Billings Area
I-90 Corridor Planning Study

Final Report

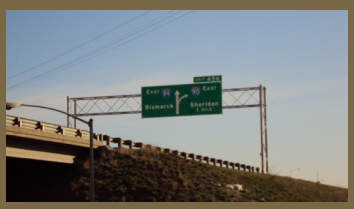
March 2012

For:

MONTANA MDT

By:

DOWL HKM



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Visit the study website at:

http://www.mdt.mt.gov/pubinvolve/i90corridor

ACKNOWLEDGEMENTS

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ABBREVIATIONS AND ACRONYMS

AADT ..... Annual Average Daily Traffic
AASHTO ..... American Association of State Highway and Transportation Officials
ADT ..... Average Daily Traffic
APE ..... Area of Potential Effect
ATR ..... Automatic Traffic Recorder
BBWA ..... Billings Bench Water Association
CIL ..... Complete Interchange Lighting
CO ..... Carbon Monoxide
CWA ..... Clean Water Act
DEQ ..... Department of Environmental Quality
EB ..... Eastbound
EIS ..... Environmental Impact Statement
EO ..... Executive Order
FHWA ..... Federal Highway Administration
ft ..... feet
FPPA ..... Farmland Protection Policy Act
HBRRP ..... Highway Bridge Replacement and Rehabilitation Program
HCM ..... Highway Capacity Manual
HCS ..... Highway Capacity Software
HSIP ..... Highway Safety Improvement Program
I-90 ..... Interstate 90
IM ..... Interstate Maintenance
LOS ..... Level of Service
LUST ..... Leaking Underground Storage Tank
MDT ..... Montana Department of Transportation
MDU ..... Montana Dakota Utilities
MNHP ..... Montana Natural Heritage Program
MPDES ..... Montana Pollutant Discharge Elimination System
mph ..... miles per hour
MPO ..... Metropolitan Planning Organization
NEPA/MEPA ..... National and Montana Environmental Policy Acts
NHPA ..... National Historic Preservation Act
NHS ..... National Highway System
NPL ..... National Priority List
NRHP ..... National Register of Historic Places
NRIS ..... Natural Resource Information System
PIL ..... Partial Interchange Lighting
PWS ..... Public Water System
RCRA ..... Resource Conservation and Recovery Act
ROD ..... Record of Decision
RP ..... Reference Post
Section 4(f) ..... Section 4(f) of the 1966 Department of Transportation Act
Section 6(f) ..... Section 6(f) of the National Land and Water Conservation Funds Act
SEH ..... Short Elliott Hendrickson Inc
SO_2 ..... Sulfur Dioxide
SPA ..... Stream Protection Act
SPUI ..... Single Point Urban Interchange
STPU ..... Surface Transportation Program – Urban
TBS ..... Traffic by Section
TCP ..... Traffic Count Program
TEM ..... Traffic Engineering Manual
TMDLs ..... Total Maximum Daily Loads
TWSC ..... Two-Way Stop-Controlled
USACE ..... U.S. Army Corps of Engineers
USEPA ..... U.S. Environmental Protection Agency
WB ..... Westbound

EXECUTIVE SUMMARY

The Montana Department of Transportation (MDT), in cooperation with the City of Billings, Yellowstone County, and the Federal Highway Administration (FHWA), initiated the Billings Area I-90 Corridor Planning Study to assess approximately 22 miles of Interstate 90 (I-90) beginning at the Laurel Interchange (Reference Post [RP] 433.8) and ending immediately west of the Pinehills Interchange Reference Post (RP 455.85).

Yellowstone County and the City of Billings are continuing to grow, putting increased pressure on the I-90 corridor near Billings. This study was initially requested by the MDT Billings District Office to help plan for future operational, geometric, and safety improvements and address issues in a timely manner as traffic demand increases. Near term and long term options are recommended to address the I-90 corridor needs and objectives within the 2035 planning horizon. These recommendations will help MDT identify potential future projects to be implemented over time as funding becomes available.

The study focuses on mainline I-90 elements, including Interstate segments and interchange ramps. It also analyzes the Laurel and Mossmain Interchanges, supplementing analysis conducted for the 2006 Billings I-90 Interchanges Project report (Short Elliott Hendrickson Inc [SEH] 2006). The 2006 SEH report assessed the Shiloh, South Billings Boulevard, South 27th Street, Lockwood, and Johnson Lane Interchanges. The West Billings Interchange was not included in the 2006 SEH report or this study due to MDT improvements completed in 2007.

ES.2 Corridor Needs

Corridor needs and objectives were developed through a review of existing and projected conditions, input from community members and resource agencies, and coordination with MDT staff. They reflect transportation system issues and concerns and the desired condition of the corridor.

Need 1: Accommodate existing and future transportation demand on I-90.

Objectives

1.a Maintain Level of Service (LOS) B or better for rural and urban mainline segments and interchange ramps through the 2035 planning horizon.

1.b Maintain LOS C or better for Laurel and Mossmain ramp intersections through the 2035 planning horizon year.

Need 2: To the extent practicable, provide a facility that safely accommodates Interstate travel.

Objectives

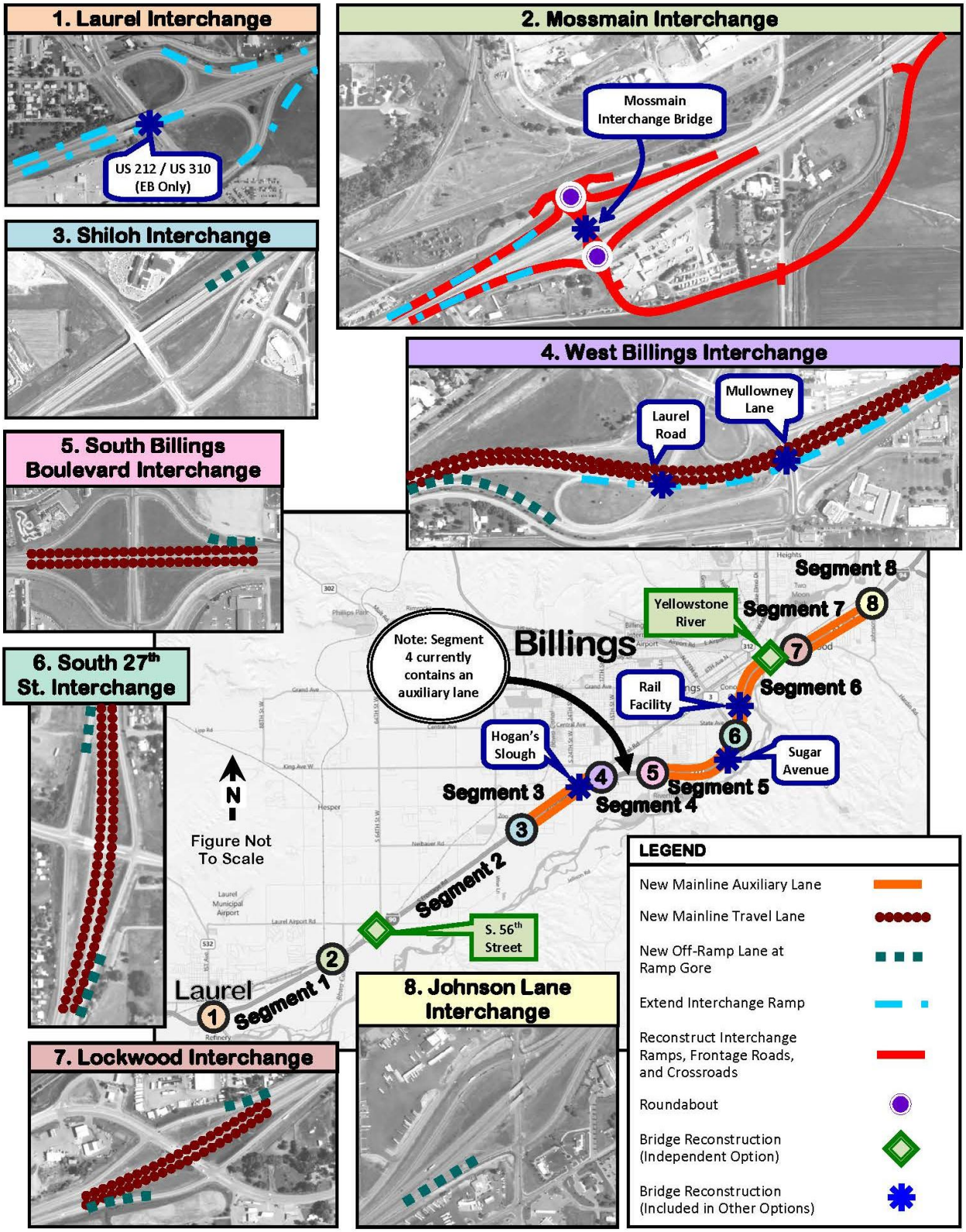
2.a Provide roadway elements that meet current MDT design standards.

2.b Provide bridge structures that meet current MDT design standards.

ES.3 Improvement Options

Recommended improvement options are illustrated in Figure ES-1. Options include improvements to mainline Interstate segments, bridges, and interchanges to address corridor operational, geometric, and safety needs.

Figure ES-1 Recommended Improvement Options



ES.4 Conclusion

This corridor study recommends a set of near term and long term improvements to the I-90 corridor from the Laurel Interchange (RP 433.8) to the mainline segment ending immediately west of the Pinehills Interchange (RP 455.85). Improvements were developed to address corridor needs, including current and projected traffic demands and safety issues.

Recommended improvement options include:

- mainline Interstate widening and interchange reconstruction to address capacity needs and traffic operations within the 2035 planning horizon;
- bridge reconstruction to accommodate mainline Interstate widening and bring structures up to current MDT standards;
- safety improvements to reduce conflicts at interchange ramps; and
- geometric improvements to bring the Interstate facility into compliance with current MDT design standards.

Development and implementation of appropriate combinations of improvement options will depend upon future funding availability and other system priorities. For all improvement options, a traffic analysis and geometric design would be developed during project design. This study indicates there are no major technical or environmental impediments to further development of recommended improvements.

1.0 INTRODUCTION

1.1 Purpose and Scope of Study

The Montana Department of Transportation (MDT), in cooperation with the City of Billings, Yellowstone County, and the Federal Highway Administration (FHWA), initiated the Billings Area I-90 Corridor Planning Study to assess approximately 22 miles of Interstate 90 (I-90) beginning at the Laurel Interchange (Reference Post [RP] 433.8) and ending immediately west of the Pinehills Interchange (RP 455.85). Figure 1-1 illustrates the study area termini, mainline Interstate segments, and interchanges within the corridor.

Yellowstone County and the City of Billings are continuing to grow, putting increased pressure on the I-90 corridor near Billings. This study was initially requested by the MDT Billings District Office to help plan for future operational, geometric, and safety improvements and address issues in a timely manner as traffic demand increases. Near term and long term options are recommended to address corridor needs and objectives within the 2035 planning horizon. These recommendations will help MDT identify potential future projects to be implemented over time as funding becomes available.

The study focuses on mainline I-90 elements, including Interstate segments and interchange ramps. It also analyzes the Laurel and Mossmain Interchanges, supplementing analysis conducted for the 2006 Billings I-90 Interchanges Project report (Short Elliott Hendrickson Inc [SEH] 2006). The 2006 SEH report assessed the Shiloh, South Billings Boulevard, South 27th Street, Lockwood, and Johnson Lane Interchanges. The West Billings Interchange was not included in the 2006 SEH report or this study due to MDT improvements completed in 2007.

1.2 Process

The study follows the 2009 Montana Business Process to Link Planning and National and Montana Environmental Policy Act (NEPA/MEPA) Reviews, MDT's guideline for conducting corridor planning studies. This process facilitates a smooth and efficient transition from early transportation planning efforts to project development and environmental review conducted in compliance with NEPA/MEPA. The planning process identifies corridor needs and objectives; provides opportunities for early engagement with community members, stakeholders, and resource agencies; and develops feasible improvement options that minimize impacts to important resources. Early planning efforts simplify and streamline subsequent project development by identifying and avoiding fatal flaws.

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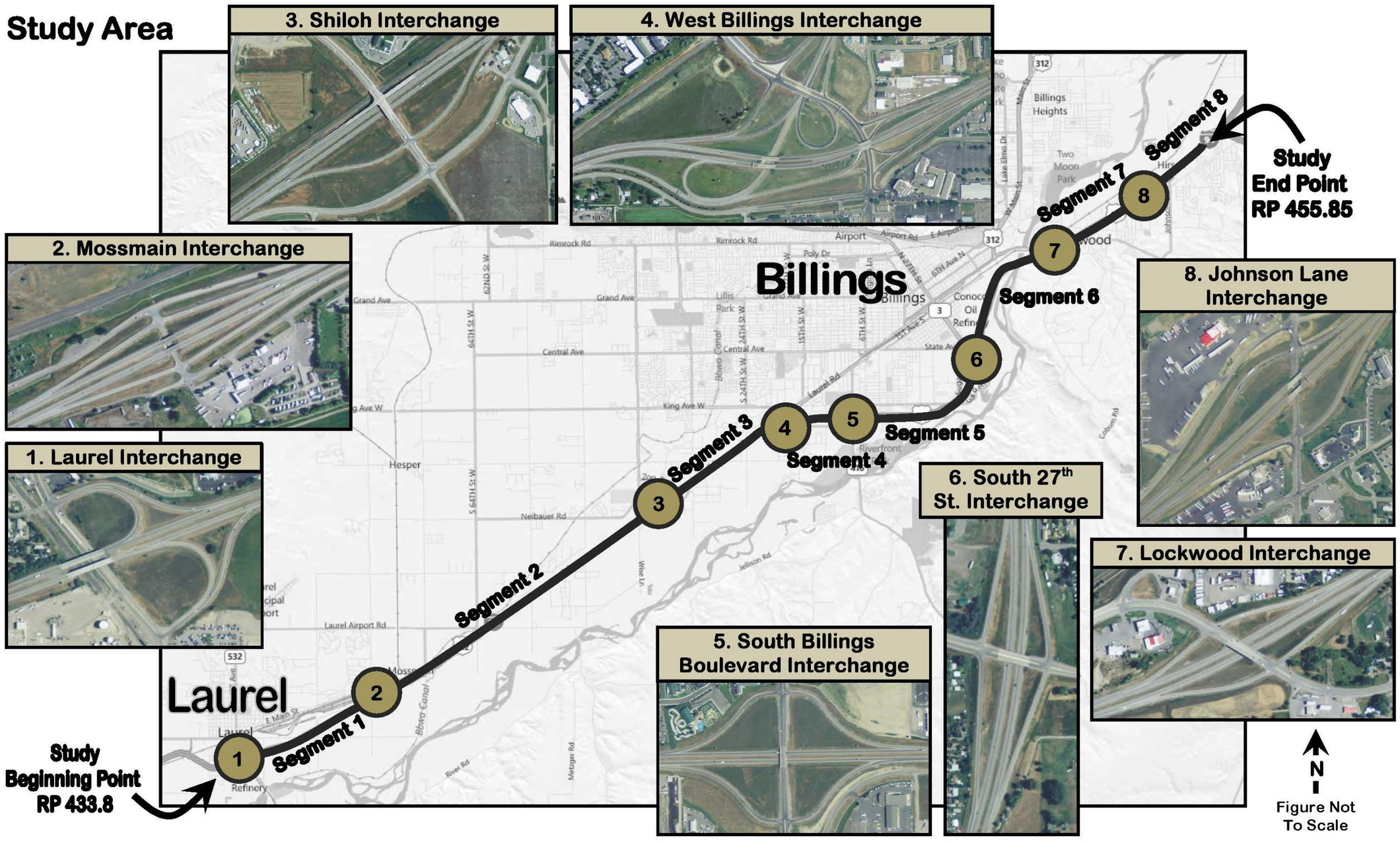
Figure 1-1 Study Area



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2.0 COMMUNITY AND AGENCY PARTICIPATION

Public involvement and consultation with federal, state, and local agencies are key elements in linking planning studies and subsequent NEPA/MEPA reviews. MDT provides avenues for resource agencies, stakeholders, and community members to participate throughout the corridor planning process to provide input on needs, issues, concerns, and recommended improvement options. Specific opportunities are described in the following sections. Additional information is provided in the Community and Agency Participation Plan developed for this study (Appendix A).

