Interstate 90 Exit 34
Interstate Modification
Justification Report

Interstate Modification
Justification Report (IMJR) for the
Interstate 90 Exit 34 (Black Hills
National Cemetery) Interchange

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Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

EXECUTIVE SUMMARY

The South Dakota Department of Transportation (SDDOT) has initiated an assessment of the existing interchange on Interstate 90 (I-90) at Exit 34 (Black Hills National Cemetery) near Sturgis, South Dakota. Hereinafter referred to as the Exit 34 Interchange. This Interchange Modification Justification Report (IMJR) is the result of several studies that have been completed to document the positive and negative impacts associated with a range of proposed alternatives for the existing interchange. This document was completed following the outline provided in the Federal Highway Administration's (FHWA's) August 2010 *Interstate System Access Informational Guide* and meets the requirements of the Policy on *Access to the Interstate System* established May 22, 2017.

PURPOSE AND NEED FOR THE REQUEST

The purpose of the Exit 34 Interchange modification on I-90 is to address deficiencies in the current interchange geometry, improve safety, and preserve future mainline I-90 expansion opportunities. The deficiencies identified resulted from a series of studies completed by SDDOT dating back to the year 2000. A summary of the studies completed and resulting deficiencies at the Exit 34 Interchange can be found in **Table 1-1** within this IMJR.

PROPOSED MODIFICATION REQUEST

This modification request proposes to reconstruct the existing Exit 34 standard diamond interchange as a standard diamond interchange at the current interchange location. The proposed Exit 34 Interchange (referred to as Alternative 34-19B) includes correcting existing geometric deficiencies present in the current ramps and underpass by replacing the existing bridges. Currently, the existing overpass bridges have columns very close to the cross-street lanes of travel and do not have protective barriers in place to protect the columns from errant vehicles. If the columns are struck, the bridge may become structurally compromised. The columns have been struck in the past and were repaired in 1984. The proposed alternative would also accommodate a widened median of 108 feet in preparation for a future 6 lane configuration. On the west side of I-90, Pleasant Valley Drive would be aligned to fit between the Rapid City, Pierre and Eastern (RCP&E) Railroad which runs parallel I-90. Control of access for the proposed alternative would remain generally similar to existing. **Section 4: Need,** of this IMJR provides a detailed description of the deficiencies present at Exit 34. The build alternative proposed within this IMJR, Alternative 34-19B is shown in **Figure ES-1**.

FHWA REQUIREMENTS

The FHWA has requirements that need to be addressed when evaluating changes to access points on interstate facilities (May 22, 2017 Policy). The requirements are part of a policy that was put in place to maintain high levels of safety and mobility on the Interstate System. The policy consists of two requirements that new access locations should meet. The following is the

summarized response to each requirement. The full response to each requirement can be found in **Chapter 9: Recommendations**.

1. 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 should, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (23 Code of Federal Regulations 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 the 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 should 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 operational analysis contained in this study indicate that mainline I-90, ramp junctions, and ramp terminal intersections are all projected to function within operational goals for both the Build and No Build scenarios through the planning horizon year of 2050.

Interchange AM and PM peak hour analyses were performed for the eastbound and westbound directions for the Base Year (2017), Opening Year (2025) and the Design Year (2050). The Design Year 2050 analysis represents both the 2050 No Build and 2050 Build Alternative scenarios. This is because there are no proposed changes to the traffic control or intersection lanes and turn lane geometries between the No Build and Build Scenarios.

For the I-90 mainline, the Level of Service (LOS) remains unchanged for the Design Year 2050. It maintains LOS A throughout the study area from Exit 32 to Exit 40. At Exit 34, the intersections also maintain their LOS A while Control Delay increased by less than 1 sec/veh between the Base Year (2017) and Design Year (2050).

An analysis of crash records for the five-year period of 2012-2016 has been provided in the "Existing Safety Conditions" section of this report. Crash occurrences were broken down into severity, location, and type. These categories were then plotted on a map of the study area to determine any areas of concern. The study area was broken down into segments to better analyze patterns. The segments were analyzed based on their length, number of crashes, ADT, and facility type, and then compared to statewide

averages. The safety analysis indicates that there are no apparent or correctable crash patterns within the influence area of the Exit 34 Interchange.

The existing interchange is constrained by steep terrain and culturally sensitive sites on both sides and would benefit from a relocated diamond interchange where control of access could be optimized. However, it was determined that the hillside along the westbound lanes is a berm at the toe of a larger steeper hill that is susceptible to landsides. Due to this, no excavation is to take place along the westbound lanes from just west of Alkali Creek to the Blucksberg development. Reconstructing the interchange at the present location avoids two major design issues, 1) excavation of the hillside and 2) use of large retaining walls on along both sides of the interstate through the interchange where inclement weather from the Black Hills rapidly occurs.

The reconstructed interchange will bring substandard geometric conditions of the aging facility up to SDDOT specifications. Control of Access (COA) is limited at the existing interchange location, currently 100 feet separates the ramp terminal intersection and the adjacent intersection on both sides of the interstate. The COA is constrained by the terrain and development on the east side of I-90 and the National Cemetery and railroad on the west side of I-90. Within the proposed interchange, the COA spacing (currently 18 feet) on the east side improves by 19 feet while COA on the west side (currently 28 feet) decreases by 15 feet. Both well below the required access spacing due to the above-mentioned factors, the operational analyses of the proposed interchange show LOS A for all movements using 2050 projected traffic volumes. Safety would be maintained using the existing control of access spacing. To support in the selection of the desired alternative a benefit-cost analysis was completed comparing the no build and feasible alternatives given the above challenges. The reconstructed bridges will also include the addition of protective barriers for the overpass columns.

2. 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, high occupancy vehicle and high occupancy toll 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)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.

The access improvement maintains a connection to the public road (Old Stone Road) and replaces the current full access interchange with a reconfigured full access

interchange. The reconfigured interchange will continue to provide for all traffic movements. The improvement will meet or exceed current standards for Federal-aid projects on the Interstate system.

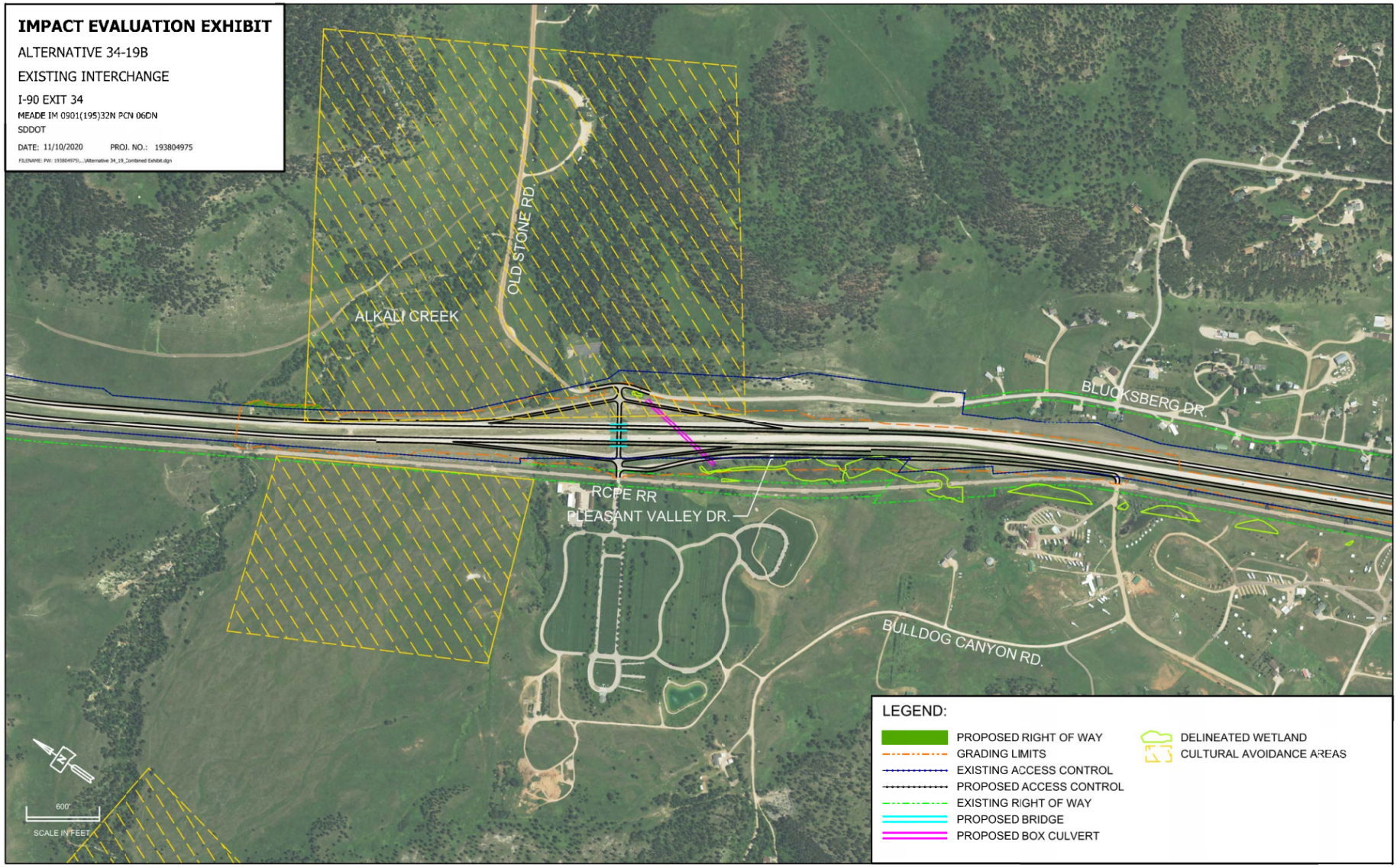

Figure ES-1 I-90 and Exit 34 Interchange Modification Build Alternative (34-19B)

1. INTRODUCTION

The South Dakota Department of Transportation (SDDOT) has determined the pavement in the eastbound lanes of I-90 between Exit 32 and 40 will require replacement within the next 6 years. Through a series of studies, deficiencies such as deteriorating drainage structures, substandard roadway geometrics, and limited interchange capacities have also been identified throughout the corridor.

BACKGROUND

Table 1-1 provides an overview of the planning history of the segment of I-90 from Exit 32 to Exit 40 and the resulting findings at the Exit 34 Interchange.

Table 1-1 Planning History

Year Completed	Document/ Procedural Step	Exit 34 Interchange Findings
2000	*Decennial Interstate Corridor Study*	Identified concern of close service road spacing, recommended project to realign service roads. Identified similar concerns at nearby interchanges along the I-90 corridor.
2004	*I-90 Black Hawk to Sturgis Corridor Preservation Study*	Study was done to preserve transportation improvement opportunities amidst growth pressures along I-90 between Black Hawk and Sturgis. Addressed potential for widening of I-90 to six lanes and evaluated Exit 34 Interchange alternatives.
2010	*Decennial Interstate Corridor Study*	Reaffirmed Exit 34 Interchange concerns of close service road spacing and substandard interchange design.
2014	*Statewide Planning Process*	SDDOT included Exit 34 Interchange reconstruction in the Developmental Program of its statewide planning process and completed an EA reevaluation.
2018	*Structure Needs Memorandum*	Indicated low Structure Inventory Rating at I-90 over Old Stone Road.
2019 (amended in 2020)	*I-90 Exit 32-40 Corridor Report*	Reaffirmed Exit 34 Interchange concerns of close service road spacing, substandard interchange design and deteriorating pavement conditions.
2019	*Exit 37 IMJR*	Proposed adjacent interchange revisions of Exit 37.

The SDDOT's ***2000 Decennial Interstate Corridor Study*** identified concerns with the existing Exit 34 Interchange configuration and defined the I-90 corridor between Black Hawk and Sturgis as one of the top segments of South Dakota's Interstate System needing Improvement. The SDDOT responded by completing the ***Interstate 90 Black Hawk – Sturgis Corridor Preservation Study*** in 2004, which addressed the need to widen I-90 to six lanes and evaluated conceptual alternatives for the Exit 34 Interchange.

Most recently, the SDDOT completed the *I-90 Exit 32-40 Corridor Study* **(Appendix H)** in 2019 as a first step in addressing the existing roadway issues and planning for future needs within the

corridor. The document was amended in 2020 to include enhancements of the Exit 34 interchange alternatives. Outcomes of this study included a comprehensive review of existing conditions, well-defined project needs, recommendations for phased construction projects within the study area, and a clearly outlined project process. Steps completed within the I-90 Exit 32-40 Corridor Study included:

- Analysis of existing and future forecast traffic operations
- Review of geometrics at the existing I-90 mainline and interchanges
- Identification of needs along the I-90 mainline and existing interchanges
- Development of proposed build alternatives to respond to the identified needs
- Analysis of the proposed build alternatives under existing and future forecast year conditions as compared to existing conditions
- Evaluation of all identified build alternatives as compared to the existing or no-build conditions

As a result of the I-90 Exit 32 to Exit 40 Corridor Study, two projects were identified:

- Interstate I-90 Exit 32 to Exit 37 – The proposed action includes improvements to the approximate 3.4-mile segment of the I-90 corridor from Sturgis to Pleasant Valley Road and reconstruction of the existing Exit 34 Interchange.
- Interstate I-90 Exit 37 to Exit 40 - The proposed action includes improvements to the approximate 3.6-mile segment of the I-90 corridor from Pleasant Valley Road to Tilford in Meade County and improvements at the Tilford Port of Entry and the Exit 37 and Exit 40 interchanges.

The recommended improvements outlined in the Exit 32 to Exit 40 Study are being implemented through a project development process that includes concept development and environmental documentation to identify feasible alternatives, followed by design development.

The SDDOT developed a series of concepts to remedy the existing issues within the defined project area on the I-90 corridor from Exit 32 to Exit 37. Within this segment, all concepts include reconstruction of the eastbound lanes on I-90 and improvements at the Exit 34 interchange. Selection of the chosen alternative followed a three-phase evaluation approach. During the first phase, the SDDOT investigated site context to determine potential interchange configurations and developed high-level criteria for evaluation. Key items for evaluation included connectivity to local roads, property impacts, constructability/temporary traffic impacts, safety, environmental impacts, geotechnical impacts, and costs.

A total of nine early concepts were developed and analyzed. The second phase of the alternative selection process included narrowing down the list of preliminary concepts to a maximum of three to carry forward for further review. Following an alternatives evaluation,

which included additional concept modifications and development, three alternatives were moved forward. Then following a geotechnical review, the hillside east of I-90 was determined to be unstable. Two of the three alternatives were again modified to avoid all excavation to the hillside. A chosen alternative (Alternative 34-19B) was selected to be carried forward for refinement and additional study. The alternative analysis process is discussed in detail in **Section 5: Alternatives**. Alternative 34-19B is a standard diamond interchange with stop-controlled ramp terminals. The alternative interchange would operate as it does today. The interchange would improve mainline bridge clearances and overall interchange geometrics. Mainline in this tight configuration will need to be realigned and the westbound and eastbound lanes raised11 and 13 feet respectively to provide a standard 108 foot median in preparation for a future 6-lane facility avoid excavation of the hillside and provide the required bridge clearance. This allows for avoidance of several key environmental resources including the Black Hills National Cemetery, the RCP&E Railroad, Alkali Creek, and the unstable hillside.

As part of the project development process, SDDOT is requesting permission from the Federal Highway Administration (FHWA) to make modifications to the I-90 Exit 34 Interchange at Old Stone Road. This Interstate Modification Justification Report (IMJR) is prepared on behalf of the SDDOT for submittal to the FHWA, specific to the I-90 and Exit 34 Interchange modification request. A separate IMJR has been completed for the Exit 37 Interchange.

PURPOSE

The purpose of the Exit 34 Interchange modification is to address deficiencies in the current interchange geometry, improve safety, and preserve future mainline I-90 expansion opportunities.

PROJECT LOCATION

Exit 34 is an existing interchange connection between I-90 and Old Stone Road in the vicinity of the Black Hills National Cemetery (BHNC), Sturgis, and the unincorporated community of Tilford, South Dakota. The interchange is located approximately 35 miles to the east of the Wyoming state line and 2.5 miles southeast from the City of Sturgis, South Dakota. **Figure 1-1** depicts the location of the Exit 34 Interchange.

The current configuration of the Exit 34 Interchange is a standard diamond interchange as shown in **Figure 1-2**. With the proposed interchange modification, I-90 would continue to maintain all local road connections via a diamond interchange configuration. The proposed interchange geometry would result in improved safety and efficiency of the interchange and surrounding intersections.

The Exit 34 Interchange is located in an area that is constrained by environmental resources and existing terrain. The west side of I-90 is bordered by the BHNC and the east side of I-90 is bordered by a range of steep unstable hills, which limited the feasibility of options.

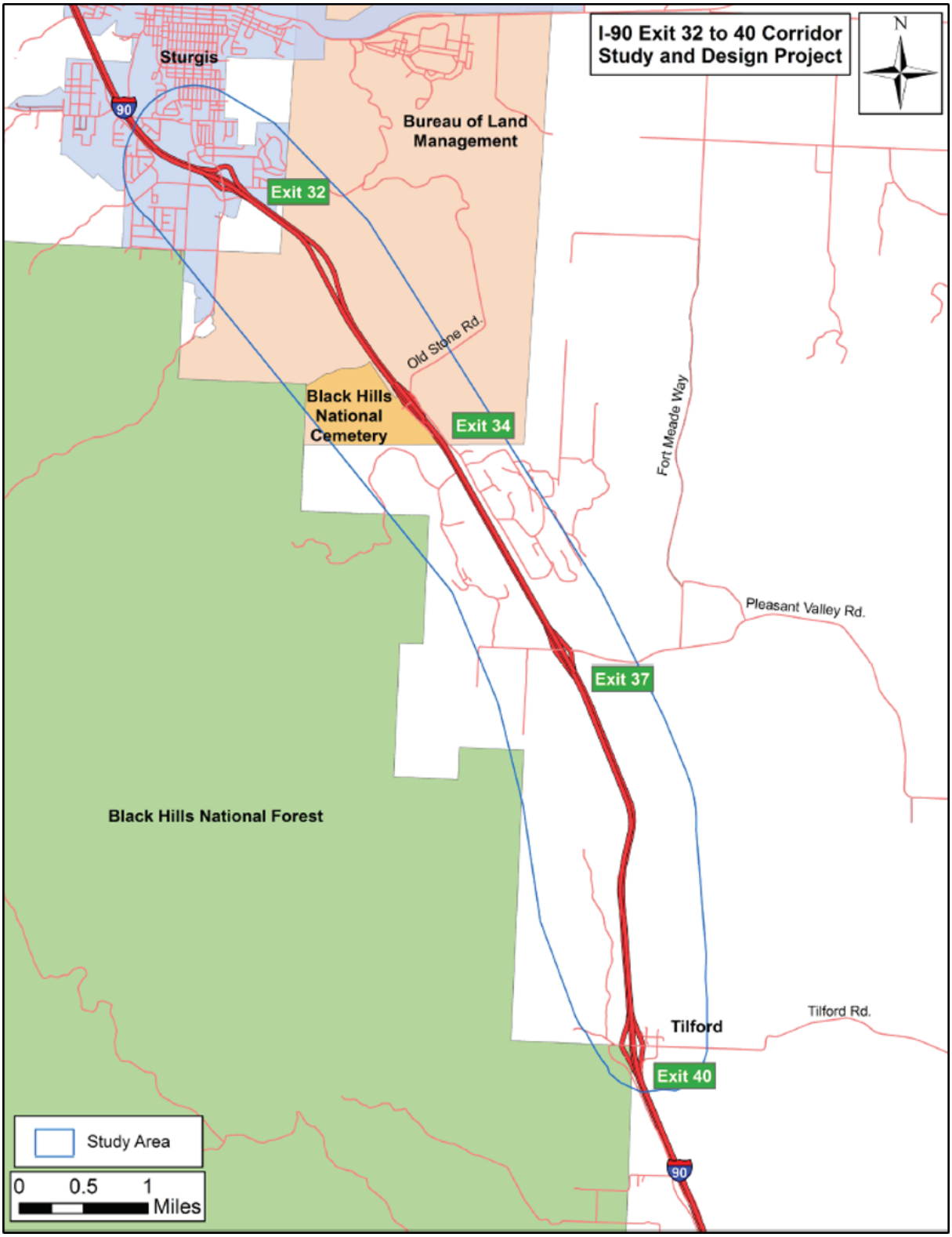

Figure 1-1 Study Area and Vicinity Map

Figure 1-2 Current Exit 34 Interchange Configuration

2. METHODOLOGY

This IMJR demonstrates that the action associated with implementing the proposed project does not have any fatal flaws. Demonstrating that no fatal flaws exist does not endorse the action, but rather allows for the conclusion that the identified access alternatives are not flawed from the perspective of traffic operations and safety, as required by FHWA. Fatal flaws would include a proposed interchange modification that:

- Does not provide full access to roads.
- Would negatively impact interstate facility traffic operations and cannot be reasonably mitigated.
- Would negatively impact interstate facility/cross street safety and cannot be reasonably mitigated.
- Conflicts with or is inconsistent with local and regional plans.
- Would create the potential for environmental consequences which could not be mitigated.

METHODS AND ASSUMPTIONS

This IMJR was developed through the following steps, which are detailed in a Methods and Assumptions Document which can be found in **Appendix A**.

1. Establishing an appropriate study area. The study area is documented in **Figure 1-1.** Study corridors include:
    - Exit 32 at Junction Avenue (SD 79)
    - Exit 34 at Pleasant Valley Drive/Blucksberg Drive/Old Stone Road
    - Exit 37 at Pleasant Valley Road
    - Exit 40 at 214th Street/Sturgis Road in Tilford

This study section also includes the Port of Entry facility located along I-90 eastbound between Exits 37 and 40.

2. Completing data collection. This includes conducting peak hour turning movement counts and daily traffic counts at the study area intersections and select roadway and interstate segments and reviewing previous studies and available existing and future land use information for the study area.

Analyses were conducted for the following years/scenarios:

- Base Year (2017)
- Opening Year (2025)
- Future No Build (2050)
- Future Build Design Year (2050)

Capacity and Level of Service analyses were conducted for the following analysis periods:

- Weekday A.M. Peak (heaviest 60 minutes between 0630-1000)
- Weekday P.M. Peak (heaviest 60 minutes between 1600-1800)

Data Collection included:

- Intersection turning movement counts
- 24-hour directional volumes and vehicle classification counts along I-90
- Roadway geometry
- GIS/mapping
- Existing traffic signal timing plans
- Travel times/speeds

3. Addressing the FHWA requirements for interstate access modifications. This step includes completion of the necessary analyses and evaluations that document the benefits and impacts of the access modification related to the FHWA requirements. These analyses included:

    - Preparing horizon year traffic forecasts. Average weekday daily and peak hour traffic forecasts for both the anticipated year of project completion (2025) and the planning horizon year (2050) were prepared for the study area interstate segments, interchanges, interstate ramp terminal intersections and adjacent arterial street intersections based on either the Urban Streets method (which includes both Signalized Intersections and Unsignalized Intersections) for urban areas or the Two-Lane Highway method for rural areas. The Exit 34 Interchange is rural. For future year analyses, Meade County Planning Office was consulted to determine whether areas currently designated as rural might become urbanized in the future (which may affect the type of analysis performed).

- Analyzing current and future traffic operations along study area roadway segments. Capacity and Level of Service were determined using methods from the Highway Capacity Manual (HCM) 6th Edition. The HCM methods were implemented using the Highway Capacity Software Version 7.4. The HCM Freeway Facilities method was used to perform directional analyses of the I-90 study sections between Exits 32 and 40. The method evaluates the individual freeway components, basic freeway segments, ramp merge and diverge segments, and weaving segments – as a system.

- Reviewing the reported crash history data for the most recently available five-year period (2012-2016) to identify crash concentrations and trends at the current Exit 34 Interchange, mainline I-90 through the interchange and adjacent intersections along Old Stone Road/Blucksburg Drive/Pleasant Valley Drive.

