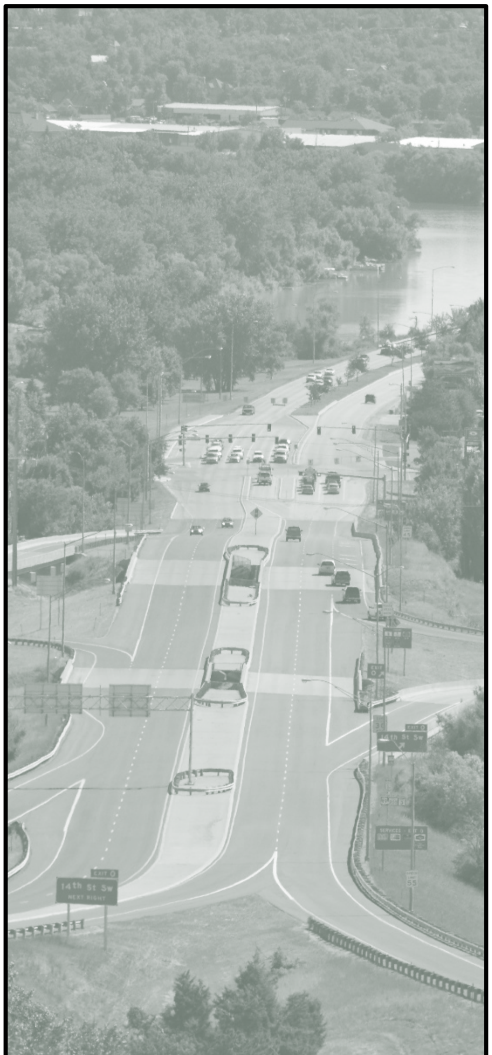

Gore Hill to Emerson Junction
Corridor Planning Study

EXISTING AND PROJECTED CONDITIONS

December 31, 2014

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Montana Department of Transportation

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EXISTING AND PROJECTED CONDITIONS

1.0 INTRODUCTION

This report identifies existing and projected roadway conditions and social, economic, and environmental factors that influence the Great Falls Interstate System. The analysis performed includes a planning level examination of the corridor by applying technical and environmental considerations to determine known issues, constraints, and/or areas of concern.

The analysis contained in this report is based on existing and historic traffic data, field measurements and observations, roadway as-built plans, aerial imagery, Geographical Information Systems (GIS), and publically available environmental information and demographics. The analysis was conducted for three main categories: demographics, transportation, and environment.

1.1 STUDY AREA

The study area for the *I-15 Gore Hill to Emerson Junction Corridor Planning Study* includes Interstate 15 (I-15) through Great Falls, beginning southwest of the Gore Hill Interchange (I-15, Exit 277) near Reference Post (RP) 277 and ending northwest of Emerson Junction (Exit 282) near RP 284. Additionally, the study area includes Interstate 315 (I-315) and 10th Avenue South, west of the Missouri River (RP 95). **Figure 1.1** presents the study area boundary.

Within the study area, I-15 is classified as a principal arterial and is part of the National Highway System (NHS). The Interstate serves as the main north-south corridor through Montana from the Idaho state line at Monida to the Canada boundary at Sweet Grass. I-315 is an interstate spur from I-15 and is known as Business Loop I-15. I-315 transitions to 10th Avenue South, east of the intersection with Fox Farm Road.