2.1 Study Website

The study website (http://www.mdt.mt.gov/pubinvolve/i90corridor/) was developed to provide information about this study. Draft documents were posted for public review and comment during the study process. Informational meeting announcements were posted to encourage community involvement in the study. Website links provided an opportunity for members of the public to post comments during the corridor study process. A Frequently Asked Questions (FAQs) page provided information about the corridor planning process and public participation opportunities. A Related Links page provided access to MDT, City of Billings, and Yellowstone County websites, as well as links to the Montana Business Process to Link Planning Studies and NEPA/MEPA Reviews and the Billings Bypass EIS website.

2.2 Community Involvement Activities

Two informational meetings were conducted during the corridor study process. Meetings were advertised in the Billings Gazette and the Laurel Outlook and a press release was issued to radio stations, newspapers, and other local media outlets before each meeting. Newsletters were distributed before and during each meeting and provided information on corridor study progress, upcoming meetings, and available study documentation. Materials from both informational meetings, including advertisements and press releases, sign in sheets, agendas, newsletters, presentations, and written comments, are included in Appendix A.

2.2.1 Informational Meeting #1

The first informational meeting was held on September 13, 2011 at the Parmly Billings Library in Billings, MT. Nine members of the public attended the meeting. The presentation provided an overview of the corridor planning study process; the study area and analysis locations; and key findings from the Existing and Projected Conditions Report.

A short discussion period followed the presentation. An attendee asked which bridges within the corridor would need to be replaced. Functionally obsolete bridges eligible for rehabilitation were identified. The bridges crossing the Yellowstone River and the term "fracture critical" were discussed. It was noted that this term does not mean the Yellowstone River bridge structures are in danger of collapsing, rather redundancy is not built in and their replacement is of high priority. Another attendee commented Billings will likely grow due to expansion of oil development activity in the area.

2.2.2 Informational Meeting #2

The second informational meeting was held on February 28th, 2012 at the Parmly Billings Library in Billings, MT. Three members of the public attended the meeting. Recommended improvement options were presented, and planning level costs and anticipated environmental impacts were discussed. Community members were asked to provide feedback on recommended improvement options. Table 2.1 summarizes comments provided during the informational meeting and the comment period for the study.

Table 2.1 Summary of Comments

Comments Provided During Informational Meeting on February 28, 2012	Response
Is construction of auxiliary lanes a step before construction of a third through travel lane? Would auxiliary lanes or a third through travel lane be more conducive to future growth in the Billings area?	Auxiliary lanes are typically developed where additional capacity is needed between adjacent interchanges, due to traffic volumes entering the Interstate at one interchange and exiting the Interstate at the following interchange. Through travel lanes are typically constructed where additional capacity is needed due to traffic volumes continuing through one or more downstream interchanges. Additional analysis will be completed during project development to determine lane configurations.
When will the improvement options be constructed?	The corridor study presents potential improvement options that could be considered as funding allows. MDT has nominated the two Yellowstone Bridge structures for replacement based on the results of the Billings Area I-90 Corridor Planning Study. MDT will identify appropriate funding and timeframes for project programming and construction.

Comments Provided During Informational Meeting on February 28, 2012	Response
Would the roundabouts proposed at the Mossmain Interchange address capacity needs at the crossroad intersections?	The proposed roundabout configuration is anticipated to address the capacity needs at the Mossmain Interchange intersections. Several other options were considered in this location, including braided ramps, a single point urban interchange, reconstruction of the frontage roads, and signal optimization. The roundabout configuration is just one solution identified to address the capacity needs at the interchange intersections. Roundabouts and other configurations will be considered during project development.
Who would be responsible for maintaining the proposed roundabouts at the Mossmain Interchange intersections?	MDT would be responsible for maintaining the roundabouts at the Mossmain Interchange intersections. However, MDT may enter into agreements for the maintenance of landscaping if specialized landscaping is requested.
What is the overall cost savings of a roundabout as opposed to a signalized intersection?	The initial construction costs between building a roundabout and a traffic signal are comparable. A roundabout may need more right-of-way within the actual intersection, but requires less space on the streets approaching the roundabout. Roundabouts usually require less overall right-of-way to build than a signal with turn lanes because traffic doesn't have to line up and wait for a green light. In addition to reducing congestion and increasing safety, roundabouts eliminate hardware, maintenance and electrical costs associated with traffic signals. However, there are typically more overhead lights and additional maintenance with the central island landscaping at a roundabout. Many communities are also favorable to the aesthetics of a well-designed and landscaped roundabout. There is typically little difference in the overall cost and maintenance between a signalized intersection and a roundabout. Additional cost savings over the lifetime of the intersection can be realized by improved safety and improved efficiency (less CO_2 emissions and associated gasoline consumption).
How far was traffic projected when the Shiloh Interchange was originally constructed?	Traffic was projected for 20 years. The Shiloh interchange was constructed in 2001 with traffic projected to 2021. The analysis completed for this study indicates by 2027 traffic will have increased to a point where improvements may be necessary at the westbound off-ramp.
Money can be saved by choosing the right configuration of auxiliary lanes or three through travel lanes. Billings will be big enough for three through travel lanes at some point.	Additional analysis would be necessary during project development to determine if auxiliary lanes or additional through travel lanes are warranted.

Comments Provided During Informational Meeting on February 28, 2012	Response
The Lockwood Interchange on-and off-ramps are not long enough.	A study of the Lockwood Interchange intersections were completed in 2006, and the recommendations from that study are still considered valid. Roundabouts at the crossroad intersections were recommended for the Lockwood Interchange. It is anticipated that roundabouts would correct the intersection proximity issues (by incorporating Coburn Road, which also alleviates the future need to signalize this intersection), and avoiding more costly widening to the bridge structure.
When will work on the Lockwood Interchange begin?	Nomination of projects will be determined by MDT based upon available funding.
Written Comments Provided During the Comment Period Ending March 16, 2012	**Response**
Letter received from the Montana Historical Society dated February 24, 2012: Thank you for the invitation. We will not be attending the meeting, but look forward to working with Jon Axline and Steve Platt on this undertaking when required. We have no comments on the Corridor Planning Study.	Thank you for your comment.
Letter received from the Department of Natural Resources and Conservation (DNRC) dated March 13, 2012: In reviewing the Study, it appears the only identified project that would require additional review from DNRC Trust Lands is the proposed reconstruction of the eastbound and westbound I-90 bridges that span the Yellowstone River in Section 34-T1N-R26E. The DNRC asserts ownership over this portion of the Yellowstone River and have not been able to find evidence that an easement was previously granted to the Montana Department of Transportation for these bridges. The right-of-way illustrations in the Study do not show a right-of-way across the Yellowstone River. Additionally, this conflicts with Table 5.8 that indicates that no right-of-way acquisition is required for Option B-6.	Thank you for your comment. Right-of-way plans (Appendix B) and mainline plan sheets (Appendix D) have been updated to reflect right-of-way/easement boundaries noted on as-built plans for this portion of the corridor. The status of right-of-way/easement agreements would need to be verified during project development. Table 5.8 has been updated to reflect the possible need for additional right-of-way/easement acquisition. Please refer to Appendix D for a discussion of anticipated permitting requirements, including a DNRC Land Use License (LUL) or easement on navigable waters.

2.3 Resource Agency Meeting

Resource agencies were invited to attend a meeting on September 22, 2011 to discuss issues and concerns regarding environmental resources within the corridor. Representatives from MDT, U.S. Fish and Wildlife Service (USFWS), Environmental Protection Agency (EPA), the City of Billings, and Yellowstone County attended the meeting.

The presentation provided an overview of the corridor planning study process, the study area and analysis locations, key findings from the Existing and Projected Conditions Report, and environmental issues and constraints within the corridor.

Agency representatives provided comments throughout the presentation. U.S. Fish and Wildlife Service (USFWS) asked if ditches in the area carry fish and if culverts were designed for fish passage. MDT noted there are reported instances of ditches carrying fish. MDT added this would be assessed in more detail during an environmental review process and culverts would be updated to current MDT design standards if improvement options are forwarded from the corridor study. USFWS stated bald eagle nests have been identified near the Laurel and Johnson Lane interchanges. MDT noted pallid sturgeon may be present in the Yellowstone River. USFWS stated reconstruction of the Yellowstone River bridge structures should minimize impacts to the Yellowstone River.

Materials from the resource agency meeting, including the invitation letter, presentation, meeting minutes, and written agency comments, are included in Appendix A.

2.4 Work Group Meetings

Work group meetings were generally held every two weeks throughout the 12-month study period. Representatives from MDT, FHWA, the City of Billings, and Yellowstone County discussed study progress, analysis methodologies and results, draft reports, and various issues and concerns during the course of the study. The work group served in an advisory role and reviewed study documentation before publication.

3.0 EXISTING AND PROJECTED CONDITIONS

3.1 Transportation System Conditions

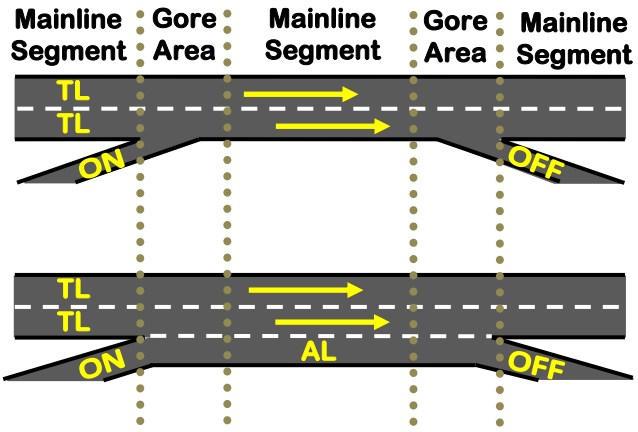
The Interstate transportation system is discussed in terms of its physical features, geometric characteristics, crash history, traffic volumes, and operational characteristics. Detailed maps, figures, and data are provided in the Existing and Projected Conditions Report (Appendix B).

Figure 3-1 illustrates terms used throughout this study to describe elements of the Interstate transportation facility. Mainline segments occur between interchange on- and off-ramps. Ramp gore areas (merge and diverge segments) are the portions of the Interstate where traffic generally enters or exits without having to change lanes to enter or leave a through travel lane. An exception to this general condition occurs with an auxiliary lane, which is defined as a lane that is located between adjacent interchanges, but does not proceed through interchanges.

Figure 3-1 Illustration of Interstate Elements

A) Interstate segment with two travel lanes

B) Interstate segment with two travel lanes and one auxiliary lane



Key		
	TL:	Travel Lane
	AL:	Auxiliary Lane
	ON:	Interchange On-Ramp
	OFF:	Interchange Off-Ramp

Note: Examples A and B illustrate two lanes of a four-lane divided Interstate facility. This figure is intended for illustrative purposes only and does not represent any portion of the I-90 study corridor.

This study focuses on mainline I-90 elements, including Interstate segments and ramp gore areas. The study also analyzes the Laurel and Mossmain Interchanges to supplement analyses conducted for the 2006 SEH report, which only assessed the Shiloh, South Billings Boulevard, South 27th Street, Lockwood, and Johnson Lane Interchange ramp intersections. Recommendations presented in the 2006 SEH report are still valid and have not been revisited by this study. Data from the 2006 SEH report is provided in the Existing and Projected Conditions Report and the Improvement Options Report (Appendices B and D).

3.1.1 Corridor Features and Characteristics

I-90 extends from Seattle, Washington to Boston, Massachusetts and is the longest Interstate highway in the United States (3,020 miles). I-90 generally runs in an east-west direction and serves as the principal east-west route in the Billings area. Within the study area, I-90 is intersected by US 212, US 87, and Montana Highway 3.

Roadway Functional Classification

Functional classification is used to characterize public roads and highways according to the type of service provided by the facility, and the corresponding level of travel mobility and access to and from adjacent property. I-90 is functionally classified as a principal arterial and is part of the National Highway System (NHS). The NHS is a system of highways with the greatest national importance to transportation, commerce and defense in the United States. A portion of I-90, from the South 27th Street Interchange in Billings to the I-90 / I-94 Interchange east of Billings, is part of the Camino Real Trade Corridor, identified by FHWA as a NHS high-priority corridor.

Interstate routes serve as a primary means of moving people, goods, and services throughout the country. They connect principal metropolitan areas, cities, and industrial centers, as directly as practicable. They are important routes into, through, and around urban areas and connect at suitable border points with routes of continental importance. Interstate facilities are characterized by controlled access,[1] high traffic volumes and speeds, and long-distance trips.

Bridges

The MDT Bridge Bureau identified 32 bridges within the study area. Of these, 10 are functionally obsolete and four are eligible for rehabilitation. The term "functionally obsolete" indicates the bridge was built to standards no longer used today. This term does not imply the bridge is unsafe, rather the bridge does not meet current MDT design standards for lane widths,

[1] A controlled access facility restricts all direct access to the facility except through the use of interchange ramps to enhance its primary purpose of unhindered traffic flow.

shoulder widths, or vertical clearances to serve current traffic demand. Eligibility for federal aid for bridge rehabilitation is determined based on the functional or structural status of the bridge and its sufficiency rating. The sufficiency rating is a numerical value ranging from 0 to 100 used to determine eligibility for federal funding. Bridges with a sufficiency rating of 80 or less are eligible for federal bridge rehabilitation funding, and bridges with a sufficiency rating of 50 or less are eligible for federal bridge replacement funding.

The twin eastbound (EB) and westbound (WB) I-90 structures crossing the Yellowstone River are currently classified as fracture critical. The term "fracture critical" indicates the bridge does not include redundant supporting elements. If key supporting elements were to fail, the bridge would be in danger of collapse. A lack of redundancy in the bridge design does not mean it is inherently unsafe, rather it doesn't meet current MDT design standards. MDT is planning for the replacement of these two structures.

Additional information regarding bridge facilities within the corridor is provided in the Existing and Projected Conditions Report (Appendix B).

Railroad Facilities

A rail line and service spur lines owned by BNSF Railway and operated by Montana Rail Link generally parallel I-90 to the north within much of the corridor. Maps illustrating the location of railroad crossings in the corridor are included in the Existing and Projected Conditions Report (Appendix B).

Bicycle and Pedestrian Facilities

There are no dedicated pedestrian or bicycle facilities paralleling I-90 within the Interstate right-of-way. Coulson Park, located on Charlene Street north of the NorthWestern Energy plant, includes a walking trail. The trail crosses under the Yellowstone River Bridge at RP 452± in segment 6, north of the South 27th Street Interchange.

Utilities

NorthWestern Energy and Montana Dakota Utilities (MDU) are the two major utility providers in the corridor. According to information provided by MDT, NorthWestern Energy owns, operates, and maintains approximately 380 power poles, 142 overhead transformers, 46 underground padmount transformers, and three natural gas lines that pass through the corridor. The Williston Basin Interstate Pipeline Company (a subsidiary of the MDU Resources Group) owns and operates a major natural gas pipeline within the corridor.

