

1. COVER PAGE



INTERSTATE 90 EXIT 46

**INTERCHANGE MODIFICATION JUSTIFICATION REPORT
(IMJR)**

**METHODS AND ASSUMPTIONS
DOCUMENT**

Prepared for:

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and

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2. STAKEHOLDER ACCEPTANCE

The undersigned parties concur with the Methods and Assumptions for the Exit 46 Interchange Modification Justification Report (IMJR) as presented in this document.

SDDOT


Signature

FHWA


Signature

Planning Engineer
Title

Planning/Civil Rights Specialist
Title

12-15-2015
Date

12/11/15
Date

Participation of the Study Advisory Team and/or signing of this document do not constitute approval of the Exit 46 IMJR Final Report or conclusions.

All members of the Study Advisory Team will accept this document as a guide and reference as the study progresses through the various stages of development. If there are any agreed upon changes to the assumptions in this document a revision will be created, endorsed and signed by all the signatories.

3. INTRODUCTION AND PROJECT DESCRIPTION

A. Background Information

As part of the *Interstate 90 Black Hawk – Sturgis Corridor Preservation Study* completed in 2004, it was determined that relocating the I-90 Exit 46 (Elk Creek Road) interchange would be the best alternative to prepare I-90 for future expansion. The 2008 *Environmental Assessment (EA) of Exit 40 to Exit 51* confirmed the need to relocate the interchange in preparation of future mainline I-90 expansion and determined a diamond configuration to be the preferred alternative for that relocated interchange.

The SDDOT has been making progress implementing the recommendations from the *Interstate 90 Black Hawk – Sturgis Corridor Preservation Study*. As such, the SDDOT intends to let for construction the project to relocate the Exit 46 interchange in Federal fiscal year 2020 for which this interchange study will help bring to fruition.

The Exit 46 Interchange Modification Justification Report (IMJR) must be completed to address Federal Highway Administration (FHWA) requirements prior to implementation. This document provides the Methods and Assumptions by which the IMJR will be conducted.

B. Location and Affected Facilities

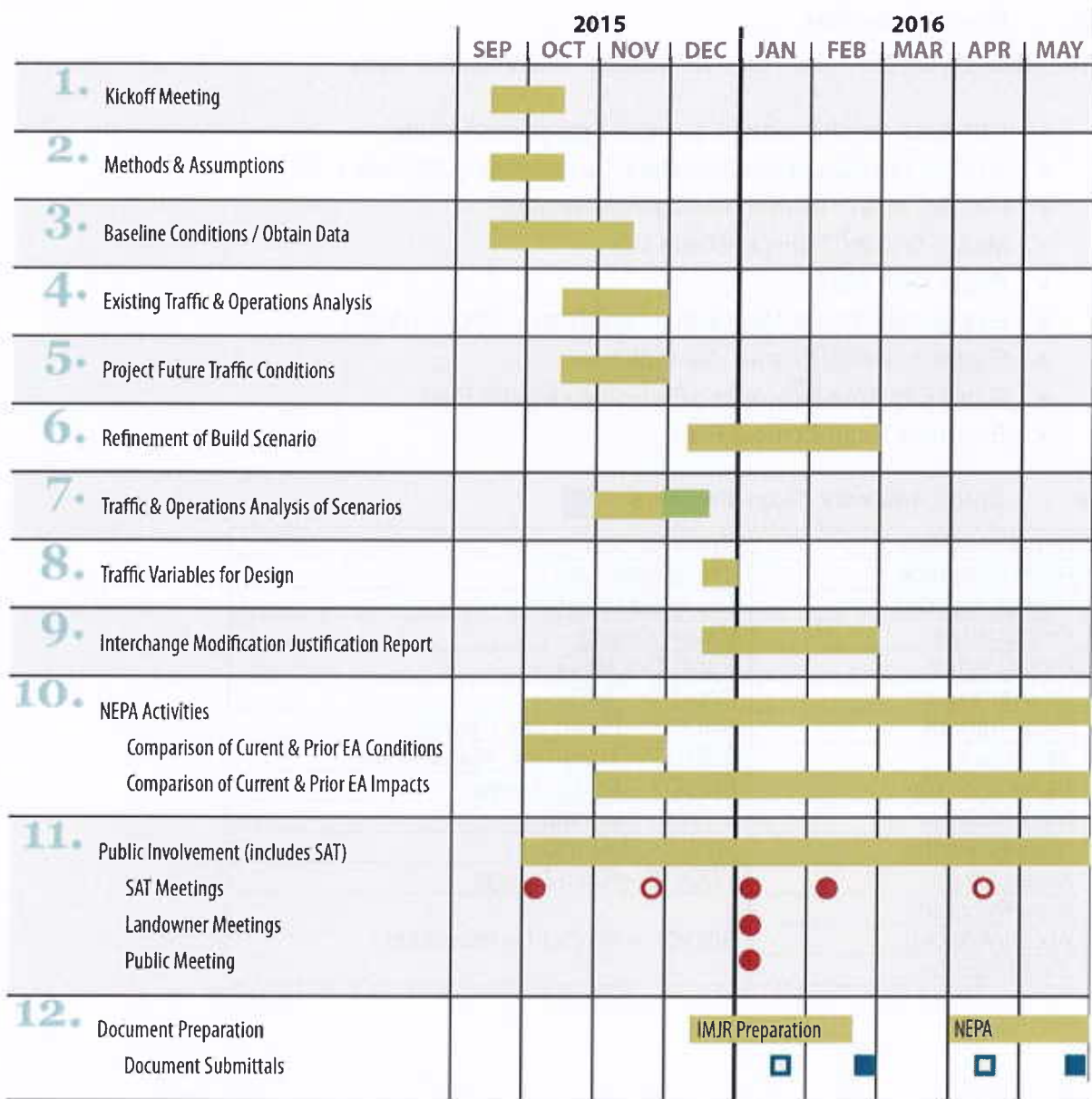
Interstate 90 (I-90) Exit 46 is configured as a diamond interchange in Meade County serving Elk Creek Road, which lies adjacent to the cities of Piedmont and Summerset. In addition to Elk Creek Road and I-90, affected facilities include Sturgis Road, Spring Valley Road, Deerview Road (Exit 44), and Stage Stop Road (Exit 48).