- Evaluating the potential future lane geometry and traffic control needed for the interchange modification. While there is a regional travel demand model for the Rapid City area maintained by the Rapid City Area Metropolitan Planning Organization (MPO), it does not cover the project study area. Additionally, there is no South Dakota statewide travel model from which future year traffic forecasts can be based. The SDDOT Inventory Management Office developed traffic growth rates per functional class and county that have been provided; these growth rates were the primary basis for developing future year project traffic forecasts.

This IMJR document is organized in accordance with section 3.5.3 of FHWA's *Interstate System Access Informational Guide, August 2010.*

3. EXISTING CONDITIONS

DEMOGRAPHICS

Providing access to the Black Hills National Cemetery, the Exit 34 Interchange lies roughly 2.5 miles southeast of the City of Sturgis in Meade County, South Dakota. Based on 2010 Census data Sturgis is predominately white with 24.1% under the age of 18 and 20.5% over the age of 65. Immediately to the southeast of the Exit 34 interchange is the unincorporated community of Blucksberg Mountain home to 462 people in 2010.

EXISTING LAND USE

The Exit 34 Interchange is surrounded by a mix of land uses. Within a 5-mile radius of the Exit 34 interchange are many single-family residences, pasture lands, numerous recreational areas, and the Black Hills National Cemetery. The area also contains several known culturally rich sites, including the multiple Bureau of Land Management (BLM) identified cultural sites. Historic properties include the Fort Meade Historic District and the Black Hills National Cemetery as well as Black Hills National Forest. Land uses in the City of Sturgis to the north and west of the interchange include commercial retail, church and residential. **Figure 3-1** shows the existing land interests within proximity to the Exit 34 Interchange. Sturgis, SD is home to the largest motorcycle rally in the world drawing half a million people annually. Blucksberg Mountain, and Tilford, are unincorporated communities to the south and east of Exit 34 and are primarily residential.

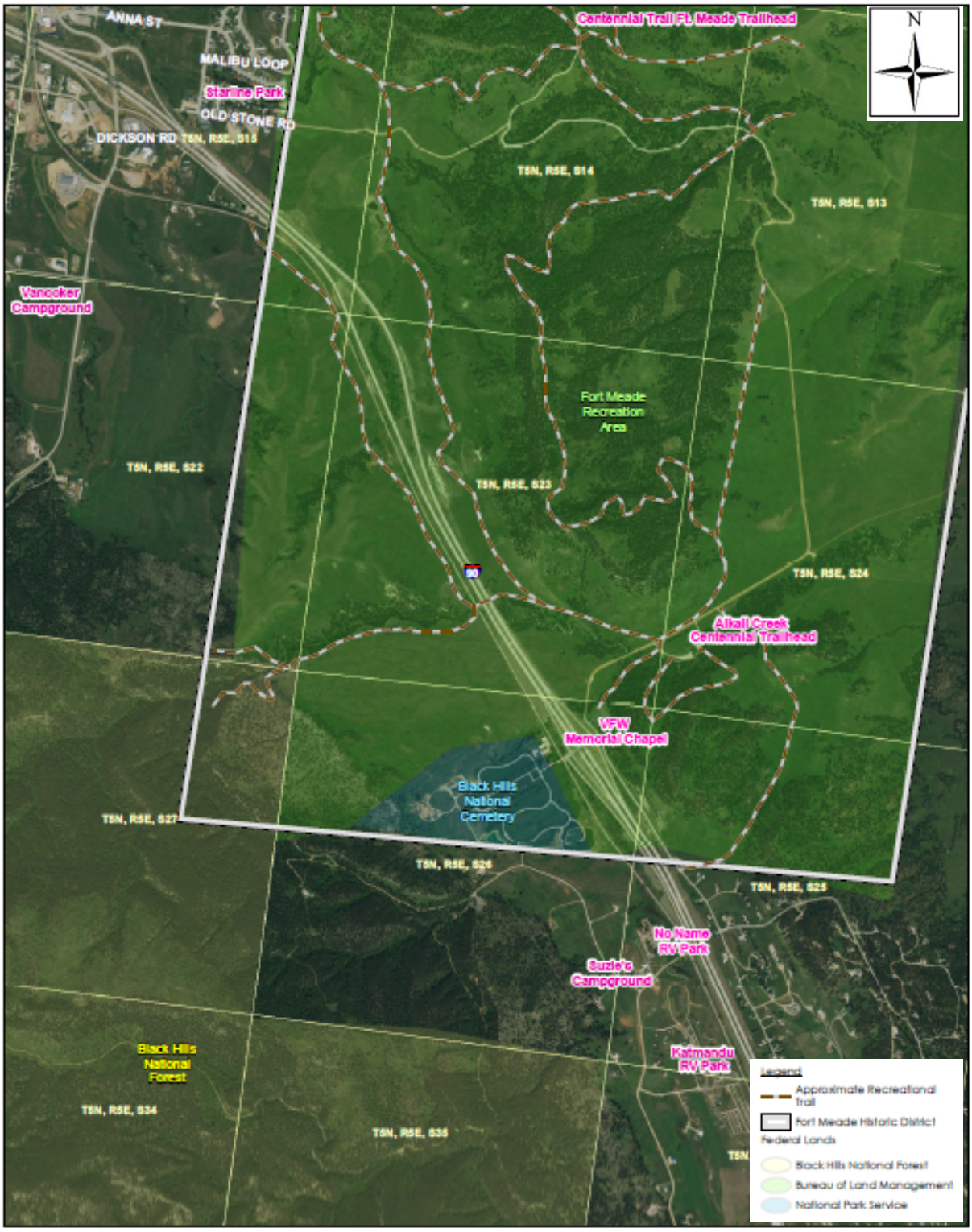

Figure 3-1 Exit 34 Existing Land Interests

EXISTING ROADWAY NETWORK

The following roads comprise the primary roadway network surrounding the Exit 34 Interchange. **Figure 3-2** depicts the roadways and the federal functional classification.

Interstate 90: I-90 is an interstate freeway with two travel lanes in each direction extending across state lines. Although it is oriented on a north-south alignment through the interchange, it is designated as an east-west interstate.

Old Stone Road: Old Stone Road is classified as a rural local road and is the crossroad for the Exit 34 Interchange. Old Stone Road provides access to the Black Hills National Cemetery and connects with Pleasant Valley Drive on the west side of the interstate highway. On the east side of the interstate Old Stone Road provides access to recreational areas and Blucksberg Drive.

Blucksberg Drive: Blucksberg Drive classified as a rural local road connects to Old Stone Road on the east side of the interstate as Old Stone Road bends 90-degrees to the northwest. Blucksberg Drive provides access to Bucksberg Mountain, an unincorporated residential community southeast of the Exit 34 Interchange.

Pleasant Valley Drive: Pleasant Valley Drive classified as a rural local road, T's into Old Stone Road on the west side of the interstate between the railroad tracks and the Exit 34 Interchange eastbound on ramp. Pleasant Valley Drive connects the interchange to Bulldog Canyon Road and in-turn provides access to homes and three RV parks on the west side of the interstate.

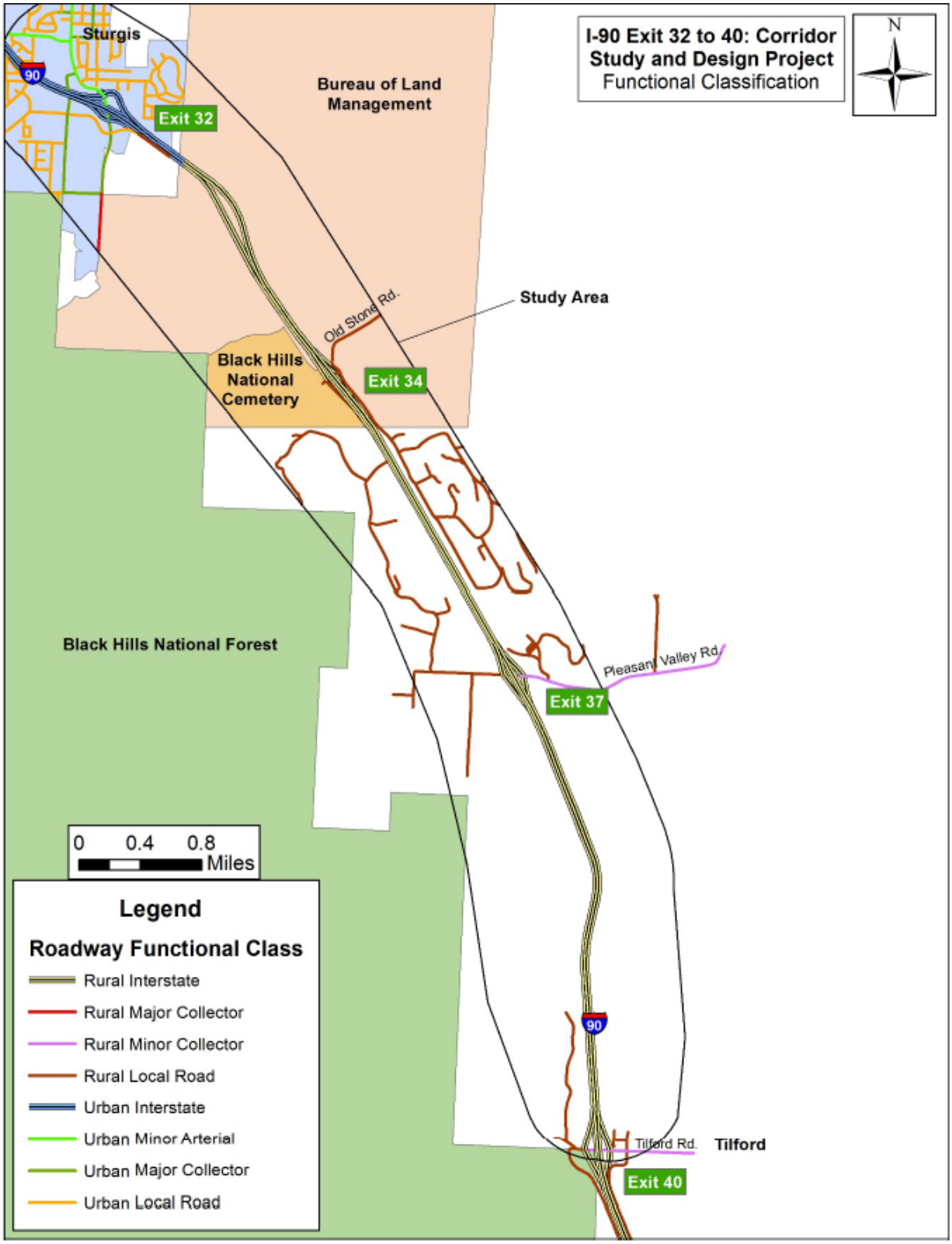

Figure 3-2 Existing Roadway Network

ALTERNATIVE TRAVEL MODES

Bus Transit

Prairie Hill Transit provides weekday bus service by request between various communities along the I-90 corridor and Rapid City. Riders must contact Prairie Hills to schedule trips. Interstate transit is provided daily along I-90 by Jefferson Bus Lines between Rapid City and Billings, Montana. No stops are provided in the vicinity of the Exit 34 Interchange.

Airports

There are several airports in the vicinity of the Exit 34 Interchange, the closest of which is the Sturgis Municipal Airport, located approximately 6 miles northeast of Exit 34. The nearest commercial airport is the Rapid City Regional Airport, located approximately 35 miles to the southeast of Exit 34.

Railroad

The RCP & E Railroad is a Class II freight railroad affiliated with the Genesee & Wyoming, Inc. rail company. The RCP & E rail line parallels I-90 on its west side through the interchange area and crosses Old Stone Road and Pleasant Valley Drive at grade to the west of the Exit 34 Interchange.

Bicycle/Pedestrian

I-90 crosses over Old Stone Road at a location where bicycle and pedestrian travel is not desirable. The Blucksberg residential development is located near the Exit 34 Interchange on the east side of the interstate. On the west side of I-90, four RV parks are located between the Black Hills National Cemetery and the Exit 37 Interchange to the south. A trailhead for the Centennial Trail is located a half mile northeast of the interchange along Old Stone Road. The trail crosses under I-90 at Alkali Creek north of the existing Exit 34 interchange. While this is a recreational destination, it is unlikely that pedestrians would travel on foot from the RV parks on the west side of I-90 to access the Centennial Trail. Bicycle travel along Old Stone Road under I-90 is unsafe due to existing narrow roadway widths. No dedicated pedestrian facilities currently exist within the Exit 34 Interchange and the at-grade railroad crossing at Old Stone Road does not have a dedicated pedestrian facility.

INTERCHANGES

I-90 Exit 34 Interchange: Black Hills National Cemetery

The existing interchange of I-90 and Old Stone Road (Exit 34) is a diamond interchange with a spacing of approximately 400 feet between the interchange ramp terminal intersections. Both ramp terminal intersections are currently controlled with STOP signs on the ramps. The ramps were each originally designed and striped as single lanes. Old Stone Road crosses under I-90 and ties into Blucksberg Drive on the east side of the interstate and Pleasant Valley Drive on the west. Both connecting roads have two-lane cross-sections and are spaced 100 feet from their adjacent ramp intersection. An at-grade crossing of the RCP & E Railroad is located approximately 150 feet west of the eastbound ramp terminal intersection. The existing Exit 34 Interchange configuration is shown in **Figure 3-3.**

Figure 3-3 Existing Configuration – I-90 Exit 34 Interchange

I-90 Exit 32 Interchange: Junction Avenue

The adjacent interchange, I-90 Exit 32, is located 2.3 miles northwest of the I-90 Exit 34 Interchange. The interchange is a diamond configuration, with a spacing of approximately 800 feet between the interchange ramp intersections along Junction Avenue. Both ramp terminal intersections are currently controlled with STOP signs on the ramps. During the Sturgis Motorcycle Rally, temporary signals are placed at these intersections to manage the high volume of traffic. Junction Avenue is a three-lane section with dedicated left turns for each direction within the

ramp intersections. All ramps were originally designed and striped as single lane ramps. The westbound off-ramp (Ramp B) is striped to include three lanes; free right, stop controlled right turn and stop controlled left turn lane. The existing Exit 32 Interchange configuration is shown in **Figure 3-4.**

Figure 3-4 Existing Configuration I-90 Exit 32 Interchange

I-90 Exit 37 Interchange: Pleasant Valley Road

Located 2.26 miles southeast of the I-90 Exit 34 Interchange is the Exit 37 Interchange. This existing interchange at I-90 and Pleasant Valley Road (Exit 37) is a skewed diamond configuration, with a spacing of approximately 680 feet between the interchange ramp intersections along Pleasant Valley Road. Both ramp terminal intersections are currently controlled with STOP signs on the ramps. All ramps were originally designed and striped as single lane. Pleasant Valley Road has a two-lane cross-section. The existing bridge over mainline I-90 does not provide pedestrian or bicycle facilities. An at-grade crossing of the RCP & E Railroad is located approximately 120 feet beyond the west (eastbound I-90) ramp terminal intersection. The existing Exit 37 Interchange configuration is shown on the aerial photo in **Figure 3-5.** It should

be mentioned that Exit 37 will be reconstructed prior to the reconstruction of Exit 34, the crossroad will be realigned perpendicular to I-90 and ramp lengths reconstructed to meet current standards for acceleration and deacceleration. **Figure 5-4** shows the proposed I-90 Exit 37 Interchange layout.

Figure 3-5 Existing Configuration - I-90 Exit 37 Interchange

EXISTING DATA

Traffic Volumes

Year 2017 existing traffic volumes were obtained from two sources:

1. Interstate 90 mainline 24-hour directional volumes were obtained at permanent automatic traffic recorder (ATR) stations from the SDDOT. Traffic counts were obtained for the week of September 11-14, 2017 and included vehicle classification data.

2. Hourly intersection turning movement counts were collected by the consultant team on two occasions – August 8-9, 2017, **Figure 3-6** (during the Sturgis Motorcycle Rally), and again on September 12, 2017, **Figure 3-7**. The counts collected during the Sturgis Rally (between 9:00 a.m. and 9:00 p.m.) were collected for reference purposes only and were provided to SDDOT to supplement turning movement counts collected during the Sturgis Rally from previous years. The counts obtained on September 12, 2017 were collected from 6:30 a.m. to 7:00 p.m. and were used as inputs to the intersection analyses. Both sets of counts included vehicle classification data.

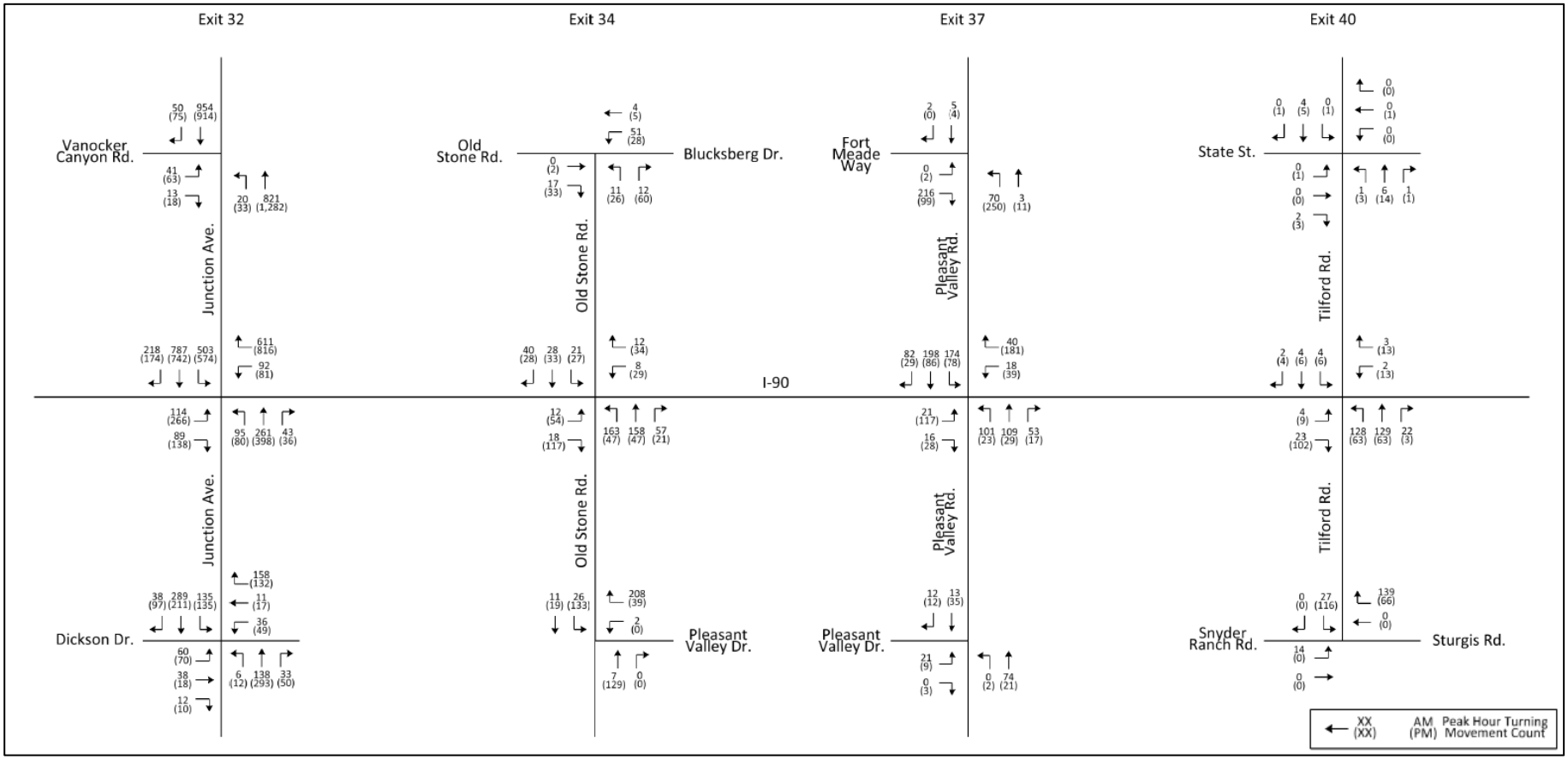

Figure 3-6 August 2017 Turning Movement Counts

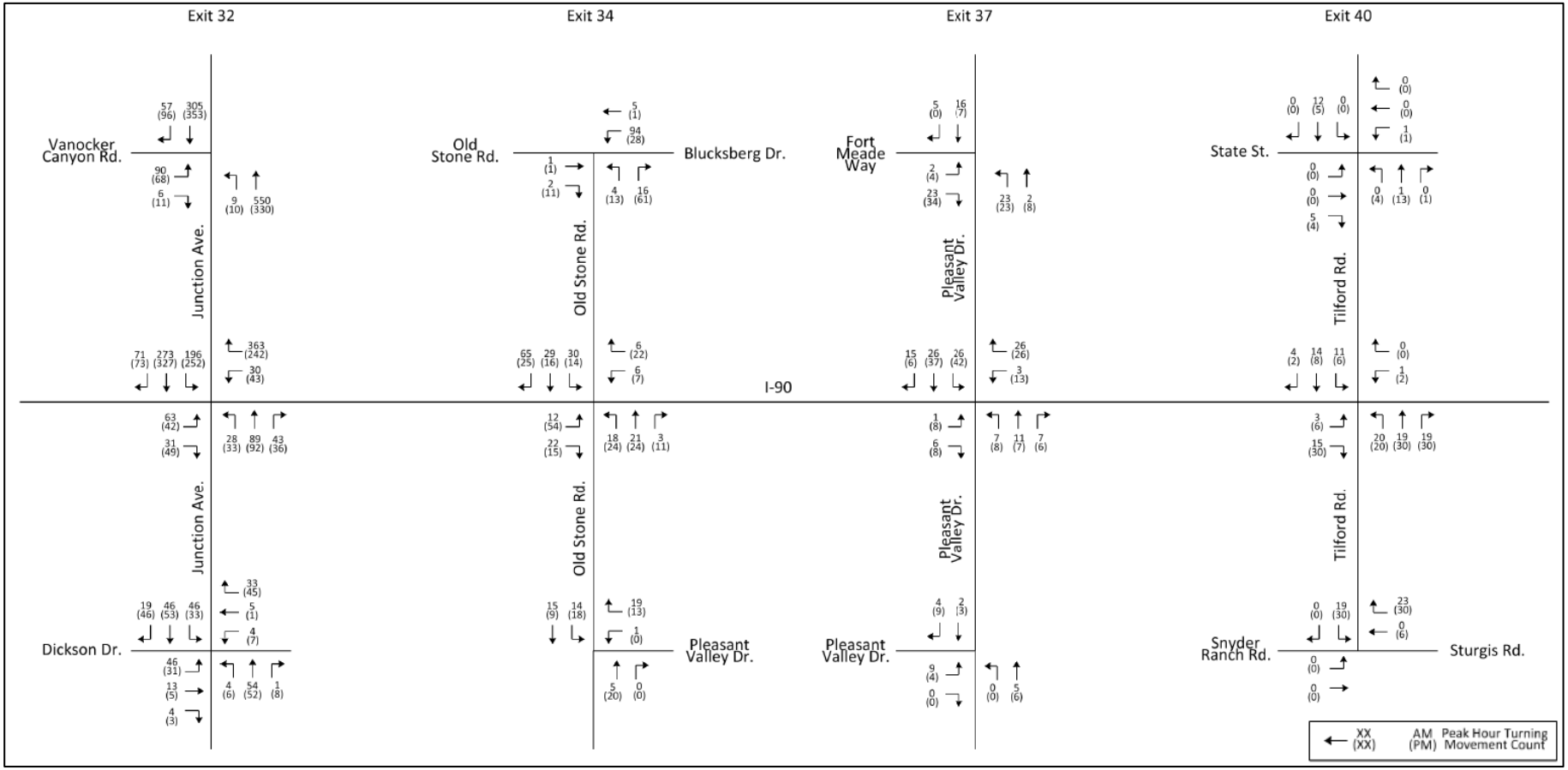

Figure 3-7 September 2017 Turning Movement Counts

The I-90 directional counts were corrected for daily and seasonal variation based on factors developed by the SDDOT from data collected at the weigh-in-motion station within the corridor ("WIM 901"). These are scaling factors that equate traffic counts by month of the year for which they are collected to an annual average daily traffic (AADT) volume. Year 2017 average daily traffic volumes (ADT) for I-90 mainline study segments are shown in **Figure 3-8.**

Traffic Crash Data

Historical crash data was collected along the study area for the five-year period between 2012 and 2016 and constitute the "Analysis Period" for this report. The information included location and severity along with basic information about type and contributing factors.

