BELGRADE to BOZEMAN corridor
FRONTAGE ROAD study

Improvement Options

Technical Memorandum

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1.0. INTRODUCTION

The purpose of this memorandum is to identify and evaluate options for improving the Frontage Road corridor between Belgrade and Bozeman. Potential improvement options were identified to address previously defined issues or areas of concern and are intended to satisfy the corridor needs and objectives. The following steps were applied to develop improvement options:

1. Review 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. Analyze the information gathered to develop a range of improvement options that are consistent with the needs and objectives of the corridor.

Implementation of improvement options, ultimately, depends on the availability of funding, right-of-way needs, and other project delivery elements. Estimated implementation timeframes were developed for each improvement option based on anticipated project delivery. Implementation timeframes were defined as follows:

- Short-term timeframe: Implementation is recommended within a 0- to 5-year period.
- Mid-term timeframe: Implementation is recommended within a 5- to 10-year period.
- Long-term timeframe: Implementation is recommended within a 10- to 20-year period.

Planning level cost estimates are listed in 2016 dollars for each improvement option. The planning level costs were developed in accordance with procedures outlined by MDT[1]. The costs include estimates for preliminary engineering, right-of-way, utilities, drainage, construction engineering, construction, and indirect costs (IDC). In addition, an inflationary factor of three 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 estimate worksheets for each option.

Limitations/constraints and resource considerations were identified for each improvement option. Potential barriers such as right-of-way, physical features, and environmental conditions may influence the project development process and could add additional time and cost. Project-level analysis would be required for any improvements forwarded from this study. Information contained in this report may be used to support future project development and environmental documentation.

2.0. IMPROVEMENT OPTIONS CONSIDERED

This section contains an evaluation of potential improvement options intended to address previously defined issues and areas of concern. Improvement options were identified for individual spot locations, as well as corridor-wide treatments. There may be opportunity to develop spot improvements individually or as part of larger corridor-wide recommendations. A summary of potential improvements is included in **Section 3** of this memorandum.

For each potential improvement option, an evaluation was made to determine if the improvements would address the needs and objectives of the corridor. The previously identified needs and objectives are as follows:

Need 1 – Improve the Safety of the Corridor for all Users

- Reduce the frequency and severity of all crashes.
- Improve roadway elements to meet current design standards.
- Reduce conflicts for all modes.

Need 2 – Improve the Operations of the Roadway

- Reduce corridor and intersection congestion for existing and future demands.
- Improve operations to meet acceptable LOS guidelines.
- Accommodate alternative transportation modes.

Other Considerations

- Local and regional planning consistency
- Funding availability
- Construction feasibility and physical constraints
- Truck movements
- Maintenance costs and responsibility
- Railroad coordination
- Impacts to aquatic resources
- Impacts to environmental resources

2.1. MDT Projects Under Development

There are three projects currently under development by MDT along the study corridor. One is to flatten slopes and provide turn lanes between RP 23.0 and RP 24.6; the second is to install traffic signals at the intersections of the East Valley Center Spur Road with the Frontage Road and with East Valley Center Road; the third is to make modifications to the intersection of North 7th Avenue and Griffin Drive. The following provides a summary of these planned projects.

Slope Flattening – RP 23.0 to RP 24.6

A project is planned to reconstruct the Frontage Road from the Hyalite Creek crossing (Reference Post [RP] 23.0) to east of Sacajawea Peak Drive (RP 24.6). The reconstruction project will include wider shoulders (eight feet wide), flatter side slopes, a center left-turn lane, and turn bays at major approaches. Also included will be shoulder rumble strips and centerline rumble strips on the two-lane segment.

The project is intended to address single-vehicle roadway departure crashes by providing a recoverable clear zone. Widened shoulders and rumble strips are also intended to help reduce the number and severity of roadway departure crashes. Installation of turn lanes is a hazard mitigation measure that provides separation for slowing or stopping turning traffic from the high speed through traffic. It is anticipated that this project would be let in 2018.

East Valley Center Spur Intersections Improvements

The intersection of the Frontage Road and East Valley Center Spur Road is a four-legged intersection (north leg is currently a closed private approach) with stop control on the minor approach legs. The west leg consists of dedicated right-turn, through, and left-turn lanes while the east leg consists of a dedicated left-turn bay and a shared through/right-turn lane. The south leg has a single shared-use lane.

The intersection of East Valley Center Spur Road and East Valley Center Road is a three-legged intersection with stop control along the north leg. The west leg has a dedicated left-turn lane, the east leg is a shared through/right-turn lane, and the north leg has dedicated left- and right-turn lanes.

The two intersections are separated by approximately 550 feet. Interstate 90 (I-90) crosses over the East Valley Center Spur Road between the two intersections. Immediately south of the intersection with the Frontage Road is an at-grade MRL rail line crossing. The at-grade crossing is controlled with an automatic crossing gate.

A project is under development to install traffic signals at both ends of the East Valley Center Spur Road (at the intersection with the Frontage Road and at the intersection with East Valley Center Road). The project would also include geometric improvements to the intersections, including a westbound right-turn lane on Valley Center Road. The project is intended to address safety and operational concerns at the intersections. Signal timing will be developed to coordinate with the railroad crossing. The letting date for this project is currently unknown.

Griffin Drive Intersection Improvements

The intersection of North 7th Avenue and Griffin Drive is an urban four-legged signal controlled intersection. The south approach consists of a shared through/left-turn lane and a dedicated right-turn lane. The north approach has a shared through/left-turn lane and a shared through/right-turn lane. The eastbound and westbound approaches are single lanes which allow for all movements.