C. Need for Study

The IMJR is needed to evaluate whether Exit 46 can be relocated in a fashion that provides acceptable traffic operations and safety upon opening day and into the long term future. The IMJR will address each of FHWA's eight policy points and will be formatted according to the FHWA Interstate Access Guide, Section 3.5.3. A new environmental document will be developed alongside the IMJR to ensure that NEPA requirements are satisfied.

D. Study Schedule

The project officially began with a kickoff meeting with the Study Advisory Team on October 1, 2015. The anticipated project schedule, provided below, assumes this initiation date and details key activities and events needed to complete the IMJR.



● In-Person Meetings ○ Remote Meetings □ Draft Submittal ■ Final Submittal

Key events called out include:

- Public meeting and landowner meetings conducted in early/mid January of 2015.
- Study Advisory Team meetings held in October and December of 2015 and January, February and April of 2016.

It is anticipated that that a draft IMJR will be completed by January 2016 with the final report by late February 2016. Efforts will be made to accelerate the schedule.

E. Previous Studies

The following are the known previous studies relevant to this study.

- I-90 Black Hawk to Sturgis Corridor Preservation Study
- 2010 SDDOT Decennial Interstate Corridor Study (Phases 1-3)
- I-90 Exit 40 to 51 Environmental Assessment
- Meade County Transportation Plan
- Rapid TRIP 2040
- Exit 44 Interchange Modification Justification Report (IMJR)
- Piedmont Valley Shared Use Path Plan
- Rapid City Area Bicycle and Pedestrian Master Plan
- Elk Creek Road Corridor Plan