Over the Analysis Period, there were 423 crashes in the study area. Of these, two resulted in fatalities, 21 resulted in incapacitating injuries, and 46 resulted in non-incapacitating injuries. Additional analysis of the collected crash data is presented later within this report.

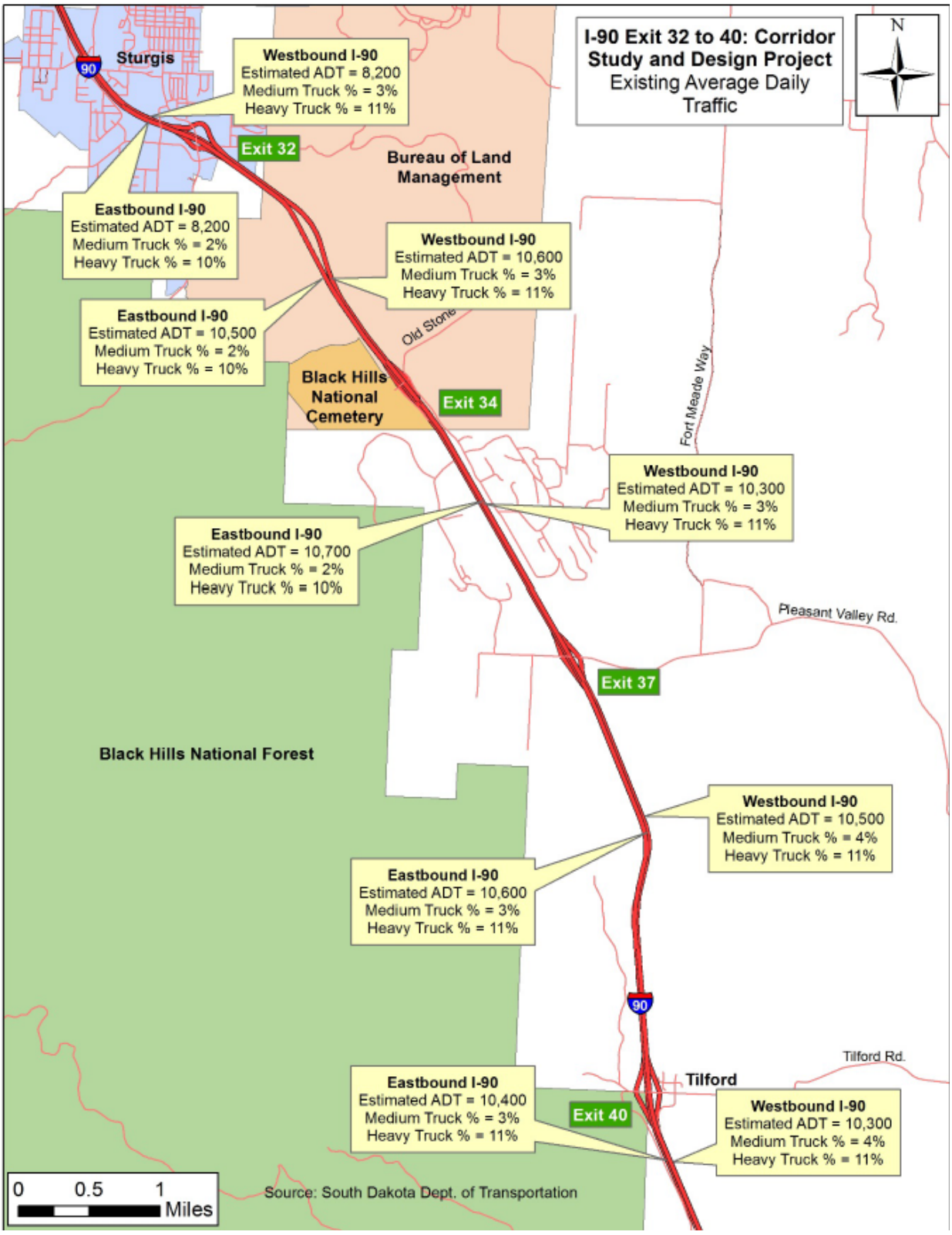

Figure 3-8 Existing Average Daily Traffic and Truck Percentages

EXISTING YEAR 2017 OPERATIONAL PERFORMANCE

Existing traffic operations were assessed using methods prescribed in the Highway Capacity Manual (HCM) 6th Edition. Operations were assessed for existing weekday a.m. and p.m. peak hour traffic conditions based on traffic counts and other data collected in September 2017. "Operations" were quantified based on performance measures associated with analytical methods for the following facility types within the project study area:

- Freeway Facilities (Chapter 10)
- Two-Way STOP-Controlled Intersections (Chapter 20)

I-90 Freeway Segments

The Interstate 90 mainline was evaluated using the Freeway Facilities methodology for the HCM. The method analyzes an extended length of freeway composed of continuously connected basic freeway, weaving, merge, and diverge segments. The methodology analyzes the connected segments over a set of sequential 15-minute time periods. The HCM core freeway facility method generates the following performance measures for each segment and time period:

- Capacity
- Free-flow speed
- Demand-to-capacity (D/C) and volume-to-capacity (V/C) ratios
- Average speed (space mean speed)
- Average density
- Travel time (minutes per vehicle)
- Vehicle miles traveled (VMT)
- Vehicle hours of travel (VHT)
- Vehicle hours of delay (VHD)
- Motorized vehicle level of service (LOS) for each component and for the facility

Additionally, space mean speed, average density, travel time, VMT, VHT, VHD, and LOS are aggregated in each time interval across all segments in the facility. Performance measures are not aggregated across time periods.

Freeway Facilities analyses of existing conditions were performed for the a.m. peak period (7:00 – 8:30 a.m.) and for the p.m. peak period (4:00 – 5:30 p.m.), as determined from the traffic counts. The Freeway Facilities method is a directional analysis. For individual segments, the following performance measures are reported: average travel speed (mph), density (pc/mi/ln), LOS, and demand-to-capacity ratio (D/C). The a.m.

and p.m. peak in both the eastbound and westbound directions are summarized in **Appendix B.**

According to the HCM, studies on LOS perception by rural travelers indicate the presence of lower-density thresholds in comparison to urban freeway travelers. The Freeway Facilities method presents different LOS thresholds, both based on the same density criterion, for urban versus rural areas, as shown in **Table 3-1.** These different thresholds apply only to the facility-level analysis. For the individual segments, the LOS thresholds are defined for the different components, including basic segments, merge and diverge segments, etc. and do not differentiate between urban vs. rural. The majority of the I-90 study section is located outside the Sturgis city limits, thus the entire corridor was evaluated as a rural facility. Facility results by time period are presented in **Table 3-2.** Overall facility results are presented in **Table 3-3.**

Table 3-1 LOS Criteria for Urban and Rural Freeway Facilities

LOS	Freeway Facility Density (pc/mi/ln)	
	Urban	Rural
A	≤ 11	≤ 6
B	> 11 – 18	> 6 – 14
C	> 18 – 26	> 14 – 22
D	> 26 – 35	> 22 – 29
E	> 35 – 45	> 29 – 39
F	> 45 or Any component D/C > 1.00	> 39 or Any component D/C > 1.00

Table 3-2 Facility Results by Time Period

A.M. Peak		Eastbound				Westbound			
Period	Time	Speed (mi/hr)	Density (pc/mi/hr)	Travel Time (min)	LOS	Speed (mi/hr)	Density (pc/mi/hr)	Travel Time (min)	LOS
1	7:00 – 7:15	70.1	1.6	9.3	A	71.3	1.2	9.4	A
2	7:15 – 7:30	70.1	1.6	9.3	A	71.3	1.6	9.4	A
3	7:30 – 7:45	70.2	1.6	9.3	A	71.3	1.6	9.4	A
4	7:45 – 8:00	70.2	1.2	9.3	A	71.3	1.4	9.4	A
5	8:00 – 8:15	70.1	1.2	9.3	A	71.2	1.4	9.4	A
6	8:15 – 8:30	70.2	1.3	9.3	A	71.3	1.3	9.4	A
P.M. Peak		**Eastbound**				**Westbound**			
Period	Time	Speed (mi/hr)	Density (pc/mi/hr)	Travel Time (min)	LOS	Speed (mi/hr)	Density (pc/mi/hr)	Travel Time (min)	LOS
1	16:00 – 16:15	69.1	1.8	9.3	A	71.0	1.6	9.4	A
2	16:15 – 16:30	70.1	1.8	9.3	A	71.0	1.6	9.4	A
3	16:30 – 16:45	70.1	1.7	9.3	A	71.0	1.5	9.4	A
4	16:45 – 17:00	70.2	1.6	9.3	A	71.0	1.6	9.4	A
5	17:00 – 17:15	70.1	1.7	9.3	A	71.0	1.8	9.4	A
6	17:15 – 17:30	70.2	1.4	9.3	A	71.0	1.9	9.4	A

Table 3-3 Overall Facility Results

Analysis Direction	Space Mean Speed (mi/hr)	Average Travel Time (min)	Density (pc/mi/ln)	LOS
A.M. Peak				
Eastbound	70.1	9.3	1.4	A
Westbound	71.3	9.4	1.4	A
P.M. Peak				
Eastbound	70.0	9.4	1.7	A
Westbound	71.0	9.4	1.6	A

The results indicate, both at the segment level and at the facility level, the study section of Interstate 90 operates at an acceptable level of service during typical weekday a.m. and p.m. peak hours. For this analysis, "typical" means no inclement weather, incidents, work zone activities, or special events.

Unsignalized Intersections

Existing conditions for selected unsignalized intersections in the study area were also evaluated, using the Two-Way Stop-Control method identified in the HCM 6th Edition. The method computes delay and LOS for those movements required to yield right-of-way, such as the left-turn movement on the major street approach and the side-street approaches. The following intersections were evaluated:

- Junction Avenue at Vanocker Canyon Road
- Junction Avenue at Dickson Drive
- Junction Avenue at I-90 Eastbound Ramps (Exit 32)
- Junction Avenue at I-90 Westbound Ramps (Exit 32)
- Horse Soldier Road (Old Stone Road) at I-90 Eastbound Ramps (Exit 34)
- Horse Soldier Road (Old Stone Road) at I-90 Westbound Ramps (Exit 34)
- Horse Soldier Road (Old Stone Road) at Blucksberg Drive
- Horse Soldier Road (Old Stone Road) at Pleasant Valley Drive
- Pleasant Valley Road at I-90 Eastbound Ramps (Exit 37)
- Pleasant Valley Road at I-90 Westbound Ramps (Exit 37)
- Pleasant Valley Road at Pleasant Valley Drive
- Pleasant Valley Road at Fort Meade Way

The Junction Avenue intersections with I-90 ramps (Exit 32) are signalized only during the motorcycle rally. They operate as unsignalized intersections with STOP-control on the exit ramp approaches during the remainder of the year. It should also be noted that turning movement counts were collected at Exit 40 as part of the evaluation of the Exit 37 interchange. However, Exit 40 was under construction at the time. For this reason, the following locations were not included in the analysis of the corridor:

- Sturgis Road-Tilford Road at Snyder Ranch Road
- Tilford Road at I-90 Eastbound Ramp (Exit 40)
- Tilford Road at I-90 Eastbound Ramp (Exit 40)
- Tilford Road at State Street

Existing delay and levels of service for the a.m. and p.m. peak at these intersections are shown in **Figure 3-9.**

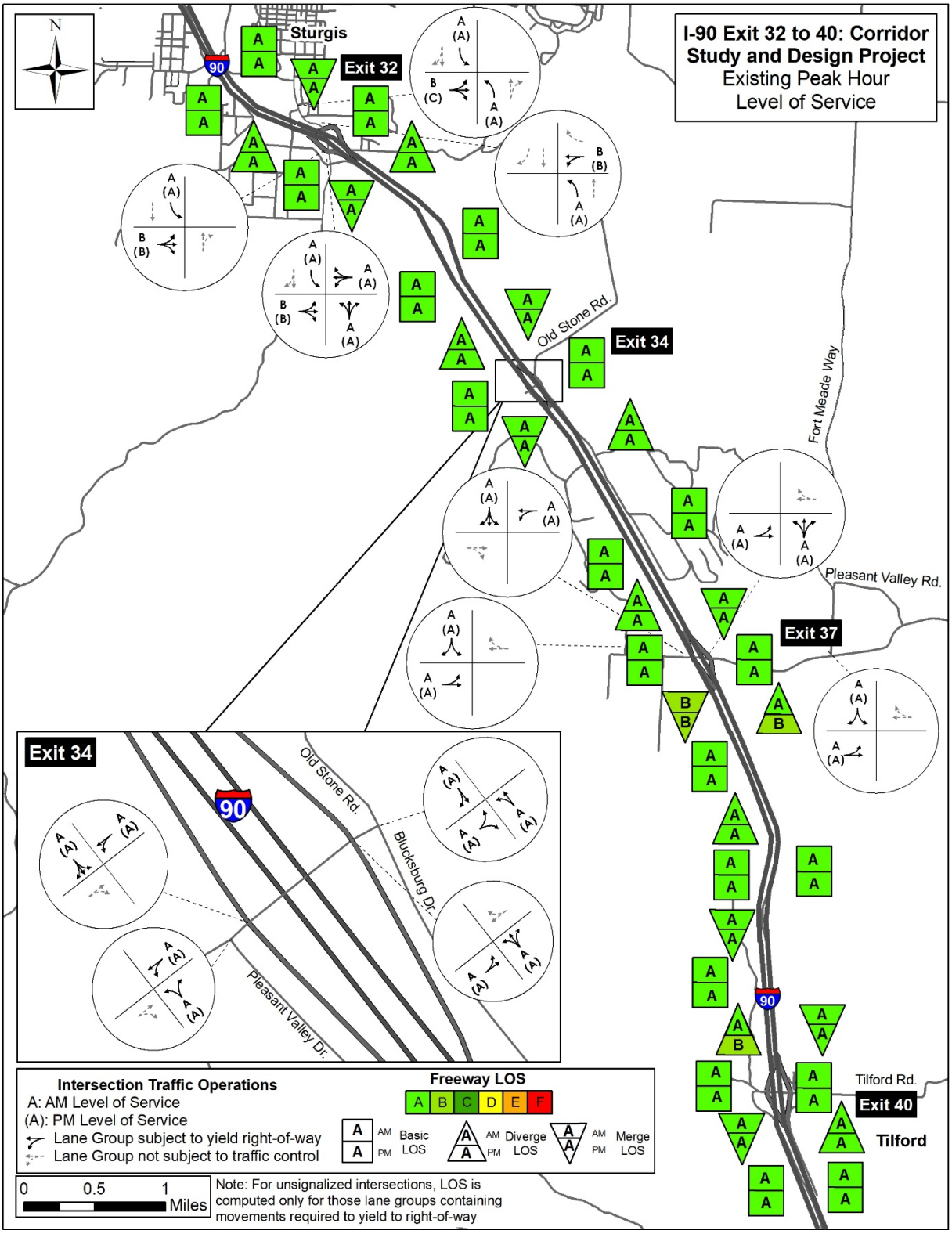

Figure 3-9 Existing Peak Hour Delay and LOS

Existing Deficiencies and Needs

There are no existing capacity deficiencies, for the I-90 mainline or for the crossroads that form its service interchanges within the study area. For typical weekday a.m. and p.m. peak periods, with one exception, all facilities operated at Level-of-Service B or better. The one exception was the STOP-controlled minor street approach of eastbound Vanocker Canyon Road at Junction Avenue, which operates at LOS D during the a.m. peak and LOS C during the p.m. peak.

EXISTING SAFETY CONDITIONS

Crash History

Historical crash data was collected along the study area for the five-year period between 2012 and 2016 and constitute the "Analysis Period" for this report.

Crash Severity

Over the Analysis Period, there were 423 crashes in the study area. Of these, two resulted in fatalities, 21 resulted in incapacitating injuries, and 46 resulted in non-incapacitating injuries. It should be noted that 131 crashes were designated as "wild animal hit" crashes. Although this is not typically a crash severity category, it was included to highlight crashes that would be difficult to mitigate with safety improvements to the roadway. Figure 3-10 displays the crash severity distribution for the I-90 corridor between Exit 32 and Exit 40.

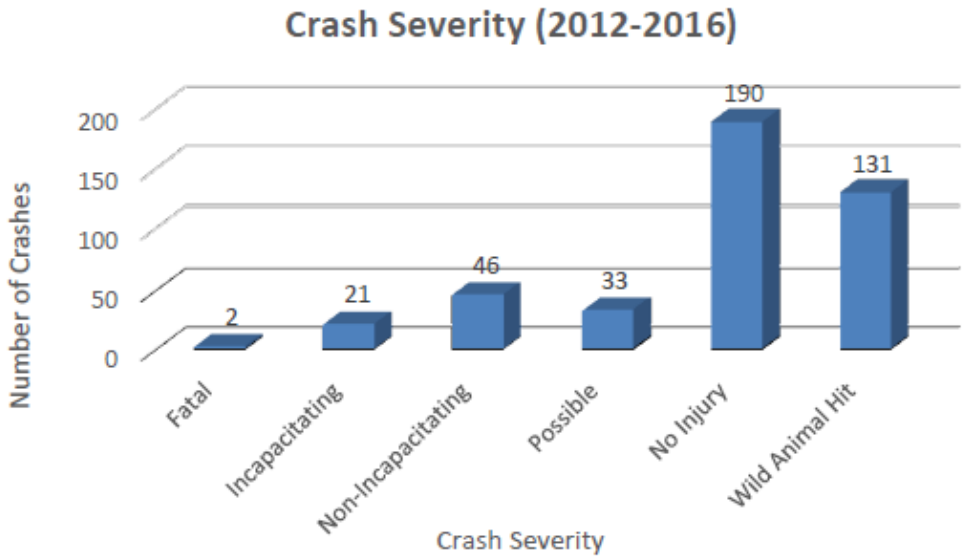

Figure 3-10 Distribution of Crashes by Severity

Crashes were evaluated by severity and by type. Crashes were also evaluated by location – first by segment, then by shorter 0.3-mile "spots."

Crash Type

To better understand the crash history along this corridor, the crash types were examined based on the "Manner of Collision" field in the crash reports. Single vehicle crashes were the most common crash type (281 crashes, 66%) and were predominately run-off-the-road incidents. Animal collisions were the second most commonly reported crash type, however many of these collisions were coded as single vehicle collisions. Of the 423 crashes, 167(39%) were coded as run-off-the-road collisions (ROR), which was the most common crash event. **Figure 3-11** summarizes the ROR collisions by location. There is a cluster of collisions at the horizontal curve (MRM 38.0-38.7) between Exit 37 and Exit 40. Of the 34 total collisions at this curve, 15 were ROR incidents and 19 occurred during wet weather conditions, (of the 15 ROR collisions, 12 occurred during wet weather conditions). **Figure 3-12** and **Figure 3-13** summarize the distribution of crashes by type and severity.

A map of the top five crash "hot spots" is shown in **Figure 3-14.** The two segments with the highest and second highest crash frequencies, Spot 4 and Spot 8, can be considered as locations for further study. The spots with the third and fourth highest crash frequencies, Spot 7 and Spot 16, are both located near interchanges. Spot 7 is located near Exit 34 and Spot 16 is located near Exit 40. The most common crash type at Spot 7 was animal collisions and the most common crash type at Spot 16 was single vehicle collisions. The spot with the fifth highest crash frequency was Spot 11, which also could be considered for further study.

The full crash analysis completed for the corridor can be found in **Appendix C**.

