadway to meet current standards for horizontal and vertical curvature.

Benefits:

- Would improve safety by addressing roadway geometrics and increased sight distances.

Limitations/Drawbacks:

- Would potentially impact adjacent waterbodies.
- Would require additional right-of-way.
- May impact the hillside on the west side of the roadway.
- Is an identified landslide area with faults and tight fold structures.

Estimated Cost:

- $3,100,000

Recommended Action:

- **DO NOT ADVANCE** – This improvement option was not advanced for further consideration. The cost of reconstruction of this section of the corridor would likely exceed the overall benefit. There has been no identified safety trend associated with the substandard geometrics at this location. Appropriate advance warning signage would likely increase driver awareness in the area at a much lower cost.

2.2 Vehicle Congestion and Passing Opportunities

The performance of a roadway is expressed in terms of level of service (LOS), which accounts for vehicle congestion and roadway capacity. Roadway LOS also provides a measure of the driver's perception of the roadway's performance. When drivers experience delays due to reduced travel speeds, lack of passing opportunities, heavy vehicles in the traffic stream, and steep roadway grades, the roadway LOS deteriorates.

The LOS analysis conducted for the corridor shows that portions of the highway currently exhibit, or are projected to exhibit, poor levels of service that are below current standards. The performance of the highway can be improved by reducing vehicular traffic (unlikely) and/or increasing roadway capacity. Roadway capacity can be increased by providing additional passing opportunities, reducing access density, or adding additional travel lanes. Additional passing opportunities may be provided by increasing passing zones (through pavement striping), or by constructing dedicated passing lanes.

A "Highway Capacity and Level of Service Analysis" for both current and future year conditions was previously completed to document congestion and levels of service. Relevant information from this analysis is located in the *Existing and Projected Conditions Report.*

Improvement options that arise from this strategy address a myriad of concerns, and directly tie to ***Need 1 – Improve the safety of US 89 in the study area for all users*** and ***Need 2 – Improve the operations of US 89 within the study area***.

2.2.1 Improvement Options – Vehicle Congestion and Passing Opportunities

7. Passing Opportunities and Increased Capacity

Passing opportunities are currently provided by passing zones designated with dashed yellow centerlines. Passing zones are typically located where there is adequate sight distance and away from public approaches. Passing opportunities are limited by terrain and the volume of opposing vehicles. As traffic volumes increase, the effectiveness of passing zones decreases.

In addition to passing zones, dedicated passing lanes can be constructed in the form of additional travel lanes. Passing lanes allow for unobstructed passing without having to cross into the opposing travel lane, and they can help reduce long platoons behind slow-moving vehicles. Passing lanes should be installed at incremental locations along the highway to maximize their effectiveness.

Actions to increase highway capacity can also improve the corridor's LOS. The most apparent means of increasing the roadway's capacity would be to construct additional travel lanes. The corridor currently consists of one travel lane in each direction.

7(a). Evaluate No-Passing Zones

Passing opportunities are provided along the corridor in areas where roadway geometrics allow. No-passing zones are designated by solid yellow lines, and they are established in areas where there is insufficient passing sight distance or near public approaches. An engineering study to evaluate passing zones to determine if removal or addition of no-passing zones is warranted should be completed and recommendations implemented.

Recommendation:

- Evaluate existing no-passing signing and striping for compliance with current standards.

Benefits:

- Would improve safety for passing vehicles.

Limitations/Drawbacks:

- Would create potential for decreased passing opportunities.

Estimated Cost:

- $45,000

Recommended Action:

- **ADVANCE**

Implementation Timeframe:

- Short-term

7(b). Pullouts for Slow-moving Vehicles

Pullouts for slow-moving vehicles were identified as a potential mechanism to improve traffic flow. Pullouts can be found along various types of roadways to allow vehicles to exit the traffic stream quickly as queues form behind them. Pullouts already exist in Yankee Jim Canyon along US 89. US 191 through the Gallatin Canyon south of Bozeman also contains sporadic pullouts that allow traffic separation of slow-moving vehicles, plus improved recreational access to the Gallatin River and trailheads.

The following are potential locations reviewed for pullouts based on preliminary review of roadway geometrics, terrain, and known use areas. In some cases, informal pullouts are starting to become established at river access points.

- RP 5.7 (west side of Yellowstone River)
- RP 6.8 (east side of Yellowstone River)
- RP 28.6 (east side of Yellowstone River)
- RP 38.6 (east side of Yellowstone River)
- RP 48.8 (east side of Yellowstone River)
- RP 49.3 (east side of Yellowstone River)

Recommendation:

- Construct pullouts at suitable locations along the corridor to allow slow-moving vehicles to exit the traffic stream.

Benefits:

- Would increase passing opportunities.
- Would increase safety for thru-movement vehicles as RV's and slow-moving vehicles could exit the thru-travel lane, thereby improving flow characteristics for other vehicles.
- Would improve level of service.

Limitations/Drawbacks:

- Would create potential impacts on environmental resources.
- Would likely require additional right-of-way.
- Would create unintended recreational river access points.
- Would potentially decrease safety due to speed differentials when exiting or entering mainline traffic.

Estimated Cost:

- $220,000 EA

Recommended Action:

- **DO NOT ADVANCE** – This option was not advanced for further consideration. The posted speeds along much of US 89 do not allow for quick and safe ingress/egress to periodic pullouts along the corridor. Those already in place in Yankee Jim Canyon, and others along US 191 in Gallatin Canyon, are located in lower posted speed areas.

7(c). Passing Lanes at Spot Locations

Dedicated passing lanes provide opportunities to pass slower-moving vehicles without the need to cross into the opposing travel lane. Passing lanes can be constructed as three, four, or five-lane roadway sections with a center two-way, left-turn lane (TWLTL) and left-turn bays at major intersections.

The location and length of passing lanes are determined based on vehicle demand, roadway geometrics, and known constraints. Ideally, passing lanes would be constructed at regular intervals throughout the corridor. Further study is needed to determine the appropriate locations for passing lanes. The following are potential locations for passing lanes based on preliminary review of roadway geometrics, terrain, known environmental resource constraints, and public approaches:

- RP 16.6 (Tom Miner Creek Road) to RP 19.8 (East River Road)
- RP 25.6 to RP 28.4
- RP 40.0 (Inverness Road) to RP 42.0
- RP 44.4 (Old Yellowstone Trail) to RP 47.9 (Farm Access Overpass)

Recommendation:
- Construct passing lanes at incremental locations along the corridor, with primary focus on the bulleted areas above.

Benefits:
- Would increase passing opportunities.
- Would increase safety.
- Would improve level of service.

Limitations/Drawbacks:
- May create potential impacts on environmental resources.
- Would likely require additional right-of-way.

Estimated Cost:
- $12,400,000 EA

Recommended Action:
- **ADVANCE**

Implementation Timeframe:
- Long-term

7(d). Four- or Five-lane Typical Section

This improvement option would increase highway capacity by providing a four- or five-lane roadway. The addition of a center TWLTL or dedicated left-turn bays would result in areas with a five-lane typical section. This option allows for higher capacities and increased unopposed passing opportunities.

Recommendation:
- Reconstruct the corridor to include two travel lanes in each direction and a center TWLTL, or designated left-turn bays at major intersections.

Benefits:
- Would increase capacity.
- Would improve level of service.
- Would reduce travel times.

Limitations/Drawbacks:
- May create potential impacts on environmental resources.
- May require additional right-of-way.

Estimated Cost:
- $6,200,000 per mile

Recommended Action:
- **DO NOT ADVANCE** – This option was not advanced for further consideration. Traffic volumes during most of the year do not warrant a full four- or five-lane facility. This option would require

substantial new right-of-way acquisition and would result in greater environmental impacts than other options. In addition, a four- or five-lane highway would be considered out of context with the scenic nature of the corridor.

7(e). Alternating Passing Lanes

This improvement option would result in alternating sections of the highway being reconstructed to add an additional passing lane in one direction. This type of facility, known as a “Super 2 Highway,” would create directional passing areas along the corridor. This option would require a narrower roadway than a four-lane facility, but would have fewer passing opportunities and a lower capacity.

Recommendation:

- Reconstruct portions of the corridor to include directional passing lanes at incremental locations.

Benefits:

- Would increase opportunities for unopposed passing.
- Would improve level of service.
- Would increase capacity.
- Would reduce travel times.

Limitations/Drawbacks:

- May create potential impacts on environmental resources.
- May require additional right-of-way.
- May result in overall reduction in passing opportunities within the corridor.