Multiple pipelines owned and operated by Exxon Mobile, Conoco Phillips, and Cenex oil refineries also traverse the corridor. These pipelines generally convey petroleum products, and operate under pressure. Additionally, multiple water, wastewater, and fiber crossings occur within the corridor.

Right-of-Way

Right-of-way boundaries were estimated based on cadastral data review, available MDT record drawings, and MDT right-of-way plans. Right-of-way boundaries vary throughout the corridor, but are generally 200 to 300 feet wide. Drawings illustrating approximated right-of-way boundaries are included in Existing and Projected Conditions Report (Appendix B).

3.1.2 Geometric Characteristics

Mainline Interstate

Table 3.1 presents MDT geometric design criteria used for this study.

The design speed within the corridor is 70 miles per hour (mph) for a level terrain type. The posted speed limit within the rural portion of the study corridor (RP 433.8 to RP 442.7, from the Laurel Interchange to approximately the Shiloh Interchange) is 75 mph, with a posted truck speed of 65 mph. The posted speed limit for the portion of the study corridor within the Billings urban area (RP 442.7 to RP 455.85, from the Shiloh Interchange to the mainline segment west of the Johnson Lane Interchange) is 65 mph for both passenger cars and trucks.

Table 3.1 Design Criteria

Element			Criteria
Design Controls	Design Forecast Year (Geometrics)		20 Years
	Design Speed	Level Terrain	70 mph
	Level of Service (LOS)		B
Roadway Elements	Travel Lane Width		Four lanes, 12 ft
	Shoulder Width	Outside Shoulder	10 ft
		Inside Shoulder	4 ft
	Cross Slope	Travel Lane	2%
		Shoulder	2%
	Median Width	Level Terrain	Minimum 36 ft
Earth Cut Sections	Ditch	Inslope	6:1 (Width: 6 ft)
		Width	10 ft Minimum
		Slope	20:1 towards back slope
	Backslope; Cut Depth at Slope Stake	0 to 5 ft	5:1
		5 ft to 10 ft	4:1
		10 ft to 15 ft	3:1
		> 15 ft	2:1
Earth Fill Slopes	Fill Height at Slope Stake	0 to 10 ft	6:1
		10 ft to 20 ft	4:1
		20 ft to 30 ft	3:1
		> 30 ft	2:1
Alignment Elements	Stopping Sight Distance		730 ft
	Minimum Horizontal Curve Radius (e = 8%)		1820 ft
	Vertical Curvature (K-Value)	Crest Vertical Curve	247
		Sag Vertical Curve	181
	Maximum Grade	Level Terrain	3%
	Minimum Vertical Clearance		17 ft

Source: MDT Road Design Manual, Chapter 12, page 12(4), Figure 12-2, "Geometric Design Criteria for Freeways (National Highway System – Interstate) U.S. Customary," December 2008.

Roadway Width

I-90 is generally a four-lane divided highway with separate two-lane roadbeds. The area between the West Billings Interchange and the South Billings Boulevard Interchange (RP 446.3 to RP 446.8) includes a third auxiliary lane in each direction. The total paved width in each direction generally ranges from 37 to 45 feet throughout the corridor.

Horizontal Alignment

Horizontal alignment refers to the degree of turns and bends in the road, and includes consideration of horizontal curvature, superelevation, and sight distance. All horizontal curves within the corridor meet current MDT design standards for curve radius and stopping sight distance based on MDT design criteria for a 70 mph design speed. Superelevation information was not available for the corridor.

Vertical Alignment

Vertical alignment refers to the elevation change on a roadway, and includes consideration of grade, vertical curve length, vertical curve type, and sight distance. Table 3.2 lists eight vertical curve locations failing to meet current MDT design standards for a 70 mph design speed.

Table 3.2 Substandard Mainline Vertical Curves

Approximate Mainline Interstate Location	Substandard Element
Laurel Interchange Bridge	Vertical Curvature / Vertical Grade
Laurel Interchange Bridge	Vertical Curvature / Vertical Grade
Mossmain Interchange Bridge	Vertical Curvature
Mossmain Interchange Bridge	Vertical Curvature
Mossmain Interchange Bridge	Vertical Curvature
S. 56th St. Bridge Approach	Vertical Curvature
West Billings Interchange Bridge	Vertical Curvature
Lockwood Interchange Bridge	Vertical Curvature
Lockwood Interchange Bridge	Vertical Curvature

Source: MDT, 2011; DOWL HKM, 2011; MDT Record Drawings; MDT Road Design Manual, pages 10.5(1), 10.5(3), 10.5 (5), 10.5(7), 12(4).

Ramp Gore Areas

Chapter 9 of the MDT Road Design Manual (December 2004) and Chapter 29 of the MDT Traffic Engineering Manual (November 2007) were consulted for guidance on exit and entrance ramps and mainline Interstate junctions.

Horizontal and Vertical Alignment

The Laurel and Mossmain Interchange ramp gore areas were assessed to determine if merge/diverge angles and acceleration and deceleration lengths at entrance and exit ramps meet current MDT design standards. Vertical elements, including grade and vertical curvature, were assessed. Elements failing to meet current MDT design standards are listed in Table 3.3.

Table 3.3 Substandard Geometric Elements at Interchanges

Location		Substandard Element
Interchange	Ramp	
Laurel Interchange	Westbound On-Ramp	Ramp Taper Length, Ramp Acceleration Distance, Curve Radius, Vertical Curvature
	Westbound Off-Ramp	Ramp Deceleration Distance
	Eastbound On-Ramp	Ramp Acceleration Distance, Curve Radius
	Eastbound Off-Ramp	Ramp Deceleration Distance, Vertical Curvature
Mossmain Interchange	Westbound On-Ramp	Ramp Acceleration Distance
	Eastbound On-Ramp	Ramp Acceleration Distance

Source: MDT, 2011; DOWL HKM, 2011; MDT record drawings; MDT Road Design Manual (RDM), page 9.3(3), 10.5(1), 10.5(2), 10.5(5), 10.5(6); MDT Traffic Engineering Manual (TEM) pages 29.5(5), 29.5(12), 29.5(14), 29.5(18), 29.6(1), 29.6(10).

Ramp Intersections

Chapter 13 of the MDT Road Design Manual (September 2007) and Chapter 28 of the MDT Traffic Engineering Manual (November 2007) were consulted for signalized and non-signalized intersection design criteria. Additionally, the American Association of State Highway and Transportation Officials (AASHTO) Roadway Lighting Design Guide (October 2005) was consulted regarding Interstate lighting.

The Laurel and Mossmain Interchange ramp intersections were assessed to identify issues with intersection configuration, sight distance, and vertical clearance. Figure 3-2 illustrates ramp intersection locations at the Laurel and Mossmain interchanges. A summary of the analysis is provided below.

Figure 3-2 Intersections at Laurel and Mossmain Interchanges

Laurel Interchange Ramp Intersections

The Laurel Interchange includes two intersections. The northern intersection is signal controlled and the southern intersection is stop-controlled. The intersections meet current MDT design standards.

Mossmain Interchange Ramp Intersections

The Mossmain interchange incorporates four intersections. All intersections are stop-controlled on the minor legs (defined as the legs generally carrying lower volumes). The intersections generally meet current MDT design standards, although free-flowing movements between the east leg and the north leg at the southern intersection occur at 90 degrees, which could hinder some drivers. Additionally, Interstate bridges over the interchange crossroad do not meet current MDT design standards vertical clearance (17 feet).

3.1.3 Safety Analysis

Mainline Interstate

Crash data from 2006 to 2010 was reviewed within the rural and urban portions of the study corridor. The portion of I-90 from RP 433.0 to RP 442.3 is defined as rural Interstate by MDT. The remainder of the corridor (RP 442.3 to RP 457.0) is classified as urban Interstate.

Engineers assess crash rate, severity rate, and severity index to identify safety concerns. MDT defines the crash rate as a measure of crashes per million vehicle miles of travel. The severity index provides a weighted assessment of crashes, with fatal crashes and crashes resulting in incapacitating injuries weighted more heavily compared to crashes resulting in less serious injuries or property damage only. The severity rate is calculated by multiplying the crash rate and severity index, providing a weighted measure of crashes per million vehicle miles of travel.

The crash rate and severity rate for rural and urban portions of the I-90 corridor are generally similar to or lower than statewide averages for similar facilities, as presented in Table 3.4.

Table 3.4 Crash History Comparison (Statewide Average vs. I-90 Corridor, 2006 - 2010)

Criteria	Rural		Urban	
	Statewide Average for Rural Interstate	I-90 Corridor RP 433.0 – 442.3	Statewide Average for Urban Interstate	I-90 Corridor RP 442.3 – 457.0
Crash Rate (All Vehicles)	0.92	0.89	1.18	0.96
Severity Index (All Vehicles)	1.86	1.81	1.79	1.90
Severity Rate (All Vehicles)	1.70	1.61	2.11	1.82

Source: MDT, 2011.

The crash rates and severity rates for most mainline segments were below the statewide average values within the analysis period. Segment 4 (West Billings Interchange to South Billings Boulevard Interchange) had a higher crash rate and severity rate than the statewide average rates for similar facilities.

The half-mile stretch located between the West Billings Interchange and the mid-point of mainline segment 4 (RP 446.0 to RP 446.5) had the highest number of crashes as compared to all other half-mile stretches in the corridor. A total of 106 crashes were reported in this location during the five-year period. The majority of crashes (58 of 106, or 55%) were classified as rear-end collisions. Most crashes involved two vehicles and occurred on the roadway during dry, clear, daylight conditions in or near an intersection or interchange. The West Billings Interchange has five merge/diverge locations, which adds to the complexity of the weaving and merging patterns and may influence the number of crashes in this location.

Crash and animal carcass data reflect relatively even distribution of animal conflicts throughout the corridor. Within the five-year analysis period, 46 crashes involved wild animals (approximately two per mile or nine per year) and 37 animal carcasses were retrieved by maintenance personnel.

Ramp Intersections

The Laurel and Mossmain Interchanges were assessed to supplement analysis contained in the 2006 SEH report. To avoid duplication of the mainline Interstate analysis, crashes coded as occurring on the I-90 mainline were not included in this analysis.

Laurel Interchange Analysis

Rear-end collisions occurred most frequently (5 out of 13, or 38%) from 2006 to 2010, followed by right angle crashes (4 out of 13, or 31%) and left turn crashes (2 out of 13, or 15%). Signal phasing modifications or similar measures may be needed at this intersection.

Mossmain Interchange Analysis

Only one crash was reported at the Mossmain Interchange from 2006 to 2010. All other crashes occurring near the Mossmain Interchange during the analysis period were coded as mainline crashes. No trends were identified at this interchange.

Overhead Lighting

A lighting assessment of the Laurel and Mossmain Interchanges was conducted for this study. MDT and AASHTO classify lighting at interchanges as Partial Interchange Lighting (PIL) or Complete Interchange Lighting (CIL). PIL is a lighting system providing illumination only of decision-making areas of roadways, including acceleration and deceleration lanes, ramp terminals, crossroads at frontage road or ramp intersections, and other areas of nighttime hazard. CIL provides relatively uniform lighting within the limits of the interchange, including mainline facilities, direct connections, ramp terminals, and frontage roads or crossroad intersections.

Based on MDT and AASHTO guidelines, CIL is currently warranted for the Laurel and Mossmain interchanges.

3.1.4 Existing and Projected Traffic Volumes

Mainline Interstate and Ramp Gore Areas

I-90 serves as the principal east-west route in the region. Primary users of this route are local residents, commuters, commercial truck drivers, recreational users accessing the Yellowstone River, and tourists traveling to Yellowstone National Park and other regional attractions. The vehicle mix includes automobiles, light trucks, delivery vans, intercity passenger buses, school buses, tractor trailers, motorcycles, and semi-trucks.

Traffic volume data is summarized below. Additional information is provided in the Existing and Projected Conditions Report (Appendix B).

Annual Average Daily Traffic Volumes

Annual Average Daily Traffic (AADT) is an estimate of all motorized vehicles traveling in both directions on a highway on an average day of a year. MDT's TransCAD model was used to

generate existing (2010) AADT values for Interstate segments and ramp gore areas in the corridor. Projected (2035) AADT volumes were calculated from the 2010 model output values using growth rates provided by MDT. Existing and projected AADT volumes are listed in Table 3.5.

Table 3.5 AADT Volumes (2010 and 2035)

Segment	Description	AADT	
		2010	2035
	Laurel Under	9,000	16,300
1	**Laurel to Mossmain**	23,600	31,700
	Mossmain Under	20,300	26,200
2	**Mossmain to Shiloh**	24,400	32,600
	Shiloh Under	19,600	23,700
3	**Shiloh to West Billings**	24,600	40,200
	West Billings Over	10,300	21,300
	West Billings Over Part 2*	4,100	9,100
4	**West Billings to South Billings Boulevard**	27,500	47,200
	South Billings Boulevard Under	21,000	35,200
5	**South Billings Boulevard to South 27th Street**	25,600	45,500
	South 27th Street Under	19,600	33,200
6	**South 27th Street to Lockwood**	27,200	44,600
	Lockwood Under	18,200	29,200
7	**Lockwood to Johnson Lane**	23,600	39,300
	Johnson Lane Under	15,200	23,800
8	**Johnson Lane to Pinehills**	17,300	27,500

Source: MDT, 2011.
*No WB component.
The terms "Under" and "Over" are used to describe the portion of the mainline Interstate within an interchange between on-ramps and off-ramps.

Peak Hour Mainline Traffic Volumes

Field count data from April 2011 was used to identify the highest peak hour of the day (defined as the four consecutive 15-minute periods with the highest volumes during the three-day count period) and the peak hour percent of Average Daily Traffic (ADT). Peak hour mainline traffic volumes for 2010 and 2035 were calculated from the AADT generated by the TransCAD model using the field count percent of ADT.

Ramp Intersections

Peak Hour Volumes

Peak hour 15-minute turning movement counts were collected by MDT at the two Laurel ramp intersections on April 12, 2011 and at the four Mossmain ramp intersections on April 13, 2011. The highest peak hour of the day for the study intersections was calculated from the observed field data and the consecutive 15-minute counts. Growth rates provided by MDT were applied to adjusted peak hour volumes from the April 2011 field count data for each intersection leg to calculate projected 2035 volumes.

3.1.5 Existing and Projected Operational Characteristics

Mainline Interstate

Traffic conditions on transportation facilities are commonly defined using the Level of Service (LOS) concept. The Highway Capacity Manual (HCM) 2010 defines LOS based on a variety of factors to provide a qualitative assessment of the driver's experience. For mainline Interstate operations, the HCM defines LOS on the basis of density. LOS for Interstate segments is generally a measure of the degree of congestion on a roadway and applies to a specific time period, usually 15 minutes. Six LOS categories ranging from A to F are used to describe traffic operations, with A representing the best conditions and F representing the worst. Highway Capacity Software (HCS) Version 2010 was used to analyze LOS for Interstate segments throughout the corridor.

Analysis Results

Table 3.6 presents the results of the mainline Interstate operational analysis for existing (2010) and projected (2035) conditions. The terms "Under" and "Over" are used to describe the portion of the mainline Interstate within an interchange between on-ramps and off-ramps.