The traffic signal allows for permissive left-turn movements only and does not provide for protected left-turn movements along any approach. The intersection operates at a LOS C and D during the AM and PM peak hours, respectively, under existing conditions. The intersection is projected to operate at a LOS of D and F during the respective peak hours in 2040. The intersection experiences delay due to the southbound and westbound left-turn movements.

A traffic and geometric analysis was completed for this intersection by MDT in October, 2016[2]. The purpose of the analysis was to identify improvements to signal timing and geometrics to address operational concerns. A recommendation was made to reconstruct the intersection to include dual westbound left-turn lanes and to realign the northbound and southbound legs to include left-turn lanes. Also included would be upgrades to the traffic signal. It is anticipated that this project would be let in May 2019.

2.2. Potential Improvement Options

This section contains descriptions of potential improvement options developed for the Frontage Road corridor. These improvement options are intended to address areas of concern identified in the *Existing and Projected Conditions Technical Memorandum*[3]. The options are grouped into improvements for intersections, spot locations, and corridor-wide. The improvements can either be developed as stand-alone projects, or, in some cases, combined together as larger improvements. There may be cost savings and efficiencies by packaging improvement options together.

2.2.1. Intersection Improvements

1. Broadway Street Intersection Improvements

The intersection of Main Street and Broadway Street is a four-legged all-way stop controlled intersection. All of the approaches consist of a single shared lane allowing all movements. On-street parking is available on the north side of Main Street and on both sides of Broadway Street on the north approach. Angle parking is available on the south side of Main Street on the east approach. The MRL railroad line is located approximately 180 feet south of the northbound stop bar.

Under existing traffic conditions, the intersection operates at a LOS of A and C during the AM and PM peak hours, respectively. Under projected conditions, the intersection is shown to operate at a LOS of B and F during the respective peak hours. The failing projected peak hour is mainly a result of heavy westbound through and left-turn movements. Additional traffic control could improve operations and reduce vehicle delay.

Potential changes to traffic control could include construction of a traffic signal or a single-lane roundabout. Installation of a single-lane roundabout would provide the greatest improvements to intersection operations and safety. However, construction of a roundabout may be difficult due to

limited available right-of-way and proximity to the at-grade railroad crossing. Installation of a traffic signal would also provide operational benefits over the existing configuration. Construction of a traffic signal would fit within existing constraints better than a single-lane roundabout.

Two traffic signal configurations were considered for the intersection, one with eastbound and westbound left-turn lanes, and one with single lanes along all approaches. The main source of delay at the intersection during the PM peak hour is westbound left-turning vehicles. The MDT *Traffic Engineering Manual*[4] recommends that dedicated left-turn lanes should be considered for the following situations:

- At any intersection where capacity analysis determines a left-turn lane is necessary to meet the level-of-service criteria, and
- As a general rule, on the major roadway at any signalized intersection.

By this guidance, left-turn bays on the east and westbound approaches are recommended. Construction of left-turn lanes would likely require the removal of on-street parking along the east and west approach legs. Construction of a roundabout would also likely result in the removal of some on-street parking. Additional off-street parking may be accommodated south of the intersection if necessary.

A comparison of the operational analysis for the existing configuration, under traffic signal control (with and without left-turn lanes), and with a single-lane roundabout is provided in **Table 1**. More detailed information is provided in **Appendix B**.

Table 1: Broadway Street Intersection Operational Analysis

APPROACH	EXISTING CONDITIONS (2016)				PROJECTED CONDITIONS (2040)			
	AM		PM		AM		PM	
	DELAY (S)	LOS	DELAY (S)	LOS	DELAY (S)	LOS	DELAY (S)	LOS
Existing Configuration (All-way Stop Control)								
Main Street / Broadway Street	**9.2**	**A**	**15.5**	**C**	**11.0**	**B**	**57.7**	**F**
Northbound	*9.1*	*A*	*14.2*	*B*	*10.9*	*B*	*33.5*	*D*
Southbound	*8.8*	*A*	*12.0*	*B*	*9.9*	*A*	*18.9*	*C*
Eastbound	*9.4*	*A*	*12.9*	*B*	*11.4*	*B*	*26.1*	*D*
Westbound	*9.4*	*A*	*19.3*	*C*	*11.1*	*B*	*108.1*	*F*
Traffic Signal with Eastbound and Westbound Left-turn Lanes								
Main Street / Broadway Street	**12.2**	**B**	**14.0**	**B**	**13.1**	**B**	**16.3**	**B**
Northbound	*13.7*	*B*	*16.2*	*B*	*15.7*	*B*	*20.9*	*C*
Southbound	*12.5*	*B*	*13.7*	*B*	*13.8*	*B*	*16.3*	*B*
Eastbound	*11.0*	*B*	*11.9*	*B*	*11.2*	*B*	*12.4*	*B*
Westbound	*11.8*	*B*	*13.8*	*B*	*12.2*	*B*	*15.5*	*B*
Traffic Signal without Eastbound and Westbound Left-turn Lanes								
Main Street / Broadway Street	**12.2**	**B**	**14.4**	**B**	**13.1**	**B**	**18.9**	**B**
Northbound	*12.2*	*B*	*16.2*	*B*	*14.0*	*B*	*20.9*	*C*
Southbound	*11.2*	*B*	*13.7*	*B*	*12.3*	*B*	*16.3*	*B*
Eastbound	*12.4*	*B*	*11.7*	*B*	*12.6*	*B*	*12.1*	*B*
Westbound	*12.4*	*B*	*15.1*	*B*	*13.1*	*B*	*22.4*	*C*
Single Lane Roundabout								
Main Street / Broadway Street	**4.6**	**A**	**6.3**	**A**	**5.5**	**A**	**8.5**	**A**
Northbound	*4.9*	*A*	*6.0*	*A*	*5.8*	*A*	*7.9*	*A*
Southbound	*4.0*	*A*	*5.9*	*A*	*4.6*	*A*	*7.9*	*A*
Eastbound	*4.8*	*A*	*5.6*	*A*	*5.7*	*A*	*7.1*	*A*
Westbound	*4.5*	*A*	*7.1*	*A*	*5.2*	*A*	*10.0*	*A*