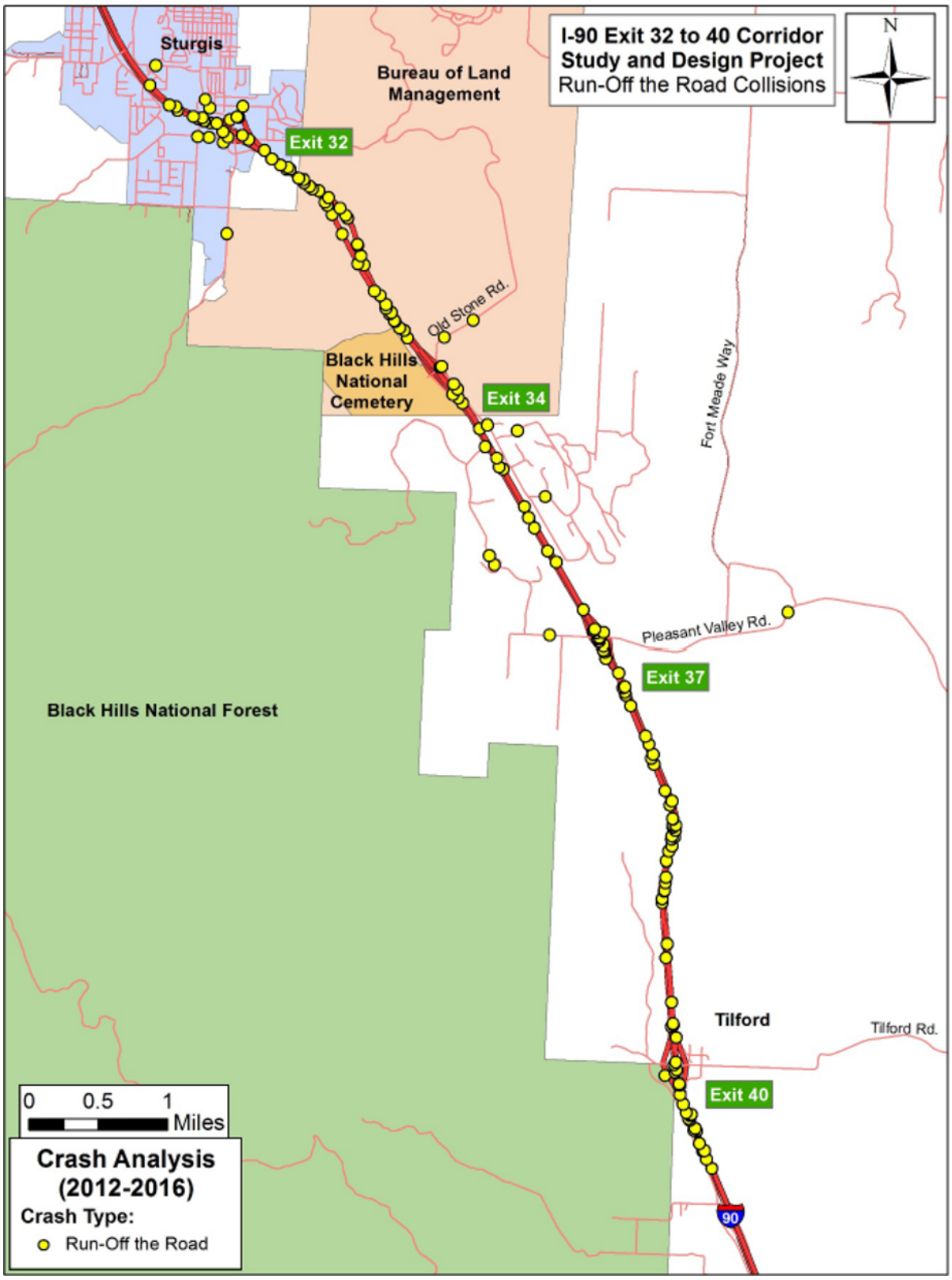

Figure 3-11 Run off the Road Crashes by Location

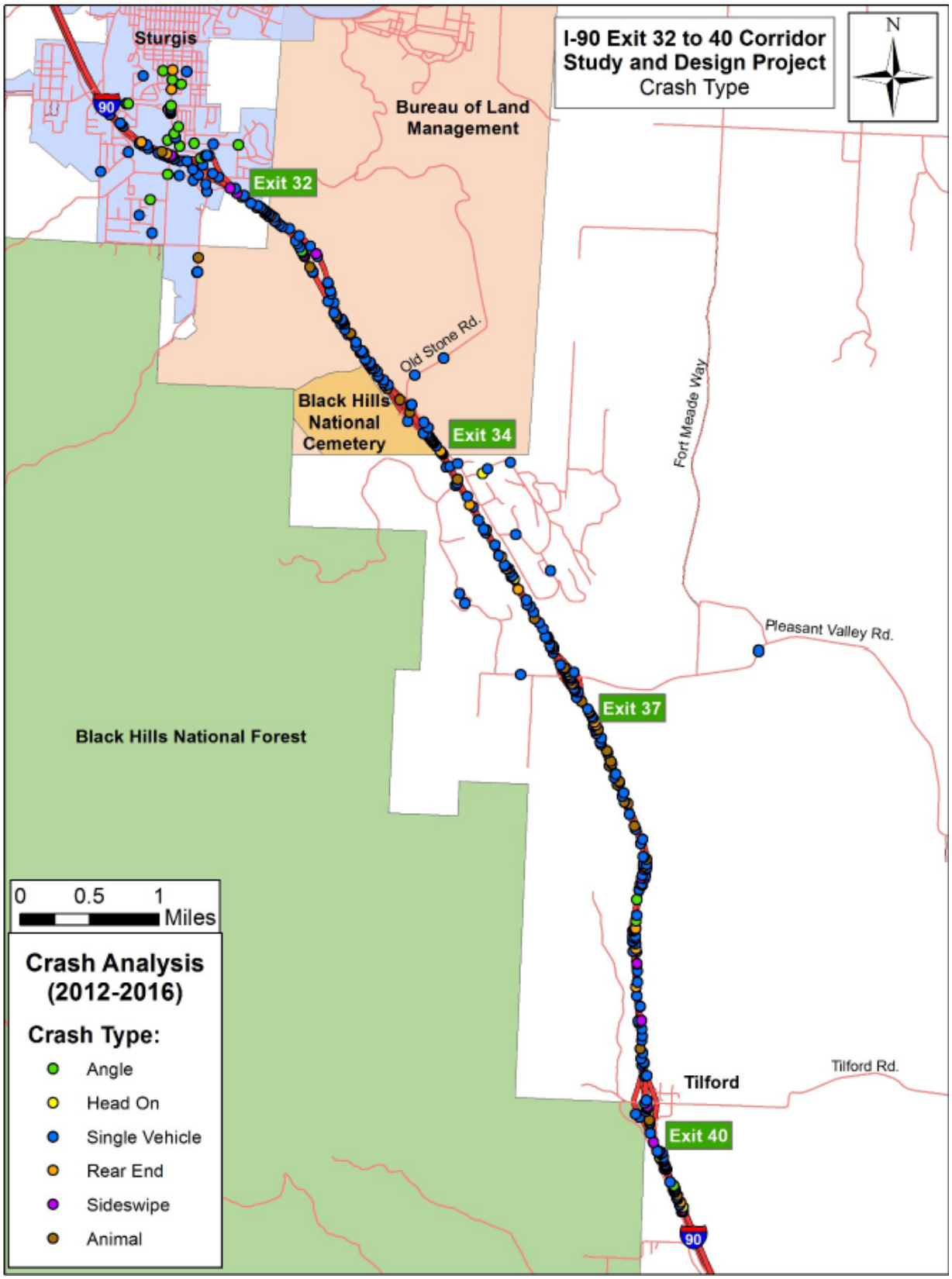

Figure 3-12 Crashes by Type

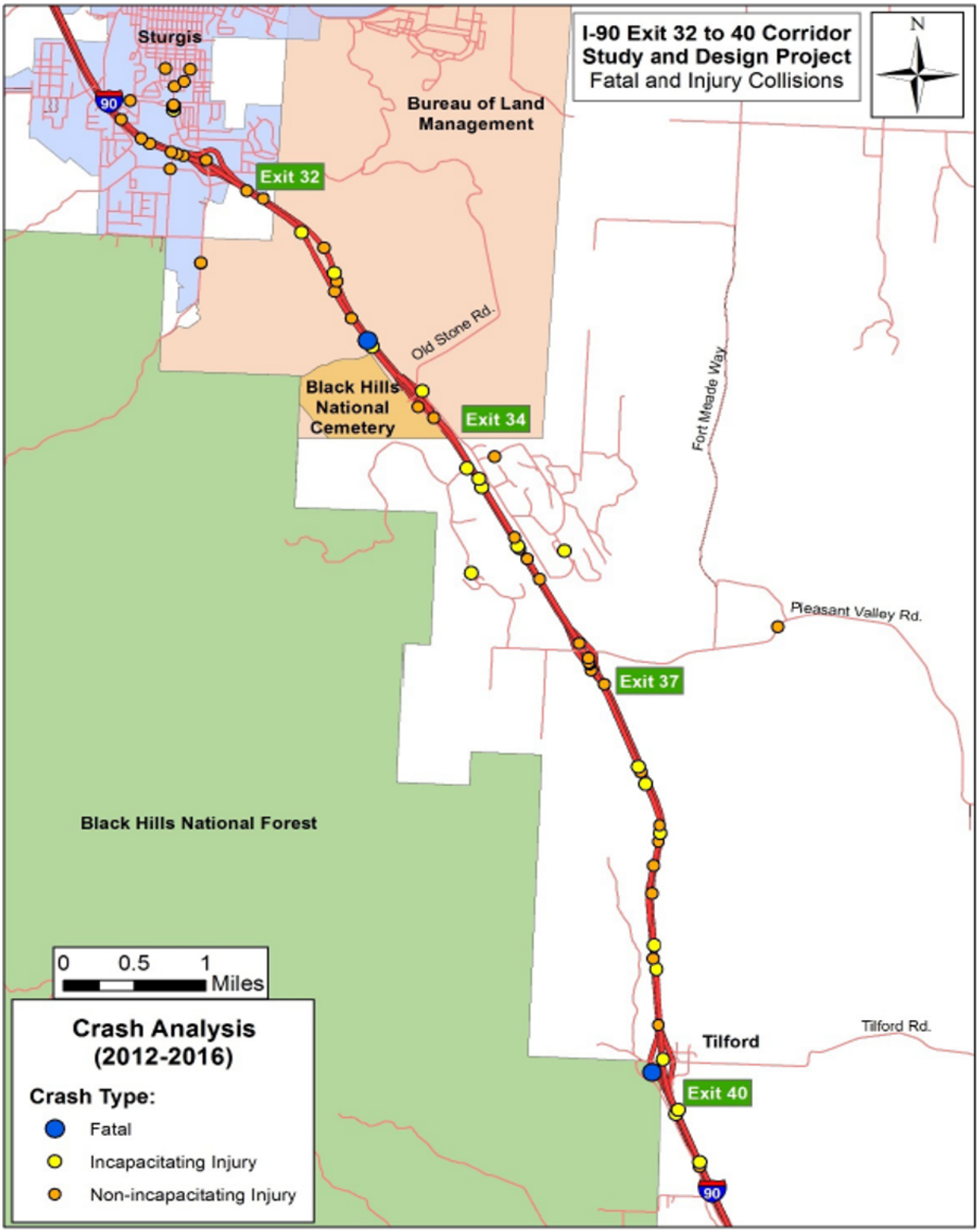

Figure 3-13 Crashes by Severity

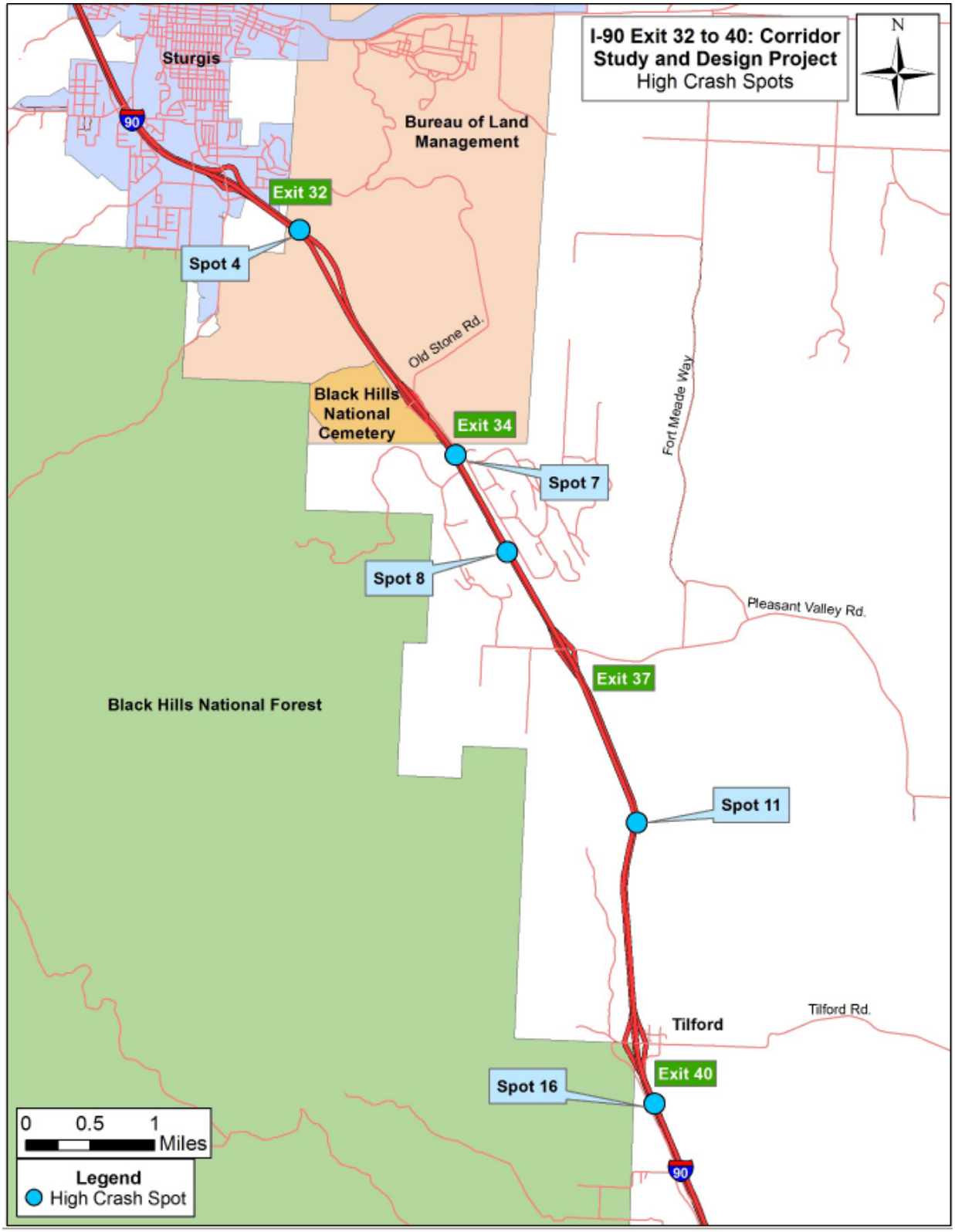

Figure 3-14 Top 5 Crash "Hot Spots"

EXISTING ENVIRONMENTAL CONSTRAINTS

Understanding the environmental, social and cultural resources that exist in and around the project area is essential to creating improvement concepts that minimize impacts to these resources. These items provide site context to determine potential interchange configurations and provide high-level criteria for evaluation. A preliminary scan of the project corridor determined the following resources within or adjacent to the project corridor:

Table 3-4 Environmental, Social and Cultural Resources

Resource Type Feature	Resource
4(f)/6(f) Properties	4(f) Properties • Bureau of Land Management Property • Fort Meade Recreation Area • Alkali Creek Centennial Trail • Black Hills National Cemetery • Seventh Calvary Trail System • Fort Meade Archeological Site 6(f) - None identified
Wildlife and Vegetation	• Least tern • Red knot • Whooping crane • Northern long eared bat • No designated Critical Habitat
Water Resources	• Alkali Creek, a beneficial use stream for: i) Domestic water supply waters ii) Coldwater marginal fish life propagation waters iii) Limited-contact recreation waters • Bulldog Creek • Forested Wetlands • Freshwater Emergent (PEM) Wetlands
Cultural Resources	• Ute Burial ground avoidance area and scatter sites • BLM archeological features • Recommended eligible sites • National Register listed sites • Railroad (segments are historic) • BHNC gates • BHNC property • Fort Meade Historic District • Fort Meade Archaeological Site
Farmland	• Farmland of Statewide Importance • Prime Farmland (if irrigated)
Noise Receptors	• Black Hills National Cemetery • No Name RV Park • Katmandu RV Park

The Exit 34 Interchange is tightly constrained on all sides by existing resources, including the Black Hills National Cemetery, the Bureau of Land Management property, a railroad corridor, and known cultural resource sites.

4. NEED

GEOMETRIC

The following substandard conditions would persist when Exit 34 Interchange conditions are analyzed in comparison to the current *South Dakota Department of Transportation Road Design Manual:*

- Access intersection spacing to the east and west of the interchange is substandard
- Combined ramp width is 24 feet (standard 25 feet)
- Ramp superelevation does not meet 50 MPH design speed
- Ramp acceleration and deceleration lengths for 50 MPH design speed
- Ramp stopping sight distance
- Inslopes measured at 4:1 (6:1 standard)
- Control of Access less than standard 300 feet for reconstruction of existing interchange
- Median horizontal offset less than minimum distance (550 feet)

PAVEMENT

The need to replace or rehabilitate the pavement is often the driving force behind the timing of many construction projects on the state highway system. The SDDOT has determined the pavement in the eastbound lanes of I-90 between Exits 32 and 40 will require replacement before 2025. A pavement condition survey was conducted by SDDOT in 2017 and the surface condition index (SCI) was calculated for each segment. The SCI ranks pavements based on surface condition in order to identify when pavements may need rehabilitation. The index ranks pavements from 0 to 5, 5 being new pavement. The study area pavement conditions and approximate ages are shown in **Figure 4-1.** Based on the rankings, the eastbound pavement between Exit 32 and the Tilford Port of Entry was identified as needing to be replaced in the next few years.

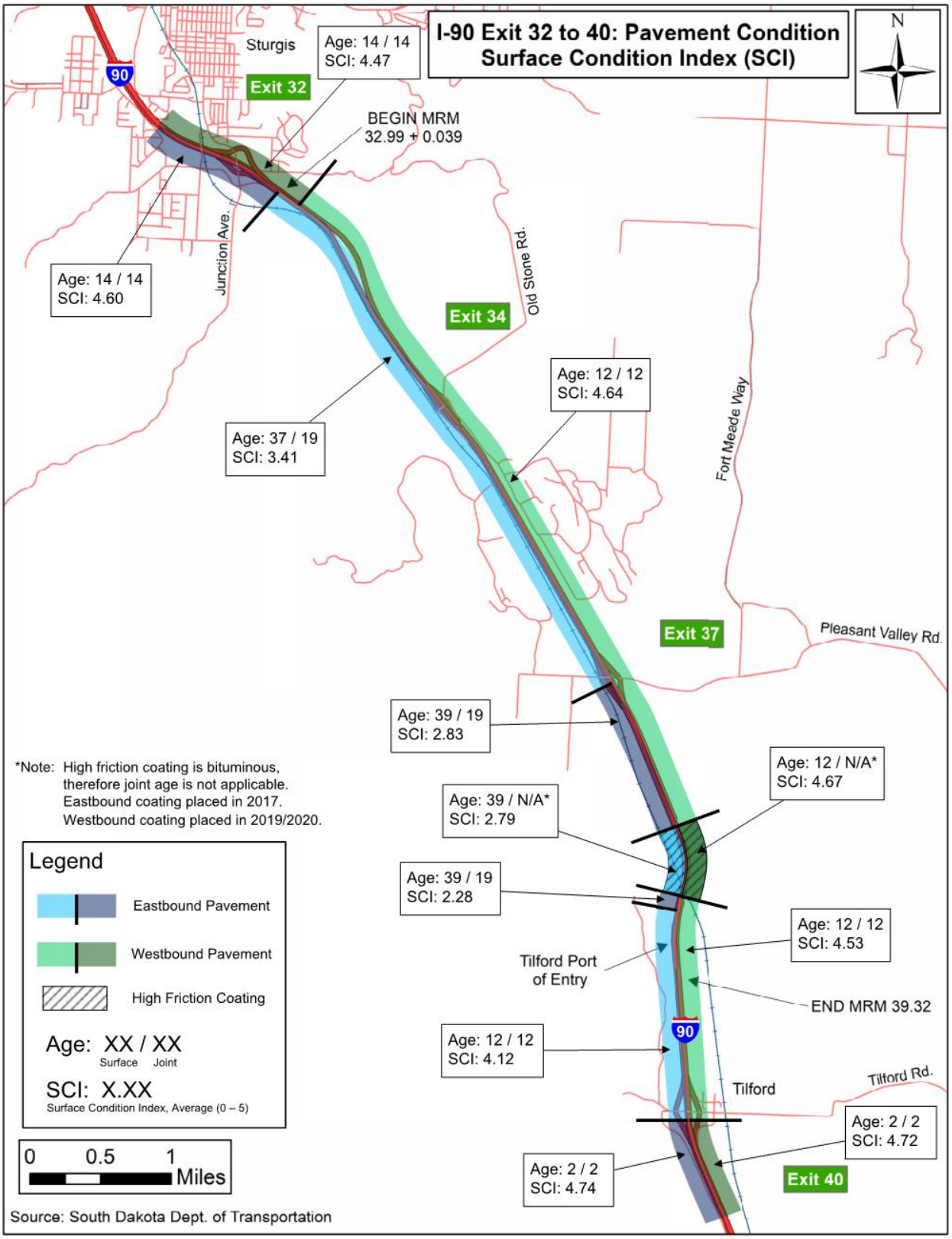

Figure 4-1 Pavement Condition Surface Condition Index

SAFETY

The Exit 34 Interchange ranked 59th of 62 interchanges evaluated in Phase 1 of the *2000 Interstate Corridor Study* based on Average Daily Traffic Volumes and Accidents and 18th of 126 interchanges for crash rates in the *2010 Interstate Corridor Study*. Neither study noted Exit 34 as a high crash location. A review of reported crashes between the Year 2012 and Year 2016 revealed no significant recurring crash patterns.

STRUCTURAL

The I-90 bridges which carry Interstate I-90 over Old Stone Road were constructed in 1963 as 3-span concrete slab span structures. The bridges have approach guardrail with all features reported as meeting currently acceptable standards. The abutments consist of concrete sills supported on timber piles, and the piers consist of three columns on individual spread footings. Both structures carry a sufficiency rating of 82.0, the westbound bridge has an inventory rating of 39.9 US tons and the eastbound bridge has an inventory rating of 38.5 US tons. The geometry, condition of primary components, and load carrying capacity, need to be considered in the measure of the bridge's performance.

TRAFFIC

The updated future traffic forecasts and operational analyses completed for the IMJR indicate that the Exit 34 interchange and study area intersections are projected to operate at acceptable levels through the 2050 design year.

The analyses indicate that the No Build and Build scenarios are anticipated to operate comparably; however, the Build scenario provides the ability to correct substandard interchange geometries.

The existing Exit 34 Interchange has a history of vehicles queuing across the at-grade rail crossing with Old Stone Road just east of the interchange and onto the Exit 34 Interchange ramp terminals during high volume traffic events at the Black Hills National Cemetery.

Previous traffic analyses of the interchange resulted in similar findings, described as follows:

- The *Interstate 90 Black Hawk – Sturgis Corridor Preservation Study* concluded that traffic operations are not currently an issue at the Exit 34 interchange. When the existing (No Build) configuration was evaluated for the year 2025, the north interchange ramp terminal intersection indicated no anticipated deterioration of LOS during the average AM and PM peak hours while the south interchange ramp terminal intersection indicated a slight deterioration of LOS from LOS A to LOS B during the average AM and PM peak hours. The study also indicated that mainline capacity may require an expansion of the mainline from 2 through lanes to 3 through lanes in each direction sometime beyond the planning horizon. The bridge design will look to accommodate

future needs by providing wider abutments so when additional capacity is needed a wider deck can be poured avoiding costly bridge reconstruction costs in the future.

- *South Dakota Department of Transportation Decennial Interstate Corridor Study* completed in February 2001 evaluated projected year 2010 and 2020 traffic conditions at the Exit 34 interchange and concluded that all ramp merge/diverge movements and ramp terminal intersections are projected to operate at LOS B or better through the year 2020.

GEOTECHNICAL

During SDDOT's geotechnical review of the project area, it was discovered that the hillside along the I-90 westbound lanes at Exit 34 is unstable. An emergency slide repair project took place in 1996 to stabilize the hillside at this location. The asbuilt plans are included in **Appendix F**. A berm was placed at the toe of slope to stabilize the hillside prior to underdrains being installed between Blucksberg Drive. Excavation of the berm or excavation near the toe of slope would reduce the lateral resistance which is providing stability to the hillside above. The SDDOT's Geotechnical department strongly recommended that no excavation occur along westbound lanes in the vicinity of Exit 34.

5. ALTERNATIVES

INITIAL CONCEPTS

The SDDOT developed a series of concepts to address the issues and deficiencies determined to exist at the Exit 34 Interchange. To guide the selection of the chosen alternative, a Project Study Advisory Team (SAT) was formed consisting of members of the SDDOT management and functional groups, Meade County, and the FHWA. The SDDOT followed a three-phase alternative evaluation approach. During the first phase, the SAT investigated site context to determine potential interchange configurations and developed high-level criteria for evaluation. Key items for evaluation included connectivity to local roads, property impacts, constructability/temporary traffic impacts, safety, environmental impacts, and costs.

During this first phase of the Exit 34 interchange alternatives process, the following series of nine individual concepts were originally developed:

- Alternative 34-1: Offset Single Point w/ local roadway connections
- Alternative 34-1B: Roundabout Interchange w/ local roadway connection
- Alternative 34-2: Folded Diamond w/ local roadway connections
- Alternative 34-3: Modified Folded Diamond w/ local roadway connections
- Alternative 34-4: Shifted Standard Diamond w/ local roadway connections
- Alternative 34-5: Westbound Button-Hook w/ local roadway connections
- Alternative 34-5B: Partial Folded Diamond w/ local roadway connections

- Alternative 34-6: Trumpet w/ local roadway connections
- Alternative 34-7: Roundabout Interchange

Figures for each of these alternatives are included in **Appendix G**.

The second phase of the alternative selection process included narrowing down the list of preliminary concepts to a maximum of three to carry forward. Of the nine early concepts, six were removed from further analysis. A description of the alternatives and reason for dismissal are given below for each concept:

Table 5-1 Dismissed Concepts

Alternative	Description	Reasons for Elimination
34-1 Offset Single Point with local roadway connections	Shifts mainline I-90 approx. 210 feet east through the interchange and brings the ramps and local road connection to a single point. A north frontage road would connect the interchange to Old Stone Road.	Requires three bridges increasing cost and future maintenance, requires a traffic signal at ramp intersections, and results in large impacts to the adjacent hillside.
34-2 Folded Diamond w/ local roadway connections	Shifts I-90 approx. 485 feet east within the interchange area. The folded diamond has two standard long ramps and two loop ramps. A north frontage road would connect the interchange to Old Stone Road.	Requires box culvert at Alkali Creek for mainline, adds at-grade railroad crossing, and results in large impacts to the adjacent hillside. This configuration would be difficult to construct under traffic.
34-4 Shifted Standard Diamond w/ local roadway connections	Shifts I-90 approx. 485 feet east within the interchange area. The standard diamond provides desired separation of the ramp terminals. A north frontage road would be constructed to connect the interchange to Old Stone Road.	Requires multiple crossings of Alkali Creek for mainline and ramps, adds at-grade railroad crossing, and results in large impacts to the adjacent hillside.
34-5 Westbound Button Hook	Shifts I-90 approx. 220 feet to the east and uses a button hook design for traffic exiting and entering I-90 westbound lanes. The eastbound lanes use a more standard ramp configuration. The button hook allows the westbound ramps to shift north and away from the steep hillside. A north frontage road would be constructed to connect the interchange to Old Stone Road.	Requires multiple crossings of Alkali Creek for mainline and ramps, adds at-grade railroad crossing, and results in large impacts to the adjacent hillside. This alternative is an unfamiliar design and would be difficult to construct under traffic.