Table 3.6 Mainline Interstate Operational Analysis Results (2010 and 2035)

Segment	Description	Level of Service			
		2010		2035	
		EB	WB	EB	WB
	Laurel Under	A	A	A	A
1	**Laurel to Mossmain**	A	A	B	B
	Mossmain Under	B	A	B	A
2	**Mossmain to Shiloh**	B	B	B	B
	Shiloh Under	A	A	B	B
3	**Shiloh to West Billings**	B	B	C	C
	West Billings Over	A	A	A	A
	West Billings Over Part 2*	A	*	A	*
4	**West Billings to South Billings Boulevard**	A	A	B	B
	South Billings Boulevard Under	A	A	B	B
5	**South Billings Boulevard to South 27th Street**	B	A	C	B
	South 27th Street Under	A	A	B	B
6	**South 27th Street to Lockwood**	B	B	C	B
	Lockwood Under	A	A	B	B
7	**Lockwood to Johnson Lane**	A	B	B	C
	Johnson Lane Under	A	A	B	A
8	**Johnson Lane to Pinehills**	A	A	B	A

Source: DOWL HKM, 2011.
*No WB component.
The terms "Under" and "Over" are used to describe the portion of the mainline Interstate within an interchange between on-ramps and off-ramps.
The MDT Traffic Engineering Manual and MDT Road Design Manual define desirable operations for urban and rural Interstate facilities as LOS B. Shaded cells indicate undesirable operations (LOS C or worse).

The MDT Traffic Engineering Manual and MDT Road Design Manual define desirable operations for urban and rural Interstate facilities as LOS B. Several Interstate segments within the study area are projected to reach LOS C by 2035. Segments projected to operate at an undesirable level include Shiloh to West Billings, South Billings Boulevard to South 27th Street, and South 27th Street to Lockwood EB segments; and Shiloh to West Billings and Lockwood to Johnson Lane WB segments.

The WB segment from South Billings Boulevard to South 27th Street and the WB segment from South 27th Street to Lockwood are predicted to operate near the demarcation between LOS B and LOS C by 2035.

Sensitivity Analysis

HCS was used to conduct a sensitivity analysis to determine when operations would be expected to shift from LOS B to LOS C. Table 3.7 presents the results of the sensitivity analysis for mainline Interstate segments.

Table 3.7 Mainline Interstate Sensitivity Analysis

Location		Deficiency Year	
		EB	WB
3	Shiloh to West Billings	2028	2030
5	South Billings Boulevard to South 27th Street	2032	-
6	South 27th Street to Lockwood	2023	-
7	Lockwood to Johnson Lane	-	2031

Source: DOWL HKM, 2011.

Dashes (-) indicate locations operate at LOS B or better through 2035. The South Billings Boulevard to South 27th Street and South 27th Street to Lockwood WB segments are projected to reach LOS C by 2036.

Ramp Gore Areas

Six LOS categories ranging from A to F are used to describe traffic operations for ramps, with A representing the best conditions and F representing the worst. HCS was used to analyze LOS for ramp gore areas throughout the corridor.

Analysis Results

Table 3.8 presents the results of the ramp gore area operational analysis for existing (2010) and projected (2035) conditions.

Table 3.8 Ramp Gore Area Operational Analysis Results (2010 and 2035)

Interchange	Ramp Gore	Level of Service			
		2010		2035	
		EB	WB	EB	WB
Laurel	On-Ramp	B	A	B	A
	Off-Ramp	A	A	A	B
Mossmain	On-Ramp	B	B	C	B
	Off-Ramp	B	B	C	B
Shiloh	On-Ramp	B	B	C	C
	Off-Ramp	B	B	B	B
West Billings	On-Ramp	A	B	B	C
	Off-Ramp	A	A	B	B
	On-Ramp at Mullowney*	A	*	B	*
South Billings Boulevard	On-Ramp	B	A	C	B
	Off-Ramp	A	B	B	C
27th Street	On-Ramp	B	B	C	B
	Off-Ramp	B	B	C	B
Lockwood	On-Ramp	B	B	C	C
	Off-Ramp	B	B	C	C
Johnson Lane	On-Ramp	B	B	B	C
	Off-Ramp	B	A	B	B

Source: DOWL HKM, 2011.
*No WB component.
The MDT Traffic Engineering Manual and MDT Road Design Manual define desirable operations for urban and rural Interstate facilities as LOS B. Shaded cells indicate undesirable operations (LOS C or worse).

Fourteen gore areas within the study area are projected to operate at an undesirable level by 2035. These include on-ramps at the Mossmain (EB), Shiloh (EB and WB), West Billings (WB), South Billings Boulevard (EB), South 27th Street (EB), Lockwood (EB and WB), and Johnson Lane (WB) Interchanges and off-ramps at the Mossmain (EB), South Billings Boulevard (WB), South 27th Street (EB), and Lockwood (EB and WB) Interchanges. The Shiloh EB off-ramp, the South 27th Street WB on-ramp, and the Johnson Lane EB off-ramp are predicted to operate near the demarcation between LOS B and LOS C.

Sensitivity Analysis

HCS was used to conduct a sensitivity analysis to determine when operations would be expected to shift from LOS B to LOS C. Table 3.9 presents the results of the sensitivity analysis for ramp gore areas.

Table 3.9 Ramp Gore Area Sensitivity Analysis

Interchange	Ramp Gore	Deficiency Year	
		EB	WB
Mossmain	On-Ramp	2033	-
	Off-Ramp	2027	-
Shiloh	On-Ramp	2027	2035
West Billings	On-Ramp	-	2027
	Off-Ramp	2028	-
	On-Ramp at Mullowney*	-	*
South Billings Boulevard	On-Ramp	2034	-
	Off-Ramp	-	2028
South 27th Street	On-Ramp	2027	-
	Off-Ramp	2030	-
Lockwood	On-Ramp	2031	2031
	Off-Ramp	2026	2034
Johnson Lane	On-Ramp	-	2027

Source: DOWL HKM, 2011.
*No WB component.
Dashes (-) indicate locations operate at LOS B or better through 2035.

Ramp Intersections

Intersection capacity and LOS analyses were completed using procedures outlined in the HCM 2010 for both signalized and unsignalized intersections. In accordance with HCM procedures, LOS was determined by estimating the average vehicular delay of the intersections and the intersection movements. Six LOS categories ranging from A to F are used to describe traffic operations, with LOS A representing no delay and LOS F represent substantial delay.

Ramp intersections for the Laurel Interchange and the Mossmain Interchange were evaluated to supplement analysis included in the 2006 SEH report. The northern intersection at the Laurel Interchange is a signalized intersection. All other intersections at the Laurel Interchange and Mossmain Interchange are stop-controlled on the minor legs.

Analysis Results

Table 3.10 presents the results of the ramp intersection operational analysis for existing (2010) conditions.

Table 3.10 Operational Analysis Results for Intersections (2010 and 2035)

Intersection		Control Type	Intersection Approach	Turning Movement	LOS	
					2010	2035
Laurel Interchange	S. 4th Street / WB I-90 Ramps / US 212	Signalized	EB Approach (S. 4th Street)	EB Left / Through / Right	A	A
			WB Approach (WB I-90 Ramps)	WB Left	A	B
				WB Through / Right	A	A
			NB Approach (US 212)	NB Left	A	A
				NB Through & Through / Right	A	A
			SB Approach (US 212)	SB Left	A	A
				SB Through & Through / Right	A	B
	I-90 EB Ramps / US 212	Stop	WB Approach (EB I-90 Ramps)	WB Right	B	C
		Uncontrolled	SB Approach (US 212)	SB Left	A	A
Mossmain Interchange	E. Main Street / S. 72nd Street West / Interchange Crossroad	Stop	EB Approach (E. Main Street)	EB Through / Right	C	F
		Stop	WB Approach (S. 72nd Street West)	WB Left / Through	F	F
		Uncontrolled	NB Approach (Interchange Crossroad)	NB Left / Right	A	A
	I-90 WB Ramps / Interchange Crossroad	Stop	WB Approach (WB I-90 Off-Ramp)	WB Left / Through / Right	C	F
		Uncontrolled	NB Approach (Interchange Crossroad)	NB Left / Through	A	A
	I-90 EB Ramps / Interchange Crossroad	Stop	EB Approach (EB I-90 Off-Ramp)	EB Left / Through / Right	B	E
		Uncontrolled	SB Approach (Interchange Crossroad)	SB Left / Through	A	A
	Magelssen Road / S. Frontage Road / Interchange Crossroad	Uncontrolled	WB Approach (S. Frontage Road)	WB Left / Through / Right	A	A
		Stop	NB Approach (Driveway)	NB Left / Through / Right	B	D

Source: DOWL HKM, 2011.
Turning movements with no conflicting movements (i.e., no delay) are not listed.
The MDT Road Design Manual notes individual interchange elements should not operate more than one LOS below the mainline Interstate. Desirable operations for the mainline Interstate and ramp intersections are defined as LOS B and LOS C, respectively. Shaded cells indicate undesirable intersection operations (LOS D or worse).

The MDT Road Design Manual recommends individual interchange elements should not operate more than one LOS below mainline Interstate LOS. Desirable operations for the mainline Interstate and ramp intersections are defined as LOS B and LOS C, respectively.

The Laurel Interchange intersections are projected to operate with sufficient capacity and with acceptable intersection delay through 2035. By 2035, at least one leg of all Mossmain Interchange intersections is projected to reach undesirable LOS, defined as LOS D or worse. This poor LOS is generally due to the close spacing of adjacent intersections and limited storage lengths, which in turn affects stop delay and queuing for all Mossmain intersections.

3.1.6 Recent and Planned Projects

As of this study, recent and planned projects include the following:

West Billings – King Avenue Bridges was a project involving reconstruction of the King Avenue Bridges and other improvements at the West Billings Interchange. The project was completed in 2007.

The *Shiloh Road* project reconstructed Shiloh Road to a five-lane urban principal arterial, resulting in improved access opportunities to I-90 at the Shiloh Interchange. A parallel project by MDT signalized the intersection at Zoo Drive and Gabel Road between the Shiloh Road corridor and the Interstate corridor. The project was completed in 2010.

2002-Safety Improvements-Billings was a 1.5 mile roadway and roadside safety improvement project widening the EB Lockwood Interchange off-ramp from a single lane to two lanes. This project began at RP 451.7 and continued to RP 453.2 on I-90. The portion of the project within the boundaries of the corridor study was approximately 1.5 miles. The project was completed in 2010.

Pinehills Interchange Southeast was a maintenance project consisting of thin overlay repaving. The project began at RP 456.6 and ended at RP 463.0, affecting 6.5 miles of Interstate adjacent to the eastern border of this corridor study. The project was completed in 2011.

Mossmain Interchange-East was a 23.6 mile roadway and roadside safety improvement project involving median slope flattening and median cable guardrail along the I-90 corridor in the Billings urban area. This project began at RP 437.4 and continued to RP 461.0. The portion of the project within the boundaries of this corridor study was approximately 19.2 miles. The project was completed in 2011.

Park City Interchange - East is a maintenance project involving mill and overlay repaving, replacement of the weigh-in-motion sensors at the Mossmain Scale at RP 438.7±, and a seal and cover from RP 426.6 to 446.0. The project will be completed in 2012.

An Environmental Impact Statement (EIS) is being prepared for the *Billings Bypass* project. The proposed purpose of the project is to improve access and connectivity between I-90 and Old Hwy 312 and to improve mobility in the eastern area of Billings. At this time all of the Build Alternatives currently being considered would connect to the Interstate corridor at the Johnson Lane Interchange and would require reconstruction of the interchange and a new crossing of the Yellowstone River. The final EIS and Record of Decision (ROD) are expected to be completed in 2013.

3.2 Environmental Conditions

An Environmental Scan Report was prepared to identify environmental resource constraints and opportunities within the study corridor. Information was gathered from previously published documents, websites, GIS data, and a windshield survey conducted on April 15, 2011. The following sections summarize key information from the Environmental Scan Report, which is provided in Appendix C.

3.2.1 Land Use and Development

Zoning maps indicate land adjacent to I-90 within the study corridor is zoned for a variety of uses, including heavy industrial, light industrial, entryway light industrial, highway commercial, community commercial, single-family residential, multi-family residential, manufactured home residential, planned unit development, public use, and agriculture. The main land uses adjacent to the Interstate are industrial, commercial, and agricultural.

Based on discussions with the City-County Transportation Planner, undeveloped areas near the Lockwood Interchange, South Billings Boulevard Interchange, and the Shiloh Interchange are zoned for commercial development and are expected to continue to develop within the 2035 planning horizon. Given the current zoning of undeveloped land, there is ample development capacity in the corridor.[2]

The 2009 Transportation Plan Update projected the number of dwelling units in the South Hills area would increase by 47.2% from 2002 to 2035. During this period, the number of dwelling

[2] Communication with Scott Walker, Transportation Planner, April 14, 2011.

units in the Shiloh Northwest and the Shiloh West areas are expected to increase by 466.0% and 108.0%, respectively.[3] These areas feed into the South Billings Boulevard Interchange and the Shiloh Interchange.

Applications for building permits in Billings have been somewhat flat in recent years, including commercial retail and larger residential tract development. However, this recent trend is not expected to continue.

3.2.2 Economic and Demographic Conditions

The Billings area is a regional economic hub due to its size and relatively central location in relation to smaller communities in eastern Montana and northern Wyoming. Airport, rail, and trucking facilities support regional commerce. Billings also offers extensive medical services and retail outlets. These factors have contributed to the region's steady growth within the past 40 years, as illustrated by increases in population and per capita income within the 1970 to 2010 period.

Table 3.11 presents historic population data for the State of Montana, Yellowstone County, and the City of Billings. Yellowstone County and the City of Billings grew by a greater percentage (approximately 70%) than the state (approximately 42%) during the 40-year period from 1970 to 2010. Generally, age group distribution of population in Yellowstone County and the City of Billings are similar to that of the state.

Table 3.11 Historic Population

Year	State of Montana	Yellowstone County	City of Billings
1970	694,409	87,367	61,581
1980	786,690	108,035	66,824
1990	799,065	113,419	81,151
2000	902,195	129,352	89,847
2010	989,415	147,972	104,170
Change (1970-2010)	295,006 (42.4%)	60,605 (69.4%)	42,589 (69.2%)

Source: U.S. Census Bureau, Census of Population, 1970, 1980, 1990, 2000, and 2010.

[3] Billings Urban Area Long-Range Transportation Plan – 2009 Update, Table 3.5, Billings Urban Area Projected Dwelling Unit Distribution.

Table 3.12 presents historic per capita income data for Yellowstone County and the City of Billings. Within the 40-year period from 1970 to 2010, both areas experienced similar growth in per capita income.

Table 3.12 Per Capita Income

Year	Yellowstone County Per Capita Income[1]	Billings Metropolitan Statistical Area Per Capita Income[1]
1970	$3,869	$3,829
1980	$10,470	$10,322
1990	$17,354	$17,192
2000	$26,827	$26,684
2009[2]	$39,412	$39,212

Source: U.S. Bureau of Economic Analysis, 2011.
(1) Per capita income provided in dollars for year listed; not adjusted for inflation.
(2) 2010 per capita income data was not available from U.S. Bureau of Economic Analysis at the time of this study.

The majority of the population in Montana, Yellowstone County, and the City of Billings is classified as white by the U.S. Census Bureau, as shown in Table 3.13. Racial composition in Yellowstone County and the City of Billings is generally similar to that of the state.

Table 3.13 Racial Composition (2010)

Racial Groups	State of Montana		Yellowstone County		City of Billings	
	Number	Percent	Number	Percent	Number	Percent
White	884,961	89.4%	134,228	90.7%	93,313	89.6%
Black of African American	4,027	0.4%	935	0.6%	828	0.8%
American Indian and Alaska Native	62,555	6.3%	5,881	4.0%	4,619	4.4%
Asian	6,253	0.6%	939	0.6%	778	0.7%
Native Hawaiian and Other Pacific Islander	668	0.1%	114	0.1%	93	0.1%
Some Other Race	5,975	0.6%	1,763	1.2%	1,467	1.4%
Two or More Races	24,976	2.5%	4,112	2.8%	3,072	2.9%
Total Population	**989,415**	**100%**	**147,972**	**100%**	**104,170**	**100%**

Source: U.S. Census Bureau, 2010.