The intersection is shown to operate at a LOS B or better for all approach legs during the peak hours for existing conditions and at a LOS or C or better for projected conditions with installation of a traffic signal. Inclusion of left-turn lanes would provide a minor benefit of reduced delay along the eastbound and westbound approach legs. The intersection is shown to experience induced delay with installation of a traffic signal during the AM peak hours. Under the single-lane roundabout configuration, delay is greatly reduced and results in a LOS of A for existing and projected conditions during the peak hours.

Signal preemption by an approaching train would be required to ensure that queued vehicles on the south approach are able to clear the at-grade crossing before the train arrives. During the time when a train is present, eastbound right-turning traffic may cause blockage of through movements at the intersection. A queue length analysis should be conducted during project development to determine appropriate turn-bay lengths (if necessary), and to evaluate how train crossings may affect intersection operations.

Limitations/Constraints:

- The MRL railroad is located in close proximity to the intersection.
- There is limited queue storage on northbound approach due to the railroad.
- Signal preemption will be required to coordinate with the railroad crossing.
- There is constrained right-of-way and existing on-street parking.
- Installation of a traffic signal would require a warrant analysis.
- Reconstruction of the intersection may result in some loss of parking and could impact parcels to the south.

Resource Considerations:

- The businesses north of Main Street are likely properties of historic-age, and could be adversely impacted during construction.
- The historic MRL railroad at grade crossing is located just south of the intersection.

Estimated Cost:

- $1.6M (signal with left-turn lanes)
- $1.3M (signal without left-turn lanes)
- $2.3M (roundabout)

Implementation Timeframe:

- Mid-term

2. Oregon Street Intersection Improvements

The intersection of Main Street and Oregon Street is a four-legged stop controlled intersection. The east and west approaches consist of single lanes with free movements. The north approach is an entrance for a gas station. The south approach is stop controlled and consists of channelized through/left- and right-turn lanes. There is a median dividing the right-turn and through/left-turn lanes. There is also a median dividing the southbound and northbound lanes. An at-grade railroad crossing is located approximately 260 feet south of the intersection. A pedestrian trail crossing is located approximately 75 feet west of the intersection.

Under existing traffic conditions, the intersection operates at a LOS of C and D during the AM and PM peak hours due to delay experienced along the south leg. The intersection is projected to operate at a LOS of C and F during the respective peak hours in 2040. The intersection is shown to experience excessive delay for the northbound left-turn movement during the PM peak hour.

Changes to traffic control at the intersection, such as reconfiguring to an all-way stop, installation of a traffic signal, or construction of a single lane roundabout, were explored. Installation of a traffic signal or roundabout would likely require roadway reconstruction and realignment due to the constraints of the gas station to the north. The existing northern approach currently serves as an entrance to the gas station and is within the gas station right-of-way. Modifications to provide a standard north approach leg would require that the intersection be shifted to the south outside of the constraints of the gas station.

An alternative option may be to close the entrance to the gas station by removing the north approach leg and forcing all access to utilize the existing approach on Aspen Lane. This is likely an unpopular option for the gas station and may affect circulation for the pumps and for fuel deliveries. **Table 2** shows the results of the operational analysis for the intersection with installation of a traffic signal. More detailed information is provided in **Appendix B**.

Table 2: Oregon Street Intersection Operational Analysis

APPROACH	EXISTING CONDITIONS (2016)				PROJECTED CONDITIONS (2040)			
	AM		PM		AM		PM	
	DELAY (S)	LOS	DELAY (S)	LOS	DELAY (S)	LOS	DELAY (S)	LOS
Existing Configuration (Two-way Stop Control)								
Main Street / Oregon Street	**16.8**	**C**	**27.1**	**D**	**22.3**	**C**	**98.9**	**F**
Northbound	*12.9*	*B*	*19.3*	*C*	*15.6*	*C*	*59.1*	*F*
Southbound	*14.4*	*B*	*16.8*	*C*	*18.4*	*C*	*30.7*	*D*
Eastbound	*0.8*	*A*	*0.8*	*A*	*0.8*	*A*	*0.9*	*A*
Westbound	*0.7*	*A*	*1.0*	*A*	*0.7*	*A*	*1.0*	*A*
All-way Stop Control								
Main Street / Oregon Street	**10.3**	**B**	**14.0**	**B**	**12.8**	**B**	**41.0**	**E**
Northbound	*9.2*	*A*	*10.1*	*B*	*10.5*	*B*	*14.2*	*B*
Southbound	*8.9*	*A*	*9.9*	*A*	*9.9*	*A*	*12.5*	*B*
Eastbound	*11.2*	*B*	*11.9*	*B*	*14.8*	*B*	*20.0*	*C*
Westbound	*10.1*	*B*	*17.1*	*C*	*12.0*	*B*	*68.0*	*F*
Traffic Signal								
Main Street / Oregon Street	**12.9**	**B**	**13.4**	**B**	**13.6**	**B**	**15.4**	**B**
Northbound	*13.3*	*B*	*15.0*	*B*	*14.6*	*B*	*17.6*	*B*
Southbound	*11.7*	*B*	*13.3*	*B*	*12.8*	*B*	*14.7*	*B*
Eastbound	*13.3*	*B*	*11.9*	*B*	*14.1*	*B*	*12.8*	*B*
Westbound	*12.4*	*B*	*13.7*	*B*	*12.5*	*B*	*16.3*	*B*
Single Lane Roundabout								
Main Street / Oregon Street	**5.0**	**A**	**6.1**	**A**	**5.7**	**A**	**8.0**	**A**
Northbound	*5.0*	*A*	*4.8*	*A*	*5.8*	*A*	*5.9*	*A*
Southbound	*4.1*	*A*	*5.4*	*A*	*4.5*	*A*	*6.9*	*A*
Eastbound	*5.3*	*A*	*5.3*	*A*	*6.2*	*A*	*6.5*	*A*
Westbound	*4.9*	*A*	*7.1*	*A*	*5.5*	*A*	*9.8*	*A*