34-5B Partially Folded Diamond	Shifts I-90 approx. 220 feet to the east. A single cloverleaf loop and ramp is used in the northeast quadrant of the interchange for traffic exiting and entering I-90 westbound lanes. The eastbound lanes use a more standard ramp configuration. A north frontage road would be constructed to connect the interchange to Old Stone Road.	Requires multiple crossings of Alkali Creek for mainline and ramps, adds at-grade railroad crossing, and results in large impacts to the adjacent hillside. This alternative is an unfamiliar design and would be difficult to construct under traffic.
34-6 Trumpet	A trumpet style interchange where the eastbound mainline follows the high-speed ramp outside the loop and the westbound ramp loops back over the mainline. A north frontage road would be constructed to connect the interchange to Old Stone Road. The mainline I-90 is shifted approximately 220 feet east.	Requires multiple crossings of Alkali Creek for mainline and ramps, adds at-grade railroad crossing, and results in large impacts to the adjacent hillside. This alternative would be difficult to construct under traffic.

CONCEPTS CARRIED FORWARD FOR FURTHER STUDY

Of the nine early concepts developed, three were selected to be carried forward for additional study and refinement.

A description of the alternatives and benefits are given below for each concept:

Table 5-2 Concepts Carried Forward

Alternative	Description	Benefits
34-1B Roundabout Interchange	Shifts mainline I-90 approx. 125 feet east through the interchange and brings the ramps and local road connection to a set of two single lane roundabouts at the ramp terminals. A north frontage road would connect the interchange to Old Stone Road, although a more direct frontage road connection was shown as an option.	Avoids the railroad with less impact to the hillside compared to other alternatives. Mainline shifts less than similar alternatives.
34-3 Modified Folded Diamond Interchange	The folded diamond has two standard long ramps and two loop ramps. Alternative uses existing mainline I-90, avoiding hillside impacts. A north frontage road would connect the interchange to Old Stone Road.	An extended bridge, a box culvert and a railroad tunnel are needed adding to cost and maintenance needs. Avoids the railroad with less impact to the hillside compared to other alternatives. Mainline shift is less than similar alternatives.
34-7 Roundabout Interchange Shifted South	Also uses the existing mainline I-90 but shifts the interchange southeast of the existing. The design includes a compressed diamond with a single lane roundabout that connects the western ramp terminals and the frontage road.	Staying on mainline alignment and a tight interchange configuration allows for avoidance of several key environmental resources including the Black Hills National Cemetery, the railroad, Alkali Creek, and the local hillside.

Each of the three options carried into the Alternatives Analysis were developed to a level with sufficient detail to complete a Decision Matrix. The matrix applied project goals and prioritized criteria to score the alternatives and assist decision makers in making a fully informed choice for the chosen alternate. The matrix utilized weighted rankings, which were determined in the SAT Workshop in September 2018. The SAT ranked the evaluation criteria based not only on what was most valued, but also on the level of impact that the criteria would have on the project (i.e. – effect on constructability and design).

The Decision Matrix considered the following items:

1. Safety
2. Geometric Needs
3. Environmental Impacts
4. Cost
5. Traffic, Level of Service
6. Constructability/traffic impacts/staging considerations
7. Land Use Impacts
8. ROW Impacts
9. Future planning/land uses
10. Utility Impacts

The results of the ranking were presented to the public at the open house held in Sturgis, SD on December 10th, 2018. A tentative decision was made to select Alternative 34-7 as the chosen alternative into the environmental documentation process.

REFINEMENT OF ALTERNATIVE

As the tentative chosen, Alternative 34-7 was reviewed by the SDDOT functional groups and management to determine feasibility. During this review process, two items were noted; 1) concerns were raised regarding the use of a roundabout at the ramp terminals and 2) an issue was noted with the 660 foot Control of Access (COA) recommended between the interchange ramp terminal and the connection to the local frontage road.

In July 2019, SDDOT provided a determination that due to public concern statewide with installation and functionality of roundabouts, SDDOT determined that further refinement of the chosen alternative would be needed before determining the geometry of the chosen alternative. At this time, the SDDOT also took an additional step to refine the Exit 34 alternatives north of the existing interchange and at the existing interchange location. This led to the development of additional options at Exit 34.

A total of sixteen options were developed and reviewed. The new alternatives at the chosen interchange location southeast of the existing Exit 34 Interchange were reviewed against the same criteria used in the previous analysis. The matrix is provided as **Appendix G**. Table 5-3 describes each refined concept considered by the SAT. Concepts highlighted in grey were dismissed from further study.

Table 5-3 Refined Concepts

Alternative	Description	Benefits and Challenges
34-1B Roundabout Interchange	Described in Table 5-2 above.	Traffic modeling for the Exit 34 interchange determined that a standard stop-controlled intersection would provide the needed capacity at the ramp terminals and at the Blucksburg intersection. Neither a roundabout nor a signal were warranted at this location.
34-1C Standard Diamond Interchange Shifted North	Shifts Exit 34 north as a standard diamond. The frontage road would connect to Old Stone Road by running along the east side of I-90. In this alternative, the local connecting road crosses under the raised lanes of I-90 and results in an at-grade crossing of the railroad. COA is not an issue.	Traffic operations may create driver confusion as it is not a standard interchange configuration. Required a large amount of Right of Way in comparison to other alternatives (15 acres) and would impact a large powerline that parallels the corridor.
34-3 Modified Folded Diamond	This folded diamond alternative remains on mainline I-90 alignment but shifts the Exit 34 interchange north of Alkali Creek. The EB exit ramp follows the curve of the WB entrance ramp to avoid impacts to the railroad. Folded design avoids ramp impacts to Alkali Creek and the railroad. An east frontage road would connect the interchange to Old Stone Road.	Large impact on the railroad requiring a multiplate structure increasing cost and causing interruptions to railroad service. This option also requires the construction of local road connections on both sides of the interstate including the extension of Blucksberg Drive, requiring a new crossing over Alkali Creek and large ROW impacts (approximately 35 acres). The added expense of the local road connections makes this a less desirable option.
34-7 Roundabout Interchange South	Described in Table 5-2 above.	Neither a roundabout nor a signal were warranted at this location. This alternative was eliminated, and an identical option was developed with a stop-controlled intersection at the ramp terminals and the Blucksburg intersection. The modified version was carried forward as Alternative 34-10.
34-8 660' East COA	This is a modification of Alternative 34-7, which places the new interchange just southeast of the Black Hills National Cemetery (BHNC). The design includes a compressed diamond with a single lane roundabout that connects the western ramp terminals and the frontage road. The stop-controlled Blucksberg Drive intersection is pulled further east to provide the desired 660-foot separation from the interchange terminals. The local road crosses under the raised lanes of I-90 and results in an at-grade crossing of the railroad.	Due to the grading required to obtain the desired 660-foot COA, this alternative causes large scale impacts to the adjacent hillside east of I-90 and is the most expensive option. Four Interstate bridges drive up the costs even further. This option is also likely to impact to adjacent archeological sites. Other options were thought to provide similar or greater benefits with fewer impacts and much less cost.

34-9 100' East COA	A modification of Alternative 34-7. However, the stop-controlled Blucksberg Drive intersection is not shifted as far east and provides a 100-foot separation from the interchange terminals similar to the configuration at the existing Exit 34 interchange. In this alternative, the local connecting road crosses under the raised lanes of I-90 and results in an at-grade crossing of the railroad.	This alternative provides a 100-foot COA and maintains four interstate bridges. Alternative 34-10 is a similar option but includes two interstate bridges and two local road bridges. The crossroad does not need stopping sight distance and the COA is the same as the existing conditions.
34-10 100' East COA Crossroad and Railroad Bridge	A modification of Alternative 34-7. The variation on this alternative includes the same stop-controlled intersection with Blucksberg Drive with a 100-foot separation from the interchange terminals. This option elevates the local road to cross over the I-90 mainline and over the railroad providing a grade separated crossing.	Benefits include a grade separated crossing of the railroad for increased safety, the design requires only two interchange bridges. The alternative currently shows the COA on the east side as 100' which does not provide desired intersection spacing between the ramp intersection and Blucksberg Drive. The wetlands along eastbound exit ramp are impacted by the ramp fill slopes.
34-11 Max COA (622') Avoids Archaeological Sites	A modification Alternative 34-8 but reduces the separation between the interchange terminals and the local road to 622 feet to avoid impacting known archaeological sites. This option elevates the local road to cross over the I-90 mainline and over the railroad providing a grade separated crossing.	This option avoids the known archaeological sites, however, still results in large scale impacts to the adjacent hillside east of I-90. Other options were thought to provide similar or greater benefits with fewer impacts and much less cost.
34-12 Roundabout Interchange Shifted South	A modification of Alternative 34-7 with increased separation between the northbound and southbound ramp terminals. This option eliminates the existing bridge at the current Exit 34 location and provides a west frontage road connecting the BHNC to the interchange. In this alternative, the local connecting road crosses under the raised lanes of I-90 and results in an at-grade crossing of the railroad.	The new frontage road would impact existing wetlands. The United States Corps of Engineers (USACE) may not issue a permit for construction if there is a practicable alternative with less adverse impact on the aquatic ecosystem. Additionally, acquiring mitigation sites could be very difficult, expensive, and require a land acquisition process that could adversely impact the project schedule.
34-13 100' COA for East and West Frontage Roads	The variation on Alternative 34-9. includes a connection on the east to old stone road but eliminates the existing bridge at the current Exit 34 location. A west frontage road connects the BHNC entrance with the new interchange. The local road crosses under the raised lanes of I-90 and results in an at-grade crossing of the railroad.	This option eliminates two interstate bridges by constructing a new frontage road connection between the new interchange and the Cemetery entrance. However, the new frontage road would impact existing wetlands. Additionally, this alternative only provides a 100-foot COA and maintains an at-grade railroad crossing.
34-14 100' COA East and West Crossroad	Further variation of Alternative 34-13, with the same 100-foot COA to both frontage roads and removal of the existing bridges at Exit 34. The difference is that this option elevates the local road to cross over the I-90 mainline and over the railroad providing a grade separated crossing.	This option has similar impacts to the wetlands as alternative 34-13.

and Railroad Bridge		
34-15 Max COA (622') Avoids Archaeological Sites	A further variation of Alternative 34-11 with the same stop-controlled intersection with Blucksberg Drive and reduced separation between the interchange terminals and the local road (622 feet) to avoid impacting known archaeological sites. This option removes the existing bridge at Exit 34 and provides a west frontage road connection to the BHNC.	This option has similar impacts to the wetlands as alternative 34-13.
34-16 Through 34-18 Relocation of Cemetery Entrance	This series of alternatives was aimed at lengthening the ramps and improving access to the cemetery. These alternatives were dismissed quickly due to operational flaws and potential impacts and were not developed in detail. These options did not improve spacing within the interchange and could create driver confusion.	These options relocate the entrance gates to the BHNC are listed on the National Historic Register (NHR) and relocation of the entrance would impact the cemetery without providing improvements to interchange spacing.
34-19 Lengthened Interchange	New interchange at the same location, providing lengthened interchange ramps to meet standards. The connection to Blucksberg Drive will require a large retaining wall to allow for vertical curve corrections. Local road crosses under the raised lanes of I-90 and results in an at-grade crossing of the railroad.	This option creates minimal environmental impacts and has no impacts to right of way. However, due to the presence of known archaeological sites, the existing intersection spacing, and related safety issues are not improved. The COA also could not be much beyond the existing due to these sites.

All options that shift the proposed interchange to the southeast are variations of the original Alternative 34-7, with modifications to intersection control or local connections. Figures of each of the options are included in **Appendix G**.

One refinement was made to 34-19 (known as 34-19B) and four alternatives refinements spurred from Alternative 34-10B. Three of those four alternatives (34-20, 34-21, and 34-22) impacted residential homes and for that reason were unfeasible. The fourth refinement of Alternative 34-10B, named 34-23 (**Figure 5-2**) was selected to future develop and analyze with Alternative 34-19B (**Figure 5-1**). Further analyses, including a constructability review, safety analysis, and cost-benefit analysis (**Appendix I**) were performed resulting in Alternative 34-19B as the preferred alternative. The preferred alternative and refined alternatives plan will be presented to the public in the spring of 2021.

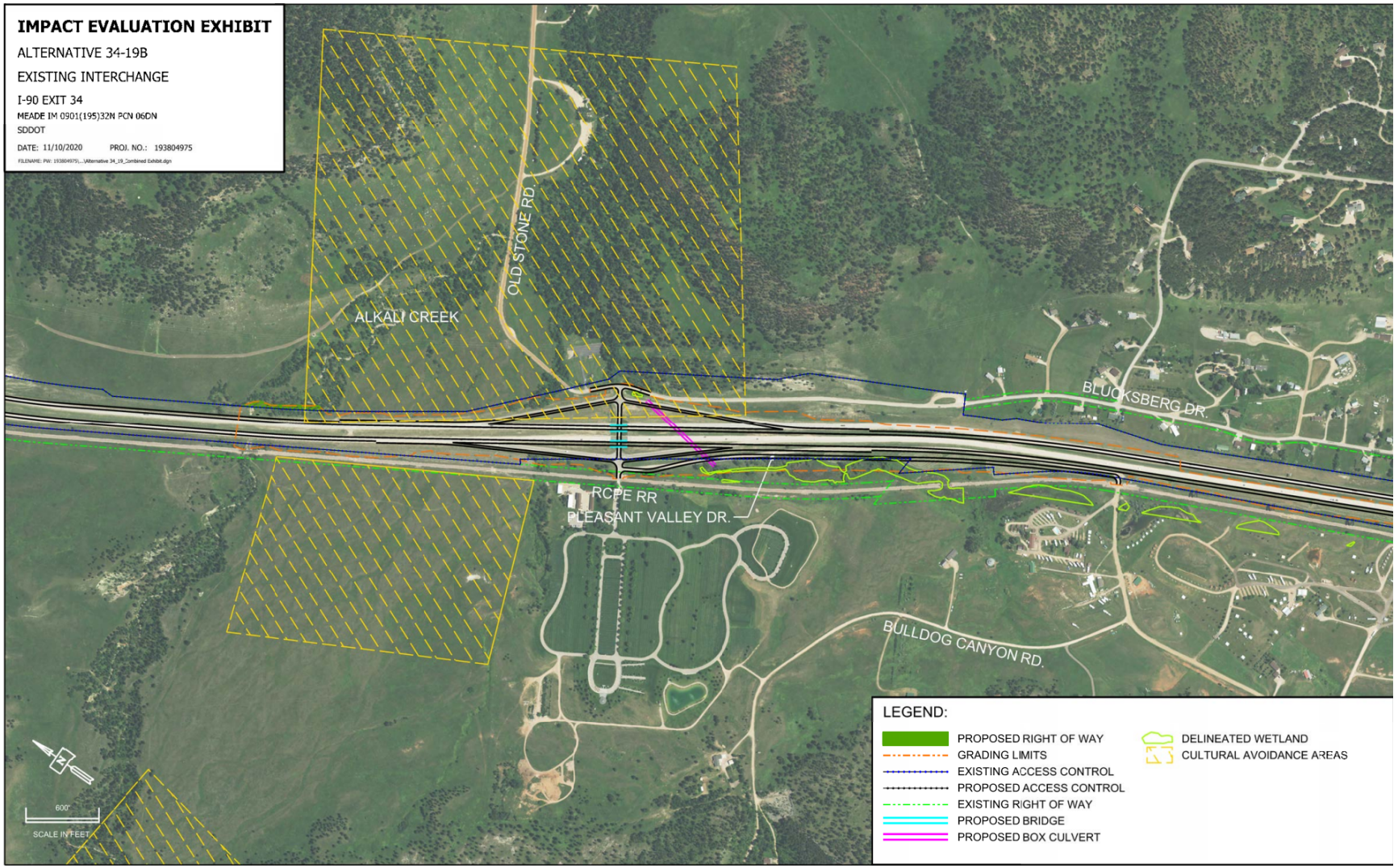

Figure 5-1 I-90 Exit 34 Interchange Modification Build Alternative (34-19B)

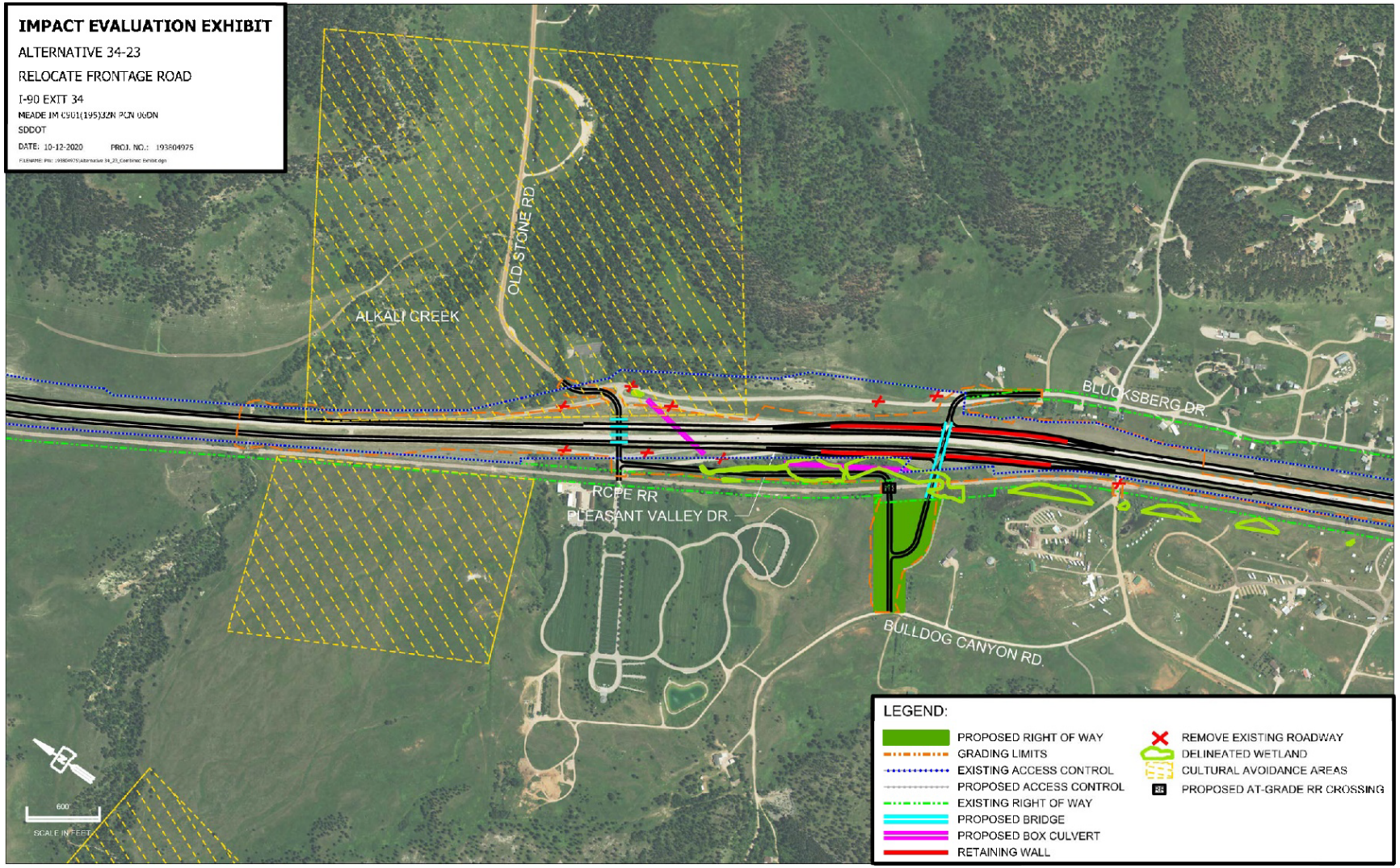

Figure 5-2 I-90 Exit 34 Alternative (34-23)

The No Build Alternative would maintain the Exit 34 Interchange in its current configuration, including:

- A crest vertical curve on Blucksberg Drive approaching the Blucksberg development has very poor sight distance and does not meet the stopping sight distance standard for the design speed equal to the posted speed of 35-mph. Due to the severity of the curve, drivers are unable to see the road or landscape approaching the curve. A "Hill blocks view" sign is currently in place at the location.

- The intersection spacing between the ramp intersections and the Blucksberg Drive and Pleasant Valley Drive intersections is less than the SDDOT standard of a desirable spacing of at least 250 feet for two-way frontage roads.

- The acceleration and deceleration lengths of the ramp terminals on all four interchange ramps (Ramp A, Ramp B, Ramp C, Ramp D) do not meet the SDDOT minimum length standards for a 50-mph ramp transitioning to an 80-mph freeway. Three of the four ramps have tapered terminals, which are not likely sufficient for the lengths required.

- Only the curves on the westbound on-ramp (Ramp A) and westbound off-ramp (Ramp B) meet the SDDOT superelevation standards for a ramp design speed of 50-mph. The eastbound on-ramp (Ramp C) and eastbound off-ramp (Ramp D) curves do not meet this superelevation standard.

- Two vertical curves within the interchange ramps do not meet the stopping sight distance standard for the design speed of 50-mph: the sag vertical curve on the westbound on-ramp (Ramp A) and the sag vertical curve on westbound off-ramp (Ramp B) at the intersection of Old Stone Road.

- The horizontal curve on Pleasant Valley Drive outside No Name City has a design speed equal to its posted advisory speed of 15-mph and meets SDDOT design standards for stopping sight distance. However, sightlines are a concern for the at-grade railroad crossing immediately after the curve. Drivers heading southbound on Pleasant Valley Drive may have difficulty seeing an incoming train. This is a safety hazard, considering the crossing is absent of warning signals or gates.

- The intersections of the interchange ramps with Old Stone Road are spaced less than 550 feet as per the SDDOT standard for a typical diamond interchange.

- There is very little space surrounding the Exit 34 interchange for vehicles to safely stop in an emergency stopping situation. Shoulders on the ramps and surrounding roads are not large enough for stopped vehicles and there are no pull-off areas.

- The existing overpass bridges have columns very close to the cross-street lanes of travel and do not have protective barriers in place to protect the columns from errant vehicles.

INTERCHANGE BUILD ATERNATIVE

Alternative 34-19B: Existing COA

Alternative 34-19B was modified from the original Alternative 34-19 to avoid all excavation of the hillside and accommodate an increased median width (total 108 foot). The alternative provides a stop-controlled intersection with Blucksberg Drive and realigns Pleasant Valley Drive. Pleasant Drive is also raised to match the elevation of mainline needed to eliminate all excavation from the hillside along I-90. The control of access separation will remain generally the same as the existing interchange.

The proposed Exit 34 build alternative was reviewed for intersection spacing and to determine the effect on the operations of adjacent interchanges. **Figure 5-3** shows the change in interchange spacing between the proposed Exit 34, and adjacent interchange spacing of Exit 32 (**Figure 3-4**) and the proposed Exit 37 Interchange. The proposed build alternative for the Exit 37 Interchange (Build Alternative 37-2) is shown in **Figure 5-4.** Exit 37 is planned to be reconstructed prior to the construction of the Exit 34 interchange. A separate IMJR has been completed for Exit 37.

TRANSPORTATION SYSTEM MANAGEMENT ALTERNATIVE

There are no areas within the State of South Dakota that will consistently experience congestion levels extreme enough for Transportation System Management (TSM) measures such as ramp metering or high occupancy vehicle (HOV) facilities to be economically feasible in the foreseeable future.