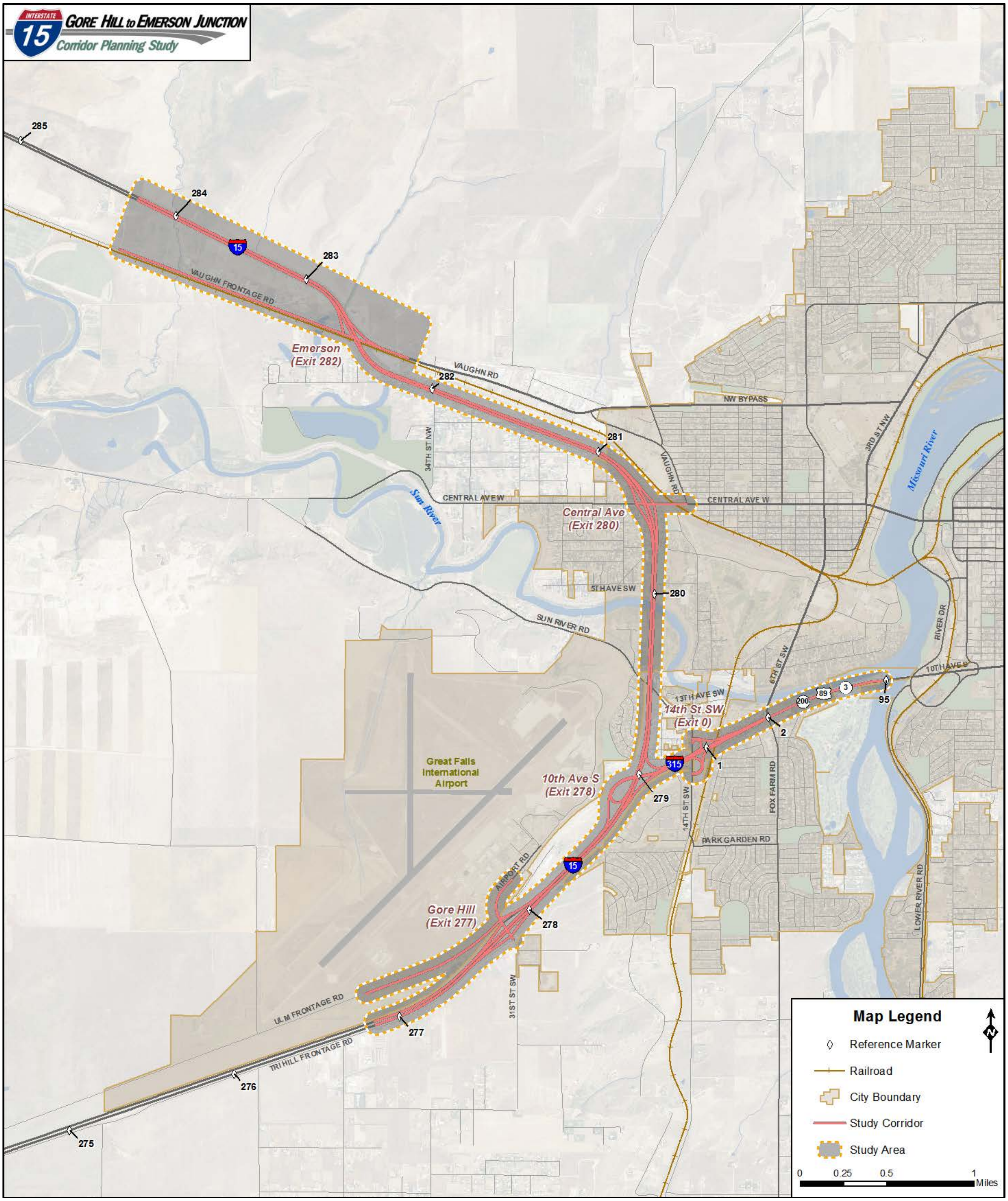

Figure 1.1: Study Area

1.2 Past, Current and Planned Projects

The Montana Department of Transportation's (MDT's) online summary of road and bridge construction projects awarded since July 23, 1987, was reviewed to identify projects previously implemented within the study area. Since 1987, MDT lists 14 completed projects along the corridor. **Table 1.1** lists these projects, along with a brief description of the scope available in MDT's Program and Project Management System.

Table 1.1: MDT Projects within the Study Area Since 1987

Project Designation	Description
10TH AVE SOUTH - WARDEN BR TO 6TH SOUTHWEST	Concrete repair, median adjustment, and diamond grinding from Warden Bridge to Fox Farm intersection
2002-10TH AVE SOUTH/FOX FARM RD-GREAT FALLS	Roadway and Roadside Safety Improvements
BRIDGE DECKS-GREAT FALLS	Rehabilitation of I-15 bridges at Sun River and the overpass at 5th Avenue Southwest
FOX FARM RD & 10TH AVE SOUTH - GREAT FALLS - CASCADE COUNTY	Safety improvement project to address rear end crashes involving right turning vehicles
GREAT FALLS - CENTRAL AVE WEST BRIDGE APPROACHES – CASCADE COUNTY	Rehabilitation of the eastbound Warden Bridge
GREAT FALLS – FOX FARM RD./10TH AVE. SO CASCADE COUNTY	Concrete resurfacing between 6th Street Southwest / Fox Farm Road and Warden Bridge
GREAT FALLS-NORTH & SOUTH	Interstate rehabilitation
GREAT FALLS-NORTH & SOUTH CASCADE COUNTY	Interstate fence replacement and installation of cattle guards
GREAT FALLS URBAN (I-315)	Overlay of I-315 and ramps at 10th Avenue South and exit 0
I15-BRIDGE REPAIR-GREAT FALLS	Emergency repair of beams damaged by trucks hauling high load
SF 129-GREAT FALLS WRONG WAY-PH 1	New signing to address wrong way traffic on off ramps on I-15
2002 INTERSECTION IMPVT-GF	Safety adjustments to northbound I-15 off ramp at Central Avenue West
D3 SIGNING (I-15)	Guide sign replacement
GREAT FALLS-VAUGHN	Seal and cover from Emerson Junction to the north

Source: MDT Project List accessible at http://www3.mdt.mt.gov:7782/mttplc/mttplc.tplk0007.project_init

The Montana 2014-2018 *Final Surface Transportation Improvement Program* (STIP) is a federally required publication that shows funding obligations over the next five years. This program identifies improvement projects to preserve and improve Montana's transportation system. The Montana 2014-2018 Final STIP identifies the following future projects within the study area:

- **Emerson Junction to Manchester:** This project will be a major rehabilitation of I-15 beginning at RP 282.2 and ending at RP 285.9. It is estimated that the letting date for this project will be in 2017.
- **Bridge Preservation, Great Falls IM:** This project is bridge deck preservation on I-15 between RP 209.1 and 247.2 (outside of the study limits) and I-315 at RP 1.06. It is estimated that the letting date for this project will be in 2016.