All three scenarios would reduce vehicle delay along the northbound approach leg. The all-way stop and traffic signal configurations would create some induced delay along the east and west approach legs (currently free-flowing), however. The all-way stop configuration is also projected to fail during the future PM peak hour due to heavy westbound traffic. The all-way stop configuration may be undesirable due to the heavy amount of eastbound and westbound traffic compared to the northbound and southbound directions.

Signal preemption by an approaching train would be required to ensure that queued vehicles on the south approach are able to clear the at-grade crossing before the train arrives. During the time when

a train is present, eastbound right-turning traffic may cause blockage of through movements at the intersection.

With any improvement option, it may be desirable to relocate the existing pedestrian crossing closer to the intersection. The crossing is currently located approximately 75 feet west of the intersection which can result in safety concerns.

Limitations/constraints:

- The existing gas station constrains the north side of the intersection.
- The business on the southeast quadrant restricts the ability to shift the intersection further south to provide separation between the gas station and the intersection.
- There is limited queue storage on northbound approach due to the railroad.
- Signal preemption may be desirable to coordinate with the railroad crossing.
- Installation of a traffic signal would require a warrant analysis.

Resource Considerations:

- There are underground storage tanks at the gas station on the north side of the intersection.
- The intersection is located in close proximity to Lewis and Clark Park (4(f) and 6(f) property).

Estimated Cost:

- $800,000 (all-way stop)
- $1.8M (traffic signal)
- $2.4M (roundabout)

Implementation Timeframe:

- Mid-term

3. Airport Road Intersection Improvements

The intersection with Airport Road is a three-legged intersection with stop control along the north approach. The intersection previously had a south approach leg which was removed with construction of the East Belgrade Interchange. The intersection currently operates at a LOS C during the AM and PM peak hours. Future projections show the intersection continuing to operate at a LOS C in 2040.

There are currently no dedicated turn lanes at the intersection. The intersection experiences a high percentage of eastbound left-turn movements and high conflicting volumes from the westbound direction. Peak hour volumes indicate the intersection meets current guidelines to consider a left-turn treatment[5]. Public comments have indicated a desire to install a dedicated eastbound left-turn lane due to the high volume of left-turning traffic.

The Belgrade City-County Planning Board has indicated that there are future development plans north of the intersection that are expected to be served by Airport Road. If traffic conditions change as the result of future development, the intersection may need to be evaluated for changes to traffic control through the MDT System Impact Process.

Limitations/constraints:

- Installation of a traffic signal requires a warrant analysis.

Resource Considerations:

- None identified.

Estimated Cost:

- $900,000 (left-turn lane)

- $1.7M (traffic signal with left-turn lane)

Implementation Timeframe:

- When warranted

4. Nelson Road Intersection Improvements

The intersection of Frontage Road and Nelson Road is a three-legged intersection with stop control along Nelson Road. The eastbound approach consists of a dedicated left-turn lane and a through lane. The westbound approach consists of a dedicated right-turn lane and a through lane. The southbound approach has a shared left/right-turn lane.

Recent construction of a new MDT facility at the intersection has raised concerns about increased traffic volumes. Heavy vehicle traffic is expected to increase, especially during winter months when winter maintenance vehicles are utilizing MDT's facility.

Under its existing configuration, the intersection operates at a LOS of B during the peak hours and is projected to operate at a LOS of C during the peak hours in 2040. Note that the operational analysis was conducted prior to the opening of the MDT facility.

To mitigate possible congestion and safety concerns, installation of a traffic signal at the intersection is recommended when signal warrants are met. Installing a traffic signal with the current lane configurations would result in a LOS of B or better for all peak hours. A traffic signal would result in induced delay along the mainline due to red signal time. **Table 3** presents the operational analysis for the intersection. More detailed information is provided in **Appendix B**.

Table 3: Nelson Road Intersection Operational Analysis

	EXISTING CONDITIONS (2016)				PROJECTED CONDITIONS (2040)			
	AM		PM		PM		AM	
APPROACH	DELAY (S)	LOS	DELAY (S)	LOS	DELAY (S)	LOS	DELAY (S)	LOS
Intersection Average	**12.8**	**B**	**10.3**	**B**	**13.6**	**B**	**10.7**	**B**
Southbound	*13.2*	*B*	*14.7*	*B*	*14.7*	*B*	*16.5*	*B*
Eastbound	*13.7*	*B*	*9.1*	*A*	*14.8*	*B*	*8.9*	*A*
Westbound	*10.4*	*B*	*10.6*	*B*	*10.1*	*B*	*11.2*	*B*

A traffic study was conducted in December, 2016 to evaluate if warrants are currently met. The results of the study showed that a traffic signal is not currently warranted at the intersection. The intersection should be re-evaluated if conditions change in the future.