Estimated Cost:

- $4,200,000 per mile

Recommended Action:

- **DO NOT ADVANCE** – This improvement option was not advanced for further consideration. This option would result in a reduction in overall passing opportunities because no passing zones would exist for traffic on the opposite side of the passing zone. In addition, this option would likely result in greater environmental impacts than other options.

2.3 Access Management

Access management is the careful planning of the location, design, and operations of approaches and road connections. The purpose of access management is to improve safety, preserve function and mobility, and manage existing and future accesses in a consistent manner. Access management is implemented through the adoption of an Access Control Resolution executed by the Montana Transportation Commission.

Safety and operational benefits of controlling access points are well documented. As access density (or the number of access points per mile) increases, there is generally a corresponding increase in crashes and travel times. Appropriate management of access within a highway corridor can improve traffic flow and reduce driveway related crashes.

Reasonable access should be maintained for all existing parcels adjacent to the highway, but some existing direct accesses could be relocated, combined, or eliminated if alternate reasonable access is available or can be provided. Some access management techniques include, but are not limited to, the following:

- **Access/Driveway Spacing:** Increasing the distance between intersecting roadways and driveways improves the flow of traffic and reduces congestion for heavily traveled corridors. Fewer access points spaced further apart allow the orderly merging of traffic and present fewer challenges to drivers. Consolidation of existing driveways and use of frontage or backage roads can reduce the number of direct access points on a road facility.

- **Turning Lanes/Medians:** Dedicated left- and right-turn lanes prioritize the flow of through traffic. TWLTLs and non-traversable, raised medians are effective ways to regulate access and reduce crashes.

The Gardiner and Livingston areas have higher densities of approaches than the rest of the corridor. Potential exists to consolidate or eliminate approaches through access management or when roadway improvements or reconstruction occurs in these areas.

Improvement options that arise from this strategy address a myriad of concerns and tie directly to ***Need 1 – Improve the safety of US 89 in the study area for all users*** and ***Need 2 – Improve the operations of US 89 within the study area***.

2.3.1 Improvement Options – Access Management

8. Access Management Plan

In advance of long-term improvement options identified later in this report, an *Access Management Plan* could be developed to address the high density of accesses within the corridor, especially near Gardiner and Livingston. The plan could explore ways to eliminate, reduce, or combine access to individual properties. In addition, the plan could identify opportunities to realign driveways and approaches, regulate the size and operations of driveways, and identify appropriate access for planned future development in the corridor in compliance with local land use planning regulations.

An *Access Management Plan* could assist local and state land use planners over the long-term planning horizon by establishing context appropriate access control guidelines, and specifying appropriate access for different segments of the corridor. This may be especially useful as future residential, commercial and industrial developments are contemplated.

Recommendation:

- Develop an *Access Management Plan* for the corridor.

Benefits:

- Would improve safety by controlling access points and limiting conflicts between thru- and turning- vehicles.
- Would improve traffic and operational characteristics.

Limitations/Drawbacks:

- Would reduce access points.

Estimated Cost:

- $180,000

Recommended Action:

- **DO NOT ADVANCE** – This improvement option was not advanced for further consideration. During the subdivision review process, Park County should coordinate with MDT when new development occurs that either directly accesses MDT routes or could substantially impact MDT routes via public or private roadways. MDT will comment and recommend potential mitigations for impacts to Park County when requested.

9. Livingston Rural/Urban Interface (RP 49.8 to RP 52.5)

This section of US 89 has a high density of public approaches and access points. North of Merrill Lane (RP 52.5) US 89 consists of a three-lane typical section (one travel lane in each direction and a center TWLTL). South of Merrill Lane, the roadway transitions to a standard two-lane section.

A desire for an extension of the three-lane typical section to the intersection with East River Road (RP 49.8) has been expressed. This area has numerous public and private approaches, particularly on the east side of the highway. A multi-use path exists along the west side of the roadway north of East River Road.

A three-lane facility would allow left-turning vehicles to exit from the traffic stream along the mainline. In addition, right-turn lanes at major intersections (Wineglass Road, Cedar Bluffs Road, and Shamrock Lane) would provide further reduction in conflicts resulting from turning vehicles. The termini of this improvement at RP 52.5 would match the existing roadway geometry traveling north into Livingston. At RP 49.8 (intersection with East River Road), both a southbound left-turn lane and a northbound right-turn lane would be considered as part of the project.

The speed limit for US 89 is currently posted at 45 mph from RP 52.5 to RP 52.36 and 55 mph from RP 52.36 to RP 49.17. If a three-lane section is constructed (Figure 2), a speed study should be conducted to determine the appropriate speed limit following improvements.

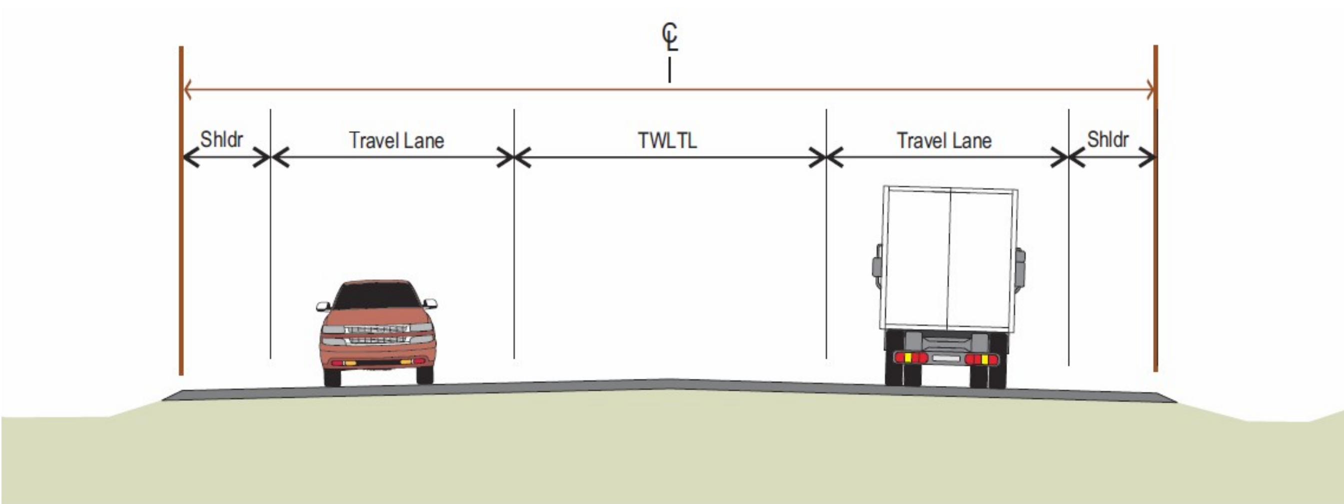


Figure 2: Three-lane Typical Section Concept

Recommendation:

- Extend a three-lane typical section of US 89 from Merrill Lane to East River Road. Include right-turn lanes at major intersections if appropriate warrants are met.

Benefits:

- Would increase safety due to left-turning traffic being removed from the traffic stream.
- Would create potential for reduction/consolidation of approaches to reduce conflict points.
- Would increase roadway capacity.

Limitations/Drawbacks:

- May create potential impact on wetlands.

- May require additional right-of-way at some locations.
- May impact some business or residential accesses.

Estimated Cost:

- $8,500,000

Recommended Action:

- **ADVANCE**

Implementation Timeframe:

- Mid-term

2.4 Alternative Travel Modes

Stakeholder input suggests the desire to improve safety and accommodate alternative (non-motorized) travel modes within the US 89 corridor. Park County's long-term vision for trails within the corridor includes a separated path between the current termini of the existing path south of Livingston all the way to Gardiner. Preliminary concepts for such a path suggest the path would leave the US 89 corridor near Yankee Jim Canyon and would cross the Yellowstone River by heading west. Strategies applicable to alternative travel modes initially reviewed for the corridor included the following:

- Developing a separated multi-use path
- Increasing minimum shoulder widths along the roadway for the entire length of US 89 of at least 8 feet (each side)
- Installing appropriate signage

Improvement options that arise from this strategy directly tie to ***Need 1 – Improve the safety of US 89 in the study area for all users***.

A cursory examination of transit opportunities that may connect Livingston to Gardiner was made. Transit options could include, but are not limited to: vanpool / carpool programs; park and ride facilities; and fixed route bus service. Currently there is charter bus service within the corridor provided by various tour operators accessing YNP. Development of viable transit options within the corridor was dismissed from further consideration due to lack of potential commuter transit riders and limitations on funding.