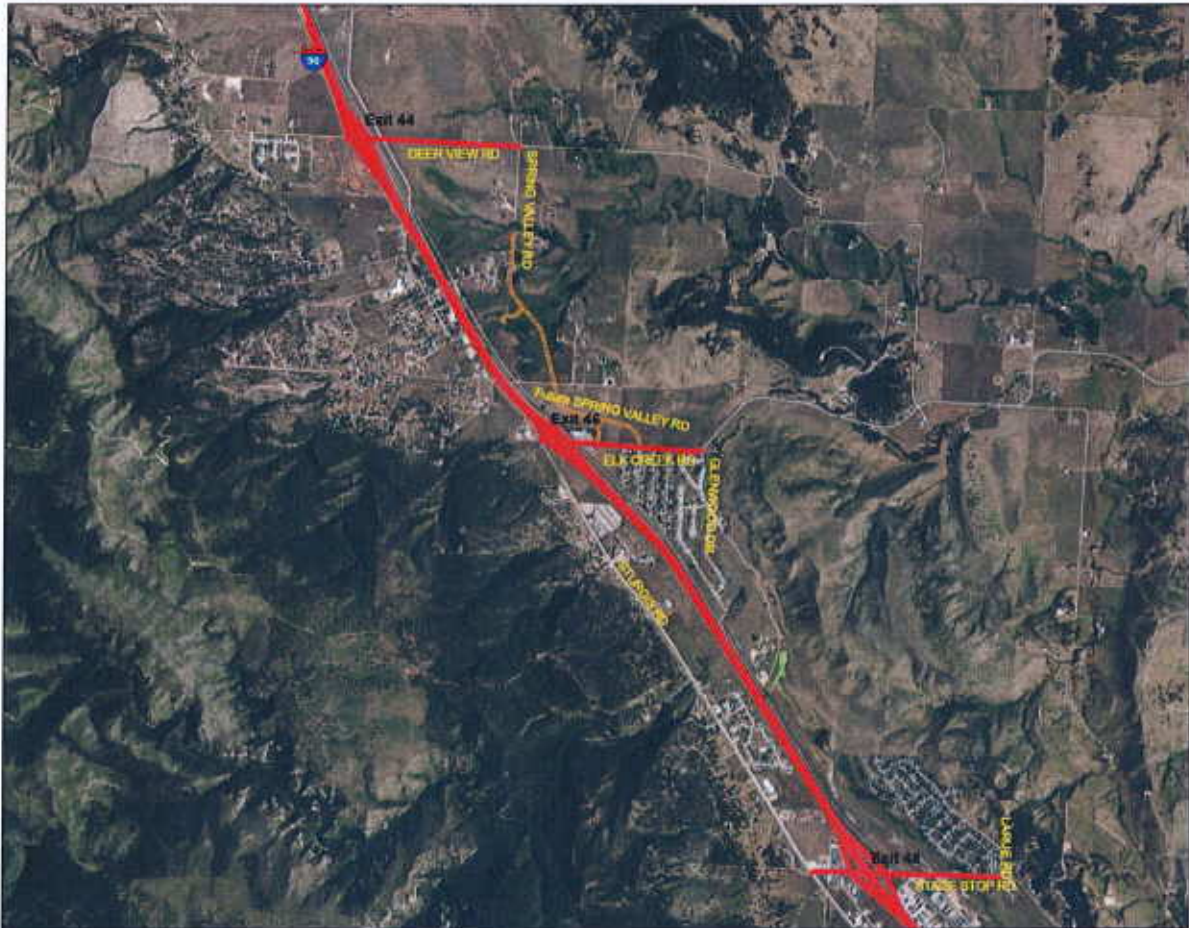
F. Study Advisory Team Members

Representative	Organization
Philip Anderson	City of Piedmont
George Mandas	City of Summerset
Kirk Chaffee	Meade County
Patsy Horton	Rapid City MPO
Kip Harrington	Rapid City MPO
Stacy Bartlett	SDDOT – Rapid City Region
Jeff Brosz	SDDOT – Trans. Inv. Management
Steve Johnson	SDDOT – Bridge Design
Mark Hoines	FHWA - Planning
Marc Hoelscher	FHWA - Operations
Karen Olson	SDDOT – Road Design
Brad Remmich	SDDOT – Project Development
Alice Whitebird	
Steve Gramm	

4. STUDY AREA

The study area encompasses the roadway corridors indicated on the following graphic:

Figure 1. Study Area



Study corridors include:

- Elk Creek Road from the intersection with Sturgis Road to the intersection with Glenwood Drive, approximately 0.70 miles,
- Deer View Road from Sturgis Road to Spring Valley Road, approximately 0.75 miles,
- Stage Stop Road from Sturgis Road to La Rue Road, approximately 0.80 miles,
- Mainline I-90 from west of I-90 Exit 44 to east of I-90 Exit 48, approximately 4 ½ miles,
- The ramps for the I-90 Exit 46 (Elk Creek Road) interchange,
- The ramps for the I-90 Exit 44 (Bethlehem Road) interchange, and
- The ramps for the I-90 Exit 48 (Stage Stop Road) interchange.

5. ANALYSIS YEARS/PERIODS

It is anticipated that operational analyses will be conducted for existing conditions and for years 2021 and 2045. Existing conditions analysis will be on existing traffic data. Existing traffic counts will be collected for weekday AM and PM peak period conditions. The AM peak period is assumed to extend from 6:30 AM to 8:30 AM, and the PM peak period from 4:00 PM to 6:00 PM. The peak one hour from these time frames will be selected for peak hour operational analyses.