Limitations/constraints:

- Installation of a traffic signal requires a warrant analysis.
- Traffic signal warrants are not currently met.

Resource Considerations:

- None identified.

Estimated Cost:

- $900,000

Implementation Timeframe:

- When warranted

2.2.2. Spot Improvements

5. Evaluate School Traffic in Belgrade

Traffic related to Belgrade High School creates congestion and operational issues along Main Street between Jackrabbit Lane and Broadway Street. Traffic operates relatively smoothly along Main Street throughout most of the day. However, when students are released from school in the afternoon, traffic congestion and operational issues were observed. When school gets out, a large number of vehicles are released onto the traffic network during a short period of time. The main roads connecting the school and Main Street are Grogan Street and Hoffman Street. The primary movement of vehicles involves right turns onto Main Street followed by left turns onto Jackrabbit Lane. This heavy movement results in long queues along Main Street between Jackrabbit Lane and Hoffman Street.

School bus traffic also influences traffic operations. School busses are required to stop at all railroad crossings. When a school bus turns onto Jackrabbit Lane, it must stop at the tracks immediately to the south of the intersection. With multiple busses in a row this can cause traffic to queue through the intersection with Jackrabbit Lane.

Detailed investigation into possible mitigation options, such as staggered release of students, alternate exit points from the school parking lots, re-routing of bus traffic, etc., may yield viable solutions to the congestion problem. A cursory field review was conducted as part of this corridor study; however, additional investigation is needed to identify recommendations to improve traffic operations. This investigation could be completed during the planned update to Belgrade's Long Range Transportation Plan.

Limitations/constraints:

- Operational issues are constrained to a short period of time during school days.

Resource Considerations:

- None identified

Estimated Cost:

- $30,000

Implementation Timeframe:

- Short-term

6. Complete Sidewalk Network along Main Street in Belgrade

There are multiple gaps in the sidewalk network within Belgrade. Between Jackrabbit Lane and Kennedy Street there is generally sidewalk on both sides of Main Street, with the exception of small gaps on the south side of the road along some business approaches. The north side of Main Street has pavement striped as a buffered pedestrian area between Kennedy Street and the Central Valley Fire Station. Between the fire station and Aspen Street there is sidewalk on the north side of Main Street. No sidewalk is present on the south side of Main Street to the east of Kennedy Street. Sidewalk was constructed with the East Belgrade Interchange between Gallatin Field to east of Airway Boulevard.

Evidence of pedestrian traffic was noted in the form of social trails in areas where sidewalk does not currently exist. It is recommended that the sidewalk network be completed within Belgrade to provide for safe pedestrian travel. Installation of sidewalk would also allow for construction of curb, gutter, and storm drainage to help direct and control storm water.

Limitations/constraints:

- There are potential impacts to adjacent business access and parking.

Resource Considerations:

- The topography of the area is flat which may provide challenges to controlling storm water.

Estimated Cost:

- $1.5M

Implementation Timeframe:

- Mid-term

7. Complete Sidewalk Network along North 7th Avenue in Bozeman

Sidewalk connectivity between Redwing Drive and the I-90 westbound ramps is intermittent on both the east and west sides of North 7th Avenue. Social trails are present between Griffin Drive and Nikles/Wheat Drive. It is recommended that the sidewalk network be completed along North 7th Avenue between I-90 and the south approach for Red Wing Drive. Installation of sidewalk would also allow for construction of curb, gutter, and storm drainage to help direct and control storm water.

Limitations/constraints:

- There are potential impacts to adjacent business access.

Resource Considerations:

- The topography of the area is flat which may provide challenges to controlling storm water.

Estimated Cost:

- $500,000

Implementation Timeframe:

- Mid-term

2.2.3. Corridor Improvements

8. Passing Zone Modifications

Passing opportunities are provided by passing zones designated with dashed yellow centerlines. Passing zones are located in areas with 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.

A total of 14 passing zones, seven eastbound and seven westbound, exist along the study corridor. Eight of the 14 passing zones are less than 1,000 feet in length, the minimum recommended length according to the MDT *Traffic Engineering Manual*[6]. It is recommended that passing zones be evaluated and modified to meet existing standards.

Limitations/constraints:

- May result in increased driver frustration due to decreased passing opportunities.

Resource Considerations:

- No impacts identified

Estimated Cost:

- $30,000

Implementation Timeframe:

- Short-term

9. Install Centerline Rumble Strips

Centerline rumble strips provide audible and vibratory warning as a means to alert drivers crossing the roadway centerline. Installation of centerline rumble strips have been shown to reduce head-on and opposite direction sideswipe crashes. Centerline rumble strips currently exist on the west end of the corridor between Airway Boulevard and RP 23.2. Centerline rumble strips are also included in the existing slope flattening project between RP 23.0 and RP 24.6 (see **Section 2.1** for more detail).

Installation of centerline rumble strips on the remaining rural portion of the corridor is recommended, as appropriate. Centerline rumble strips near residential areas is not desirable due to noise issues. Installation of centerline rumble strips is envisioned as a short-term recommendation to help improve safety.

Consideration of pavement condition and the effects of centerline rumble strips on pavement should be assessed. The corridor currently has generally poor pavement condition. Installation of centerline rumble strips on poor pavement may result in additional maintenance concerns.

Limitations/constraints:

- The corridor has generally poor pavement condition.

Resource Considerations:

- There is potential for noise impacts to adjacent lands.