2.4.1 Improvement Options – Alternative Travel Modes

10. Multi-use Trail

A multi-use path exists along the west side of US 89 between RP 49.8 and RP 52.5. In addition, sidewalks are located in the urban areas of Gardiner and Livingston. In rural portions of the corridor, no dedicated pedestrian or bicycle facilities exist along the highway. Pedestrians and bicyclists commonly use the roadway shoulder for travel. Local desire exists for a multi-use trail to connect Livingston with YNP in Gardiner. The abandoned railroad bed within the corridor presents an opportunity to develop a multi-use trail. Funding for this improvement option is limited. The MDT funding program applicable to this improvement option is the Transportation Alternatives (TA) Program, and funding from this program would have to be pursued by Park County or others via the TA nomination process.

Recommendation:

- Investigate opportunities for development of a multi-use trail between Gardiner and Livingston.

Benefits:

- Would improve safety for non-motorized users.

- Would create potential for increased economic activity and recreational use.

Limitations/Drawbacks:

- Would likely require additional right-of-way.
- May result in potential landowner opposition.

Estimated Cost:

- $390,000 per mile

Recommended Action:

- **ADVANCE**

Implementation Timeframe:

- Long-term

11. Gardiner Area (RP 0.0 to RP 1.0)

The Gardiner area experiences large seasonal peaks in traffic due to recreational use and access to YNP. The US 89 corridor through Gardiner provides access to a multitude of local businesses and residents. The Gardiner Gateway Project identifies a desire for improvements along US 89 entering Gardiner in terms of better lighting along the corridor and traffic calming for pedestrians.

11(a). On-street Parking

On-street parking is provided along US 89 in the Gardiner area. There are locations where on-street parking appears to have been delineated by adjacent property owners and is not in compliance with the MDT *Traffic Engineering Manual*. The guidelines and requirements were identified in the *Existing and Projected Conditions Report* and are summarized below:

- Prohibit parking within 20 feet of any crosswalk.
- Prohibit parking at least 10 feet from the beginning of the curb radius at mid-block approaches.
- Prohibit parking from areas designated by local traffic and enforcement regulations.
- Prohibit parking within 30 feet from end of curb return on the approach leg to any intersection with a flashing beacon, stop sign, or traffic signal.
- Prohibit parking on bridges.
- Eliminate parking across from a T-intersection.

Areas that do not meet these guidelines should be marked as no-parking locations.

Recommendation:

- Modify existing on-street parking in the Gardiner area, based on MDT guidelines, during a future resurfacing project.

Benefits:

- Would adhere to existing standards.
- Would increase safety.

Limitations/Drawbacks:

- May cause potential loss of on-street parking.
- May require heightened enforcement.

Estimated Cost:

- LABOR

Recommended Action:

- **ADVANCE**

Implementation Timeframe:

- Short-term

11(b). Lighting Improvements

Pedestrian traffic is common during seasonal peaks. While corridor lighting exists between RP 0.0 and RP 1.0, the Gardiner Gateway Project partners have expressed a desire to evaluate new, decorative lighting concepts along US 89 in Gardiner to coincide with lighting planned for the various other phases of the Gardiner Gateway Project.

Recommendation:

- Coordinate with Gardiner Gateway Project partners to evaluate the need to upgrade existing street lighting to reflect lighting consistency with other phases of the project and to increase night-time visibility. Funding over and above standard MDT street lighting would be provided by non-MDT entities.

Benefits:

- Would increase nighttime visibility.
- Would improve safety.

Limitations/Drawbacks:

- May increase utility and maintenance costs.

Estimated Cost:

- TO BE DETERMINED

Recommended Action:

- **ADVANCE (BY OTHERS)**

Implementation Timeframe:

- Short-term

2.5 Wildlife-vehicle Conflicts

Mitigation strategies to reduce wildlife-vehicle collisions were assessed through a variety of measures. Carcass data between January 2002 and December 2012 were obtained for the corridor and were reviewed to identify areas with concentrations of animal mortalities. This information was measured against formal crash report data between July 2007 and June 2012, which was provided by law enforcement agencies, via MDT.

Comments received from the resource agencies were used to develop potential improvement options to benefit wildlife and help reduce collision potential for the travelling public. The publication, titled *Wildlife-Vehicle Collision Reduction Study*[1], was reviewed for applicable mitigation strategies. Wildlife connectivity was also reviewed on a high level by examining carcass locations and comparing them to available mapping of individual species ranges.

Mitigation strategies attempting to reduce wildlife-vehicle collisions can be grouped into four distinct categories, as follows:

[1] *Wildlife-Vehicle Collision Reduction Study: Report to Congress*, FHWA-HRT-08-034, August 2008

- Influence driver behavior.
- Influence animal behavior.
- Reduce wildlife population size.
- Physically separate animals from the roadway.

Any improvement option relevant to wildlife mitigation should be reviewed on a project case-by-case basis; i.e., as part of the normal transportation project development process, wildlife connectivity issues and concerns should be reviewed with project-level design.

Improvement options that arise from this strategy directly tie to ***Need 1 – Improve the safety of US 89 in the study area for all users***.

2.5.1 Improvement Options – Wildlife-vehicle Conflicts

12. Vegetation Management Plan

Areas of unmaintained or dense vegetation were identified due to decreased sight distances and clear zones. Before vegetation removal activities are initiated, a *Vegetation Management Plan* could be developed for the entire corridor. The goals of the *Vegetation Management Plan* would include maintenance of quality wildlife habitat along the corridor, providing cover for animal movements across the highway in appropriate locations, improved sight distance for driver detection of animals in the clear zone, maintenance of riparian zone integrity and wetland function, and sediment/runoff control along the Yellowstone River and its tributaries adjacent to the highway.

Recommendation:

- Develop and implement a *Vegetation Management Plan* for the corridor.

Benefits:

- Would increase the possibility for driver detection of wildlife within roadside clear zones.
- Would improve sight distances.

Limitations/Drawbacks:

- May create potentially negative wildlife habitat and aquatic resource effects.

Estimated Cost:

- $60,000

Recommended Action:

- **DO NOT ADVANCE** – This option was not advanced for further consideration. Vegetation concerns are not a corridor-wide issue and can be assessed on a case-by-case basis during project-level design. Additionally, MDT maintenance personnel perform routine vegetative maintenance within the corridor periodically throughout each year, in accordance with established protocol.

13. Reduce Wildlife-vehicle Conflicts

Wildlife-vehicle conflicts commonly occur throughout the study area and present a danger to human safety, as well as to wildlife survival. Improvements were explored to help reduce the number and severity of these types of collisions. Grade separation, fencing, advance animal detection, signing, or speed reduction strategies may have merit in areas of the corridor. Due to the complexities and numerous variables to consider when evaluating the feasibility of wildlife mitigation strategies, these should be explored in sufficient detail during project-level design as part of the project development process.

After an initial review of potential strategies to reduce wildlife-vehicle conflicts, the following were identified as being possible counter-measures to consider during project-level design as part of the project development process. A determination of their viability and effectiveness will be determined as specific projects begin to materialize.

Grade-separated Crossing Structures–Overpasses

Grade-separated structures are increasingly being explored as a feasible strategy to physically separate animals from the road environment. Wildlife overpasses are designed primarily to provide connectivity for wildlife species, especially ungulate prey species, at critical locations. Their use is often combined with wildlife fencing. When combined with wildlife fencing, they reduce wildlife movements into the road corridor as animals are provided with a safe crossing opportunity above the roadway, thereby decreasing wildlife-vehicle conflicts.

Costs for overpasses can range between $1.5 million and $3.0 million, depending on the width and length of the structure. For purposes of this corridor planning study, a planning level cost of $2,800,000 was estimated for an overpass structure with associated amenities.

Topography can present a challenge to overpass placement, in that enough relief must be available to provide a structure within the confines of adjacent development and access points. Fencing is almost always used to guide animals to and over the structure, increasing its effectiveness. Fencing can alter natural animal movements, change pedestrian travel movements, impact adjacent landowners, and in some cases negatively impact scenic views.

Grade-separated Crossing Structures–Underpasses

A wildlife underpass is another form of grade-separated crossing structure. Underpasses can be provided underneath bridge structures, or via a variety of culvert shapes and sizes. Wildlife underpasses typically are constructed at locations where the roadway is relatively high compared to the surrounding terrain. This reduces the need to raise the roadbed or to lower the approaches to the underpass. Somewhat unique to underpasses as compared to overpasses is that animals prefer to see through to the other side, do not want to descend into a "cave" that would create a tunnel effect, and do not want to have to climb out on the other side. This is why, depending on its dimension, an underpass may be a more effective strategy for predator species. However, if large enough to provide sufficient clearance and clear line of sight, underpasses can be an effective means to pass ungulate prey species beneath the roadway, especially when combined with wildlife fencing.