6. DATA COLLECTION

Many sources of data will be used to establish the current baseline conditions assessment and identify existing issues affecting the transportation system. The data collection effort includes:

- Obtain and review current ordinances and guidelines
- Gather base mapping data from agencies
- Obtain existing traffic volume and turning movement data
- Gather other relevant data (e.g. land use, design plans, photography, utilities, existing development plans)
- Obtain and inventory existing crash history data
- Identify existing bicycle and pedestrian facilities
- Obtain available information regarding future development in the study area

The effort to provide traffic volume data for the project will be conducted using the following two methods:

1. Compile data from available historical and recent data with the study area from studies in the area and the SDDOT sources.
2. Collect weekday peak hour turning movement data at the study intersections. It is anticipated that turning movement data will be collected from 6:30 to 8:30 AM and from 4:00 to 6:00 PM. However, this will be confirmed and adjusted if necessary based information from method #1.

Turning movement counts will be compiled at the following intersections:

Ref #	Street #1	Street #2
1.	Chimney Canyon	Sturgis Rd
2.	Deerview Road	WB Ramps
3.	Deerview Road	EB Ramps
4.	Deerview Road	Sidney Stage Rd
5.	Deerview Road	Spring Valley Road
6.	Elk Creek Road	Sturgis Road

Ref #	Street #1	Street #2
7.	Elk Creek Road	WB Ramps
8.	Elk Creek Road	EB Ramps
9.	Exit 46 WB On Ramp	Sidney Stage Road
10.	Elk Creek Road	Future Spring Valley Road / Hills View Drive (East)
11.	Elk Creek Road	Glenwood Drive
12.	Stage Stop Road	Sturgis Road
13.	Stage Stop Road	EB Ramps
14.	Stage Stop Road	WB Ramps
15.	Stage Stop Road	LaRue Road

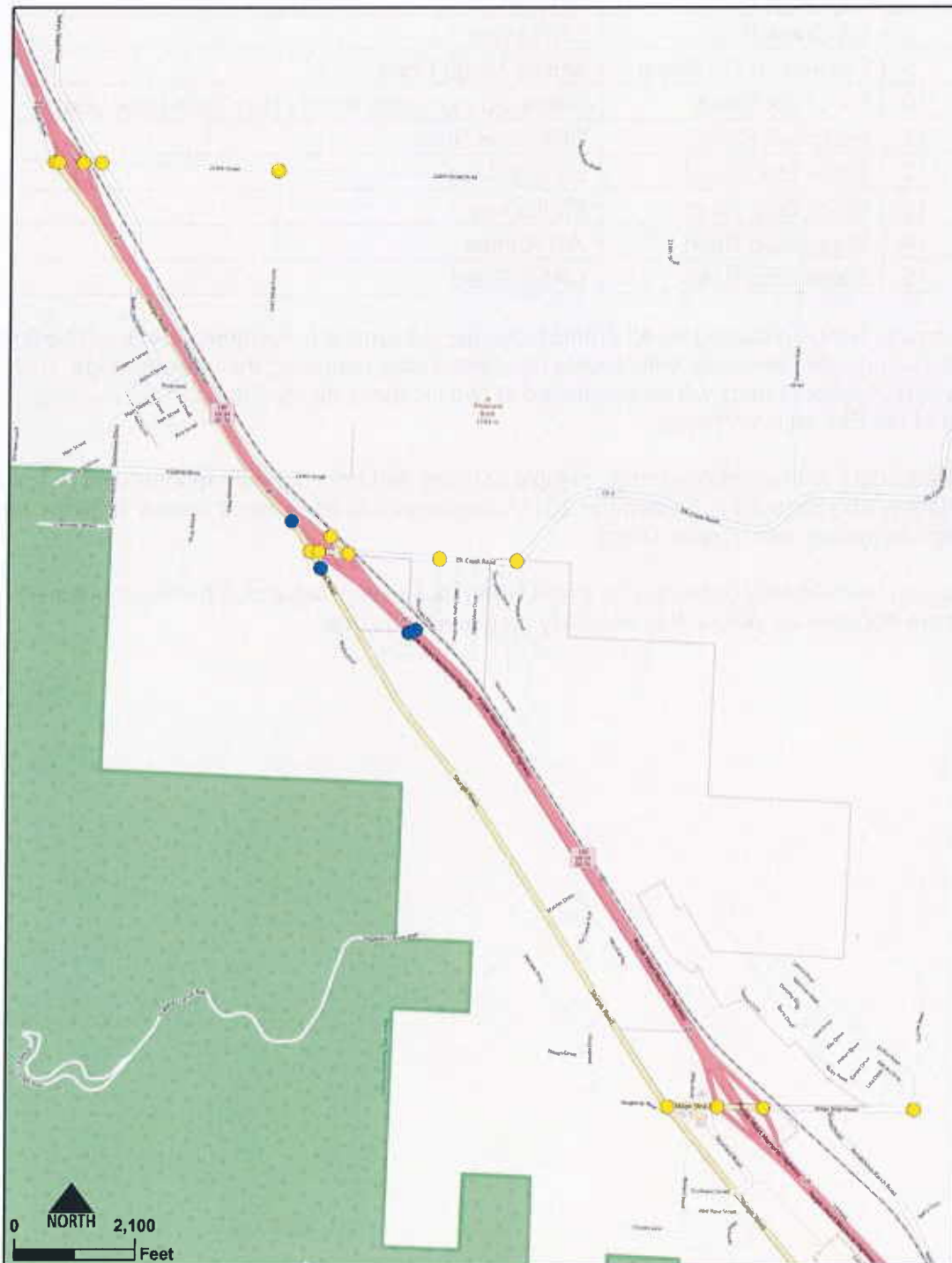
Traffic counts will be collected by All Traffic Data, Inc. All turning movement counts will be field collected using video cameras, with counts conducted after compiling the video footage. Daily vehicle classification counts will be conducted at two locations along Sturgis Road and along I-90 east of the Exit 46 interchange.