Estimated Cost:

- $30,000

Implementation Timeframe:

- Short-term

10. Develop Separated Shared-use Path

Public and stakeholder input indicates the desire to construct a separated shared-use path between Belgrade and Bozeman. Current local planning documents conflict somewhat on long-term non-motorized infrastructure recommendations for the Frontage Road. Most documents indicate a desire for a separated path in addition to widened shoulders. This option focuses specifically on developing a separated path as a stand-alone project, while widened shoulders are discussed later as part of a full roadway reconstruction (Option 10).

A separated path is envisioned to connect the urban areas of Belgrade and Bozeman to provide for non-motorized use. While some sidewalks exist along the urban portions of the corridor, there are minimal shoulders along the rural portions of the corridor.

A substantial portion of the Frontage Road is located on railroad right-of-way through easement. It is unlikely that a separated path could be developed south of the existing Frontage Road adjacent to the railroad. The railroad has provided guidance that any development south of the existing edge of roadway would be prohibited. Additional guidance suggests that development of trails within railroad right-of-way is not allowed. Preference has been expressed to develop the separated path north of the Frontage Road. Regardless of whether a separated path is constructed within the roadway easement, or if it would be constructed totally, or partially, outside of the railroad right-of-way, additional land acquisition and/or easement is required. Coordination with the railroad will be needed during project development.

Note that Option 10 discussed later recommends a long-term improvement to reconstruct the corridor to include eight-foot shoulders. Such shoulders are intended to improve safety for all users and would improve mobility for non-motorized users. A separated path may further enhance safety and mobility; initiating the development of a separated path would fall to local entities to prioritize and secure funding. Timing for the construction of the facility would be dependent upon a complete funding package.

Limitations/constraints:

- Additional right-of-way is needed.
- Coordination with the railroad will be needed during project development.
- There are physical constraints due to the railroad and existing development.

Resource Considerations:

- May require structure replacement or extension at stream crossings.
- There are areas of irrigated farmland.
- Potential impacts to roadside and adjacent landowner drainage.

Estimated Cost:

- $820,000 to $1.1M per mile

Implementation Timeframe:

- Mid- to Long-term

11. Roadway Reconstruction

The study corridor consists of multiple roadway segments with varying typical sections and adjacent land use. Between Jackrabbit Lane and Gallatin Field Road the corridor is generally urban in nature with a mixture of commercial, industrial, and residential development. The roadway has shoulders/on-street parking and includes a center left-turn between Jackrabbit Lane and North Quaw Boulevard. The corridor was reconstructed between Gallatin Field Road and Airport Road to include shoulders and turn-lanes at major intersections.

Between Airport Road and Springhill Road, the surrounding land use is primarily agricultural with occasional residential areas. This section lacks roadway shoulders and consists of one 12-foot travel lane in each direction. The roadway parallels and is generally constrained to the south by the railroad. Some spot residential developments exist on the north side along this segment.

East of Springhill Road, the corridor transitions back to an urban character. Between Springhill Road and the railroad overpass, the roadway parallels the railroad with residential development on the north side. South of the railroad overpass, the road becomes an urban roadway with shoulders and a center left-turn lane.

The segments between Jackrabbit Lane and Quaw Boulevard as well as between Gallatin Field Road and Airport Boulevard have recently been reconstructed. Reconstruction of the Frontage Road between RP 23.0 and RP 24.6 is currently under development (**Section 2.1**) with an anticipated letting sometime in 2018. The remaining portions of the corridor should be reconstructed to accommodate widened shoulders and turn lanes at select locations.

Reconstruction of the roadway is needed to address operational issues, improve safety, and to accommodate existing and future demands. The corridor was broken into multiple segments based on logical breaks for project development. An evaluation was made of multiple roadway typical sections given existing and projected demands, safety, and project development constraints. The

typical sections were developed based on existing standards. The following sections discuss the corridor reconstruction recommendations for each segment.

Segment 1 – North Quaw Boulevard to Gallatin Field Road

This segment consists of the urban portion of the corridor through Belgrade. This portion of the corridor has commercial, industrial, and residential developed lands. Existing traffic volumes along the corridor range from approximately 5,250 vehicles per day (vpd) on the west end to 9,550 vpd near Gallatin Field Road. These volumes are projected to increase to 7,300 vpd and 13,300 vpd by the year 2040.

Reconstruction of this segment is envisioned to consist of one travel lane in each direction, continuation of the center left-turn lane (or turn bays at the major intersections) where appropriate, eight-foot shoulder/parking, sidewalks, curb, gutter, and storm drainage. Between North Quaw Boulevard and North Davis Street the corridor is generally constrained to the north and south by existing development. This segment would connect to the portion reconstructed with the East Belgrade Interchange project.

Limitations/constraints:

- There are potential impacts to adjacent business access and parking.
- Would likely require additional right-of-way.

Resource Considerations:

- There are historic age properties adjacent to the roadway through downtown Belgrade.
- The topography of the area is flat which may provide challenges to controlling storm water.
- The Lewis and Clark Park, located near the intersection with Oregon Street, is subject to 4(f)/6(f) protection.
- There are three public water supply wells located in close proximity to the roadway.

Estimated Cost:

- $5.4M

Implementation Timeframe:

- Long-term

Segment 2 – Airport Road to RP 23.0

This segment of the Frontage Road is rural with mixed residential and agricultural lands to the north. The railroad parallels the roadway to the south. Under existing conditions, the roadway has approximately 7,500 vpd. Traffic volumes are projected to reach 10,500 vpd by the year 2040.