The cost of a wildlife underpass depends highly on the type considered (i.e., under a bridge, within a concrete box culvert, within a corrugated steel pipe, etc.) and the width and length of the structure. Costs can range from $500,000 to $1,000,000 for an underpass structure. For purposes of this corridor planning study, a planning level cost of $750,000 was estimated for an underpass structure with associated amenities. Topography can dictate where an underpass may be placed and animals' level of success in using it. The potential for flooding within the underpass and the need for increased maintenance can be drawbacks. The fencing considerations described for the wildlife overpass are also applicable to the wildlife underpass.

Animal Detection System (At-grade Crossing)

Animal detection systems use sensors to detect animals near roadways. When an animal is detected, warning signals and/or signs are activated to alert drivers that an animal may be on or near the roadway. Wildlife fencing is usually considered in tandem with animal detection systems. The animal detection system and fencing guide the animals to a known crossing location and influence driver behavior through real-time warning. These measures may serve to reduce wildlife-vehicle collisions. Animal detection systems may be less restrictive to wildlife movement than grade-separated crossing structures. They allow animals to use existing paths to the road or to change them over time, whereas grade-separated structure locations may depend on adjacent topography and road grade, rather than the actual locations of animal movement patterns. The cost of an at-grade animal detection system with appropriate fencing is estimated to be $220,000 per mile.

There are limitations to animal detection systems. They do not physically separate the animals from the highway, and they rely on driver response to the warning signs. They are, therefore, only effective if drivers reduce their speed and increase their awareness based on the warning. Animal detection systems only detect large animals (e.g., deer, elk, or moose). Small animals are hard to detect, so drivers may not be warned about their presence on or near the road. Also, animal detection systems usually require the presence of poles and equipment in the right-of-way, sometimes within the clear zone, presenting a safety hazard of their own. Animal detection systems may have complicated maintenance requirements for both function and effectiveness over time.

Wildlife Signage

Signage indicating the regular presence of wildlife in the area is intended to alert drivers regarding potential animal conflicts. Deer occur throughout the corridor, while elk commonly are seen between RP 1.0 and RP 5.0 and between RP 15.0 and RP 25.0. Bighorn sheep also frequent the area between RP 4.0 and RP 15.0. Static signage has proved to be relatively ineffective at reducing wildlife-vehicle collisions (as compared to mitigation strategies that actually separate animal and roadway or present real-time detection and warning). As with the other mitigation strategies previously described, wildlife fencing may or may not be used in conjunction with wildlife signage. The limitations previously described with respect to fencing also apply if used in conjunction with signing. The cost of signage is modest; it is estimated at $600 per sign.

The following improvement option was initially considered, but was ultimately removed from further consideration as the strategies described above will be examined on a case-by-case basis during project-level design as part of the project development process:

Wildlife Conflict Mitigation Study

A detailed wildlife conflict mitigation study was considered. Based on the data analyzed through the corridor study process, however, MDT and Park County agree and are committed to evaluating wildlife mitigation via examination of best-practice, wildlife mitigation strategies on a project-by-project basis. The estimated cost of such a study is $270,000.

3.0 SUMMARY

This memorandum identifies improvement options for the US 89 corridor between RP 0.0 and RP 52.5. The improvement options were based on the evaluation of several factors, including but not limited to field review, engineering analysis of as-built drawings, crash data analysis, consultation with resource agencies, and information provided by the general public.

The improvement options identified for advancement are intended to offer a range of potential mitigation strategies for corridor issues and areas of concern. Small scale improvement options were identified and may be as simple as adding advance warning signs at intersections. Larger, more complex reconstruction improvements are also envisioned. Note that the potential may exist to combine improvement options during project development for ease of implementation and other efficiencies.

Wildlife collisions have been noted to occur throughout the corridor. Certain areas of the corridor realize unique issues between wildlife and drivers. The recommended improvement options recognize the impact of the roadway on wildlife resources, and offers potential mitigation strategies that may be candidates for further exploration during project development activities. These include wildlife signing and wildlife fencing.

Tabular summaries of the improvement options, both advanced and not advanced, are included in **Table 1**. Those improvement options recommended for advancement are shown graphically in **Figure 3**.

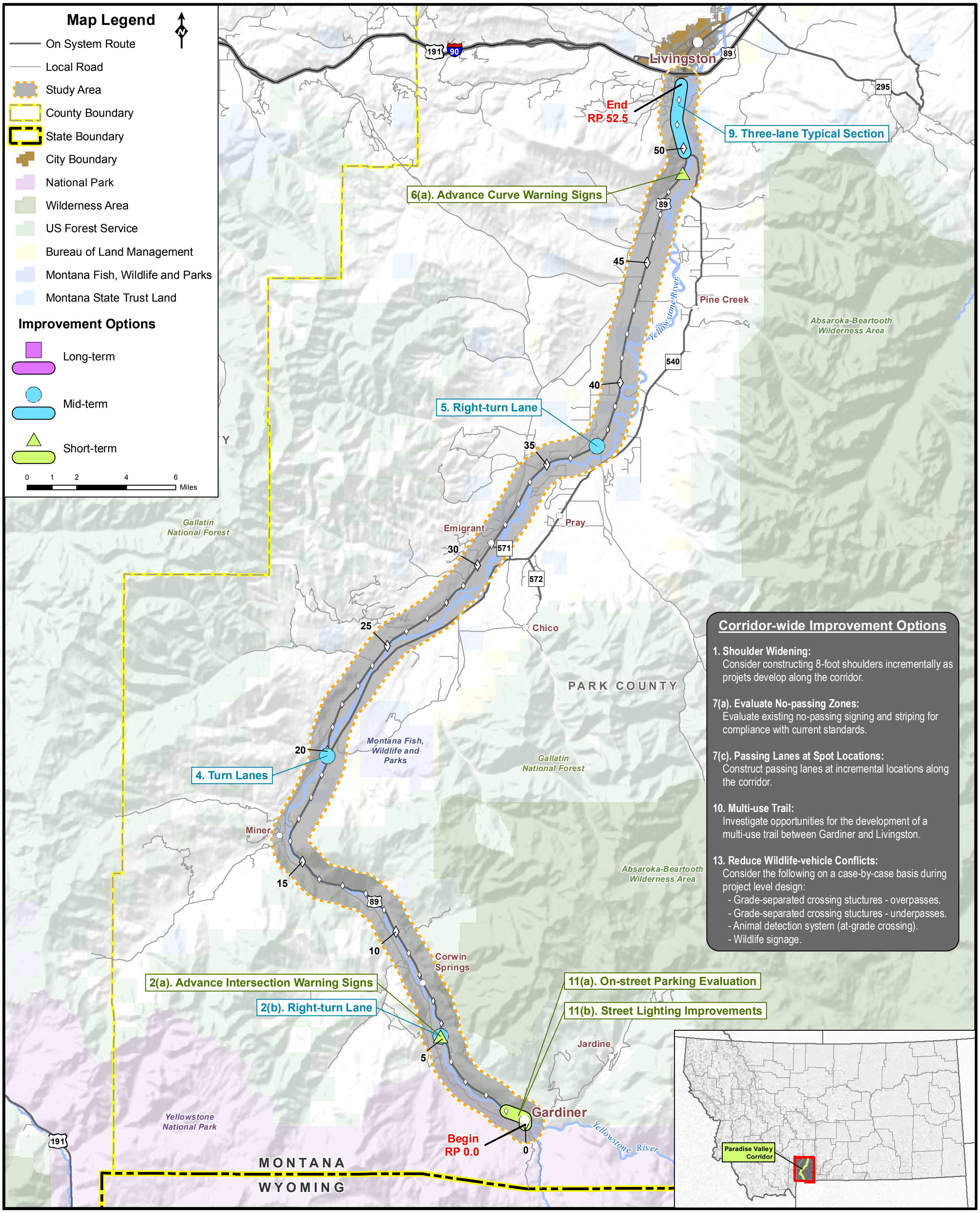
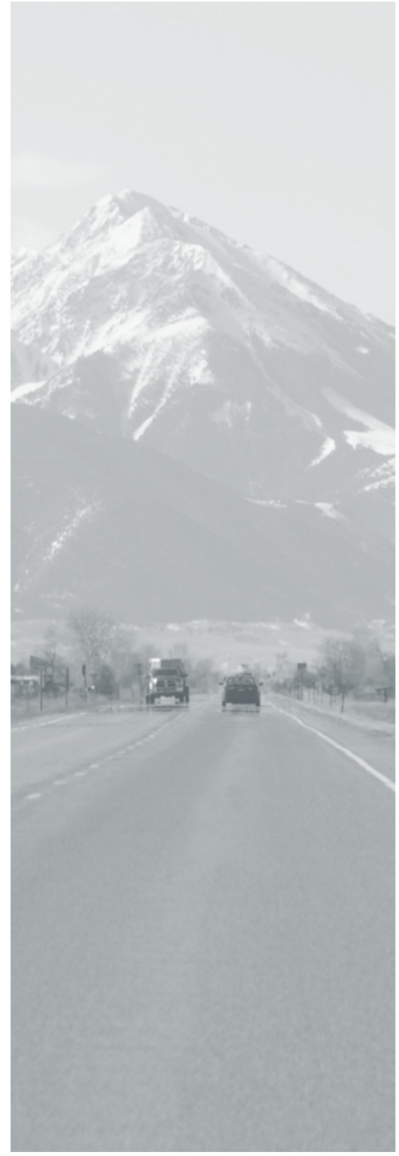