Since traffic data will be obtained from multiple sources and from different months and years. All traffic data will be factored to September 2015 using seasonal adjustment factors obtained from the weigh-in-motion station near Tilford.

The map on the following page depicts traffic count locations. Intersection turning movement counts are depicted as yellow dots and daily counts as blue dots.



Figure 2. Traffic Count Locations



7. TRAFFIC OPERATIONS ANALYSIS

Operational analysis will be based on procedures documented in the *Highway Capacity Manual 2010* (Transportation Research Board, 2010). More specifically, the following chapters of the HCM could be used to analyze specific operational conditions:

Operational Analysis

- Chapter 10 – Freeway Facilities
- Chapter 11 – Basic Freeway Segments
- Chapter 12 – Freeway Weaving Segments
- Chapter 13 – Freeway Merge and Diverge Segments
- Chapter 16 – Urban Street Facilities (Multimodal Analysis)
- Chapter 18 – Signalized Intersections
- Chapter 19 – Two-Way Stop Controlled Intersections
- Chapter 20 – All-Way Stop Controlled Intersections

Highway Capacity Software will be used to conduct operational analyses. No other traffic analysis software will be used and no micro simulations of traffic will be conducted or provided.

HCM 2010 analysis procedures require the use of certain parameters, summarized in the following table:

Traffic Parameter		I-90	Surface Streets
% heavy vehicles	Trucks and buses	Determined from recorded vehicle class on I-90	Determined from vehicle class on Sturgis Road
	RV's	0%	0%
Existing Conditions Peak Hour Factor		Determined from existing intersection counts – calculated as the PHF for the overall intersection	
Future Conditions Peak Hour Factor		0.92*	
Free-flow Speed (mph)		75	n/a
Terrain/Area Type		Level	Level
Saturation Flow Rate (vehicles per hour per lane) for two-way stop- controlled and signalized intersections		n/a	1800
Queue Length Percentile		n/a	95%ile
*A lower value may be used for the Peak Hour Factor at an intersection if the existing value is below 0.92 and future traffic forecasts indicate that the traffic stream will continue to demonstrate similar peaking characteristics. The PHF for future analysis scenarios will not be lowered below 0.88, the rural default value.			

The following table identifies urban street facilities and intersections for HCM analyses.

Urban Street Facility	Intersections		
	#	Street #1	Street #2
Exit 44: Deer View Road from Sturgis Road to Spring Valley Road	1	Chimney Canyon	Sturgis Rd
	2	Deerview Road	WB Ramps
	3	Deerview Road	EB Ramps
	4	Deerview Road	Sidney Stage Rd
	5	Deerview Road	Spring Valley Road
Exit 46: Elk Creek Road from Sturgis Road to Deerview Road	6	Elk Creek Road	Sturgis Road
	7	Elk Creek Road	WB Ramps
	8	Elk Creek Road	EB Ramps
	9	Exit 46 WB On Ramp	Sidney Stage Road
	10	Elk Creek Road	Future Spring Vly Rd / Hills View Dr E
	11	Elk Creek Road	Glenwood Drive
Exit 48: Stage Stop Road from Sturgis Road to La Rue Road	12	Stage Stop Road	Sturgis Road
	13	Stage Stop Road	EB Ramps
	14	Stage Stop Road	WB Ramps
	15	Stage Stop Road	LaRue Road