3.2.3 Physical Environment

Soil Resources and Prime Farmland

Some areas within the corridor are classified as prime and important farmlands under Section 4201 of the Farmland Protection Policy Act (FPPA) of 1981 (Title 7 U.S. Code, Chapter 73,

Sections 4201-4209). A U.S. Department of Agriculture Natural Resource Conservation Service Farmland Conversion Impact Rating Form for Linear Projects (form CPA-106) would need to be completed for any improvements impacting designated farmlands.

Surface Water Bodies, Water Quality, and Waters of the U.S.

The study corridor lies within the Yellowstone River Valley, specifically Upper Yellowstone-Lake Basin (HUC: 10070004) and Upper Yellowstone-Pompeys Pillar (HUC: 10070007). The Yellowstone River, Canyon Creek, Hogan's Slough, Billings Bench Water Association (BBWA) Canal, and several minor irrigation ditches cross I-90 within the study area.

Some of the streams within the Upper Yellowstone and Middle Yellowstone watersheds are listed as impaired in the Montana Department of Environmental Quality's (DEQ's) 2010 Integrated 303(d)/305(b) Water Quality Report for Montana. The Yellowstone River from the City of Laurel Public Water System (PWS) to the Huntley Diversion Dam is listed as an impaired water body. Total Maximum Daily Loads (TMDLs) have not yet been developed for the Yellowstone River in the study corridor. Any construction activities would need to comply with the requirements of Yellowstone River TMDLs and implementation plans once established. Coordination with DEQ should be conducted during the project development process to obtain any needed permits or authorizations, including a short-term water quality standard for turbidity (318 Authorization).

Waters of the United States (U.S.) include all surface waters such as all navigable waters and their tributaries, all interstate waters and their tributaries, all wetlands adjacent to these waters, and all impoundments of these waters. Coordination with the U.S. Army Corps of Engineers (USACE) and Fish, Wildlife & Parks (FWP) should be conducted during the project development process to obtain any needed permits or authorizations, such as a Clean Water Act (CWA) Section 404 and Section 10 permit and a Stream Protection Act (SPA) 124 authorization.

Irrigation Facilities

Irrigation facilities occur adjacent to the study corridor. Maps illustrating these facilities are contained in the Environmental Scan Report (Appendix C). Impacted irrigation canals and ditches would need to be relocated in consultation with ditch owners to minimize impacts to farming operations. Any potential impacts to irrigation facilities would also need to be examined to determine if the irrigation facilities are considered Waters of the U.S. and subject to jurisdiction by USACE.

Stormwater

Under DEQ's Montana Pollutant Discharge Elimination System (MPDES) program, the City of Billings, Yellowstone County, and MDT are co-permittees within the Billings Urbanized Area through the Small Municipal Separate Storm Sewer System (MS4) program. Receiving waters for the Billings MS4 are listed below.

- BBWA Canal
- Canyon Creek Ditch
- Canyon Creek
- Suburban Ditch
- Grey Eagle Ditch
- Yellowstone River
- Shiloh Drain
- Alkali Creek
- City/County Drain
- Yegen Drain
- Holling Drain
- Blue Creek
- Tributary to Blue Creek
- Five Mile Creek
- Coulson Ditch
- Lockwood Ditch
- Dry Creek
- Tributary to Dry Creek

If improvement options are forwarded from this study, stormwater must be addressed according to the MS4 permit.

Wetlands

The study area encompasses portions of the Yellowstone River and several other drainages with associated wetland areas. If improvement options are forwarded from this study, formal wetland delineations would need to be conducted according to standard USACE procedures. Jurisdictional wetland determinations would need to be conducted during the project development process. All unavoidable impacts to wetlands would need to be permitted and mitigated as required by the CWA and in accordance with FHWA and MDT policies and Executive Order (EO) 11990. Coordination with USACE should be conducted during the project development process to obtain any needed permits, including a CWA Section 404 permit and Section 10 permit.

Floodplains

Within the study corridor, I-90 encroaches into the 100-year floodplain for the Yellowstone River delineated by the Federal Emergency Management Agency (FEMA). FEMA is in the process of updating its floodplain mapping in the Billings area. If improvement options are forwarded from the study, coordination with Yellowstone County should be conducted during the project development process to obtain floodplain mapping and permits as necessary.

Hazardous Materials

According to the Montana Natural Resource Information System (NRIS) database, there are 16 leaking underground storage tank (LUST) sites within the I-90 study corridor. The majority of

these sites are active or former commercial gasoline stations and truck stops. Additionally, there are seven DEQ Site Response Section facilities, as well as two active refinery sites with ongoing U.S. Environmental Protection Agency (USEPA) Resource Conservation and Recovery Act (RCRA) investigations and corrective actions. I-90 crosses through the Lockwood Solvent Site, a federal National Priority List (NPL) Superfund site. Portions of the solvent plume originated from the Beall Trailer, Inc. facility and extend under I-90 from the Lockwood Interchange to the east approximately one mile.

Petroleum pipelines enter the Billings area from several directions and are connected to the Cenex Laurel Refinery, the Conoco-Phillips Refinery, and the Exxon-Mobil Refinery. The lines in close proximity to I-90 generally follow the BNSF Railway corridor. NRIS data indicate a 12-inch petroleum liquid pipeline crosses under I-90 at the Laurel Interchange and another 12-inch petroleum liquid line crosses under I-90 approximately 5 miles east of Laurel. Although not identified on NRIS, a third line of unknown diameter crosses under I-90 at the Lockwood Interchange. The Environmental Scan Report (Appendix C) contains a map illustrating hazardous materials sites within the corridor.

Further evaluation may be needed at specific sites to determine the exact location of facilities of concern and if soil or groundwater contamination could be encountered during construction. This may include reviewing DEQ files and conducting a subsurface investigation to determine the extent of soil and groundwater contamination.

Air Quality

Portions of the study corridor are located within Billings' carbon monoxide (CO) re-attainment area (2002). The corridor also traverses the former sulfur dioxide (SO_2) area of concern, which is no longer legally designated as a nonattainment area. If improvement options are forwarded from the study, an air quality analysis may be required.

3.2.4 Biological Resources

Fish and Wildlife

Threatened and Endangered Wildlife Species and Species of Concern

There are four endangered, threatened, proposed, or candidate animal species listed for Yellowstone County. None are located within the study corridor.

Table 3.14 lists species of concern documented by the Montana Natural Heritage Program (MNHP) within three miles of the study area as of August 2011.

Table 3.14 Animal Species of Concern Documented within Three Miles of Study Area

Group Name	Scientific Name	Common Name
Mammals	*Euderma maculatum*	Spotted Bat
Birds	*Ardea herodias*	Great Blue Heron
	Catharus fuscescens	Veery
	Coccyzus americanus	Yellow-billed Cuckoo
	Falco peregrinus	Peregrine Falcon
	Gymnorhinus cyanocephalus	Pinyon Jay
	Haliaeetus leucocephalus	Bald Eagle
	Spizella breweri	Brewer's Sparrow
Reptiles	*Apalone spinifera*	Spiny Softshell
	Heterodon nasicus	Western Hog-nosed Snake
	Lampropeltis triangulum	Milksnake
	Phrynosoma hernandesi	Greater Short-horned Lizard
	Sceloporus graciosus	Common Sagebrush Lizard
Fish	*Oncorhynchus clarkii bouvieri*	Yellowstone Cutthroat Trout
	Sander canadensis	Sauger

Source: MNHP, 2011.

If improvement options are forwarded from the study, an evaluation of potential impacts to all endangered, threatened, proposed, candidate, or sensitive species would need to be completed during the project development process. Coordination with FWP and USFWS should be conducted during the project development process.

Vegetation

Native vegetation in the study area generally consists of wetland and riparian areas along waterways and sagebrush/grasslands in upland areas. The remaining vegetation consists of cultivated crop land.

Threatened and Endangered Plant Species and Species of Concern

No endangered, threatened, proposed, or candidate plant species are listed for Yellowstone County, and none are expected to occur in the study area.

No plant species of concern have been documented within three miles of the study area. If improvement options are forwarded from the study, an evaluation of potential impacts to all endangered, threatened, proposed, candidate, or sensitive plant species will need to be conducted during the project development process.

Noxious Weeds

If improvement options are forwarded from the study, the study area will need to be surveyed for noxious weeds during the project development process.

3.2.5 Social and Cultural Resources

Environmental Justice

Minority and low-income persons likely live within the study corridor. If improvement options are forwarded from the study, Environmental Justice will need to be further evaluated during the project development process to determine if these populations are disproportionately adversely affected.

Cultural and Archaeological Resources

At least eleven historic or potentially historic sites are located within 300 feet of the existing I-90 alignment. Six of the sites have not been previously recorded and their National Register of Historic Places (NRHP) status would need to be determined during the project development process. Several historic-age residences are located north of the Interstate between the South Billings Boulevard and South 27th Street Interchanges (segment 5).

With the exception of the Coulson Townsite (located in segment 6), the study corridor is substantially developed and there is a low likelihood of encountering intact archaeological sites within it. The Environmental Scan Report (Appendix C) contains a map illustrating historic sites within the corridor.

Federally-funded projects forwarded from the study would require a cultural resource survey of the Area of Potential Effect (APE) as specified in Section 106 of the National Historic Preservation Act (NHPA) (36 CFR 800).

Section 4(f) Resources

Based on field observation, GIS review of public park land data, and review of the NRHP list for Yellowstone County, nineteen sites within the study area could potentially be classified as Section 4(f) resources, including the 11 historic and eight recreational sites. If improvement

options are forwarded from this study, a Section 4(f) evaluation would need to be completed for any impacted Section 4(f) resource. The Environmental Scan Report (Appendix C) contains a map illustrating potential Section 4(f) resources within the corridor.

Section 6(f) Resources

Ponderosa Park (RP 447.8±) and Coulson Park (RP 451.5±) were identified as possible 6(f) resources within the study area. If improvement options are forwarded from this study, impacts to Section 6(f) resources would need to be documented. The Environmental Scan Report (Appendix C) contains a map illustrating potential Section 6(f) resources within the corridor.

Noise

There are a number of residential developments within proximity to the study corridor. In accordance with MDT policies, a noise analysis may be needed to identify impacts resulting from forwarded options such as adding travel lanes or changing lane configurations.

4.0 NEEDS AND OBJECTIVES

Corridor needs and objectives were developed through a review of existing and projected conditions within the corridor, input from community members and resource agencies, and coordination with MDT staff.

A Purpose and Need statement is a key element in linking planning studies and subsequent NEPA/MEPA reviews. This study identifies needs and objectives for recommended improvements and can be used to support Purpose and Need development for future projects.

The following needs and objectives reflect transportation system issues and concerns and the desired condition of the corridor.

Need 1: Accommodate existing and future transportation demand on I-90.

Objectives

1.a Maintain LOS B or better for rural and urban mainline segments and interchange ramps through the 2035 planning horizon year.

1.b Maintain LOS C or better for Laurel and Mossmain ramp intersections through the 2035 planning horizon year.

Need 2: To the extent practicable, provide a facility that safely accommodates Interstate travel.

Objectives

2.a Provide roadway elements that meet current MDT design standards.

2.b Provide bridge structures that meet current MDT design standards.

5.0 IMPROVEMENT OPTIONS

An Improvement Options Report was prepared to describe the process of identifying, developing, and analyzing improvements within the study corridor. The following sections summarize key information from the Improvement Options Report, which is provided in Appendix D.

5.1 Development of Improvement Options

5.1.1 Corridor Needs

Improvement options were developed to address operational, geometric, and safety needs within the study area. Operational improvements were identified to decrease congestion and improve traffic operations at locations where LOS is projected to drop below desirable levels by 2035. Traffic operations and lane balance improvements were recommended to provide lane continuity and reduce weaving and merging maneuvers throughout the corridor. Safety improvements were developed to reduce conflicts at interchange ramps. Geometric improvements were identified where modifications are needed to bring facilities up to current MDT design standards.

5.1.2 Community and Stakeholder Input

Stakeholders and members of the public requested that improvement options avoid or minimize impacts to natural and community resources, minimize right-of-way acquisition and impacts to adjacent land uses, and maintain consistency with local plans. There were also requests for context sensitive design; aesthetic improvements; and safe passage across the Interstate facility for non-motorized users at overpasses, bridges, and interchanges in the corridor. These concepts relate to specific design elements and would be considered at the project level.

5.1.3 Mainline Capacity Considerations

Improvement options for mainline segments of the Interstate were developed to address the capacity needs of the Interstate segments and to maintain desirable LOS B through the 2035 planning horizon.

Several mainline Interstate segments between the Shiloh Interchange and the Johnson Lane Interchange are projected to operate at LOS C by 2035. A third lane in each direction would improve these segments to a desirable LOS B.

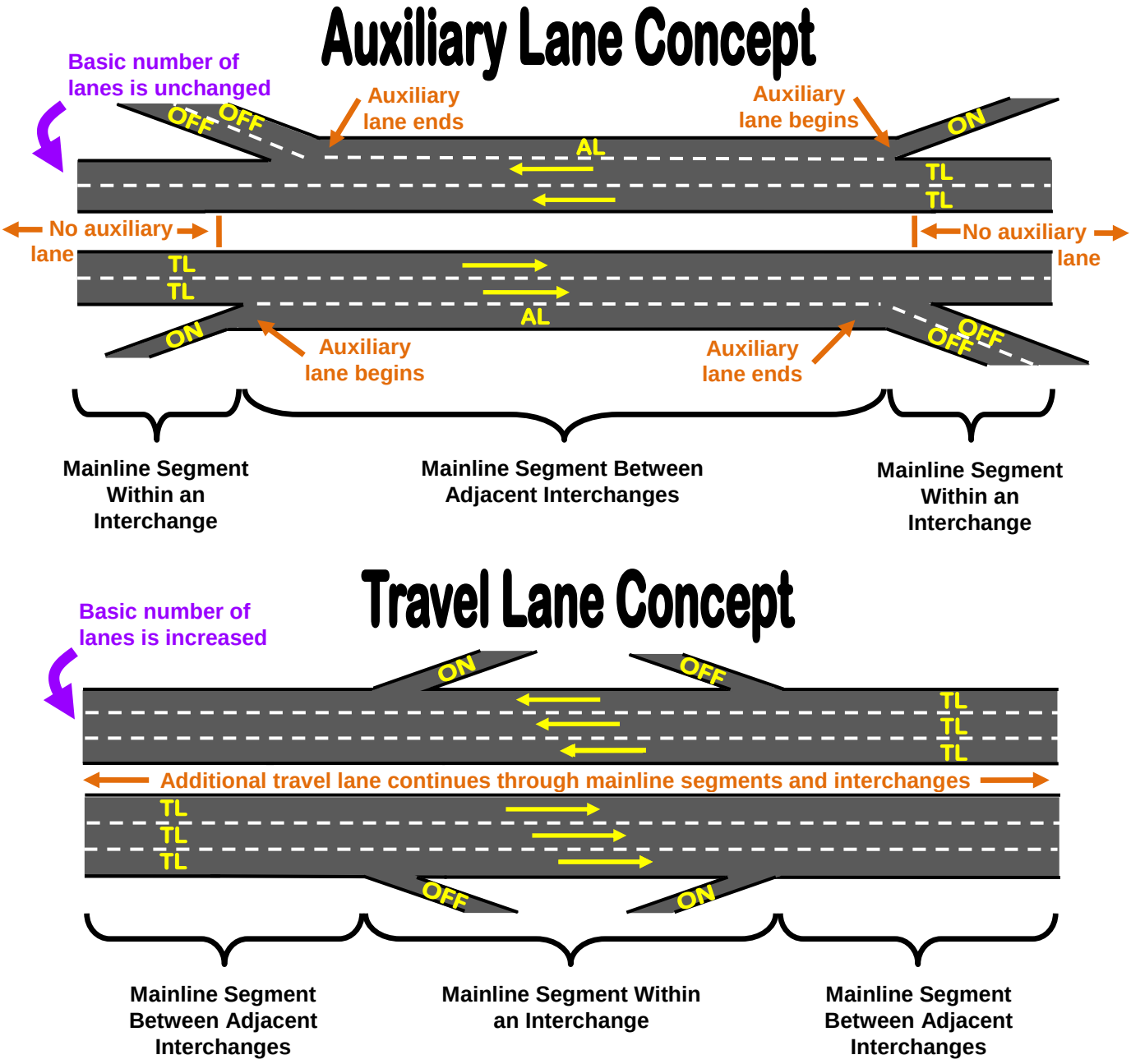
A third mainline Interstate lane can be developed in one of two ways:

- Develop an auxiliary lane on one or more mainline segments between interchanges. An auxiliary lane is a lane that occurs between interchanges, but does not proceed through adjacent interchanges. Auxiliary lanes can occur on consecutive or alternating mainline segments.
- Increase the basic number of lanes on the Interstate by constructing an additional travel lane on two or more consecutive mainline segments traveling through consecutive interchanges.