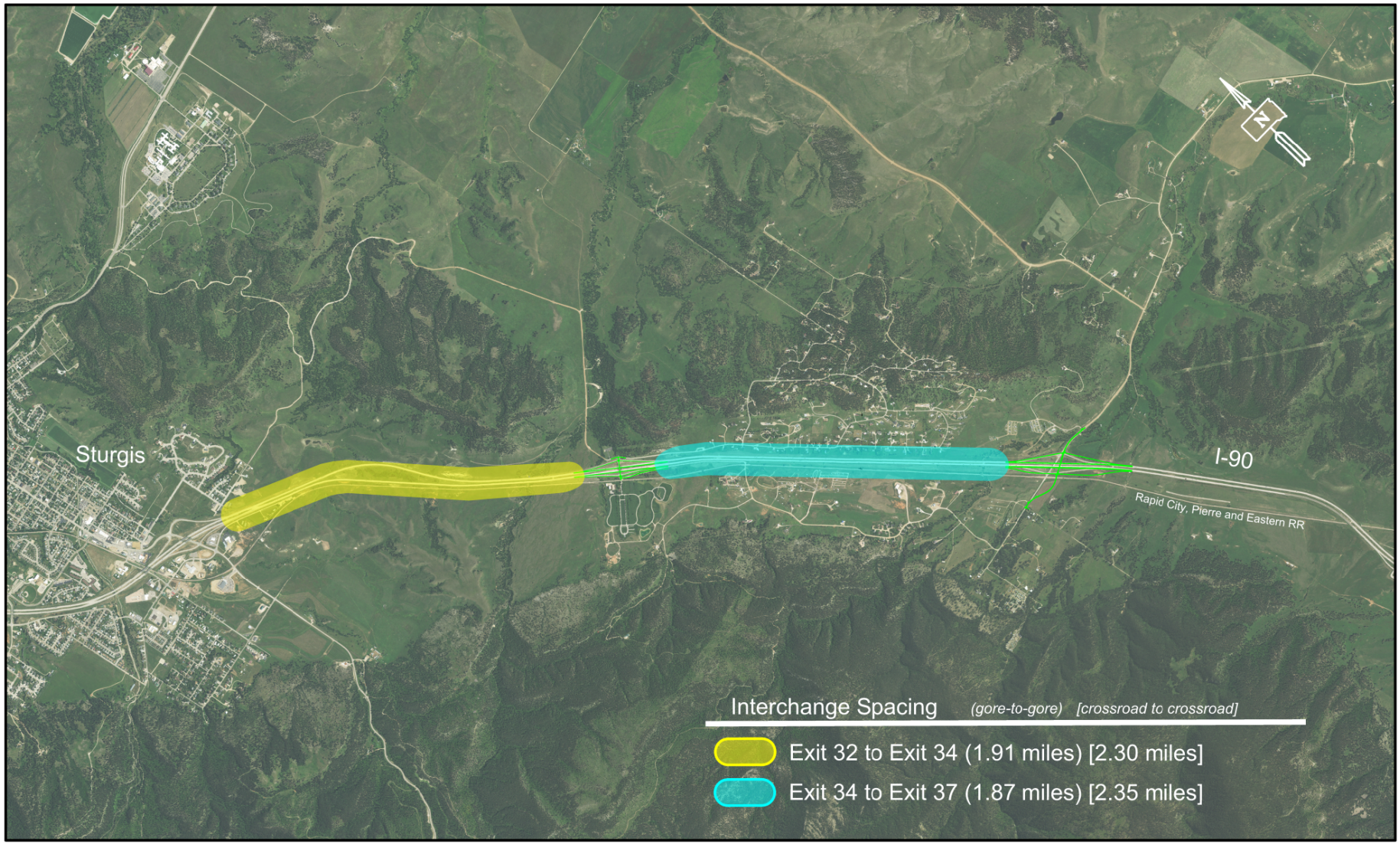

Figure 5-3 Adjacent Interchange Spacing

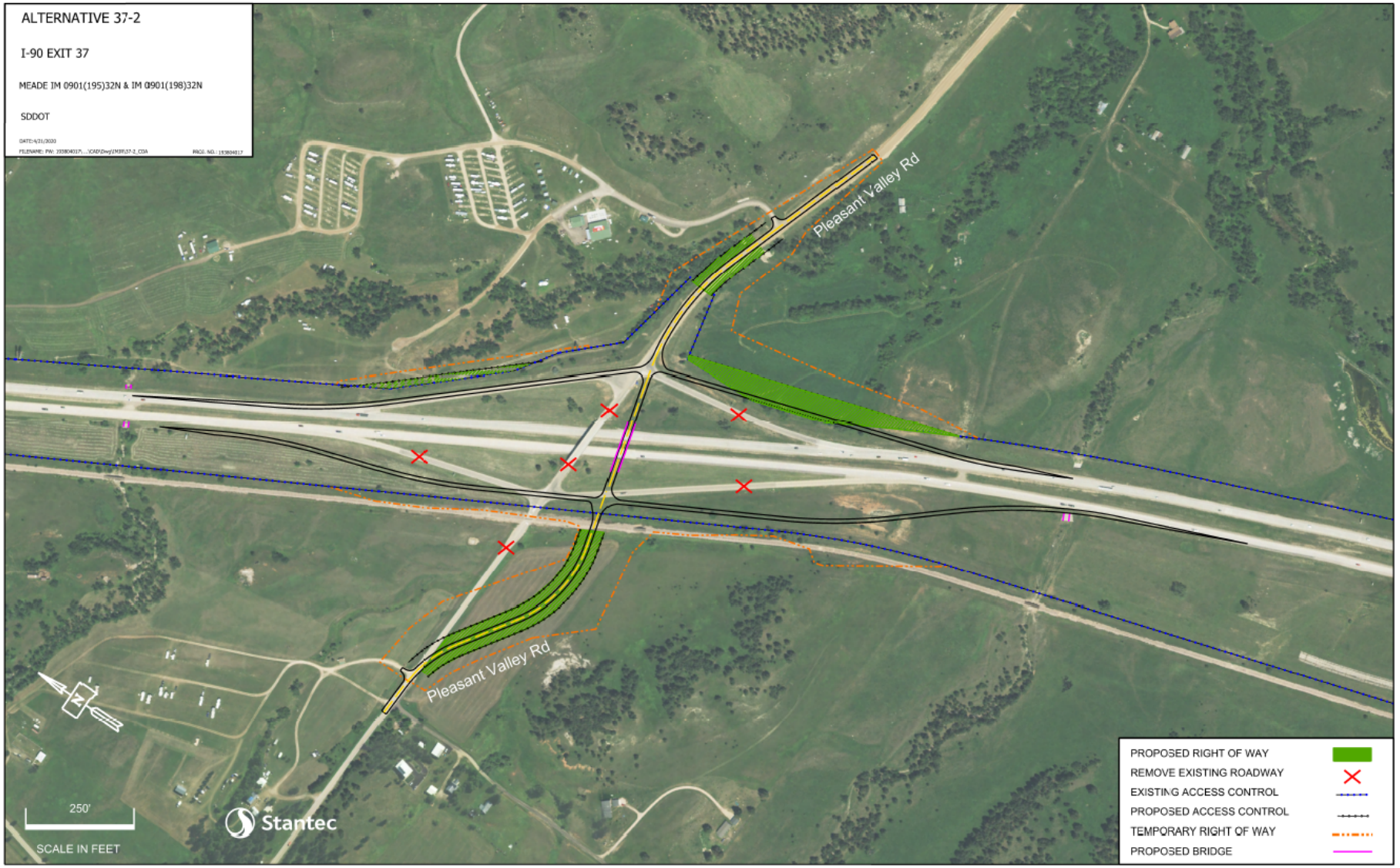

Figure 5-4 Proposed I-90 Exit 37 Interchange

6. FUTURE DESIGN YEAR 2050 TRAFFIC GROWTH AND ANALYSIS

TRAVEL DEMAND FORECASTING

The IMJR Methods and Assumptions Document describes the growth projection methodology used in the study. While there is a regional travel demand model for the Rapid City area maintained by the Rapid City Metropolitan Planning Organization (MPO), it does not cover the project study area. Additionally, there is no South Dakota statewide travel model from which future year traffic forecasts can be based. The SDDOT Inventory Management Office has developed traffic growth rates per functional class and county that have been provided; these growth rates will be the primary basis for developing future year project traffic forecasts.

Future year (both Opening Year and Design Year) intersection turning movement forecasts will be developed based on methods described in *NCHRP Report 765, Analytical Travel Forecasting Approaches for Project-Level Planning and Design.*

The project area is an approximate 10-mile section of Interstate 90 from northwest of Exit 32 in Sturgis to southeast of Exit 40 at Tilford. It includes four service interchanges with I-90:

- Exit 32, SD 79, Vanocker Canyon Road/Junction Avenue
- Exit 34, Black Hills National Cemetery/Old Stone Road
- Exit 37, Pleasant Valley Road
- Exit 40, Tilford Road

A map of the study area roadway network and functional classification is shown in **Figure 6-1.** Interstate 90 is the only Principal Arterial through the study area. At Exit 32, Junction Avenue is functionally classified as a Minor Arterial through the interchange, then transitions to a Major Collector south of I-90 as it become Vanocker Canyon Road. Pleasant Valley Road (Exit 37) and Tilford Road (Exit 40) are Minor Collectors and Old Stone Road (Exit 34) is a rural local road.

All four interchanges are service interchanges of a diamond configuration and are unsignalized with STOP-control only on the exit ramp approach. At Exit 32, only during the Sturgis Motorcycle Rally, temporary signals are installed.

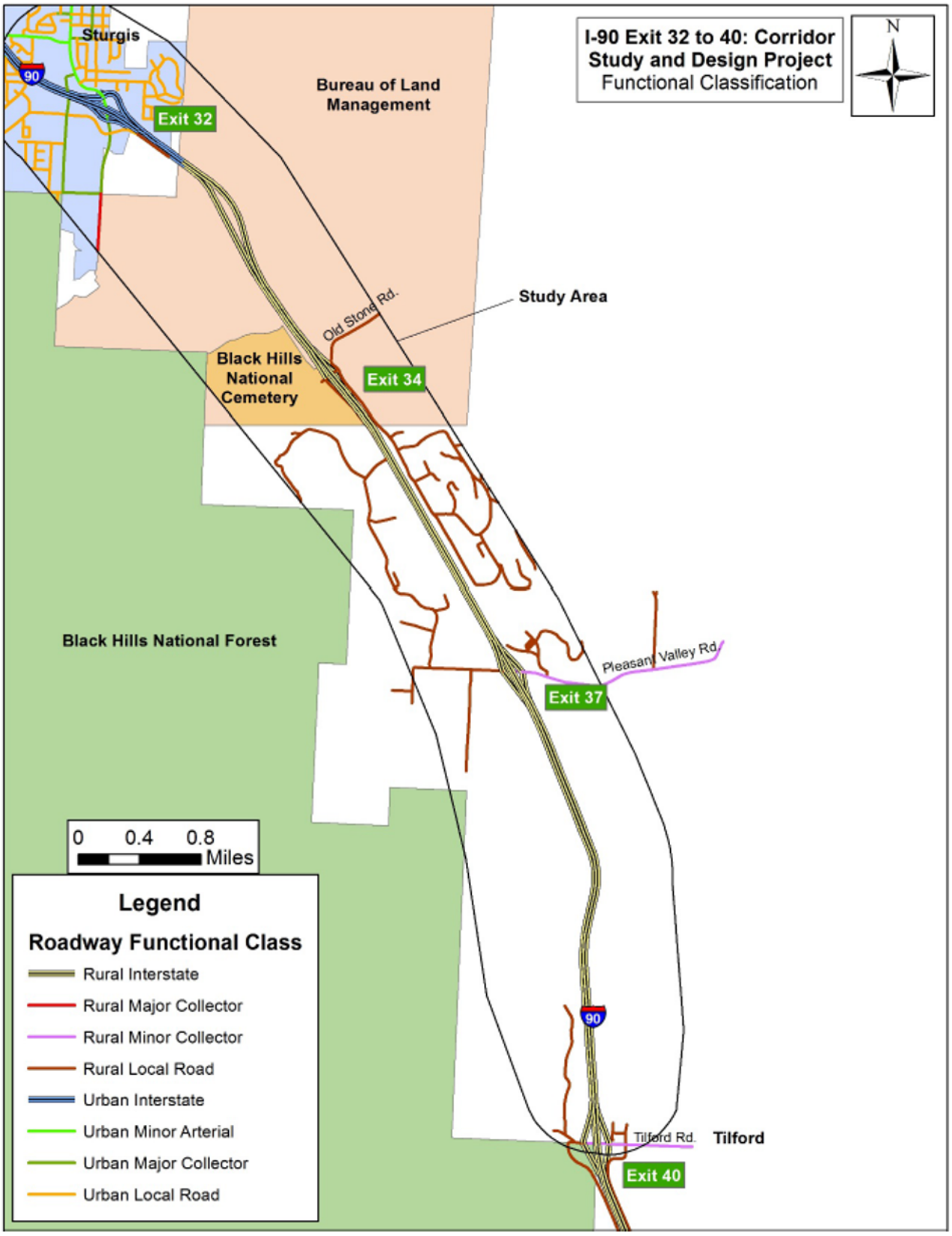

Figure 6-1 Study Area Roadway Network and Functional Classification

Chapter 3 within this report identified the methodology for conducting base Year 2017 existing traffic volumes along with Figures showing the results of the existing traffic volumes (both ADT volumes and peak hour turning movement volumes). These base Year 2017 existing traffic volumes were utilized as the basis in which the growth factors were applied to develop growth forecast year traffic volumes.

GROWTH FACTORS

Based on the *Methods and Assumptions* document prepared by Stantec and submitted in November 2017, growth factors developed by the SDDOT Inventory Management Office are the primary basis for developing future year traffic forecasts. This memorandum can be found in **Appendix E**. These growth factors, shown in **Table 6-1,** are broken down into 20-, 25-, 30-, and 35-year values for both rural and urban interstates.

Table 6-1 SDDOT Growth Factors

Area/Facility Type	20-year	25-year	30-year	35-year
Rural Interstate	1.267	1.325	1.390	1.455
Rural Arterials/ Collectors/Locals	1.339	1.425	1.510	1.595
Urban Interstate	1.407	1.500	1.600	1.700
Urban Arterials/ Collectors/Locals	1.235	1.300	1.360	1.420

The 2025 opening year forecasts were developed by computing an average annual growth rate (agr) from the 20-year growth factors, then projecting that average annual growth rate for eight years (2017 to 2025) as shown in the following equation:

$$Year\ 2025\ Forecast = Year\ 2017\ Volume * (1+agr)^{8}$$

The 2050 (33) year growth factor was computed using an interpolation of the 30- and 35- year factors established by SDDOT and applied to the existing (year 2017) seasonally adjusted traffic volumes.

The growth factors used in developing the opening year 2025 and design year 2050 forecasts are summarized in **Table 6-2.**

Table 6-2 Summary of Growth Factors

Area/Facility Type	Annual Growth Rate	Year 2025 Growth Factor*	Year 2050 Growth Factor*
Rural Interstate	1.19%	1.100	1.429
Rural Arterials/ Collectors/Locals	1.47%	1.124	1.561
Urban Interstate	1.72%	1.146	1.660
Urban Arterials/ Collectors/Locals	1.06%	1.088	1.396
*Applied to 2017 traffic volumes adjusted for day of week and month			

MAINLINE AVERAGE DAILY TRAFFIC FORECASTS

Mainline average daily traffic forecasts were developed by applying the 2025 and 2050 growth factors to existing traffic volumes adjusted for day of week and month. These forecast volumes are shown in **Tables 6-3 and 6-4** and **Figures 6-2** and **6-3.**

Table 6-3 Opening Year (2025) Average Daily Traffic Forecasts

Location	Type	Direction	2017 Adjusted ADT	2025 ADT	MT%	HT%
West of Exit 32	Urban Interstate	Eastbound	8,200	9,400	2%	10%
		Westbound	8,200	9,400	3%	11%
Between Exit 32 & 34	Rural Interstate	Eastbound	10,500	11,600	2%	10%
		Westbound	10,600	11,700	3%	11%
Between Exit 34 & 37	Rural Interstate	Eastbound	10,700	11,800	2%	10%
		Westbound	10,300	11,300	3%	11%
Between Exit 37 & 40	Rural Interstate	Eastbound	10,600	11,700	3%	11%
		Westbound	10,500	11,600	4%	11%
East of Exit 40	Rural Interstate	Eastbound	10,400	11,400	3%	11%
		Westbound	10,300	11,300	4%	11%

MT = Medium Trucks; HT = Heavy Trucks

Table 6-4 Design Year (2050) Average Daily Traffic Forecasts

Location	Type	Direction	2017 Adjusted ADT	2050 ADT	MT%	HT%
West of Exit 32	Urban Interstate	Eastbound	8,200	13,600	2%	10%
		Westbound	8,200	13,600	3%	11%
Between Exit 32 & 34	Rural Interstate	Eastbound	10,500	15,000	2%	10%
		Westbound	10,600	15,100	3%	11%
Between Exit 34 & 37	Rural Interstate	Eastbound	10,700	15,300	2%	10%
		Westbound	10,300	14,700	3%	11%
Between Exit 37 & 40	Rural Interstate	Eastbound	10,600	15,100	3%	11%
		Westbound	10,500	15,000	4%	11%
East of Exit 40	Rural Interstate	Eastbound	10,400	14,900	3%	11%
		Westbound	10,300	14,700	4%	11%

MT = Medium Trucks; HT = Heavy Trucks

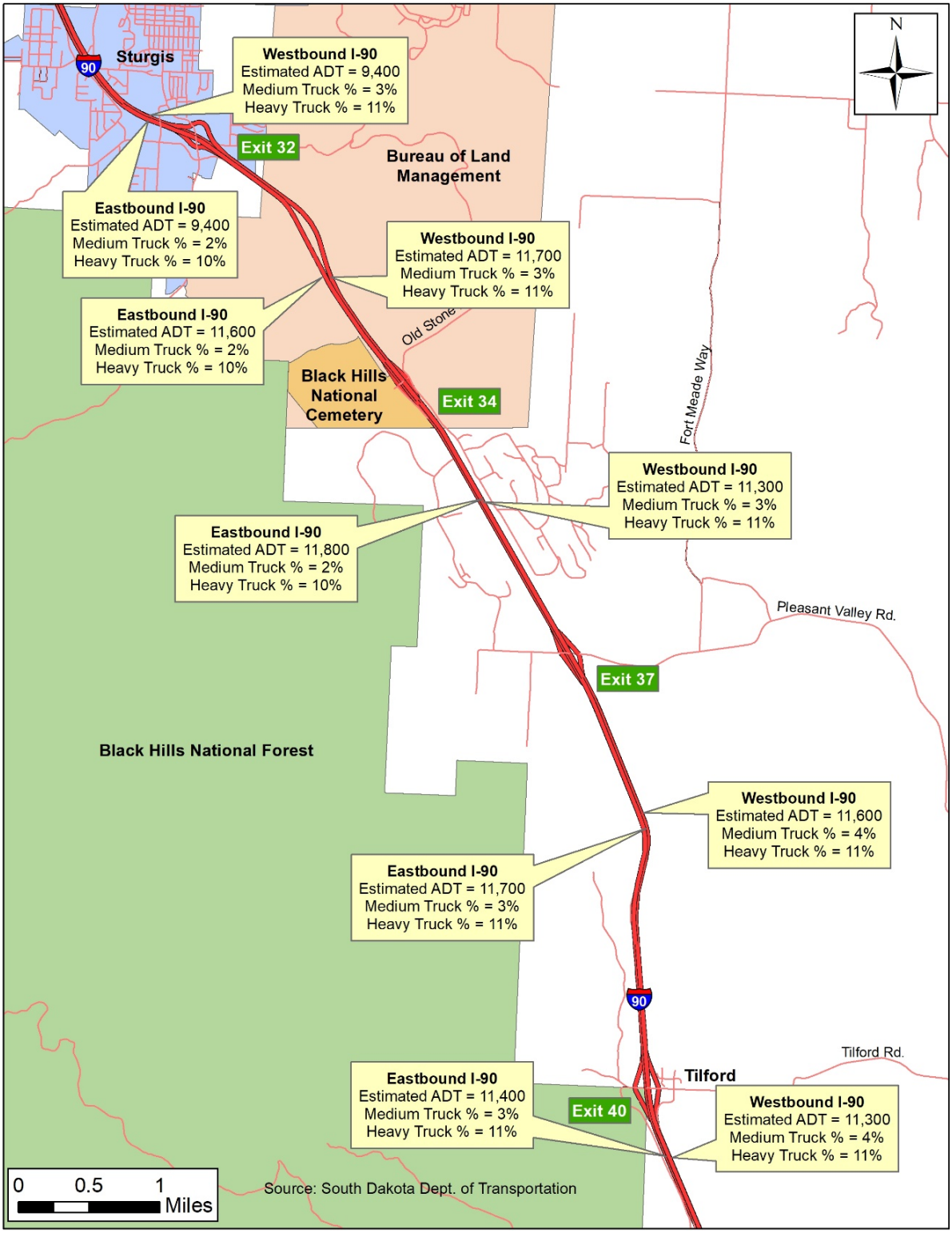

Figure 6-2 Opening Year (2025) Average Daily Traffic Forecasts

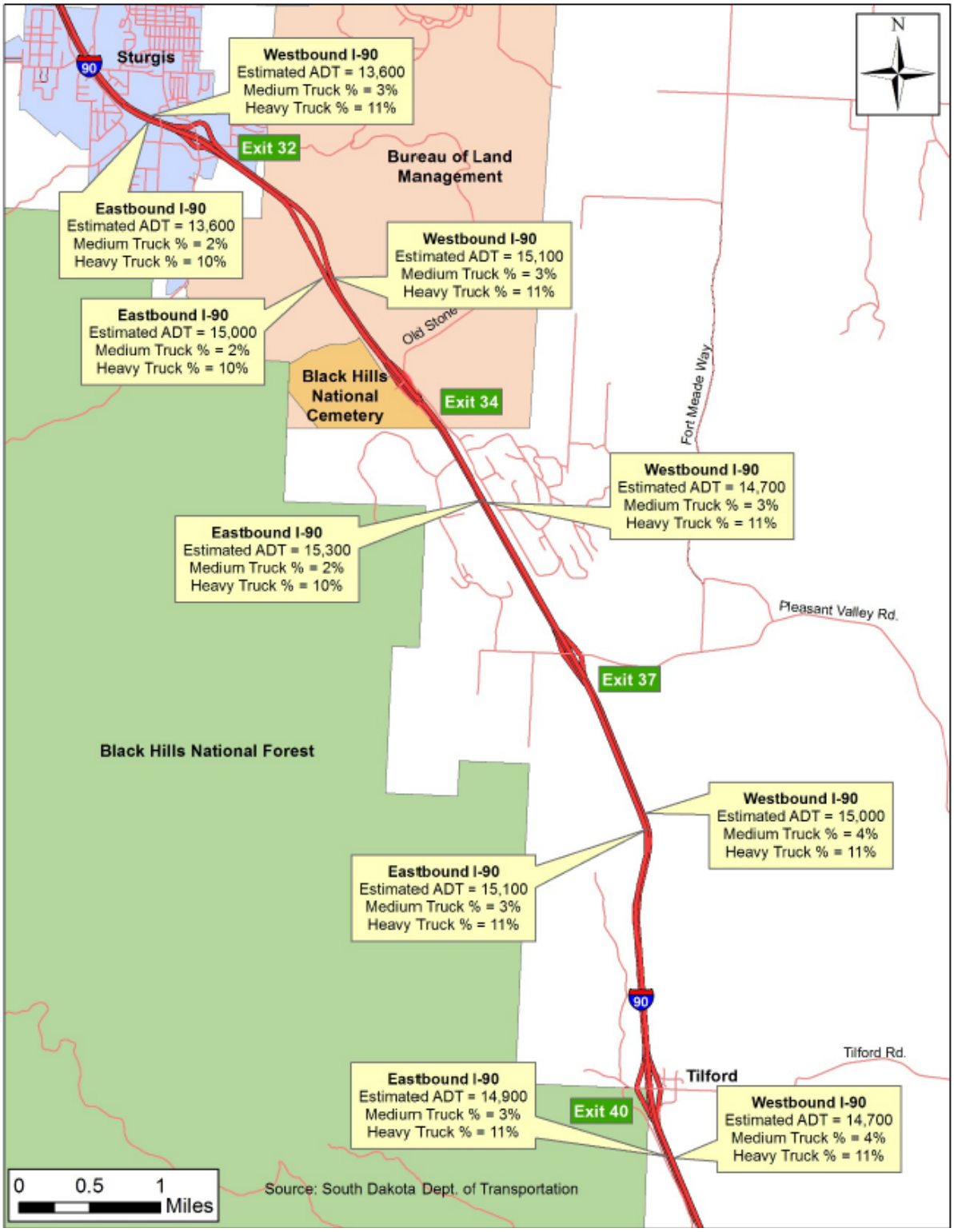

Figure 6-3 Design Year (2050) Average Daily Traffic Forecasts

PEAK HOUR FORECASTS

Year 2025 and Year 2050 a.m. and p.m. peak hour traffic forecasts were developed for:

- I-90 mainline directional segments
- Intersection turning movements

In both cases, existing (September 2017) traffic counts were adjusted for day of week and month based on 2017 seasonal adjustment factors developed by SDDOT for WIM Station 901. These adjusted volumes then were multiplied by the corresponding growth factors shown previously in **Table 6-2.**

For turning movements at I-90 ramp intersections with cross streets, the application of different growth factors to different approaches (interstate ramp vs. arterial or collector) resulted in "unbalanced" intersection volumes (i.e. entering and departing traffic volumes were not in agreement). The Iterative Directional Method as documented in NCHRP Report 765[1] was used to alternatively balance entering traffic and departing traffic volumes until an acceptable level of convergence was reached.