Reconstruction of this segment is envisioned to connect the East Belgrade Interchange project with the planned slope flattening project (see **Section 2.1**). Reconstruction would include one travel lane in each direction and eight-foot shoulders.

Limitations/constraints:

- May result in increased vehicle speeds.
- Additional right-of-way is needed.
- There are developments on the north side of the roadway in close proximity to the existing edge of pavement.

Resource Considerations:

- The railroad is in close proximity to the south edge of the roadway.
- A new crossing of Hyalite Creek is needed.

Estimated Cost:

- $5.0M

Implementation Timeframe:

- Long-term

Segment 3 – RP 24.6 to Springhill Road

This segment is similar to Segment 2; the roadway is rural in nature with mixed agricultural and residential lands to the north, and the railroad to the south. Existing traffic volumes are approximately 5,750 vpd east of East Valley Center Spur Road. Projections show volumes reaching 8,000 vpd.

As with Segment 2, reconstruction is envisioned to include one travel lane in each direction and eight-foot shoulders. This segment would connect the planned slope flattening project (see **Section 2.1**) with the Springhill Road intersection where the corridor begins to transition into urban Bozeman.

Limitations/constraints:

- May result in increased vehicle speeds.
- Additional right-of-way is needed.
- There are developments on the north side of the roadway in close proximity to the existing edge of pavement near Springhill Road.

Resource Considerations:

- The railroad is in close proximity to the south edge of the roadway.
- There are irrigated lands to the north.
- Sunset Memorial Park cemetery is located to the north at RP 25.4.

Estimated Cost:

- $7.8M

Implementation Timeframe:

- Long-term

Segment 4 – Springhill Road to Railroad Overpass

This segment of the Frontage Road serves as a transition between rural and urban environments. Lands to the north include some commercial, residential, and recreational lands. To the south, the corridor is constrained by the railroad. There are currently approximately 6,100 vpd along this segment. Traffic volumes are projected to increase to 8,000 vpd by the year 2040. Reconstruction of this segment is recommended to include one travel lane in each direction, eight-foot shoulders, and a center left-turn lane where appropriate. New development is planned south of the Frontage Road which could result in modifications to the northern Red Wing Drive access.

Limitations/constraints:

- May result in increased vehicle speeds.
- Additional right-of-way is needed.
- There are developments on the north side of the roadway in close proximity to the existing edge of pavement.

Resource Considerations:

- The railroad is in close proximity to the south edge of the roadway.
- The Cherry River Fishing Access, located on the north side of the roadway at RP 2.25, is subject to 4(f)/6(f) protection.

Estimated Cost:

- $6.9M

Implementation Timeframe:

- Long-term

Segment 5 – Railroad Overpass to I-90

This segment consists of North 7th Avenue on the north end of Bozeman. The context of the area is urban with mixed commercial and industrial developed lands on both sides of the corridor. The roadway transitions to include a center left-turn lane south of the railroad overpass. The roadway currently has narrow shoulders and has intermittent sidewalks, curb, and gutter. There are currently almost 10,000 vpd along this segment. Traffic volumes are projected to increase to nearly 14,000 AADT by the year 2040.

It is recommended that this segment be reconstructed to an urban roadway complete with one travel lane in each direction, center left-turn lane or turn bays at major intersections, eight-foot shoulders, curb, gutter, storm drainage, and sidewalks.

Limitations/constraints:

- May impact existing business access and parking.

Resource Considerations:

- There is a public water supply well located in close proximity to the roadway.

Estimated Cost:

- $4.4M

Implementation Timeframe:

- Long-term

3.0. SUMMARY

This memorandum identifies improvement options for Main Street/Frontage Road between Jackrabbit Lane in Belgrade and I-90 in Bozeman. The improvement options were based on the evaluation of several factors including, but not limited to: engineering analysis of as-built drawings, crash data analysis, consultation with resource agencies, and information provided by the public.

The potential improvements are intended to offer a range of potential mitigation strategies for corridor issues and areas of concern. Small scale improvement options were identified as low-cost options for addressing identified areas of concern. 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. A summary of the recommended improvement options is provided in **Table 4** and shown graphically in **Figure 1**.

Table 4: Improvement Options

	IMPROVEMENT OPTION	DESCRIPTION	IMPLEMENTATION TIMEFRAME	COST ESTIMATE
INTERSECTION IMPROVEMENTS				
1.	Broadway Street Intersection Improvements	Installation of a traffic signal or single lane roundabout at the intersection of Main Street and Broadway Street.	Mid-term	$1.6M (Traffic signal with left-turn lanes) $1.3M (Traffic signal without left-turn lanes) $2.3M (Single lane roundabout)
2.	Oregon Street Intersection Improvements	Installation of additional traffic control (all-way stop, traffic signal, or single lane roundabout) at the intersection of Main Street and Oregon Street.	Mid-term	$0.8M (All-way stop) $1.8M (Traffic signal) $2.4M (Single lane roundabout)
3.	Airport Road Intersection Improvements	Installation of an eastbound left-turn lane and/or traffic signal at the intersection of Frontage Road and Airport Road.	When warranted	0.9M (Left-turn lane) $1.7M (Traffic signal with left-turn lane)
4.	Nelson Road Intersection Improvements	Installation of a traffic signal at the intersection of Frontage Road and Nelson Road.	When warranted	$900,000
SPOT IMPROVEMENTS				
5.	Evaluate School Traffic in Belgrade	Detailed investigation into possible mitigation options to improve traffic operations related to school traffic.	Short-term	$30,000
6.	Complete Sidewalk Network along Main Street in Belgrade	Construction of sidewalks, curb, gutter, and storm drain along Main Street within Belgrade.	Mid-term	$1.5M
7.	Complete Sidewalk Network along North 7th Avenue in Bozeman	Construction of sidewalks, curb, gutter, and storm drain along North 7th Avenue within Bozeman.	Mid-term	$500,000
CORRIDOR IMPROVEMENTS				
8.	Passing Zone Modifications	Evaluate and modify existing passing and no-passing signing and striping to meet current standards.	Short-term	$30,000
9.	Install Centerline Rumble Strips	Construct centerline rumble strips along the rural portions of the corridor as appropriate.	Short-term	$30,000
10.	Develop Separated Shared-use Path	Investigate opportunities for the development of a shared-use path between Bozeman and Belgrade.	Mid- to Long-term	$820,000 to $1.1M per mile
11.	Roadway Reconstruction	Reconstruct the corridor to include one travel lane in each direction, center left-turn lane (where appropriate), and eight-foot shoulders.	Long-term	$5.4M (Segment 1) $5.0M (Segment 2) $7.8M (Segment 3) $6.9M (Segment 4) $4.4M (Segment 5)