Auxiliary lanes are typically developed where additional capacity is needed between adjacent interchanges, due to traffic volumes entering the Interstate at one interchange and exiting the Interstate at the following interchange. Continuous travel lanes constructed through interchanges are typically used where additional capacity is needed due to traffic volumes continuing through one or more downstream interchanges.

The auxiliary lane and travel lane concepts are illustrated in Figure 5-1.

Figure 5-1 Auxiliary Lane and Travel Lane Concepts



Key

TL: Travel Lane
AL: Auxiliary Lane
ON: On-Ramp
OFF: Off-Ramp

Note: This figure is intended for illustrative purposes only and does not represent any portion of the I-90 study corridor.

5.1.4 Lane Balance Considerations

The concept of lane balance should be considered when proposing changes to Interstate lane configuration. MDT's lane balance guidelines state:

- At entrances, the number of lanes beyond the merging of the two traffic streams should not be less than the sum of the approaching lanes minus one.
- At exits, the number of approach lanes on the highway should equal the sum of the number of mainline lanes beyond the exit, plus the number of exiting lanes, minus one.

5.2 Description of Improvement Options

Improvement options are identified using a letter and number combination.

- Letter:
  - M - an improvement to a mainline Interstate segment occurring between the gore areas of adjacent interchanges
  - U - a mainline Interstate improvement occurring underneath or through an interchange (i.e., between the gore areas of an interchange)
  - B - a bridge or structure improvement independent from other options
  - I - an interchange improvement

- Number: Improvement option numbering reflects the segment or interchange number within the study corridor and is typically consecutive from west to east

Improvement options are also categorized according to option type. The type of improvement option corresponds to the need identified in a specific location, such as capacity, geometric, traffic operations, and/or safety needs.

Anticipated permitting and regulatory agency coordination requirements are identified for each option. Construction phase permitting is not identified.

Planning level cost estimates are provided in 2012 dollars and reflect construction costs only. Costs associated with design and right-of-way acquisition are not included. Low and high cost estimate ranges were used due to the high degree of unknown factors over the planning horizon. Detailed cost estimates, including construction material assumptions, are provided in the Improvement Options Report (Appendix D).

Figure 5-2 illustrates recommended improvement options. Detailed plan view and typical section illustrations are provided in the Improvement Options Report (Appendix D).

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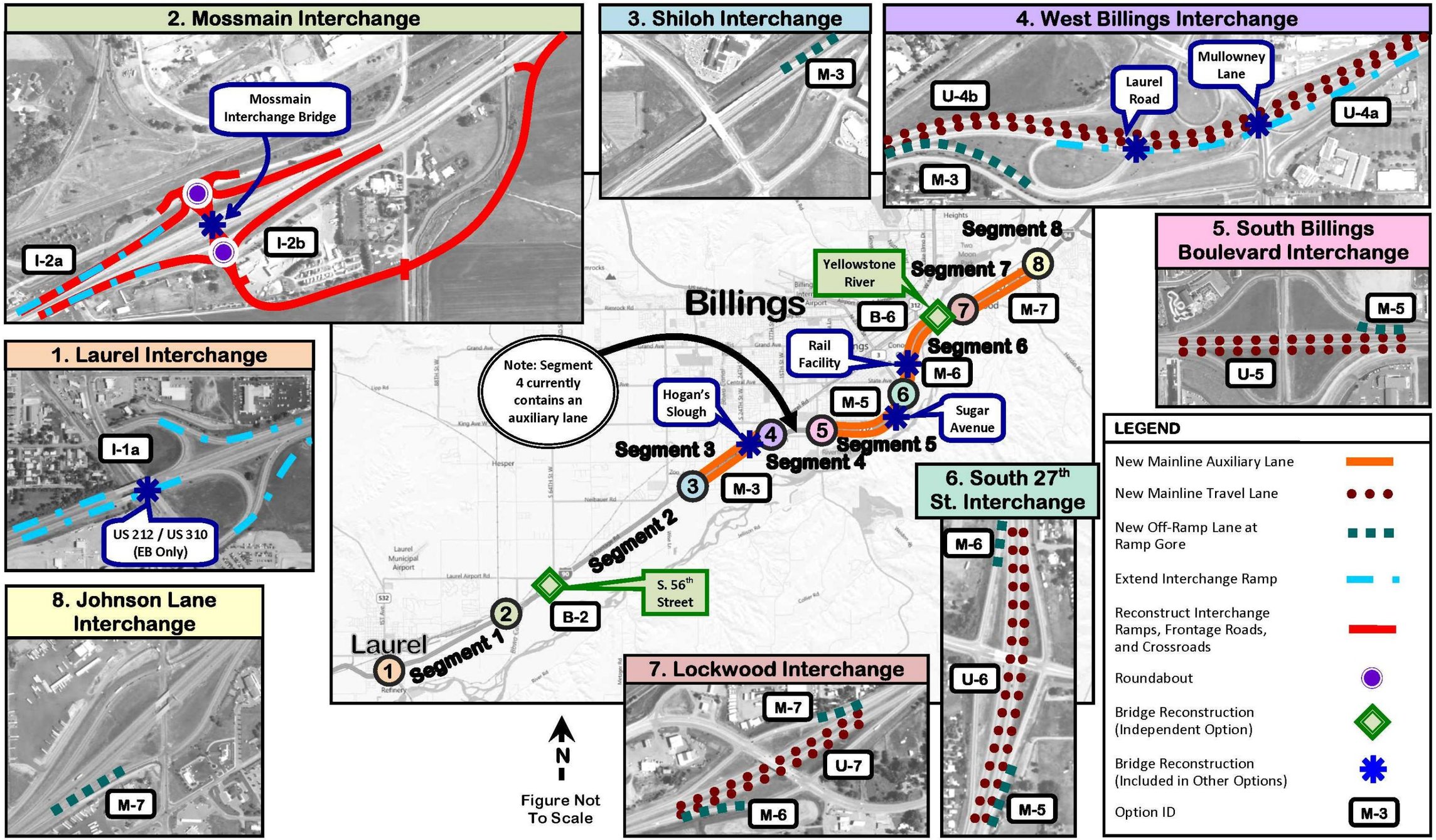
Figure 5-2 Recommended Improvement Options



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5.2.1 Mainline Segments Between Adjacent Interchanges (M Options)

Mainline segments in the I-90 corridor are generally configured with two lanes in each direction. Improvement Options M-3, M-5, M-6, and M-7 would address LOS issues by constructing an auxiliary lane on mainline segments 3, 5, 6, and 7, for a total of three lanes in each direction. The auxiliary lanes would not extend through the upstream and downstream interchanges, but would be limited to the mainline segment between adjacent interchanges. The location of the third lane would be determined during project design and development. Constructing a third lane toward the median could reduce right-of-way needs, and was assumed for this study.

Project level analysis would be required to determine if auxiliary lanes or additional through travel lanes are warranted based on observed traffic usage patterns in the I-90 corridor. For example, it may be appropriate to conduct an origin-destination study during project development to identify traffic usage patterns in the corridor, including trip length and termini. Vehicles entering the Interstate at an interchange and exiting at the following interchange would indicate a need for auxiliary lanes.

Mainline segment 4 between the West Billings Interchange and the South Billings Boulevard Interchange is configured with two through lanes and an auxiliary lane in both directions. This segment is projected to operate at LOS B through the 2035 planning horizon. No improvements are recommended for this segment.

Bridge structures impacted as a result of mainline widening improvements are identified in Table 5.1. Bridges are discussed in more detail in Section 5.2.3.

M options would require a second off-ramp lane at each ramp gore point where an auxiliary lane is recommended. Additional off-ramp lanes would address lane balance requirements and are not a requirement for LOS purposes. Lane configurations for ramp intersections at interchanges studied in the 2006 SEH report are still valid and have not been revisited by this study. If improvement options are forwarded from this study, lane transitions between ramp gore points and ramp intersections would need to be considered.

Option M-3 would involve adding an additional WB off-ramp lane at the Shiloh Interchange to maintain lane balance. This effort would include complete reconstruction of the mechanically stabilized earth (MSE) wall currently supporting the single lane off-ramp from the gore area to the ramp bridge structure. Installation of the current MSE wall involved a year-long soil

stabilization process and required coordination with BNSF Railway regarding the existing railroad easement and its daily railway operations. A similar process could be expected for ramp reconstruction. The westbound off-ramp would need to be closed during reconstruction, requiring westbound off-ramp traffic to use either the Mossmain Interchange or the West Billings Interchange.

Table 5.1 Mainline Segments Between Adjacent Interchanges (M Options)

Option ID	Improvement Option Description
M-3	Option Type: Capacity Description: Construct EB and WB auxiliary lanes on the mainline segment between the Shiloh and West Billings Interchanges. Other elements include: • Construct additional WB off-ramp lane at Shiloh Interchange ramp gore • Construct additional EB off-ramp lane at West Billings Interchange ramp gore • Reconstruct EB and WB I-90 bridge crossing of Hogan's Slough Permitting and Coordination: Impacts to Hogan's Slough may require coordination and permitting with DEQ, USACE, FWP, and USFWS. Reconstructing the MSE structure at the Shiloh Interchange may require coordination with BNSF Railway. Low Cost Estimate: $9,600,000 High Cost Estimate: $10,300,000
M-5	Option Type: Capacity Description: Construct EB and WB auxiliary lanes on the mainline segment between the South Billings Boulevard and South 27th Street Interchanges. Other elements include: • Construct additional WB off-ramp lane at South Billings Boulevard Interchange ramp gore • Construct additional EB off-ramp lane at South 27th Street Interchange ramp gore • Reconstruct EB and WB I-90 bridge crossing of Sugar Avenue Permitting and Coordination: Impacts to Suburban Ditch, Eagle Ditch, and Grey Eagle Ditch may require coordination and permitting with DEQ, USACE, FWP, USFWS, and SHPO. Low Cost Estimate: $9,200,000 High Cost Estimate: $9,900,000

Option ID	Improvement Option Description
M-6	Option Type: Capacity Description: Construct EB and WB auxiliary lanes on the mainline segment between the South 27th Street and Lockwood Interchanges. Other elements include: • Construct additional WB off-ramp lane at South 27th Street Interchange ramp gore • Construct additional EB off-ramp lane at Lockwood Interchange ramp gore • Reconstruct EB and WB I-90 bridge crossing of rail facility Permitting and Coordination: Impacts to the Yellowstone River would likely require coordination and permitting with DEQ, USACE, Yellowstone County, DNRC, FWP, and USFWS. Low Cost Estimate: $8,400,000 High Cost Estimate: $9,100,000
M-7	Option Type: Capacity Description: Construct EB and WB auxiliary lanes on the mainline segment between the Lockwood and Johnson Lane interchanges. Other elements include: • Construct additional WB off-ramp lane at Lockwood Interchange ramp gore • Construct additional EB off-ramp lane at Johnson Lane Interchange ramp gore Permitting and Coordination: None Low Cost Estimate: $5,600,000 High Cost Estimate: $6,000,000

5.2.2 Mainline Segments Under or Through an Interchange (U Options)

Mainline segments under or through an interchange (termed "under" segments) currently have two travel lanes in both directions. Improvement Options U-4b, U-5, U-6, and U-7 would construct a third travel lane within these under segments. U options would connect with M options to provide continuity in the basic number of lanes throughout the corridor and reduce weaving maneuvers as a result of ramp and auxiliary lane merging. Recommended improvement options for under segments and impacted bridge structures are identified in Table 5.2. Bridges are discussed in more detail in Section 5.2.3.

Table 5.2 Mainline Segments Under or Through an Interchange (U Options)

Option ID	Improvement Option Description
U-4a	Option Type: Safety Description: Lengthen EB on-ramp at Laurel Road. Other elements include: • Modify vertical curve • Reconstruct EB I-90 bridge crossing of Laurel Road • Reconstruct EB I-90 bridge crossing of Mullowney Lane Permitting and Coordination: None Low Cost Estimate: $6,700,000 High Cost Estimate: $7,300,000
U-4b	Option Type: Traffic operations and lane balance Description: Construct additional EB and WB mainline lanes through the West Billings Interchange. Other elements include: • Modify vertical curve • Reconstruct EB and WB I-90 bridge crossing of Laurel Road ramps • Reconstruct EB and WB I-90 bridge crossing of Mullowney Lane • Restripe WB off-ramp at West Billings Interchange Permitting and Coordination: None Low Cost Estimate: $12,200,000 High Cost Estimate: $13,100,000
U-5	Option Type: Traffic operations and lane balance Description: Construct additional EB and WB mainline lanes under and through the South Billings Boulevard Interchange Permitting and Coordination: None Low Cost Estimate: $1,500,000 High Cost Estimate: $1,700,000

Option ID	Improvement Option Description
U-6	Option Type: Traffic operations and lane balance Description: Construct additional EB and WB mainline lanes under and through the South 27th Street Interchange. Other elements include: • Restripe EB off-ramp at South Billings Boulevard Interchange Permitting and Coordination: None Low Cost Estimate: $1,800,000 High Cost Estimate: $1,900,000
U-7	Option Type: Traffic operations and lane balance Description: Construct additional EB and WB mainline lanes under and through the Lockwood Interchange Permitting and Coordination: Impacts to the Lockwood Ditch may require coordination and permitting with DEQ, USACE, FWP, and USFWS. Low Cost Estimate: $1,800,000 High Cost Estimate: $1,900,000

A third lane is not needed to improve LOS within the "under" segments during the 2035 planning horizon. Additional capacity is needed at mainline segments 3, 5, 6, and 7, which are located between the interchanges. Project level analysis would be required to determine if auxiliary lanes or additional through travel lanes are warranted based on observed traffic usage patterns in the I-90 corridor. Vehicles entering the Interstate at an interchange and continuing through multiple downstream interchanges would indicate a need for three continuous travel lanes in each direction.

Constructing a third through travel lane within the study corridor would have different lane balance implications as compared to constructing auxiliary lanes with M options. For example, if a continuous third travel lane were to be constructed through either the West Billings Interchange (Option U-4b) or the South Billings Boulevard Interchange (Option U-5), the downstream off-ramp would need to be reconstructed or restriped as a single lane diverging off-

ramp to maintain lane balance. If improvement options are forwarded from this study, the issue of lane balance would need to be investigated relating to the proper number of off-ramp lanes for each project.