Opening year 2025 a.m. and p.m. peak hour turning movement traffic forecasts are shown in **Figure 6-4.** Design year 2050 a.m. and p.m. peak hour turning movement traffic forecasts are shown in **Figure 6-5.**

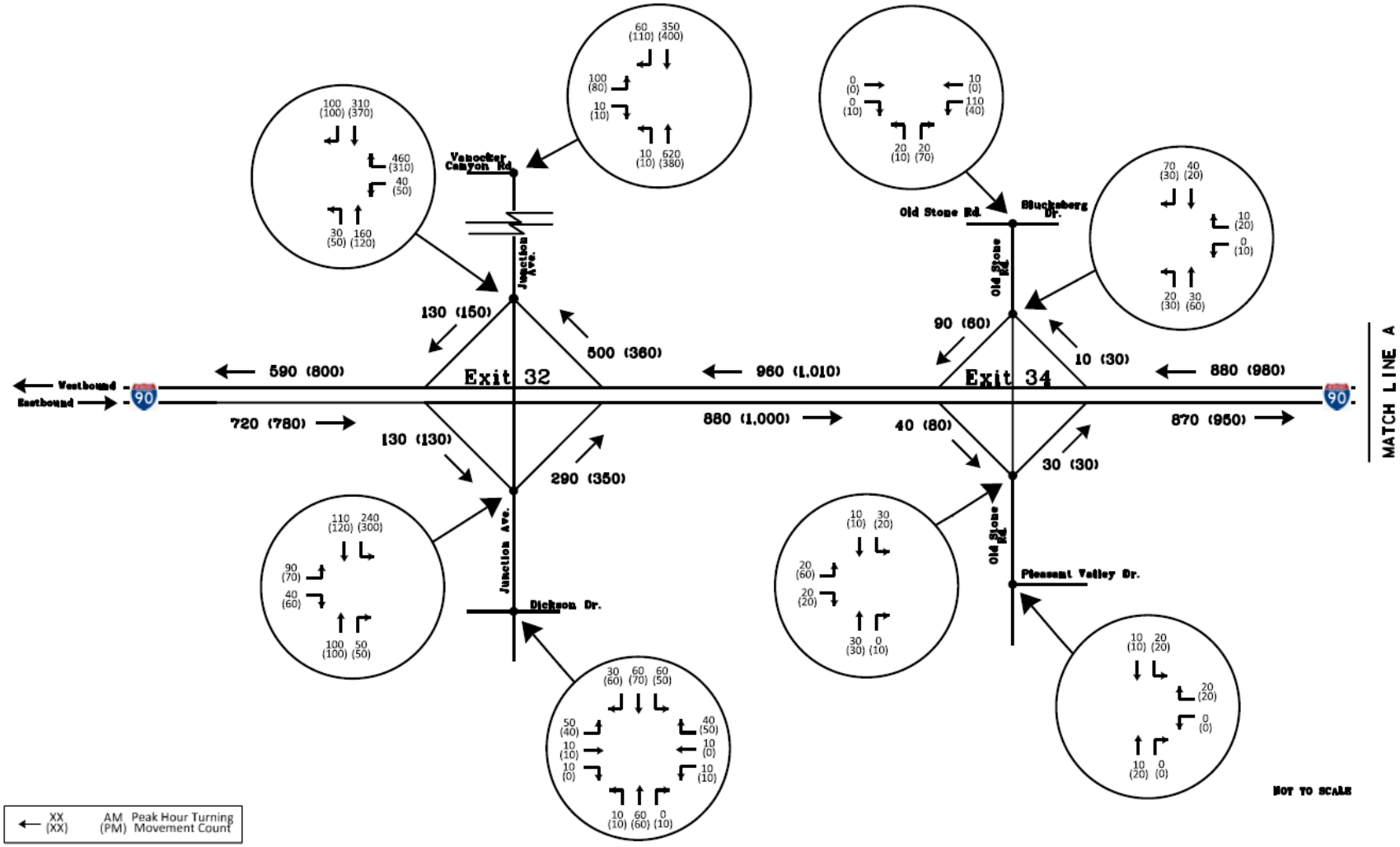

Figure 6-4 Opening Year 2025 A.M. and P.M. Peak Hour Traffic Forecasts

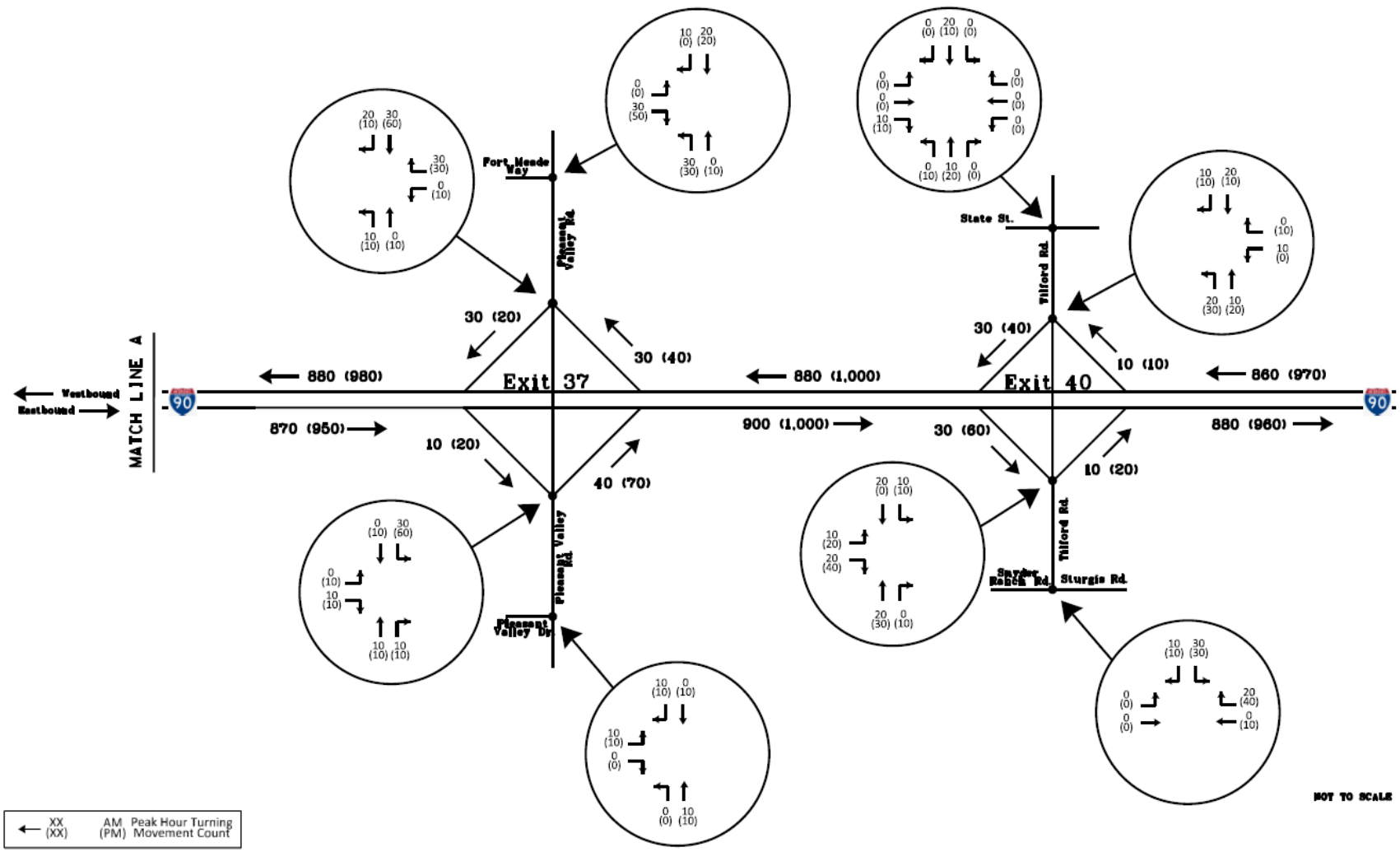

Figure 6-4 (cont.) **Opening Year 2025 A.M. and P.M. Peak Hour Traffic Forecasts**

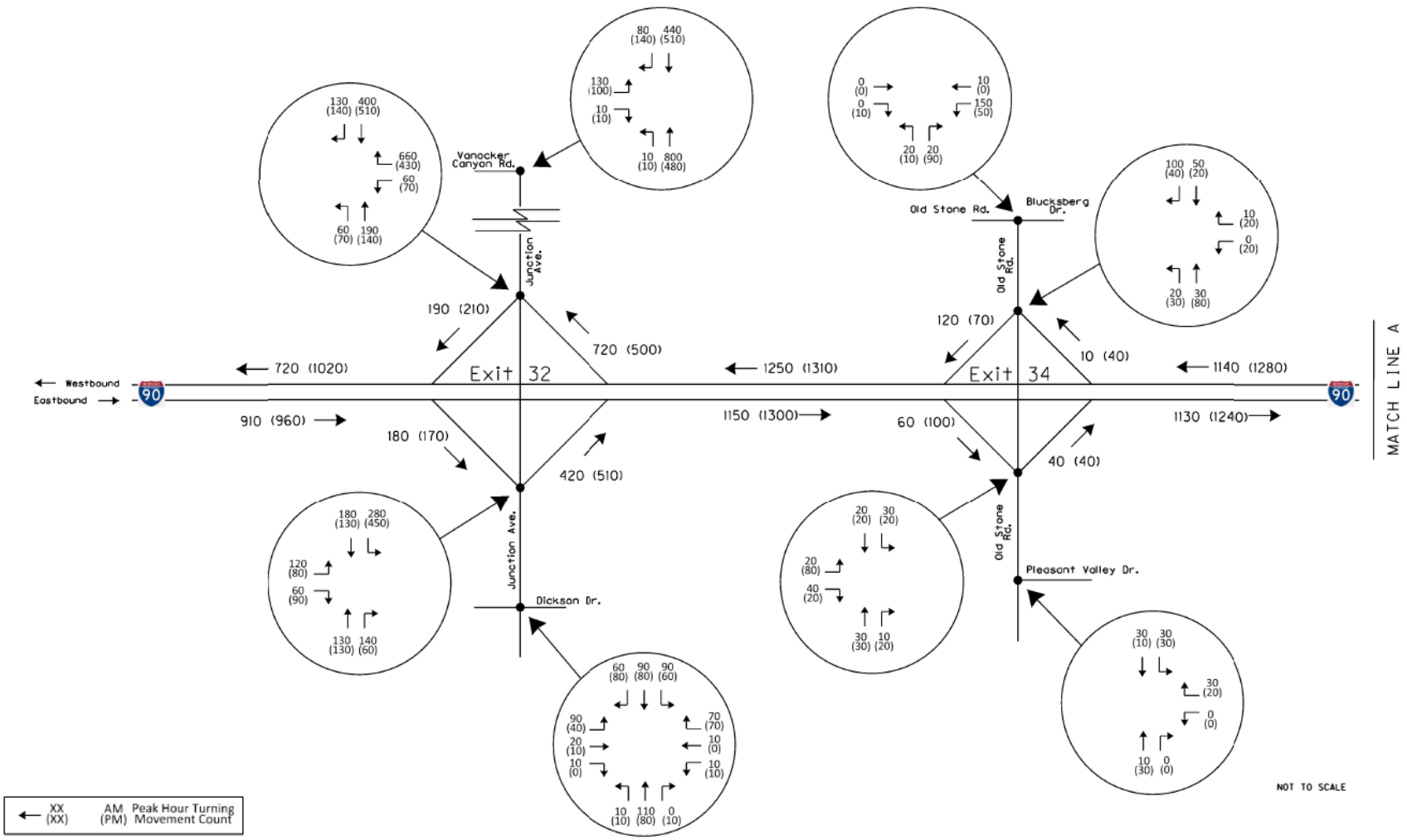

Figure 6-5 Design Year 2050 A.M. and P.M. Peak Hour Traffic Forecasts

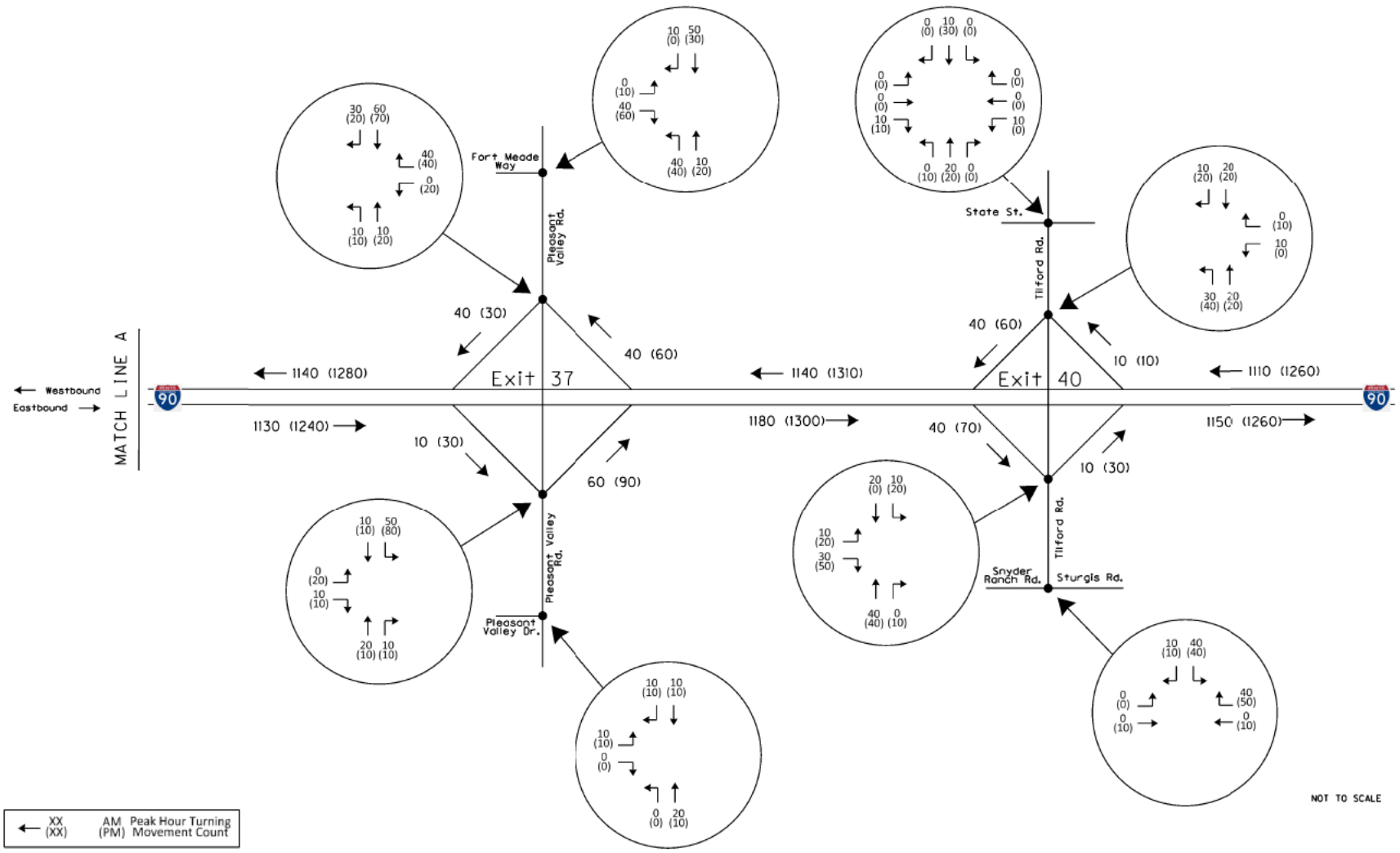

Figure 6-5 (cont.) Design Year 2050 A.M. and P.M. Peak Hour Traffic Forecasts

DESIGN YEAR 2050 AND OPENING YEAR 2025 PEAK HOUR INTERSECTION ANALYSIS

Highway Capacity Software 7th Edition (HCS7) was used to implement the procedures defined in the Highway Capacity Manual (HCM) 6th Edition. The HCS All-Way Stop Controlled (AWSC) and Two-Way Stop Controlled (TWSC) tools were used to evaluate the intersections.

Interchange AM and PM peak hour analyses were performed for the eastbound and westbound directions for the Base Year (2017), the opening year (2025), and the Design Year (2050). The results for the Base Year (2017) analysis were previously shown in Chapter 3 of this report. The Design Year 2050 analysis represents both the 2050 No Build and 2050 Build Alternative scenarios. This is because there are no proposed changes to the traffic control or intersection lanes and turn lane geometries between the No-Build and Build Scenarios.

It should be noted that Exit 40 was under construction during traffic count collection and was not included in the intersection analyses. **Figure 6-6** presents the 2025 a.m. and p.m. peak hour intersection delay and LOS. **Figure 6-7** presents the 2050 a.m. and p.m. peak hour intersection delay and LOS for both the 2050 Design Year No-Build and Build Alternative scenarios.

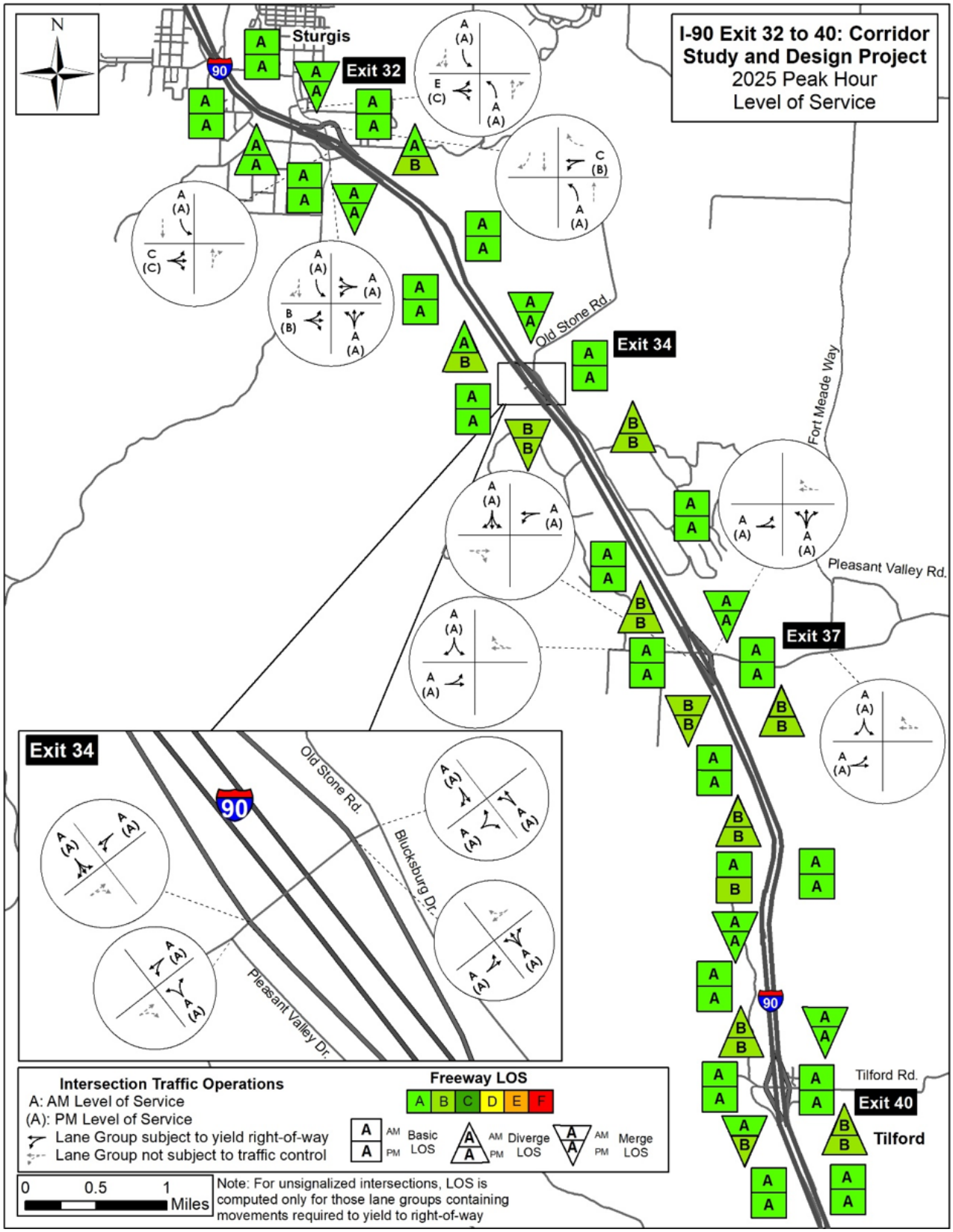

Figure 6-6 Opening Year (2025) Peak Hour Delay & LOS

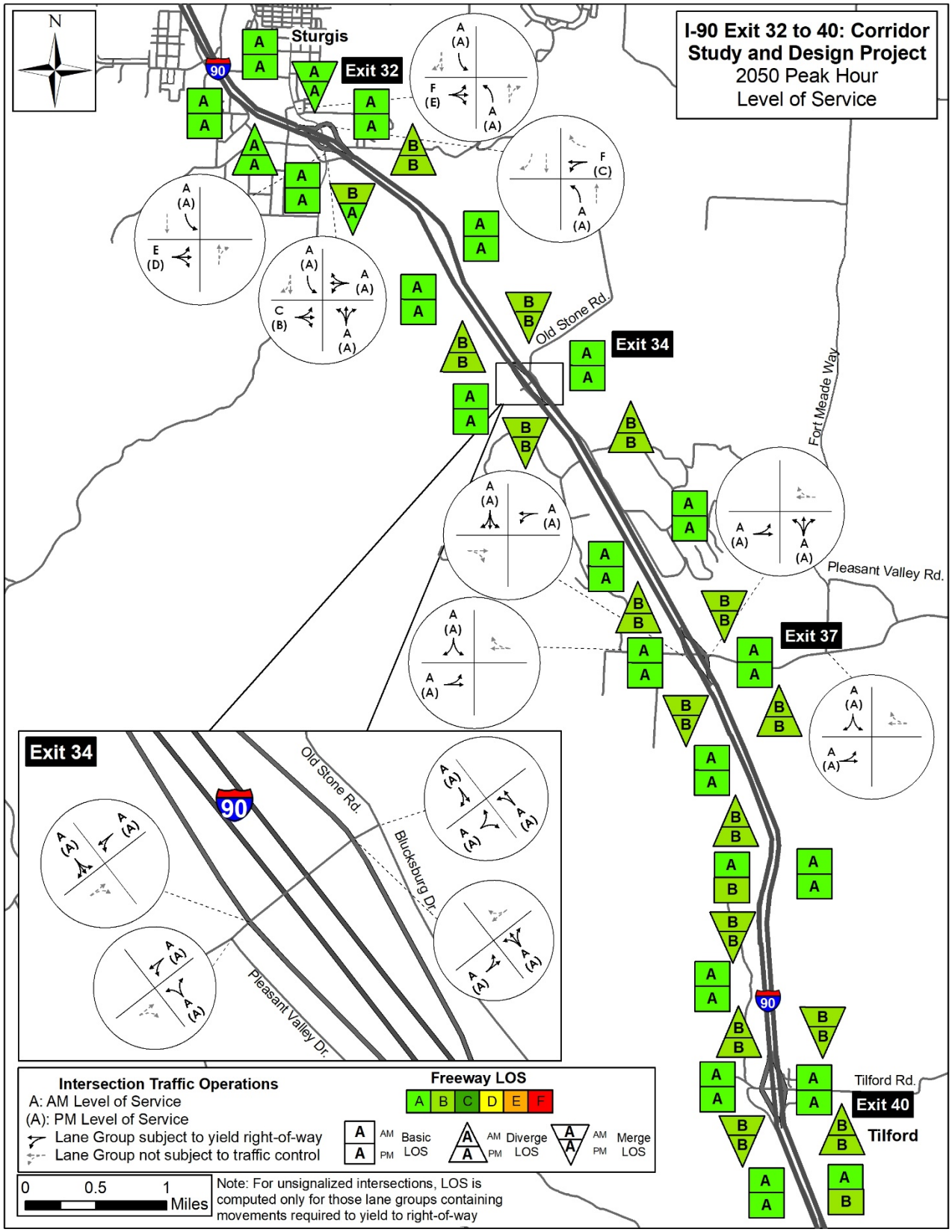

Figure 6-7 Design Year (2050) Peak Hour Delay & LOS

I-90 FREEWAY SEGMENTS

As previously explained within Chapter 3 of this report, the Interstate 90 mainline was evaluated using the Freeway Facilities methodology for the HCM. The full analysis can be found in the Traffic Operation for Feasible Scenarios Report, **Appendix B**.