Figure 3: Recommended Improvement Options

Table 1: Improvement Options

	Improvement Option	Location	Description	Recommended Action	Implementation Timeframe	Cost Estimate
			GEOMETRICS			
1	**Shoulder Widening**	Corridor-wide	Consider constructing 8-foot shoulders incrementally as projects develop along the corridor.	**ADVANCE** - Consider during project-level design	As Needed	$910,000 per mile
2(a)	**Maiden Basin Road Intersection Advance Warning Signs**	RP 5.15	Install advance intersection warning signs along US 89.	**ADVANCE**	Short-term	$600 EA
2(b)	**Maiden Basin Road Intersection Right-turn Lane**	RP 5.15	Construct a northbound right-turn lane along US 89 when appropriate warrants are met.	**ADVANCE**	Mid-term	$270,000
2(c)	**Maiden Basin Road Intersection Slope Flattening**	RP 5.15	Flatten the slopes on the east side of US 89 north of the intersection with Maiden Basin Road to increase sight distances.	**DO NOT ADVANCE**	N/A	$70,000
3(a)	**Rockfall Hazard Section #307**	RP 13.32 to 13.66	Identified mitigation would include excavating using controlled blasting, installing guardrail and rockfall barrier, and construction of a Mechanically Stabilized Earth (MSE) wall.	**DO NOT ADVANCE**	N/A	$4,000,000
3(b)	**Rockfall Hazard Section #309**	RP 13.84 to 13.96	Identified mitigation would include slope scaling, draped cable nets, and rock bolts.	**DO NOT ADVANCE**	N/A	$2,200,000
3(c)	**Rockfall Hazard Section #310**	RP 13.96 to 14.61	Identified mitigation would include installing draped mesh with a catch fence.	**DO NOT ADVANCE**	N/A	$3,000,000
4	**East River Road Intersection Turn Lanes**	RP 19.8	Construct a southbound left-turn lane and northbound right-turn lane along US 89 when appropriate warrants are met.	**ADVANCE**	Mid-term	$650,000 (both turn lanes)
5	**Mill Creek Road Intersection Right-turn Lane**	RP 37.2	Construct a northbound right-turn lane along US 89 when appropriate warrants are met.	**ADVANCE**	Mid-term	$280,000
6(a)	**Advance Warning Signs**	RP 49.10 to 49.35	Install horizontal curve warning signs for the horizontal curves located at RP 49.10 and RP 49.35.	**ADVANCE**	Short-term	$600 EA
6(b)	**Geometric Reconstruction**	RP 49.0 to 49.8	Reconstruct the roadway to meet current standards for horizontal and vertical curvature.	**DO NOT ADVANCE**	N/A	$3,100,000
			VEHICLE CONGESTION AND PASSING OPPORTUNITIES			
7(a)	**Evaluate No-passing Zones**	Corridor-wide	Evaluate existing no-passing signing and striping for compliance with current standards.	**ADVANCE**	Short-term	$45,000
7(b)	**Pull-outs for Slow-moving Vehicles**	Potential Spot Locations: • RP 5.7 • RP 6.8 • RP 28.6 • RP 38.6 • RP 48.8 • RP 49.3	Construct pullouts at suitable locations along the corridor to allow slow-moving vehicles to exit the traffic stream.	**DO NOT ADVANCE**	N/A	$220,000 EA
7(c)	**Passing Lanes at Spot Locations**	Potential Spot Locations: • RP 16.6 to 19.8 • RP 25.6 to 28.4 • RP 40.0 to 42.0 • RP 44.4 to 47.9	Construct passing lanes at incremental locations along the corridor.	**ADVANCE**	Long-term	$12,400,000 EA
7(d)	**Four- or Five-lane Typical Section**	Corridor-wide	Reconstruct the corridor to include two travel lanes in each direction and a center TWLTL, or designated left-turn bays at major intersections.	**DO NOT ADVANCE**	N/A	$6,200,000 per mile
7(e)	**Alternating Passing Lanes**	Corridor-wide	Reconstruct portions of the corridor to include directional passing lanes at incremental locations.	**DO NOT ADVANCE**	N/A	$4,200,000 per mile
			ACCESS MANAGEMENT			
8	**Access Management Plan**	Corridor-wide	Develop an Access Management Plan for the corridor.	**DO NOT ADVANCE**	N/A	$180,000
9	**Livingston Rural / Urban Interface**	RP 49.8 to 52.5	Extend a three-lane typical section of US 89 from Merrill Lane to East River Road. Include right-turn lanes at major intersections if appropriate warrants are met.	**ADVANCE**	Mid-term	$8,500,000
			ALTERNATIVE TRAVEL MODES			
10	**Multi-use Trail**	Corridor-wide	Investigate opportunities for the development of a multi-use trail between Gardiner and Livingston.	**ADVANCE**	Long-term	$390,000 per mile
11(a)	**Gardiner Area On-Street Parking**	RP 0.0 to 1.0	Modify existing on-street parking in the Gardiner area based on MDT guidelines.	**ADVANCE**	Short-term	LABOR
11(b)	**Gardiner Area Lighting Improvements**	RP 0.0 to 1.0	Coordinate with Gardiner Gateway Project partners to evaluate the need to upgrade existing street lighting to reflect lighting consistency with other phases of the project, and to increase night-time visibility.	**ADVANCE (BY OTHERS)**	Short-term	TO BE DETERMINED
			WILDLIFE-VEHICLE CONFLICTS			
12	**Vegetation Management Plan**	Corridor-Wide	Develop and implement a Vegetation Management Plan for the corridor.	**DO NOT ADVANCE**	N/A	$60,000
13	***Grade Separated Crossing Structures***	As Needed	Consider grade separated crossing structures (overpass and/or underpass) on a case-by-case basis during project-level design.	**ADVANCE** - Consider during project-level design	As Needed	$2,800,000 EA (overpass) $750,000 EA (underpass)
	Animal Detection System (At-grade Crossing)	As Needed	Consider animal detection system installation on a case-by-case basis during project-level design.	**ADVANCE** - Consider during project-level design	As Needed	$220,000 per mile
	Wildlife Signage	As Needed	Consider additional wildlife signing on a case-by-case basis during project-level design.	**ADVANCE** - Consider during project-level design	As Needed	$600 EA
	Wildlife Mitigation Study	Corridor-Wide	Conduct a wildlife conflict mitigation study for the corridor.	**DO NOT ADVANCE**	N/A	$ 270,000



APPENDIX A

Planning Level Cost Estimates

1	SHOULDER WIDENING				$ 910,000	PER MILE

		WIDTH (FT)	8	
		SURFACING (IN)	5	
		BASE (IN)	12	

TYPE	UNITS	QUANTITY / STA	UNIT PRICE	COST / MI
Embankment in Place	CUYD	148.15	$ 7.49	$ 58,588
Crushed Aggregate Course	CUYD	76.14	$ 22.49	$ 90,414
Commercial Mix-PG 64-28	TON	32.29	$ 78.03	$ 133,034
Drainage Pipe - Rural	LS	0.02	$ 25,000.00	$ 25,000
Subtotal 1				*$ 307,037*
Traffic Control			5%	$ 15,352
Subtotal 2				*$ 322,389*
Mobilization			8%	$ 25,791
Subtotal 3				*$ 348,180*
Indirect and Incidental Costs (IDIC)			10%	$ 34,818
Construction Engineering (CE)			10%	$ 34,818
Subtotal 4				*$ 417,816*
Contingency			20%	$ 83,563
Subtotal 5				$ 501,379
Estimated Right-of-Way (ROW)	ACRE	0.00	$ 15,000	$ -
Subtotal 6				$ 501,379
Long-Term Inflation	% PER YEAR	20.00	3%	$ 404,167
Total				**$ 905,546**