Project level analysis would also be needed to assess traffic patterns within segment 4 located between the West Billings Interchange and the South Billings Boulevard Interchange. This mainline segment is currently configured with two travel lanes and an auxiliary lane in each direction. Auxiliary lanes allow vehicles to enter and exit the Interstate with less conflict than mainline configurations with on-ramps and off-ramps that directly merge onto and diverge from the Interstate. If improvement options are forwarded from this study, project level analysis should be conducted to determine if traffic patterns, capacity needs, or safety issues continue to warrant an auxiliary lane configuration between the West Billings Interchange and the South Billings Boulevard Interchange mainline segment.

If three through travel lanes are not warranted and Option U-4b is not implemented, Option U-4a would address a documented safety concern at the West Billings Interchange. This option would lengthen the EB Laurel Road on-ramp at the West Billings Interchange. The high number of rear-end crashes involving multiple vehicles in this location may indicate either merging or acceleration issues. This option would allow vehicles to gradually attain speed within a lengthened parallel ramp, reducing merging conflicts with mainline volumes.

5.2.3 Bridges (B Options)

Independent bridge options involve reconstructing bridge structures classified as functionally obsolete and/or fracture critical and eligible for rehabilitation by MDT. Independent bridge options are listed in Table 5.3.

Table 5.3 Independent Bridge Options (B Options)

Option ID	Improvement Option Description
B-2	Option Type: Geometric Description: Reconstruct EB and WB I-90 bridges crossing S. 56th Street; modify vertical curve Permitting and Coordination: None Low Cost Estimate: $2,300,000 High Cost Estimate: $2,500,000
B-6	Option Type: Geometric / Capacity Description: Reconstruct EB and WB I-90 bridges crossing the Yellowstone River Permitting and Coordination: Impacts to the Yellowstone River would likely require coordination and permitting with DEQ, USACE, Yellowstone County, DNRC, FWP, and USFWS. Low Cost Estimate: $32,600,000 High Cost Estimate: $35,200,000

Option B-2 would reconstruct the EB and WB I-90 bridges crossing S. 56th Street. The structures are functionally obsolete and reconstruction would bring them in compliance with current MDT design standards. The bridges are anticipated to retain their current lane configuration throughout the 2035 planning horizon since mainline widening options are not recommended adjacent to Option B-2. If Option B-2 is forwarded from this study, additional analysis should be conducted during project development to verify traffic demands and mainline capacity needs at this location.

Option B-6 would reconstruct the EB and WB Yellowstone River Bridges. The current structures are designated as functionally obsolete and fracture critical. Reconstruction would bring the structures up to current MDT design standards and address the fracture critical designation. The Yellowstone River Bridges are located within mainline segment 6, identified as a segment requiring widening to address capacity needs within the planning horizon. To match improvement options identified for segment 6, the Yellowstone River Bridges should be

reconstructed with three travel lanes in each direction (see typical sections provided in Improvement Options Report, Appendix D). If Option B-6 is forwarded from this study, it may be appropriate to consider widening the bridge further to accommodate an emergency travel lane. Modifications to the width could be considered during the design phase of an individual project.

A number of other bridges in the corridor will need to be reconstructed due to mainline widening and interchange reconstruction projects. These bridges are otherwise functionally and structurally sound, but require reconstruction due to widening associated with recommended mainline or interchange improvements.

If improvement options involving bridge reconstruction are forwarded from this study, bridges could be designed and constructed to allow expansion to accommodate future capacity needs throughout the bridge design life (75 years). Mainline bridge structures, ramps and on-system overpass structures may be constructed using methods and structure types commonly used on the Interstate system in Montana. Recommended options provided in this study accommodate anticipated traffic demands within the 2035 planning horizon.

5.2.4 Interchanges (I Options)

This study includes an analysis of the Laurel and Mossmain Interchanges to supplement analysis conducted for the 2006 SEH report. Improvement options for the Laurel and Mossmain Interchanges are listed in Table 5.4.

Table 5.4 Interchanges (I Options)

Option ID	Improvement Option Description
I-1a	Option Type: Geometric Description: Extend EB and WB on-ramps and off-ramps; flatten horizontal curves at WB off-ramp and EB on-ramp; modify vertical curves. Other elements include: • Reconstruct EB I-90 bridge crossing of US 212 / US 310 Permitting and Coordination: Impacts to farmlands may require coordination with NRCS. Impacts to the Italian Ditch may require coordination and permitting with DEQ, USACE, FWP, USFWS, and SHPO. Low Cost Estimate: $6,700,000 High Cost Estimate: $7,300,000
I-1b	Option Type: Safety Description: Upgrade lighting at Laurel Interchange to CIL standards Permitting and Coordination: None Low Cost Estimate: $380,000 High Cost Estimate: $410,000
I-2a	Option Type: Geometric Description: Extend EB and WB on-ramps and off-ramps Permitting and Coordination: None Low Cost Estimate: $730,000 High Cost Estimate: $780,000

Option ID	Improvement Option Description
I-2b	Option Type: Capacity Description: Reconstruct Mossmain Interchange. Variations include: • Braided Ramps • Roundabouts • Single Point Urban Interchange (SPUI) • Reconstruction of Frontage Roads Figure 5-2 illustrates the roundabouts variation. Please see the Improvement Options Report (Appendix D) for illustrations of other variations. Permitting and Coordination: Impacts to farmlands may require coordination with NRCS. Impacts to Canyon Creek Ditch, the BBWA Canal and laterals, and the Mossmain Overpass may require coordination and permitting with DEQ, USACE, FWP, USFWS, and SHPO. Low Cost Estimate: Roundabouts: $10,800,000 High Cost Estimate: Roundabouts: $11,600,000
I-2c	Option Type: Safety Description: Upgrade lighting at Mossmain Interchange to CIL standards Permitting and Coordination: None Low Cost Estimate: $390,000 High Cost Estimate: $420,000

Options I-1a and I-2a would extend the EB and WB on- and off-ramps at the Laurel Interchange and the Mossmain Interchange to bring each interchange up to current MDT design standards for ramp lengths. As part of Option I-1a, the EB I-90 bridge crossing US 212 / US 310 would need to be reconstructed to accommodate the additional width needed to support the ramp improvement.

Option I-1b and I-2c would install additional lighting at the Laurel and Mossmain Interchanges to meet CIL standards. If improvement options are forwarded from this study, an appropriate level of lighting could be considered during project development. CIL is warranted at these

interchanges, although Chapter 13 of the MDT Traffic Engineering Manual (November 2007) notes PIL is generally MDT's preferred method for interchange lighting.

The Laurel Interchange intersections are anticipated to operate at LOS C or better through 2035. The Mossmain Interchange intersections are expected to experience LOS D, E, and F by 2035. Option I-2b would reconstruct the Mossmain Interchange to address operational issues. Multiple variations of this option were considered, including braided ramps, roundabout configurations, a single point urban interchange (SPUI), and reconstruction of the frontage roads. These variations would require substantial modifications to adjacent transportation systems, structure improvements, drainage and irrigation features, and right-of-way acquisition to accommodate a final design. A traffic analysis and geometric design would be developed during a future project design phase. Illustrations of these concepts are included in the Improvement Options Report (Appendix D).

FHWA has developed an 8-Point Policy Analysis for new or revised access points to the Interstate system. This 8-Point Policy Analysis must be supported by substantiated information justifying and documenting the decision to modify the existing access points along the Interstate. FHWA's decision to approve a request is dependent on the proposal satisfying and documenting the eight requirements pursuant to 23 U.S.C. 111. This policy would apply only to Improvement Option I-2b and would be addressed at the project level.

5.3 Improvement Option Analysis

Improvement options altering the number or configuration of mainline lanes or interchange ramp lanes were analyzed to determine how the options would affect LOS within the 2035 planning horizon. Mainline and ramp intersection locations were analyzed using procedures outlined in the Highway Capacity Manual (HCM) 2010. Interstate components, HCM concepts, LOS criteria, operational analysis methods, and software applications used for the study are described in detail in the Existing and Projected Conditions Report (Appendix B) and are summarized in the following sections. Additional detail regarding operational analysis results is provided in the Improvement Options Report (Appendix D).

5.3.1 Mainline Segments Between Adjacent Interchanges (M Options)

Table 5.5 presents the results of the LOS analysis for mainline improvement options between adjacent interchanges (M Options).

Table 5.5 LOS Analysis for M Options (2035)

Option	Location		Without Improvement		With Improvement	
			EB	WB	EB	WB
M-3	Shiloh	On-Ramp	C	-	B	-
		Off-Ramp	-	B	-	B
	Shiloh to West Billings	Mainline	C	C	B	B
	West Billings	On-Ramp	-	C	-	B
		Off-Ramp	B	-	B	-
M-5	South Billings Boulevard	On-Ramp	C	-	B	-
		Off-Ramp	-	C	-	B
	South Billings Boulevard to South 27th Street	Mainline	C	B	B	B
	South 27th Street	On-Ramp	-	B	-	B
		Off-Ramp	C	-	B	-
M-6	South 27th Street	On-Ramp	C	-	B	-
		Off-Ramp	-	B	-	B
	South 27th Street to Lockwood	Mainline	C	B	B	B
	Lockwood	On-Ramp	-	C	-	B
		Off-Ramp	C	-	B	-
M-7	Lockwood	On-Ramp	C	-	B	-
		Off-Ramp	-	C	-	B
	Lockwood to Johnson Lane	Mainline	B	C	B	B
	Johnson Lane	On-Ramp	-	C	-	B
		Off-Ramp	B	-	B	-

Source: DOWL HKM, 2011.
Dashes (-) indicate option does not address location.
The MDT Traffic Engineering Manual and MDT Road Design Manual define desirable operations for urban and rural Interstate facilities as LOS B. Shaded cells indicate undesirable operations (LOS C or worse).

Mainline segments and gore areas are expected to operate at LOS B or better with implementation of the recommended auxiliary lane improvements.

Several ramps are projected to operate near the threshold between LOS B and LOS C with implementation of M options, including the Shiloh EB on-ramp and the West Billings and Johnson Lane WB on-ramps. If improvement options are forwarded from this study, additional analysis should be conducted during project development to determine if traffic volumes warrant additional ramp lanes.

5.3.2 Mainline Segments Under or Through an Interchange (U Options)

Table 5.6 presents the results of the LOS analysis for mainline improvement options under or through an interchange.

Table 5.6 LOS Analysis for U Options

Option	Location		2035 Without Improvement		2035 With Improvement	
			EB	WB	EB	WB
U-4b	West Billings	On-Ramp	B	C	A	B
		Off-Ramp	B	B	B	B
		On-Ramp at Mullowney*	B	*	B	*
	West Billings Over	Mainline	A	A	A	A
	West Billings Over Part 2*	Mainline	A	*	A	*
U-5	South Billings Boulevard	On-Ramp	C	B	B	B
		Off-Ramp	B	C	B	B
	South Billings Boulevard Under	Mainline	B	B	A	A
U-6	South 27th Street	On-Ramp	C	B	B	B
		Off-Ramp	C	B	B	B
	South 27th Street Under	Mainline	B	B	A	A
U-7	Lockwood	On-Ramp	C	C	B	B
		Off-Ramp	C	C	B	B
	Lockwood Under	Mainline	B	B	B	A

Source: DOWL HKM, 2011.
*No WB component.
The MDT Traffic Engineering Manual and MDT Road Design Manual define desirable operations for urban and rural Interstate facilities as LOS B. Shaded cells indicate undesirable operations (LOS C or worse).

Under segments are not anticipated to reach LOS C by 2035. Although under options are not needed to address LOS issues, they would improve LOS due to the addition of a third lane.

Several ramps are projected to operate near the threshold between LOS B and LOS C with implementation of U options, including the West Billings WB on- and off-ramps and the Lockwood EB off-ramp. If improvement options are forwarded from this study, additional analysis should be conducted during project development to determine if traffic volumes warrant additional ramp lanes.

5.3.3 Interchanges (I Options)

Table 5.7 presents the results of the LOS analysis for the Mossmain Interchange.

Table 5.7 LOS Analysis for Option I-2b (Roundabouts)

Intersection		Intersection Approach	2035 LOS			
			Without Improvement		With Improvement Option I-2b (Roundabouts)	
			Approach	Overall Intersection	Approach	Overall Intersection
M1	E. Main Street / S. 72nd Street West / Interchange Crossroad	EB Approach (E. Main Street)	F	F	B	B
		WB Approach (S. 72nd Street West)	F		C	
		NB Approach (Interchange Crossroad)	A		A	
M2	I-90 WB Ramps / Interchange Crossroad	WB Approach (WB I-90 Off-Ramp)	F	F	C	
		NB Approach (Interchange Crossroad)	A		-	
		SB Approach (Interchange Crossroad)	-		-	
M3	I-90 EB Ramps / Interchange Crossroad	EB Approach (EB I-90 Off-Ramp)	E	E	A	A
		NB Approach (Interchange Crossroad)	-		B	
		SB Approach (Interchange Crossroad)	A		A	
M4	Magelssen Road / S. Frontage Road / Interchange Crossroad	EB Approach (Magelssen Road)	-	D	-	-
		WB Approach (S. Frontage Road)	A		-	
		NB Approach (Driveway)	D		-	
		SB Approach (Interchange Crossroad)	-		-	

Source: DOWL HKM, 2011.
Dashes (-) indicate no conflicting movements (i.e., no delay).
The MDT Road Design Manual notes individual interchange elements should not operate more than one LOS below the mainline Interstate. Desirable operations for the mainline Interstate and ramp intersections are defined as LOS B and LOS C, respectively. Shaded cells indicate undesirable intersection operations (LOS D or worse).

All intersections at the Mossmain Interchange are expected to deteriorate to failing LOS (defined as LOS D or worse) by 2035, indicating substantial delay and queuing.

Option I-2b would reconstruct the Mossmain Interchange to address operational issues. Four conceptual reconstruction scenarios were assessed to determine if they would operate at a desirable LOS C through the 2035 planning horizon. The roundabout variation of Option I-2b is anticipated to address the interchange's operational and capacity needs. All other variations of this option (including the braided ramps, SPUI, and frontage road reconstruction variations) would not achieve desirable LOS C or better through 2035. These variations were eliminated from further consideration.

5.4 Other Planning Efforts and Projects

This study and the 2006 SEH report recommend improvement options assuming the configurations of Interstate mainline and interchange facilities remain unchanged throughout the respective study horizon years. Corridor recommendations from the 2008 Lockwood Transportation Study and the Billings Bypass EIS are listed below. If constructed, these improvement options would alter conditions at the Johnson and Lockwood Interchanges under which improvement options were recommended for the subject study and the 2006 SEH report.

5.4.1 Billings Bypass EIS

MDT, in cooperation with FHWA, is preparing an EIS for a proposed project to improve access and connectivity between I-90 and Old Hwy 312 in the northeast portion of the Billings urban area. The area assessed in the EIS is mainly outside the corridor study area. The area of overlap is described below.

Johnson Lane Interchange

- Alternatives include a No Build Alternative and several Build Alternatives requiring reconstruction of the interchange and a new crossing of the Yellowstone River. Build Alternatives generally begin at the Johnson Lane Interchange and head northwesterly towards Old Highway 312. The final EIS and Record of Decision (ROD) for this project are expected to be completed and approved by 2013.

5.4.2 Lockwood Transportation Study

The 2008 Lockwood Transportation Study identified transportation improvement options in the Lockwood area northwest of Billings. Recommended corridor improvements are described below.