Design Year 2050 Analysis

HCS7 Freeway Facilities analyses were performed for the Design Year (2050) peak hour for both the eastbound and westbound directions. Single-period analyses were used since future traffic patterns cannot be assumed. The output tables provide a summary of the average speed, density in passenger cars per mile per lane, level of service (LOS), and demand-to-capacity ratio on each of the segments for peak hours. All mainline segments are expected to operate at LOS A or B in the year 2050, indicating no anticipated capacity issues.

Since the interchange alternatives did not affect the demand or capacity of the mainline and ramp sections, they did not affect the mainline analysis and were therefore not included in the design year analysis. A discussion of these alternatives can be found in the I-90 Interchange Analysis section of the full report.

Based on the Highway Capacity Software (HCS) freeway facilities analyses, the mainline section of I-90 between Exits 32 and 40 currently operates at an acceptable Level of Service (LOS). This indicates that there are no existing capacity issues on this portion of I-90. Similarly, the Design Year (2050) analyses showed an acceptable LOS on I-90, indicating that there are no capacity issues expected by the year 2050. Facility results are presented in **Table 6-5.**

Table 6-5 I-90 Facility Results - Design Year 2050

Analysis Direction	Space Mean Speed (mi/hr)	Average Travel Time (min)	Density (pc/mi/ln)	LOS
A.M. Peak				
Eastbound	70.1	9.4	9.6	B
Westbound	71.2	9.4	9.5	B
P.M. Peak				
Eastbound	69.0	9.5	10.5	B
Westbound	70.9	9.4	10.2	B

CONCLUSION

The operational analysis results for the Design Year 2050 show minimal degradation to the I-90 Mainline, Ramps, or the Exit 34 Interchange intersections. Because the No-Build scenario is identical to the Build Alternative 34-19B for both intersection lanes and intersection control, there is no change to the Design Year 2050 intersection delay and LOS results between the two scenarios. The reconfigured ramps for the proposed Exit 34 Interchange are anticipated to be longer than the existing ramps and provide additional acceleration/deceleration length. This additional length is not anticipated to cause ramp junction merge/diverge LOS to change.

7. ALTERNATIVE ANALYSIS

The three build alternatives were examined to understand their relative performance and facilitate the selection of an alternative. This evaluation borrows and builds upon alternative analyses included in the 2000 and 2010 Interstate Corridor Studies, *I-90 Black Hawk – Sturgis Corridor Preservation Study,* and *I-90 Exit 32-40 Corridor Report.* The alternatives were previously described in Chapter 5 of this report.

CONFORMANCE WITH TRANSPORTATION PLANS

Each of the interchange build alternatives conform with current local and state transportation plans and standards. The existing Exit 34 Interchange was first identified as having geometric needs in the 2000 Statewide Interstate Corridor Study. An interchange improvement is not currently listed in the developmental program for the 2020-2023 Statewide Transportation Improvement Program (STIP) but is anticipated to be reconstructed within the next five years. As noted previously, the need and proposed alternatives for an Exit 34 Interchange have been included in the 2000 and 2010 Interstate Corridor Studies, the I-90 Black Hawk-Sturgis Corridor Preservation Study and the Exit 32-40 Corridor Report.

COMPLIANCE WITH POLICIES AND ENGINEERING STANDARDS – GEOMETRICS NEEDS

The No Build Alternative will not address the known geometric deficiencies of the existing interchange. The following substandard conditions would remain when analyzed in light of the current *South Dakota Department of Transportation Road Design Manual:*

- Access intersection spacing to the east and west of the interchange is substandard
- Combined ramp width is 24 feet (standard 25 feet)
- Ramp superelevation does not meet 50 MPH design speed
- Ramp acceleration and deceleration lengths for 50 MPH design speed
- Ramp stopping sight distance
- Inslopes measured at 4:1 (6:1 standard)
- Control of Access is 100 feet (standard 300 feet)
- Median horizontal offset less than minimum distance (550 feet)

The proposed build Alternative 34-19B would correct all identified geometric deficiencies, except for the median horizontal offset and the control of access requirements between ramp terminal intersections and the adjacent intersection. Alternative 34-23 would address these but would not be able to reduce wetland impacts. The required retaining walls along the mainline

would be problematic to snow drifting from winter storms in the Black Hills which would lead to an increased amount of I-90 closures.

ENVIRONMENTAL IMPACTS

A preliminary review of environmental impacts was completed as part of the Exit 32 to 40 Corridor Report, which can be found in **Appendix H**. This review identified the Exit 34 interchange as tightly constrained on all sides by existing environmental and cultural resources. Partially due to these constraints, viable improvement concepts had to consider fully relocating the existing Interchange.

As part of the preliminary review and through the alternative development process, it was determined that wetland impacts would be the largest environmental differentiator between the two build Exit 34 Interchange alternatives. Preliminary wetland impacts were calculated, and the results of this comparative wetland impact analysis are shown in **Table 7-1.** Build Alternative 34-19B resulted in fewer wetland impacts as the reconstruction of the frontage road was able to reduce impacts.

Table 7-1 Wetland Impact Results for Exit 34 Interchange Build Alternatives

	Alt 34-19B	Alt 34-23
Approximate Acres of Wetland Impacts	1.4	2.6

The reconstruction of the existing interchange (Alternative 34-19B) will likely categorize the project as a Class II Action – Categorical Exclusion (CatEx). A CatEx is prepared for projects with no significant effects on the human environment an EA or EIS is not required. The CatEx will review the no build alternative and any project build alternatives under consideration analysis to a level that is sufficient to document there are no significant environmental impacts. The relocation of the interchange (Alternative 34-23) would have more significant impacts than reconstructing the interchange at the present location, which would likely require an Environmental Assessment (EA).

Categorical Exclusions are planned for the Exit 32-37 and Exit 37-40 projects.

SAFETY

After review of the existing crash data summarized in the **Existing Safety Conditions** section, no specific, correctable crash patterns were identified near Exit 34. Although improvements to the ramps and reduction of an at-grade railroad crossing may serve as a proactive safety measures, each of the proposed build alternatives evaluated equivalently when reviewed against each other. The safety with the reconstruction of the interchange at the existing location score slightly higher when reviewed in the IHSDM Predictive Crash Model.

OPERATIONAL PERFORMANCE

The No Build Alternative was shown to provide acceptable peak hour traffic operations for all mainline, ramp merge/diverge sections at Exit 34 through the Year 2050. Surface street intersection movements would also operate acceptably.

All the build alternatives would provide operational conditions equal to or better than the No Build Alternative, based both on traffic analyses included in the *I-90 Black Hawk – Sturgis Corridor Preservation Study* and updated analyses for design year 2050 in the Exit 32 to 40 Traffic Operations Analysis for Feasible Scenarios, found in **Appendix B.**

CONSTRUCTABILITY REVIEW

When the two build alternatives for the Exit 34 Interchange were evaluated against one another, the Build Alternative 34-19B scored the highest due to the following:

- Shorter construction duration
- Reduces the impact to Blucksberg residents
- Westbound ramps can be constructed while existing ramps are in use
- Minimal impact to railroad during construction

The results of the review can be found in more detail in the I-90 Exit 32 to 40 Constructability Analysis (**Appendix D**).

COST AND RIGHT OF WAY IMPACTS

The No Build Alternative will cost $0 and will have no right of way impacts. The two build alternatives were conceptually analyzed for comparative and planning purposes as part of the I-90 Exit 32 to 40 Corridor Report. The results of this preliminary analysis indicate that the Exit 34 Interchange Build Alternative (34-19B) is the lowest cost alternative, estimated at $15.437 Million. Alternative 34-19B also greatly reduces impacts to adjacent property. It is anticipated permanent right of way will be needed along the westbound on-ramp and temporary easements within the railroad right of way. With the build alternative, no impacts to individual residents are anticipated. In comparison, Alternative 34-23 would permanently impact two residents, one significantly by splitting their parcel in two. The alternative would also temporarily impact the railroad along with four additional residents.

Table 7-2 Preliminary Cost Estimates and Right of Way Impacts

	Alt 34-19B	Alt 34-23
Preliminary Cost Estimate	$15.437 M	$23.720 M
Preliminary Right of Way Impacts - Temporary & Permanent	4 Acres	10 Acres

COST-BENEFIT ANALYSIS

A benefit-cost analysis was performed for Alternative 34-19B and Alternative 34-23 to determine whether the alternative is considered economically justified. The benefit-cost analysis accounts for benefits and costs from the installation of any of the build alternatives accruing over an analysis period of 25 years, from 2025 to 2050. The No-Build alternative was included in the analysis to determine the baseline operation and maintenance costs and provide baseline performance results.

The analysis took into consideration the following benefits:

- user travel time savings
- vehicle operating
- safety

The benefits of Alternative 34-23 were higher than the benefit total of Alternative 34-19B. However, when factoring the costs for each project Alternative 34-19B performed higher.

CONCLUSION

In summary, the No-Build Alternative for the Exit 34 Interchange is the least impactful. However, the No-Build Alternative does not address the need for the project to correct the geometric deficiencies identified. While Alternative 34-19B addresses all deficiencies with the exception of spacing requirements which are unable to be met due to geotechnical constraints. Alternative 34-23 looked to maximize spacing at a location east of the existing interchange but created additional deficiencies caused by walls that would be required to be placed along both sides of mainline I-90.

When comparing the two Exit 34 Interchange Build Alternatives, the alternative 34-19B scored the highest amongst several evaluation criteria discussed within this report. The results of the evaluation can be found in more detail in the I-90 Exit 32 to 40 Corridor Report (**Appendix H**) and are also summarized in **Table 7-3.**

Table 7-3 I-90 Exit 34 Interchange – Alternative Evaluation Matrix

I-90 Exit 32 to Exit 40 Corridor Study

Exit 34 Alternative Evaluation Matrix

	Evaluation Criteria												
	Safety Improvements	Geometric Needs	Environmental Impacts	Geotechnical Impacts	Cost[1]	Traffic and Level of Service	Constructability Issues	Impact to existing land use or new development including access	Right of Way Impacts	Flexibility to accommodate future improvements or land use changes	Bicycle Facility Enhancement	Utility Impacts	Overall Score of Alternative (Highest Value is Best)
Weight	4.7	4.5	4.4	4.2	4.0	3.9	3.8	3.4	3.3	3.2	2.0	1.9	
Alternatives													
34-1B	Alternative Removed - Traffic Volumes do not justify Roundabout Intersection. Alternative further refined as 34-1C.												
34-1C[1]	3	5	3	1	3	5	5	3	2	4	5	2	**147.9**
34-3[1,2]	4	3	3	1	2	5	2	3	1	5	5	4	**131.9**
34-7	Alternative Removed - Traffic Volumes do not justify Roundabout Intersection. Alternative refined as Alternatives 34-8 through 34-15.												
34-8[1]	3	4	3	1	1	5	3	4	3	3	4	2	**129.3**
34-9[1]	2	2	4	1	3	5	2	4	4	3	4	2	**127.5**
34-10B[1]	5	3	4	1	3	5	3	4	4	3	4	2	**149.9**
34-11[1]	3	4	4	1	1	5	3	4	3	3	4	2	**133.7**
34-12	Alternative Removed - Traffic Volumes do not justify Roundabout Intersection												
34-13[1]	1	2	1	1	4	5	1	4	4	3	4	3	**111.7**
34-14[1]	4	3	1	1	3	5	3	4	4	3	4	4	**135.8**
34-15[1]	3	3	1	1	2	5	3	4	3	3	4	2	**120.0**
34-16	Alternative Removed - Impact to Black Hills National Cemetery Unfeasible												
34-17	Alternative Removed - Driver Expectation of Ramp/Local Road Configuration Undesirable												
34-18	Alternative Removed - Driver Expectation of Ramp/Local Road Configuration Undesirable												
34-19[1]	1	3	5	1	5	3	5	5	1	4	4	4	
34-19B	1	2	2	5	5	5	4	5	5	1	4	4	**150.5**
34-20	Alternative Removed - Impact to 2 homes Unfeasible												
34-21	Alternative Removed - Impact to 2 homes Unfeasible												
34-22	Alternative Removed - Impact to 2 homes Unfeasible												
34-23	2	2	1	5	3	5	4	4	4	3	4	4	**142.5**

5	Is most positive regarding the Evaluation Criteria
4	
3	Is neutral regarding the Evaluation Criteria
2	
1	Is least positive regarding the Evaluation Criteria

NOTE:

[1]While the alternatives were scored a 1 for geotechnical impacts, the cost does not reflect the true cost to construct the alternative based on geotechnical issues present. The cost of geotechnical mitigation for these options would make the alternatie unfeasible and the true cost ranking would be lower than presented in the table.

[2]The preferred Local Road Connection alternative was factored into the final criteria score for Alternatives 34-3.

8. FUNDING PLAN

The planned project to replace the existing Exit 34 Interchange also includes the reconstruction of the eastbound lanes between Exit 32 and Exit 37, updates to drainage structures, and the reconstruction of westbound lanes to provide the standard median. The proposed project is currently estimated to cost $31.092 million (in 2019 dollars). The SDDOT is currently anticipating funding the project with a combination of funding sources as listed in **Table 8-1**.

Table 8-1 Anticipated Funding Allocation Breakdown

Project Number	State Funding Category	Federal Funding Category	Federal Funds	State Funds	Total Funds
IM 0901(198)32 PCN 06DN	Interstate	National Highway Performance Program	$25.434 Million	$5.658 Million	$31.092 Million
Total			$25.434 Million	$5.658 Million	$31.092 Million

Note: As funding is fluid, category breakdown may be different at time of project authorization.

As the project is anticipated to be let to contract in Federal fiscal year 2025, the inflated estimated cost for the overall project is $34.326 Million.

9. RECOMMENDATIONS

This modification request is to reconstruct the existing Exit 34 Interchange and maintain the diamond configuration, as shown in **Figure 9-1.**

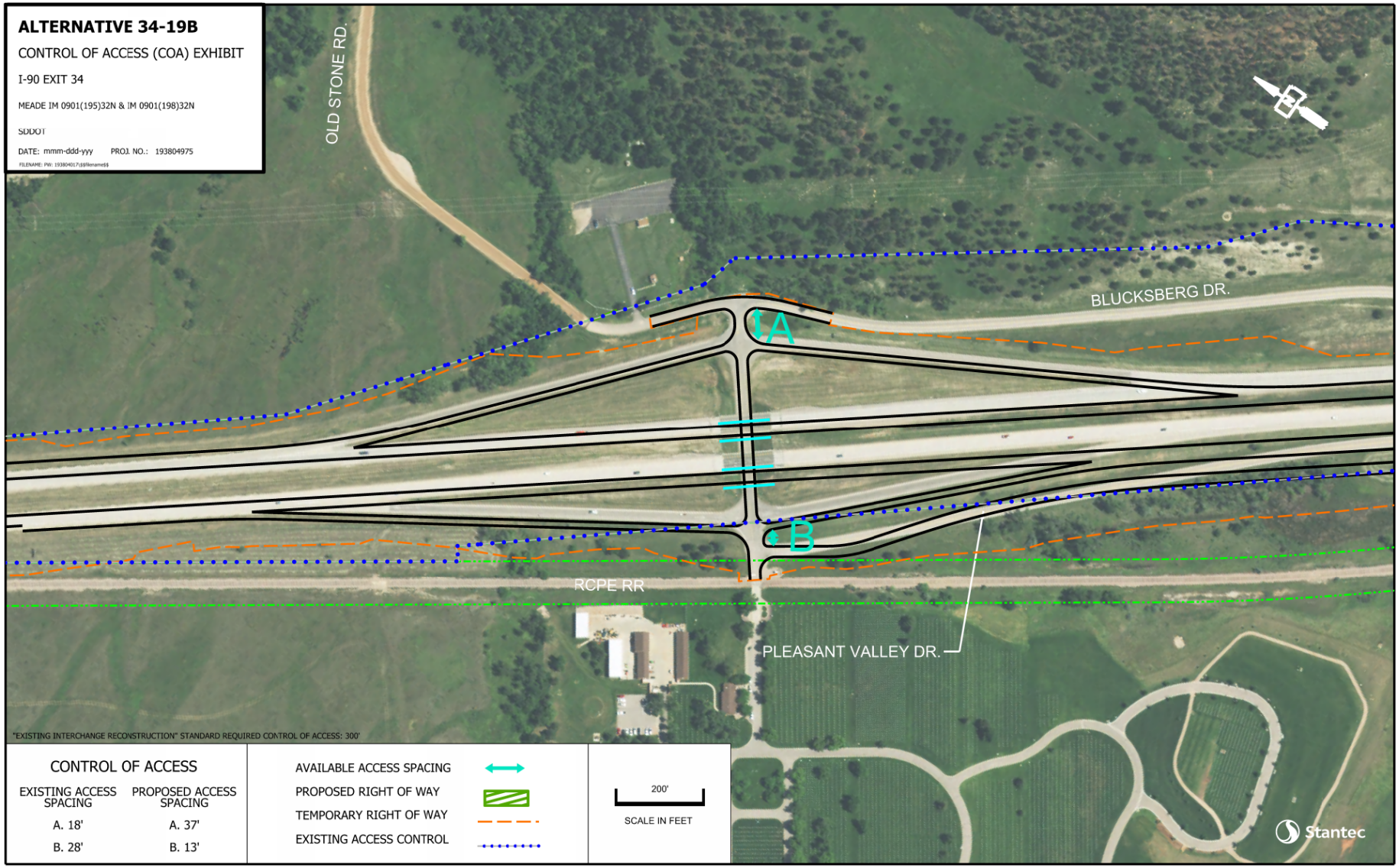

Figure 9-1 Alternative 34-19B (Build Alternative) I-90 Exit 34

This recommendation addresses the two policy requirements for new or revised access points to the existing Interstate system published in the May 22, 2017 Policy on Access to the Interstate System issued by the Federal Highway Administration.

1. **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 should, 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, should 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 should 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 should 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 operational analysis contained in this study indicate that mainline I-90, ramp junctions, and ramp terminal intersections are all projected to function within operational goals for both the Build and No Build scenarios through the planning horizon year of 2050.

   Interchange AM and PM peak hour analyses were performed for the eastbound and westbound directions for the Base Year (2017), Opening Year (2025) and the Design Year (2050). The Design Year 2050 analysis represents both the 2050 No Build and 2050 Build Alternative scenarios. This is because there are no proposed changes to the traffic control or intersection lanes and turn lane geometries between the No Build and Build Scenarios.

   For the I-90 mainline, the Level of Service (LOS) remains unchanged for the Design Year 2050. It maintains LOS A throughout the study area from Exit 32 to Exit 40. At Exit 34, the intersections also maintain their LOS A while Control Delay increased by less than 1 sec/veh between the Base Year (2017) and Design Year (2050).

   An analysis of crash records for the five-year period of 2012-2016 has been provided in the "Existing Safety Conditions" section of this report. Crash occurrences were broken down into severity, location, and type. These categories were then plotted on a map of

the study area to determine any areas of concern. The study area was broken down into segments to better analyze patterns. The segments were analyzed based on their length, number of crashes, ADT, and facility type, and then compared to statewide averages. The safety analysis indicates that there are no apparent or correctable crash patterns within the influence area of the Exit 34 Interchange.

The existing interchange is constrained by steep terrain and culturally sensitive sites on both sides and would benefit from a relocated diamond interchange where control of access could be optimized. However, it was determined that the hillside along the westbound lanes is a berm at the toe of a larger steeper hill that is susceptible to landsides. Due to this, no excavation is to take place along the westbound lanes from just west of Alkali Creek to the Blucksberg development. Reconstructing the interchange at the present location avoids two major design issues, 1) excavation of the hillside and 2) use of large retaining walls on along both sides of the interstate through the interchange where inclement weather from the Black Hills rapidly occurs.

The reconstructed interchange will bring substandard geometric conditions of the aging facility up to SDDOT specifications. Control of Access (COA) is limited at the existing interchange location, currently 100 feet separates the ramp terminal intersection and the adjacent intersection on both sides of the interstate. The COA is constrained by the terrain and development on the east side of I-90 and the National Cemetery and railroad on the west side of I-90. Within the proposed interchange, the COA spacing (currently 18 feet) on the east side improves by 19 feet while COA on the west side (currently 28 feet) decreases by 15 feet. Both well below the required access spacing due to the above-mentioned factors, the operational analyses of the proposed interchange show LOS A for all movements using 2050 projected traffic volumes. Safety would be maintained using the existing control of access spacing. To support in the selection of the desired alternative a benefit-cost analysis was completed comparing the no build and feasible alternatives given the above challenges. The reconstructed bridges will also include the addition of protective barriers for the overpass columns.

Figure 9-2 depicts the proposed permanent signage for the diamond interchange at Exit 35.

Figure 9-2 Permanent Signing Layout I-90 Exit 34

2. **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)). In rare instances where all basic movements are not provided by the proposed design, the report should include a full-interchange option with a comparison of the operational and safety analyses to the partial-interchange option. The report should also include the mitigation proposed to compensate for the missing movements, including wayfinding signage, impacts on local intersections, mitigation of driver expectation leading to wrong-way movements on ramps, etc. The report should describe whether future provision of a full interchange is precluded by the proposed design.**

   The access improvement will maintain a connection to Old Stone Road and will update the current full access interchange with a reconfigured full access interchange. The reconfigured interchange will continue to provide for all traffic movements. The improvement will meet or exceed current standards for Federal-aid projects on the Interstate system.