8. TRAVEL FORECAST

Exit 46 falls within the Rapid City Area MPO boundary. Therefore, the RCMPO regional travel demand model will be the basis for long range transportation projections. FHU possesses the 2040 version of the MPO travel demand model and will utilize the model to develop traffic forecasts for both the year of project completion (2021) and planning horizon year (2045) along the study corridor. Year 2021 forecasts will be developed by interpolating growth between the travel demand model base year of 2013 and 2040.

Year 2045 traffic forecasts will be developed by extending the growth rate(s) from the travel demand model an additional five years beyond 2040.

Future intersection turning movement forecasts will be developed by applying growth rates derived from the travel demand model to existing counts.

9. SAFETY ISSUES

Crash history data for the most recently available five (5) complete years will be analyzed (2010-2014) to identify crash concentrations and trends at the current Exit 46 interchange, mainline I-90 through the interchange, and adjacent intersections along Elk Creek Road. Locations showing elevated crash experience will be noted and reviewed to identify particular crash type and severity patterns.

10. SELECTION OF MEASURES OF EFFECTIVENESS (MOE)

The primary measures of effectiveness for this effort will include the following:

- Intersection and facility operations will use average delay per vehicle, density and speed as calculated by the Highway Capacity Software (HCS) to determine Level of Service (LOS).
- Bicycle and pedestrian LOS evaluations for Urban Street Analysis will rely upon scores calculated using the HCM methodology. For this analysis, no transit results will be calculated as it is assumed that no fixed route transit service will be provided.

In general, the primary mobility goal for the study will be Level of Service (LOS) D or better for overall signalized intersection operations and for individual movements at unsignalized intersections; however, it is understood that there might be some instances where minor street level of service is LOS E or LOS F, in which case the volume-to-capacity ratio and 95th percentile queue lengths will also be considered. LOS C or better will be the goal for mainline freeway, ramp terminal intersections, merge/diverge and weaving segments.

11. FHWA INTERSTATE ACCESS MODIFICATION POLICY POINTS

The eight FHWA policy points are listed as follows, with a brief description of the level of detail anticipated to be provided for each:

1. *The need being addressed by the request cannot be adequately satisfied by existing interchanges to the Interstate, and/or local roads and streets in the corridor can neither provide the desired access, nor can they be reasonably improved (such as access control along surface streets, improving traffic control, modifying ramp terminals and intersections, adding turn bays or lengthening storage) to satisfactorily accommodate the design-year traffic demands (23 CFR 625.2(a)).*

The existing Exit 46 interchange will be reviewed to identify potential minor improvements that would accommodate future widening of I-90 while also serving interchange traffic volumes. The analysis will be described in the text of the IMJR to address this policy point.

2. *The need being addressed by the request cannot be adequately satisfied by reasonable transportation system management (such as ramp metering, mass transit, and HOV facilities), geometric design, and alternative improvements to the Interstate without the proposed change(s) in access (23 CFR 625.2(a)).*

A review of TSM strategies and tools will be conducted to determine whether any are applicable to or feasible for Exit 46. If any are found, their effect will be evaluated to determine whether they reduce peak traffic demand enough to eliminate the need for interchange relocation. SDDOT has indicated that ramp metering and HOV facilities are not used in South Dakota at this time.

3. *An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis shall, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (23 CFR 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, shall be*

included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access must include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request must also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).

The IMJR will include a full analysis of existing, future opening day (2021) and Year 2045 traffic operations at Exit 46, including its ramp connections to I-90 and Elk Creek Road on both sides of the interchange. Exits 44 and 48 will be analyzed similarly for current and future scenarios. The analyses are expected to yield information regarding the potential for adverse operational effects. Crash history will be reviewed to identify existing crash patterns and the influence of a relocated Exit 46 on safety will be assessed using available crash prediction methods. A preliminary Exit 46 signing concept, showing the signs one mile away on both sides of the Exit 46 interchange, will be included in the IMJR. This will be reviewed by the Region Traffic Engineer.

- 4. The proposed access connects to a public road only and will provide for all traffic movements. Less than "full interchanges" may be considered on a case-by-case basis for applications requiring special access for managed lanes (e.g., transit, HOVs, HOT lanes) or park and ride lots. The proposed access will be designed to meet or exceed current standards (23 CFR 625.2(a), 625.4(a)(2), and 655.603(d)).*

The preferred alternative will be reviewed to ensure all movements are provided.