2 MAIDEN BASIN ROAD INTERSECTION (RP 5.15)

2(a)	ADVANCE WARNING SIGNS (RP 5.15)	$ 600	EA

TYPE	UNITS	QUANTITY / SIGN	UNIT PRICE	COST / EA
Signs - Alum Sheet Invr IV	SQFT	9.0	$ 25.06	$ 226
Poles - Treated Timber - Barn 4 IN	LNFT	12	$ 13.47	$ 162
Subtotal 1				$ 387
Contingency			20%	$ 77
Subtotal 2				$ 465
Short-Term Inflation	% PER YEAR	5.00	3%	$ 74
Total				**$ 539**

2(b)	RIGHT-TURN LANE (RP 5.15)	$ 270,000	TOT

		LENGTH (FT)	950	
		WIDTH (FT)	16	
		SURFACING (IN)	5	
		BASE (IN)	18	

TYPE	UNITS	QUANTITY / STA	UNIT PRICE	COST
Excavation-Unclassified	CUYD	599.96	$ 3.56	$ 20,291
Excavation-Unclass Borrow	CUYD	60.00	$ 5.85	$ 3,334
Crushed Aggregate Course	CUYD	177.69	$ 22.49	$ 37,964
Cover - Type 1	SQYD	178.00	$ 0.52	$ 879
Traffic Gravel	CUYD	11.85	$ 14.99	$ 1,687
Commercial Mix-PG 64-28	TON	56.08	$ 78.03	$ 41,571
Emulsified Asphalt CRS-2P	TON	0.40	$ 621.17	$ 2,360
Drainage Pipe - Rural	LS	0.02	$ 82,000.00	$ 14,754
Subtotal 1				*$ 122,842*
Traffic Control			5%	$ 6,142
Subtotal 2				*$ 128,984*
Mobilization			8%	$ 10,319
Subtotal 3				*$ 139,302*
Indirect and Incidental Costs (IDIC)			10%	$ 13,930
Construction Engineering (CE)			10%	$ 13,930
Subtotal 4				*$ 167,163*
Contingency			20%	$ 33,433
Subtotal 5				$ 200,595
Estimated Right-of-Way (ROW)	ACRE	0.00	$ 15,000	$ -
Subtotal 6				$ 200,595
Mid-Term Inflation	% PER YEAR	10.00	3%	$ 68,988
Total				**$ 269,583**

2(c)	SLOPE FLATTENING (RP 5.15)	$ 70,000	TOT

		AREA (CUYD)	7,176	
		RATIO	50%	
		LENGTH (FT)	775	
		HEIGHT (FT)	10	
		DEPTH (FT)	50	

TYPE	UNITS	QUANTITY	UNIT PRICE	COST
Excavation-Unclassified	CUYD	7,176	$ 3.56	$ 25,546

Subtotal 1				$	*25,546*
Contingency			35%	$	8,941
Subtotal 2				$	34,488
Estimated Right-of-Way (ROW)	ACRE	0.00	$ 15,000	$	-
Subtotal 3				$	34,488
Long-Term Inflation	% PER YEAR	20.00	3%	$	27,801
Total				**$**	**62,288**

3 ROCKFALL HAZARDS (RP 13.3 TO RP 14.6)

3(a) ROCKFALL HAZARD SECTION #307 (RP 13.32 to RP 13.66) — $ 4,000,000 TOT

2005 ESTIMATE	$ 1,706,000
INFLATION (PER YEAR)	3%
YEARS	28
TOTAL	**$ 3,903,205**

3(b) ROCKFALL HAZARD SECTION #309 (RP 13.84 to RP 13.96) — $ 2,200,000 TOT

2005 ESTIMATE	$ 945,000
INFLATION (PER YEAR)	3%
YEARS	28
TOTAL	**$ 2,162,092**

3(c) ROCKFALL HAZARD SECTION #310 (RP 13.96 to RP 14.61) — $ 3,000,000 TOT

2005 ESTIMATE	$ 1,311,000
INFLATION (PER YEAR)	3%
YEARS	28
TOTAL	**$ 2,999,473**

4 EAST RIVER ROAD INTERSECTION - TURN LANES (RP 19.8) — **$ 650,000 TOT**

LEFT-TURN LANE

LENGTH (FT)	1250
WIDTH (FT)	16
SURFACING (IN)	5
BASE (IN)	18

TYPE	UNITS	QUANTITY / STA	UNIT PRICE		COST
Embankment in Place	CUYD	296.30	$ 7.49	$	27,741
Crushed Aggregate Course	CUYD	177.69	$ 22.49	$	49,953
Cover - Type 1	SQYD	178.00	$ 0.52	$	1,157
Traffic Gravel	CUYD	11.85	$ 14.99	$	2,220
Commercial Mix-PG 64-28	TON	56.08	$ 78.03	$	54,699
Emulsified Asphalt CRS-2P	TON	0.40	$ 621.17	$	3,106
Drainage Pipe - Rural	LS	0.02	$ 82,000.00	$	19,413
Subtotal 1				*$*	*158,289*
Traffic Control			5%	$	7,914
Subtotal 2				*$*	*166,203*
Mobilization			8%	$	13,296
Subtotal 3				*$*	*179,500*
Indirect and Incidental Costs (IDIC)			10%	$	17,950
Construction Engineering (CE)			10%	$	17,950
Subtotal 4				*$*	*215,400*
Contingency			20%	$	43,080
Subtotal 5				$	258,480
Estimated Right-of-Way (ROW)	ACRE	0.90	$ 15,000	$	13,430
Subtotal 6				$	271,909
Mid-Term Inflation	% PER YEAR	10.00	3%	$	93,514
Total				**$**	**365,423**

RIGHT-TURN LANE

LENGTH (FT)	950
WIDTH (FT)	16
SURFACING (IN)	5
BASE (IN)	18

TYPE	UNITS	QUANTITY / STA	UNIT PRICE		COST
Embankment in Place	CUYD	296.30	$ 7.49	$	21,083
Crushed Aggregate Course	CUYD	177.69	$ 22.49	$	37,964
Cover - Type 1	SQYD	178.00	$ 0.52	$	879
Traffic Gravel	CUYD	11.85	$ 14.99	$	1,687
Commercial Mix-PG 64-28	TON	56.08	$ 78.03	$	41,571
Emulsified Asphalt CRS-2P	TON	0.40	$ 621.17	$	2,360
Drainage Pipe - Rural	LS	0.02	$ 82,000.00	$	14,754
Subtotal 1				*$*	*120,300*
Traffic Control			5%	$	6,015
Subtotal 2				*$*	*126,315*
Mobilization			8%	$	10,105
Subtotal 3				*$*	*136,420*
Indirect and Incidental Costs (IDIC)			10%	$	13,642

Construction Engineering (CE)			10%	$ 13,642	
Subtotal 4				*$ 163,704*	
Contingency			20%	$ 32,741	
Subtotal 5				$ 196,444	
Estimated Right-of-Way (ROW)	ACRE	0.69	$ 15,000	$ 10,331	
Subtotal 6				$ 206,775	
Mid-Term Inflation	% PER YEAR	10.00	3%	$ 71,113	
Total				**$ 277,888**	

5 MILL CREEK ROAD INTERSECTION - RIGHT-TURN LANE (RP 37.2)				**$ 280,000**	**TOT**

LENGTH (FT)	950
WIDTH (FT)	16
SURFACING (IN)	5
BASE (IN)	18

TYPE	UNITS	QUANTITY / STA	UNIT PRICE	COST
Embankment in Place	CUYD	296.30	$ 7.49	$ 21,083
Crushed Aggregate Course	CUYD	177.69	$ 22.49	$ 37,964
Cover - Type 1	SQYD	178.00	$ 0.52	$ 879
Traffic Gravel	CUYD	11.85	$ 14.99	$ 1,687
Commercial Mix-PG 64-28	TON	56.08	$ 78.03	$ 41,571
Emulsified Asphalt CRS-2P	TON	0.40	$ 621.17	$ 2,360
Drainage Pipe - Rural	LS	0.02	$ 82,000.00	$ 14,754
Subtotal 1				*$ 120,300*
Traffic Control			5%	$ 6,015
Subtotal 2				*$ 126,315*
Mobilization			8%	$ 10,105
Subtotal 3				*$ 136,420*
Indirect and Incidental Costs (IDIC)			10%	$ 13,642
Construction Engineering (CE)			10%	$ 13,642
Subtotal 4				*$ 163,704*
Contingency			20%	$ 32,741
Subtotal 5				$ 196,444
Estimated Right-of-Way (ROW)	ACRE	0.69	$ 15,000	$ 10,331
Subtotal 6				$ 206,775
Mid-Term Inflation	% PER YEAR	10.00	3%	$ 71,113
Total				**$ 277,888**