Lockwood Interchange

- A recommended improvement option would construct an additional right-turn lane at the EB off-ramp. This improvement would modify traffic flow at the interchange intersection.
- A recommended improvement option would construct a Single Point Urban Interchange (SPUI). This improvement would modify the design of the interchange ramps and traffic flow at the interchange intersections.

Johnson Lane Interchange

- A recommended improvement option would construct dual right-turn lanes at the EB off-ramp interchange intersection. This improvement would modify traffic flow at the interchange intersection.

- A recommended improvement option would:
    - remove the EB off-ramp connection from Johnson Lane and connect it with Old Hardin Road just west of the Flying J Truck Stop located at Old Hardin Road and Johnson Lane;
    - alter the deceleration distance of the off-ramp; and
    - remove the connection with Johnson Lane.

  These changes would redirect traffic at the interchange intersection.

This corridor study was conducted assuming no changes would occur within the I-90 study corridor through the planning horizon of 2035. Reconstruction of the Lockwood and Johnson Lane Interchanges and resulting effects on traffic volumes were not considered. Construction of the Billings Bypass project or other improvements in the corridor could alter trip distribution patterns in the region, affecting traffic volumes and LOS within the Interstate corridor.

5.5 Summary of Recommended Improvement Options

Table 5.8 summarizes improvement options recommended within the corridor. Improvement options are listed from west to east. Table elements not previously defined are described below.

For capacity improvements, the deficiency year is defined as the year when operations are anticipated to reach LOS C for Interstate facilities, and LOS D for ramp intersections. The deficiency year for traffic operation improvements located under and through interchanges is based on the deficiency year for adjacent mainline Interstate segments. The deficiency year for geometric and safety improvements is 2012, reflecting the condition occurs currently. The deficiency year does not indicate the anticipated timeframe for implementation of any recommended improvements, which is dependent on available funding and other system priorities.

Planning priority categories are defined as follows:

- Near Term: Implementation is recommended in the near term (5-10 years) to address a documented need.
- Long Term: Implementation is recommended in the long term (10-20 years) to address a documented need.
- As Needed: Option could be implemented to meet current MDT design standards as funding allows. Option is not associated with a documented crash trend or capacity need.

Impacts to environmental resources and right-of-way acquisition are identified as follows.

- "No" indicates an option is anticipated to result in negligible impacts to environmental resources and is anticipated to remain within the existing MDT right-of-way.
- "Yes" indicates an option is anticipated to require coordination and permitting with regulatory agencies and is anticipated to require new right-of-way.

Planning level cost estimates are listed in 2012 dollars for each improvement option. Detailed cost estimates, including construction material assumptions, are provided in the Improvement Options Report (Appendix D).

Reconstructing the entire Interstate facility within the study corridor as a single project may be difficult to fund and may pose constructability challenges. This corridor study identifies multiple improvement options to address discrete mainline segments, bridges, and interchanges within the study corridor. If multiple improvement options are implemented together, there may be cost savings associated with engineering design, mobilization, construction administration, and material costs. However, implementation decisions will be based on available funding.

Project level analysis would be required to determine if auxiliary lanes or additional through travel lanes are warranted based on observed traffic usage patterns in the I-90 corridor. Mainline (M) options would involve construction of auxiliary lanes between adjacent interchanges, providing additional capacity in these discrete segments. The combination of all M options and Under (U) options would result in three continuous travel lanes, providing additional capacity throughout the entire corridor. Appropriate combinations of these options may be selected in the future following project level analysis for specific improvement projects.

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Table 5.8 Recommended Improvement Options

Location	Option ID[1]	Option Type[2]	Improvement Option Description	Deficiency Year[3]	Planning Priority[4]	Impacts to Environmental Resources[5]	Right-of-Way Acquisition[6]	Low Cost Estimate[7]	High Cost Estimate[7]
Interchange 1: Laurel	**I-1a**	Geometric	Extend EB and WB on-ramps and off-ramps; flatten horizontal curves at WB off-ramp and EB on-ramp; modify vertical curves Other elements include: • Reconstruct EB I-90 bridge crossing of US 212 / US 310	2012	As Needed	Yes	Yes	$6,700,000	$7,300,000
	I-1b	Safety	Upgrade lighting at Laurel Interchange to CIL standards	2012	As Needed	No	No	$380,000	$410,000
Interchange 2: Mossmain	**I-2a**	Geometric	Extend EB and WB on-ramps and off-ramps	2012	Near Term	No	No	$730,000	$780,000
	I-2b	Capacity	Reconstruct Mossmain Interchange with two roundabouts	2012	Near Term	Yes	Yes	$10,800,000	$11,600,000
	I-2c	Safety	Upgrade lighting at Mossmain Interchange to CIL standards	2012	As Needed	No	No	$390,000	$420,000
Mainline Segment 2	**B-2**	Geometric	Reconstruct EB and WB I-90 bridges crossing S. 56th Street; modify vertical curve	2012	Long Term	No	No	$2,300,000	$2,500,000
Mainline Segment 3	**M-3**	Capacity	Construct EB and WB auxiliary lanes on the mainline segment between the Shiloh and West Billings Interchanges Other elements include: • Construct additional WB off-ramp lane at Shiloh Interchange ramp gore • Construct additional EB off-ramp lane at West Billings Interchange ramp gore • Reconstruct EB and WB I-90 bridge crossing of Hogan's Slough	2027	Long Term	Yes	No	$9,600,000	$10,300,000
Interchange 4: West Billings	**U-4a**	Safety	Lengthen EB on-ramp at Laurel Road Other elements include: • Modify vertical curve • Reconstruct EB I-90 bridge crossing of Laurel Road • Reconstruct EB I-90 bridge crossing of Mullowney Lane	2012	Near Term	No	No	$6,700,000	$7,300,000
	U-4b	Traffic Operations & Lane Balance	Construct additional EB and WB mainline lanes through the West Billings Interchange Other elements include: • Modify vertical curve • Reconstruct EB and WB I-90 bridge crossing of Laurel Road ramps • Reconstruct EB and WB I-90 bridge crossing of Mullowney Lane • Restripe WB off-ramp at West Billings Interchange	2028	Long Term	No	No	$12,200,000	$13,100,000
Interchange 5: South Billings Boulevard	**U-5**	Traffic Operations & Lane Balance	Construct additional EB and WB mainline lanes under and through the South Billings Boulevard Interchange	2028	Long Term	No	No	$1,500,000	$1,700,000
Mainline Segment 5	**M-5**	Capacity	Construct EB and WB auxiliary lanes on the mainline segment between the South Billings Boulevard and South 27th Street Interchanges Other elements include: • Construct additional WB off-ramp lane at South Billings Boulevard Interchange ramp gore • Construct additional EB off-ramp lane at South 27th Street Interchange ramp gore • Reconstruct EB and WB I-90 bridge crossing of Sugar Avenue	2028	Long Term	Yes	No	$9,200,000	$9,900,000
Interchange 6: South 27th Street	**U-6**	Traffic Operations & Lane Balance	Construct additional EB and WB mainline lanes under and through the South 27th Street Interchange Other elements include: • Restripe EB off-ramp at South Billings Boulevard Interchange	2028	Long Term	No	No	$1,800,000	$1,900,000

Location	Option ID[1]	Option Type[2]	Improvement Option Description	Deficiency Year[3]	Planning Priority[4]	Impacts to Environmental Resources[5]	Right-of-Way Acquisition[6]	Low Cost Estimate[7]	High Cost Estimate[7]
Mainline Segment 6	**M-6**	Capacity	Construct EB and WB auxiliary lanes on the mainline segment between the South 27th Street and Lockwood Interchanges Other elements include: • Construct additional WB off-ramp lane at South 27th Street Interchange ramp gore • Construct additional EB off-ramp lane at Lockwood Interchange ramp gore • Reconstruct EB and WB I-90 bridge crossing of rail facility	2023	Long Term	Yes	No	$8,400,000	$9,100,000
	B-6	Capacity Geometric	Reconstruct EB and WB I-90 bridges crossing the Yellowstone River	2012	Near Term	Yes	Yes	$32,600,000	$35,200,000
Interchange 7: Lockwood	**U-7**	Traffic Operations & Lane Balance	Construct additional EB and WB mainline lanes under and through the Lockwood Interchange	2027	Long Term	Yes	No	$1,800,000	$1,900,000
Mainline Segment 7	**M-7**	Capacity	Construct EB and WB auxiliary lanes on the mainline segment between the Lockwood and Johnson Lane interchanges Other elements include: • Construct additional WB off-ramp lane at Lockwood Interchange ramp gore • Construct additional EB off-ramp lane at Johnson Lane Interchange ramp gore	2027	Long Term	No	No	$5,600,000	$6,000,000

Options are listed from west to east throughout the corridor.

[1] Option ID: M = Improvement to a mainline segment between gore areas of adjacent interchanges; U = Mainline Interstate improvement occurring underneath or through an interchange (i.e., between the gore areas of an interchange); B = Bridge Improvement Option; I = Interchange Improvement Option. Improvement option numbering reflects the segment or interchange number within the study corridor.

[2] Option Type corresponds to the need identified in a specific location, including capacity, geometric, traffic operations, and safety needs.

[3] Deficiency Year indicates the year the condition occurs or is expected to occur. It does not indicate the year the improvement option would be implemented.

[4] Planning Priority does not imply projects will be programmed or implemented. Project programming is based on funding availability and other system priorities. Planning Priority categories are defined as follows.

- Near Term: Implementation is recommended in the near term (5-10 years) to address a documented need.
- Long Term: Implementation is recommended in the long term (10-20 years) to address a documented need.
- As Needed: Options can be implemented as funding allows to meet current MDT design standards. Options are not associated with a documented crash trend or capacity need

[5] "No" indicates an option anticipated to result in negligible impacts to environmental resources. "Yes" indicates an option involving potential impacts to environmental resources that may require permitting or coordination with regulatory agencies. Construction phase permitting is not identified.

[6] "No" indicates an option anticipated to remain within the existing MDT right-of-way. "Yes" indicates an option may require new right-of-way.

[7] Planning level cost estimates are listed in 2012 dollars and are rounded for planning purposes. Cost estimates reflect construction costs only based on planning level estimates, and should not be considered an actual cost or encompassing all scenarios and circumstances. Low and high cost estimate ranges were used due to the high degree of unknown factors over the planning horizon, as well as the substantial amount of items not accounted for in this planning level cost estimate. Costs associated with right-of-way acquisition design or utility relocations are not included. Detailed cost estimates are provided in Appendix D.

6.0 FUNDING

6.1 Potential Funding Sources

This section describes potential sources to help fund transportation improvement projects in the I-90 corridor.

6.1.1 Interstate Maintenance (IM) Program

Interstate Maintenance (IM) funds are federally apportioned to Montana and allocated based on system performance by the Montana Transportation Commission. The Commission approves and awards projects for improvements on the Interstate Highway System which are let through a competitive bidding process. The federal share for IM projects is 91.24% and the state is responsible for the remaining 8.76%. The IM Program finances projects to rehabilitate, restore, resurface, and reconstruct the Interstate System. Adding capacity by constructing new lanes for single-occupancy vehicles is not an eligible activity under the IM program.

6.1.2 National Highway System Program

National Highway (NH) funding is intended to provide an interconnected system of principal arterial routes to serve major population centers, international border crossings, intermodal transportation facilities and other major travel destination; meet national defense requirements; and serve interstate and interregional travel. NH funding includes all Interstate routes, a large percentage of urban and rural principal arterials, the defense strategic highway network, and strategic highway connectors.

NH funds are federally-apportioned to Montana and allocated based on system performance by the Montana Transportation Commission. The federal share for NHS projects is 86.58% and the state is responsible for the remaining 13.24%. The state share is funded through the Highway State Special Revenue Account.

Activities eligible for NH funding include construction, reconstruction, resurfacing, restoration, and rehabilitation of NHS segments. Operational improvements as well as highway safety improvements are also eligible. Research, planning, carpool projects, bikeways, and pedestrian walkways may also qualify for NH funding. Construction of new lanes for single occupancy vehicles is an eligible activity under the NHS program.

6.1.3 Highway Safety Improvement Program (HSIP)

HSIP funds are federally apportioned to Montana and allocated to safety improvement projects identified in the strategic highway safety improvement plan by the Montana Transportation Commission. Projects described in the state strategic highway safety plan must correct or improve a hazardous road location or feature, or address a highway safety problem. Generally, the federal share for the HSIP projects is 91.24% and the state is responsible for 8.76%.

6.1.4 Highway Bridge Replacement and Rehabilitation Program (HBRRP)

HBRRP funds are federally apportioned to Montana and allocated to two programs by the Montana Transportation Commission. Federal funds generally cover 86.58% of project costs and the state is responsible for the remaining 13.42%. The state share is funded through the Highway State Special Revenue Account.

The On-System Bridge Program receives 65% of the federal HBRRP funds. All highway bridges on the state system are eligible for On-System Bridge Program funding . Eligible activities under this program include rehabilitation, replacement, painting and seismic retrofitting. MDT's Bridge Bureau assigns a priority for replacement or rehabilitation of

structurally deficient and functionally obsolete structures based upon each bridge's sufficiency rating. A structurally deficient bridge is eligible for rehabilitation or replacement; a functionally obsolete bridge is only eligible for rehabilitation; and a bridge rated as sufficient is not eligible for funding under this program.

6.1.5 State Funded Construction

The State Funded Construction Program, which is funded entirely from the Highway State Special Revenue Account, typically provides funding for projects that are not eligible for federal funding programs. This program required no federal match. Funding from this source depends on availability and need. MDT Districts establish priorities and the Montana Transportation Commission approves the program.

6.1.6 Discretionary Funds

Discretionary funds may be received through either highway program authorization or annual appropriations processes. These funds are generally described as "demonstration" or "earmark" funds. Receiving discretionary funds has been a viable mechanism for local governments to secure federal funding for projects in the past. If a locally sponsored project receives these types of funds, MDT will administer the funds in accordance with the Montana Transportation Commission Policy #5 – "Policy resolution regarding Congressionally directed funding: including Demonstration Projects, High Priority Projects, and Project Earmarks." The current federal fiscal condition makes it unlikely that discretionary funding will be available for the I-90 corridor.

7.0 CONCLUSIONS AND NEXT STEPS

This corridor study recommends a set of near term and long term improvements to the I-90 corridor from the Laurel Interchange (RP 433.8) to the mainline segment ending immediately west of the Pinehills Interchange (RP 455.85). Improvements were developed to address corridor needs, including current and projected traffic demands and safety issues.

Recommended improvement options include:

- mainline Interstate widening and interchange reconstruction to address capacity needs and traffic operations within the 2035 planning horizon;
- bridge reconstruction to accommodate mainline Interstate widening and bring structures up to current MDT standards;
- safety improvements to reduce conflicts at interchange ramps; and
- geometric improvements to bring the Interstate facility into compliance with current MDT design standards.

Development and implementation of appropriate combinations of improvement options will depend upon future funding availability. For all improvement options, a traffic analysis and geometric design would be developed during project design. This study indicates there are no major technical or environmental impediments to further development of recommended improvements.

MDT has nominated the two Yellowstone Bridge structures for replacement based on the results of the Billings Area I-90 Corridor Planning Study. MDT will identify appropriate funding and timeframes for project programming and construction. Potential sources of funding may include IM program and HBRRP funds.

The following list identifies next steps toward reconstruction of the two Yellowstone Bridge structures:

- Include the reconstruction of the two Yellowstone Bridge structures in the Billings Urban Area Long-Range Transportation Plan update and the Billings Transportation Improvement Program.

- Attain approval for the reconstruction of the two Yellowstone Bridge structures by the Montana Transportation Commission.

- Initiate preliminary engineering and environmental review process.

8.0 REFERENCES

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