- 5. The proposal considers and is consistent with local and regional land use and transportation plans. Prior to receiving final approval, all requests for new or revised access must be included in an adopted Metropolitan Transportation Plan, in the adopted Statewide or Metropolitan Transportation Improvement Program (STIP or TIP), and the Congestion Management Process within transportation management areas, as appropriate, and as specified in 23 CFR part 450, and the transportation conformity requirements of 40 CFR parts 51 and 93.*

Relevant plans will be reviewed for inclusion of the Exit 46 project.

- 6. In corridors where the potential exists for future multiple interchange additions, a comprehensive corridor or network study must accompany all requests for new or revised access with recommendations that address all of the proposed and desired access changes within the context of a longer-range system or network plan (23 U.S.C. 109(d), 23 CFR 625.2(a), 655.603(d), and 771.111).*

Based on a review of previous studies, no new interchanges are anticipated in the Exit 46 vicinity. This statement will be included in the IMJR.

- 7. When a new or revised access point is due to a new, expanded, or substantial change in current or planned future development or land use, requests must demonstrate appropriate coordination has occurred between the development and any proposed transportation system improvements (23 CFR 625.2(a) and 655.603(d)). The request must describe the*

commitments agreed upon to assure adequate collection and dispersion of the traffic resulting from the development with the adjoining local street network and Interstate access point (23 CFR 625.2(a) and 655.603(d)).

The IMJR effort includes outreach to local communities and landowners to understand development plans. The text will provide a qualitative description of the relationship of Exit 46 to surrounding land use and development plans. A public meeting and meetings with affected landowners are planned to be held.

8. *The proposal can be expected to be included as an alternative in the required environmental evaluation, review and processing. The proposal should include supporting information and current status of the environmental processing (23 CFR 771.111).*

The I-90 Exit 40 to 51 Environmental Assessment included Exit 46 relocation, and environmental documentation will be developed for current conditions. The IMJR will document the status of these efforts.

12. DEVIATIONS / JUSTIFICATIONS

We do not anticipate any deviations from stated standards.

13. CONCLUSION

The study will include performing a HCM2010 based traffic analysis comparison of the relocated interchange option of the I-90 Exit 46 interchange (As shown in Figure 2) brought forth by the *Environmental Assessment (EA) of Exit 40 to Exit 51* versus the existing configuration.

In addition to the interchange specific objective listed above, the study is expected to fulfill the following additional objectives:

1. Create an Interchange Modification Justification Report (IMJR) for the SDDOT to submit to FHWA.
2. Develop new environmental document specific to the I-90 Exit 46 interchange.
3. Create final products for use by the City of Piedmont, the City of Summerset, Meade County, the Rapid City Area MPO and the SDDOT which will provide guidance to implement recommended improvements and react to future development plans within the area.

14. APPENDICES

Appendix A Methods & Assumptions Meeting Notes

Appendix A **Methods & Assumptions Meeting Notes**

I-90 Exit 46 IMJR Meeting Minutes

Methods and Assumptions Meeting

Thursday, October 1, 2015 at 1:30 PM MST
 SDDOT Rapid City Region – Large Meeting Room

ATTENDEES

<u>Name</u>	<u>Agency</u>
Steve Gramm	SDDOT
Brad Remmich	SDDOT
Marc Hoelscher	FHWA
Kip Harrington	Rapid City MPO
Lyle DeVries	FHU
Devin Joslin	FHU

METHODS AND ASSUMPTIONS DOCUMENT DISCUSSION

The DRAFT Methods and Assumptions Document prepared by FHU was reviewed section by section, with discussion points summarized as follows:

- **Section 1. Cover Page**
 - The attendees agreed with the contents of this section as written.
- **Section 2. Stakeholder Acceptance Page**
 - SDDOT and FHWA gave concurrence with format of stakeholder acceptance page.
- **Section 3. Introduction and Project Description**
 - The following edits were suggested:
 - Consider revising the description of the location of the interchange to more accurately describe its proximity to the boundaries of the cities of Piedmont and Summerset.
 - It was noted that a new environmental document will be produced in conjunction with the IMJR report to ensure NEPA requirements are satisfied. References to an environmental “update” within the document are to be removed.
 - A typo in the project schedule under item 9 is to be fixed regarding the spelling of “Justification.”
 - January 1, 2015 was noted as the absolute latest date acceptable for a DRAFT IMJR Report.
 - The Elk Creek Road Corridor Plan is to be added to the list of Previous Studies.
 - The specific name of the Meade County Transportation Plan (Meade Moving Forward) will be added.
 - Marion Barber is to be removed from the Study Advisory Team. She would have been involved had an EA evaluating Elk Creek Road been required.