6 GEOMETRIC IMPROVEMENTS (RP 49.0 TO RP 49.8)			
6(a) ADVANCE WARNING SIGNS		$ 600	EA

TYPE	UNITS	QUANTITY / SIGN	UNIT PRICE	COST / EA
Signs - Alum Sheet Invr IV	SQFT	9.0	$ 25.06	$ 226
Poles - Treated Timber - Barn 4 IN	LNFT	12	$ 13.47	$ 162
Subtotal 1				$ 387
Contingency			20%	$ 77
Subtotal 2				$ 465
Short-Term Inflation	% PER YEAR	5.00	3%	$ 74
Total				**$ 539**

6(b) GEOMETRIC RECONSTRUCTION (RP 49.0 TO RP 49.8)	$ 3,100,000	TOT

LENGTH (MI)	0.8
WIDTH (FT)	32
SURFACING (IN)	5
BASE (IN)	18

TYPE	UNITS	QUANTITY / STA	UNIT PRICE	COST
Excavation-Unclassified	CUYD	1240.69	$ 3.56	$ 186,568
Excavation-Unclass Borrow	CUYD	124.07	$ 5.85	$ 30,658
Special Borrow-Excavation	CUYD	62.03	$ 15.20	$ 39,829
Crushed Aggregate Course	CUYD	266.57	$ 22.49	$ 253,236
Cover - Type 1	SQYD	356.00	$ 0.52	$ 7,819
Traffic Gravel	CUYD	23.70	$ 14.99	$ 15,006
Commercial Mix-PG 64-28	TON	103.68	$ 78.03	$ 341,728
Emulsified Asphalt CRS-2P	TON	0.70	$ 621.17	$ 18,367
Guard Rail - Steel	LNFT	100.00	$ 15.48	$ 65,388
Drainage Pipe - Rural	LS	0.02	$ 82,000.00	$ 65,600
Subtotal 1				*$ 1,024,199*
Traffic Control			5%	$ 51,210
Subtotal 2				*$ 1,075,409*
Mobilization			8%	$ 86,033
Subtotal 3				*$ 1,161,441*
Indirect and Incidental Costs (IDIC)			10%	$ 116,144
Construction Engineering (CE)			10%	$ 116,144
Subtotal 4				*$ 1,393,729*
Contingency			20%	$ 278,746
Subtotal 5				$ 1,672,475

Estimated Right-of-Way (ROW)	ACRE	0.97	$ 15,000	$ 14,545	
Subtotal 6				$ 1,687,021	
Long-Term Inflation	% PER YEAR	20.00	3%	$ 1,359,926	
Total				**$ 3,046,947**	

7 PASSING OPPORTUNITIES AND INCREASED CAPACITY

7(a) EVALUATE NO-PASSING ZONES — $ 45,000

7(b) PULL-OUTS FOR SLOW MOVING VEHICLES — $ 220,000 EA

LENGTH (FT)	300.0
WIDTH (FT)	36
SURFACING (IN)	5
BASE (IN)	18

TYPE	UNITS	QUANTITY / STA	UNIT PRICE	COST
Embankment in Place	CUYD	666.67	$ 7.49	$ 14,980
Crushed Aggregate Course	CUYD	288.80	$ 22.49	$ 19,485
Cover - Type 1	SQYD	400.00	$ 0.52	$ 624
Traffic Gravel	CUYD	26.67	$ 14.99	$ 1,199
Commercial Mix-PG 64-28	TON	115.57	$ 78.03	$ 27,054
Emulsified Asphalt CRS-2P	TON	0.80	$ 621.17	$ 1,491
Drainage Pipe - Rural	LS	0.02	$ 20,000.00	$ 1,136
Subtotal 1				*$ 65,970*
Traffic Control			5%	$ 3,298
Subtotal 2				*$ 69,268*
Mobilization			8%	$ 5,541
Subtotal 3				*$ 74,810*
Indirect and Incidental Costs (IDIC)			10%	$ 7,481
Construction Engineering (CE)			10%	$ 7,481
Subtotal 4				*$ 89,771*
Contingency			20%	$ 17,954
Subtotal 5				$ 107,726
Estimated Right-of-Way (ROW)	ACRE	0.57	$ 15,000	$ 8,609
Subtotal 6				$ 116,335
Long-Term Inflation	% PER YEAR	20.00	3%	$ 93,779
Total				**$ 210,113**

7(c) PASSING LANES AT SPOT LOCATIONS — $ 12,400,000 EA

LENGTH (MI)	2.0
WIDTH (FT)	78
SURFACING (IN)	5
BASE (IN)	18

TYPE	UNITS	QUANTITY / STA	UNIT PRICE	COST
Embankment in Place	CUYD	851.85	$ 7.49	$ 673,767
Crushed Aggregate Course	CUYD	522.13	$ 22.49	$ 1,240,030
Cover - Type 1	SQYD	867.00	$ 0.52	$ 47,609
Traffic Gravel	CUYD	57.78	$ 14.99	$ 91,463
Plant Mix Bit Surf GR S - 3/4"	TON	240.50	$ 28.00	$ 711,110
Hydrated Lime	TON	4.00	$ 173.97	$ 73,485
Asphalt Cement PG 64-28	TON	12.99	$ 707.20	$ 970,097
Emulsified Asphalt CRS-2P	TON	1.60	$ 621.17	$ 104,953
Drainage Pipe - Rural	LS	0.02	$ 82,000.00	$ 164,000
Subtotal 1				*$ 4,076,513*
Traffic Control			5%	$ 203,826
Subtotal 2				*$ 4,280,339*
Mobilization			8%	$ 342,427
Subtotal 3				*$ 4,622,766*
Indirect and Incidental Costs (IDIC)			10%	$ 462,277
Construction Engineering (CE)			10%	$ 462,277
Subtotal 4				*$ 5,547,319*
Contingency			20%	$ 1,109,464
Subtotal 5				$ 6,656,783
Estimated Right-of-Way (ROW)	ACRE	12.12	$ 15,000	$ 181,818
Subtotal 6				$ 6,838,602
Long-Term Inflation	% PER YEAR	20.00	3%	$ 5,512,673
Total				**$ 12,351,275**

7(d) FOUR- OR FIVE-LANE TYPICAL SECTION — $ 6,200,000 PER MILE

WIDTH (FT)	78
SURFACING (IN)	5
BASE (IN)	18

TYPE	UNITS	QUANTITY / STA	UNIT PRICE	COST / MI
Embankment in Place	CUYD	851.85	$ 7.49	$ 336,884
Crushed Aggregate Course	CUYD	522.13	$ 22.49	$ 620,015

Cover - Type 1	SQYD	867.00	$ 0.52	$	23,804	
Traffic Gravel	CUYD	57.78	$ 14.99	$	45,731	
Plant Mix Bit Surf GR S - 3/4"	TON	240.50	$ 28.00	$	355,555	
Hydrated Lime	TON	4.00	$ 173.97	$	36,742	
Asphalt Cement PG 64-28	TON	12.99	$ 707.20	$	485,049	
Emulsified Asphalt CRS-2P	TON	1.60	$ 621.17	$	52,476	
Drainage Pipe - Rural	LS	0.02	$ 82,000.00	$	82,000	
Subtotal 1				*$*	*2,038,257*	
Traffic Control			5%	$	101,913	
Subtotal 2				*$*	*2,140,170*	
Mobilization			8%	$	171,214	
Subtotal 3				*$*	*2,311,383*	
Indirect and Incidental Costs (IDIC)			10%	$	231,138	
Construction Engineering (CE)			10%	$	231,138	
Subtotal 4				*$*	*2,773,660*	
Contingency			20%	$	554,732	
Subtotal 5				$	3,328,392	
Estimated Right-of-Way (ROW)	ACRE	6.06	$ 15,000	$	90,909	
Subtotal 6				$	3,419,301	
Long-Term Inflation	% PER YEAR	20.00	3%	$	2,756,337	
Total				**$**	**6,175,637**	