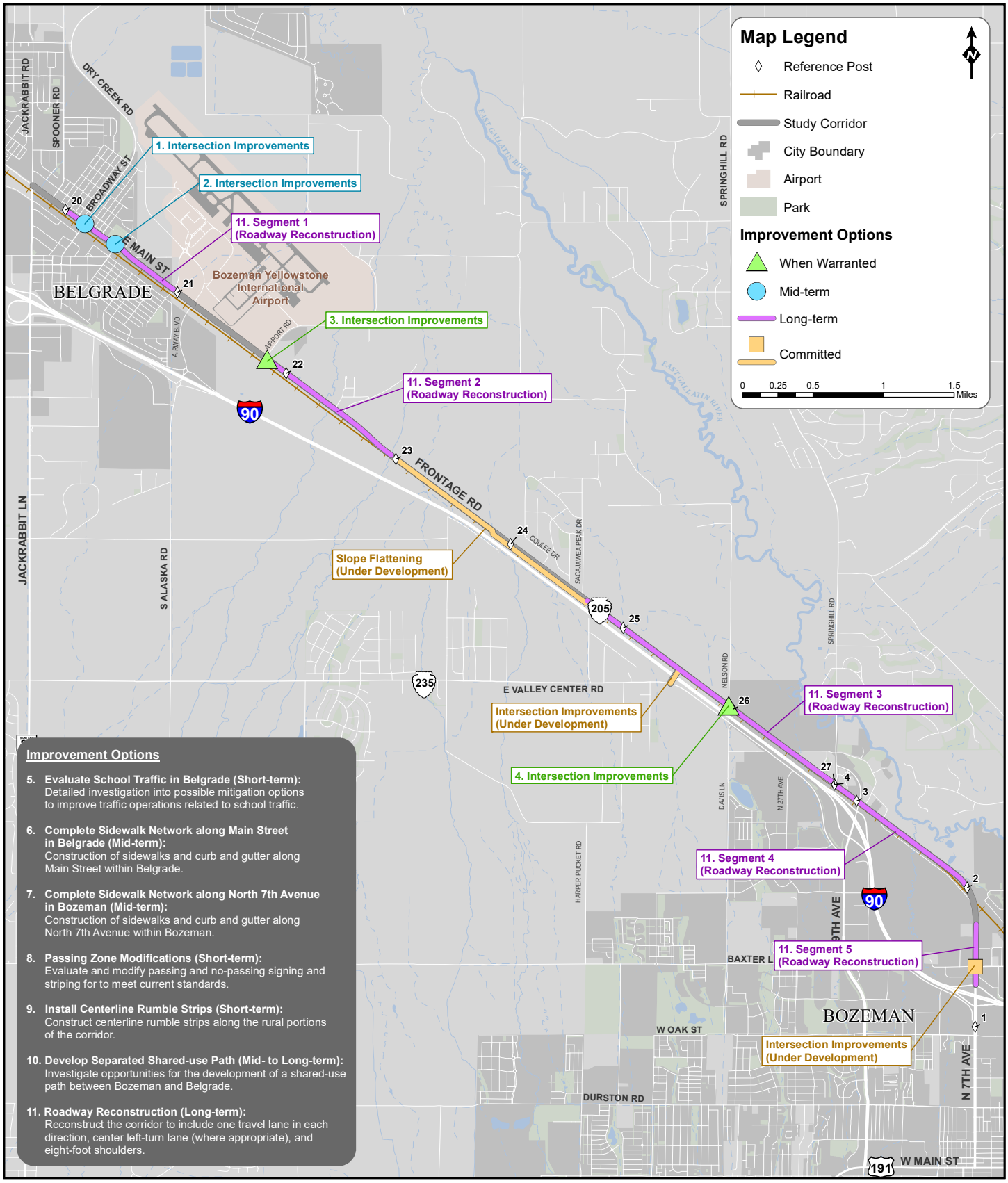

Figure 1: Improvement Options

4.0. REFERENCES

[1] *MDT Cost Estimation Procedure for Highway Design Projects*, November, 2016, http://www.mdt.mt.gov/other/webdata/external/cadd/report_templates_guidance/costest_procedure.pdf

[2] *Geometric Analysis, North 7th Street Intersections – Bozeman*, UPN 8036012, October 4, 2016, Montana Department of Transportation

[3] *Existing and Projected Conditions Technical Memorandum*, Robert Peccia and Associates, December 09, 2016, http://www.mdt.mt.gov/belgradetobozeman/docs/E-P.pdf.

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