- **Section 4. Study Area**
 - The attendees agreed with the contents of this section as written.
- **Section 5. Analysis Years/Periods**
 - The attendees agreed with the contents of this section as written.
- **Section 6. Data Collection**
 - It was suggested the following items be removed from the bulleted list on page 6 describing the data collection effort:
 - Identify freight capabilities;
 - Determine functional class of the existing roadway network; and
 - Identify existing transit systems.
 - The times of the peak hours based on the count data SDDOT had provided were discussed. It appears that the AM peak hour occurs between 7:00-8:00 AM and the PM peak hour occurs between 4:45-5:45 PM, based on counts conducted at the Exit 46 ramps conducted in 2013.
 - It was agreed the peak hour intersection turning movement counts would be conducted between 6:30 AM-8:30 AM and 4:00-6:00 PM.
 - A map showing the locations where traffic count data was collected will be added to the IMJR report.
 - Seasonal factors were discussed and it was determined that data from the I-90 Tilford Weigh-In-Motion station should be used to factor counts to September 2015.
 - It was requested that SDDOT set tubes on Interstate 90 to the north of Exit 46.
- **Section 7. Traffic Operations Analysis**
 - It was requested that the values planned to be used for analysis variables, such as PHF, truck percentage, saturation flow rate, etc. be listed or methodology planned to be used to calculate them be defined.
 - Limitations to the methodology contained in Chapter 16 of the *Highway Capacity Manual, 2010* related to analysis of Urban Street Facilities (Multimodal Analysis) were briefly discussed.
 - It was noted that no signalized intersections currently exist within the study area and that certain intersections within the study area will need to be assumed to be signalized in order to conduct the multimodal analysis.
 - It was reiterated that analyses will be conducted using HCS™ 2010 software; no microsimulation will be conducted and no other traffic analysis software program is to be used.
- **Section 8. Travel Forecast**
 - It was noted that it would be difficult for the Rapid City MPO to provide year 2045 land use forecasts, given the relatively short timeframe within the traffic volume forecasts are to be completed.
 - It was agreed that the method to be used to forecast year 2045 traffic volumes was to extend the growth rate(s) from the travel demand model an additional five years beyond 2040.

- **Section 9. Safety Issues**
 - The attendees agreed with the contents of this section as written.
- **Section 10. Selection of Measures of Effectiveness (MOE)**
 - The LOS D or better requirement for individual movements at unsignalized intersections was to be evaluated on a case-by-case basis. It was noted that there may be instances where the side-street LOS is E or F, but with acceptable v/c ratios and manageable 95th percentile queue lengths.
 - Analysis of the ramp terminal intersections is also planned to be included.
- **Section 11. FHWA Interstate Access Modification Policy Points**
 - Under Policy Point #2, it was deemed that ramp metering and HOV facilities are unnecessary, as they are not used in the State of South Dakota.
 - Under Policy Point #3, the requirements for the preliminary signing concept were discussed in more detail.
 - It was noted that the plan should include signs within one mile in either direction of Exit 46.
 - Some examples of previous signing plans were shown and a preference for the plan being shown on top of an aerial background was noted.
 - The signing plan will be reviewed by the Region Traffic Engineer.
 - Under Policy Point #7, the public meeting is to be mentioned.
 - Under Policy Point #8, the word “refresh” is to be changed to study to note that a new environmental document is planned to be prepared, as opposed to an update to the EA.
- **Section 12. Deviations/Justifications**
 - The attendees agreed with the contents of this section as written.
- **Section 13. Conclusion**
 - Objective #2 noted will be revised to state that a new environmental document will be prepared.
- **Section 14. Appendices**
 - Meeting Minutes from the Methods and Assumptions meeting are to be included as an Appendix to the Methods and Assumptions document.

ACTION ITEMS

- SDDOT and FHWA gave verbal approval for traffic data collection to occur prior to formal acceptance of the Methods and Assumptions document.
- SDDOT to conduct daily counts on I-90 to the north of Exit 46.
- FHU to revise Methods and Assumptions document to reflect edits and changes noted in these meeting minutes.
- FHU to coordinate traffic data collection; traffic data collection was delayed until the week of November 2 due to a construction project at Exit 44 within the study area.