7(e) ALTERNATING PASSING LANES				$	4,200,000	PER MILE

WIDTH (FT)	52
SURFACING (IN)	5
BASE (IN)	18

TYPE	UNITS	QUANTITY / STA	UNIT PRICE		COST / MI
Embankment in Place	CUYD	370.37	$ 7.49	$	146,471
Crushed Aggregate Course	CUYD	377.69	$ 22.49	$	448,496
Cover - Type 1	SQYD	578.00	$ 0.52	$	15,870
Traffic Gravel	CUYD	38.52	$ 14.99	$	30,488
Plant Mix Bit Surf GR S - 3/4"	TON	163.17	$ 28.00	$	241,231
Hydrated Lime	TON	3.00	$ 173.97	$	27,557
Asphalt Cement PG 64-28	TON	8.81	$ 707.20	$	328,967
Emulsified Asphalt CRS-2P	TON	1.10	$ 621.17	$	36,078
Drainage Pipe - Rural	LS	0.02	$ 82,000.00	$	82,000
Subtotal 1				*$*	*1,357,156*
Traffic Control			5%	$	67,858
Subtotal 2				*$*	*1,425,014*
Mobilization			8%	$	114,001
Subtotal 3				*$*	*1,539,015*
Indirect and Incidental Costs (IDIC)			10%	$	153,902
Construction Engineering (CE)			10%	$	153,902
Subtotal 4				*$*	*1,846,818*
Contingency			20%	$	369,364
Subtotal 5				$	2,216,182
Estimated Right-of-Way (ROW)	ACRE	3.64	$ 15,000	$	54,545
Subtotal 6				$	2,270,727
Long-Term Inflation	% PER YEAR	20.00	3%	$	1,830,459
Total				**$**	**4,101,186**

8 ACCESS MANAGEMENT PLAN				**$**	**180,000**	**TOT**
Subtotal 1				$	150,000	
Short-Term Inflation	% PER YEAR	5.00	3%	$	23,891	
Total				**$**	**173,891**	

9 LIVINGSTON RURAL / URBAN INTERFACE (RP 49.8 TO RP 52.5)				**$**	**8,500,000**	**TOT**

LENGTH (MI)	2.7
WIDTH (FT)	54
SURFACING (IN)	5
BASE (IN)	18

TYPE	UNITS	QUANTITY / STA	UNIT PRICE		COST
Embankment in Place	CUYD	407.41	$ 7.49	$	435,019
Crushed Aggregate Course	CUYD	388.80	$ 22.49	$	1,246,561
Cover - Type 1	SQYD	600.00	$ 0.52	$	44,479
Traffic Gravel	CUYD	40.00	$ 14.99	$	85,479
Plant Mix Bit Surf GR S - 3/4"	TON	169.11	$ 28.00	$	675,033
Hydrated Lime	TON	3.00	$ 173.97	$	74,403
Asphalt Cement PG 64-28	TON	9.13	$ 707.20	$	920,472
Emulsified Asphalt CRS-2P	TON	1.10	$ 621.17	$	97,409
Drainage Pipe - Rural	LS	0.02	$ 82,000.00	$	221,400
Subtotal 1				*$*	*3,800,256*
Traffic Control			5%	$	190,013
Subtotal 2				*$*	*3,990,268*
Mobilization			8%	$	319,221

Subtotal 3					$	*4,309,490*
Indirect and Incidental Costs (IDIC)				10%	$	430,949
Construction Engineering (CE)				10%	$	430,949
Subtotal 4					$	*5,171,388*
Contingency				20%	$	1,034,278
Subtotal 5					$	6,205,666
Estimated Right-of-Way (ROW)	ACRE	3.27	$	15,000	$	49,091
Subtotal 6					$	6,254,756
Long-Term Inflation	% PER YEAR	10.00		3%	$	2,151,113
Total					**$**	**8,405,870**

10 MULTI-USE TRAIL **$ 390,000 PER MILE**

WIDTH (FT)	8
SURFACING (IN)	2
BASE (IN)	6

TYPE	UNITS	QUANTITY / STA		UNIT PRICE		COST / MI
Embankment in Place	CUYD	59.26	$	7.49	$	23,435
Crushed Aggregate Course	CUYD	27.50	$	22.49	$	32,655
Commercial Mix-PG 64-28	TON	10.88	$	78.03	$	44,825
Drainage Pipe - Rural	LS	0.02	$	7,500.00	$	7,500
Subtotal 1					$	*108,416*
Traffic Control				5%	$	5,421
Subtotal 2					$	*113,837*
Mobilization				8%	$	9,107
Subtotal 3					$	*122,944*
Indirect and Incidental Costs (IDIC)				10%	$	12,294
Construction Engineering (CE)				10%	$	12,294
Subtotal 4					$	*147,533*
Contingency				20%	$	29,507
Subtotal 5					$	177,039
Estimated Right-of-Way (ROW)	ACRE	2.42	$	15,000	$	36,364
Subtotal 6					$	213,403
Long-Term Inflation	% PER YEAR	20.00		3%	$	172,027
Total					**$**	**385,430**

11 GARDINER AREA (RP 0.0 TO RP 1.0)

11(a) ON-STREET PARKING LABOR

11(b) LIGHTING IMPROVEMENTS TO BE DETERMINED

12 VEGETATION MANAGEMENT PLAN **$ 60,000 TOT**

Subtotal 1				$	50,000
Short-Term Inflation	% PER YEAR	5.00	3%	$	7,964
Total				**$**	**57,964**

13 WILDLIFE-VEHICLE CONFLICTS

GRADE SEPARATED CROSSING STRUCTURES - OVERPASSES **$ 2,800,000 EA**

TYPE	UNITS	QUANTITY / SIGN		UNIT PRICE		COST / EA
Grade Separated Crossing Structure (with Associated Fencing)*	EA	1.0	$	1,250,000.00	$	1,250,000
Subtotal 1					$	1,250,000
Contingency				20%	$	250,000
Subtotal 2					$	1,500,000
Long-Term Inflation	% PER YEAR	20.00		3%	$	1,209,167
Total					**$**	**2,709,167**

* *Reference MT-1 Anaconda Corridor Planning Study &*
WVC Report cost ranges (adjusted for inflation 2007-2013)

GRADE SEPARATED CROSSING STRUCTURES - UNDERPASSES **$ 750,000 EA**

TYPE	UNITS	QUANTITY / SIGN		UNIT PRICE		COST / EA
Grade Separated Crossing Structure (with Associated Fencing)*	EA	1.0	$	345,000.00	$	345,000
Subtotal 1					$	345,000
Contingency				20%	$	69,000
Subtotal 2					$	414,000
Long-Term Inflation	% PER YEAR	20.00		3%	$	333,730
Total					**$**	**747,730**

* *Reference MT-1 Anaconda Corridor Planning Study*
WVC Report cost ranges (adjusted for inflation 2007-2013)

ANIMAL DETECTION SYSTEM (AT-GRADE CROSSING) **$ 220,000 PER MILE**

TYPE	UNITS	QUANTITY / SIGN		UNIT PRICE		COST / EA
Animal Detection System (with Associated Fencing) *	MI	1	$	100,000.00	$	100,000
Subtotal 1					$	100,000

Contingency			20%	$ 20,000	
Subtotal 2				$ 120,000	
Long-Term Inflation	% PER YEAR	20.00	3%	$ 96,733	
Total				**$ 216,733**	

** Reference MT-1 Anaconda Corridor Planning Study*
WVC Report cost ranges (adjusted for inflation 2007-2013)

WILDLIFE SIGNAGE				**$ 600**	**EA**
TYPE	**UNITS**	**QUANTITY / SIGN**	**UNIT PRICE**	**COST / EA**	
Signs - Alum Sheet Invr IV	SQFT	9.0	$ 25.06	$ 226	
Poles - Treated Timber - Barn 4 IN	LNFT	12	$ 13.47	$ 162	
Subtotal 1				$ 387	
Contingency			20%	$ 77	
Subtotal 2				$ 465	
Short-Term Inflation	% PER YEAR	5.00	3%	$ 74	
Total				**$ 539**	

** Reference MT-1 Anaconda Corridor Planning Study*
WVC Report cost ranges (adjusted for inflation 2007-2013)

WILDLIFE CONFLICT MITIGATION STUDY				**$ 270,000**	**TOT**
Subtotal 1				$ 200,000	
Mid-Term Inflation	% PER YEAR	10.00	3%	$ 68,783	
Total				**$ 268,783**	