1.3 Existing Plans and Regulations

The following provides a summary of existing planning documents and regulations associated with transportation in the area. A number of local plans exist with goals and objectives related to the transportation system. Additionally, Federal regulations would have to be adhered to should changes occur to the Interstate System.

Great Falls Area Long Range Transportation Plan – 2014

The *Great Falls Area Long Range Transportation Plan (LRTP) – 2014* is intended to offer guidance for the decision-makers in the Great Falls Area by responding to existing transportation system concerns through a menu of large and small improvements to the transportation network. The LRTP provides a blueprint for guiding transportation infrastructure investments based on system needs and associated decision-making principles.

The LRTP identified the need for an Interstate Corridor Study through the Great Falls area. The LRTP states the following:

> *Due to preliminary recommendations to make improvements to both the Emerson Junction and Gore Hill interchanges and other identified needs for added lanes and operational improvements on I-15 and I-315, an Interstate Corridor Study for the Great Falls area is recommended. The need for new interchanges, feasibility, and analysis of capacity and operational concerns, will assist in identifying potential locations, priorities, costs and scope for improvements. The study should include westbound movements on 10th Avenue South, east of the intersection of Fox Farm Road and 6th Street SW, for traffic that exits at "Exit 0", as well as connections with I-315 to I-15.*

Cascade County Growth Policy Update (2014)

The *Cascade County Growth Policy Update (2014)* was drafted as a comprehensive plan to provide guidance on decisions regarding land development and public investments within Cascade County. The document outlines 13 goals, of which the transportation goal is most relevant:

Goal 6:

Promote and maintain a transportation system that provides safety, efficiency, and is cost effective.

Objectives:

A. New additions to the transportation system should be compatible with the existing road system and coordinated with roads from other jurisdictions.
B. Transportation planning for new developments should support the Cascade County Growth Policy.
C. Ensure that all new roads, both public and private, are built to county design standards for new construction. These standards can be found within the Cascade County Subdivision Regulations.
D. Encourage provisions for multi-modal types of transportation including: bike lanes, trails, pedestrian facilities, etc.
E. Develop and implement road and bridge improvement standards and maintenance schedules.
F. Develop a policy and implementation program in cooperation with developers and school districts to provide walks, bridges and pathways for children to improve safety and reduces transportation costs between residential neighborhoods, schools and stores.

G. Develop secondary means of access, where practical, to settlements and subdivisions in order to improve safety and overall traffic circulation.
H. Continue using Road Improvement Districts and Rural Maintenance Districts to maximize funding strategies.
I. Coordinate transportation issues with wildfire and fire protection issues, policies and goals.

City of Great Falls Growth Policy Update (2013)

The *City of Great Falls Growth Policy Update (2013)* is intended to provide guidance to the local government with regard to establishing policy and a framework to guide the social, environmental, economic, and physical makeup of the city of Great Falls. The *Growth Policy* recognizes that transportation and growth go hand in hand. Furthermore, the *Growth Policy* identifies I-15 as the main regional route. Tenth Avenue South is also identified within the *Growth Policy* as being the largest road facility in the city.

Great Falls International Airport Master Plan (Ongoing)

Great Falls International Airport is currently developing a master plan to evaluate the long-term vision for its properties and adjacent areas. The Airport is primarily served by the Gore Hill Interchange. Changes to the transportation system and land use near the airport could impact the function of the Interstate System.

Great Falls Transit Development Plan (2010)

The *Great Falls Transit Development Plan (TDP)* was developed to analyze and recommend strategies that will affect the delivery of public transportation services for the Great Falls Transit District. The TDP states the following: "The mission of the Great Falls Transit District is to provide a safe, reliable, affordable and fiscally sound transportation system for the people of Great Falls and Black Eagle, Montana." Currently no fixed routes use roads within the I-15 corridor study area, with the exception of one line using the intersection of Fox Farm Road and 10th Avenue South. Furthermore, no new alternative routes were recommended within the study area.

Interstate System Access Informational Guide (2010)

The intent of the Interstate system is to provide for movement of military and civilian equipment, freight, and personnel over long distances and between and within states. The Federal Highway Administration (FHWA) is charged with administrating the Interstate System to ensure its structural and operational integrity. In 2010, FHWA published the *Interstate System Access Informational Guide* to provide guidance for both FHWA field staff and state departments of transportation (DOTs) on how and what should be addressed in requests for new or modified access to the Interstate System. The *Guide* provides information and methods for evaluating requests for new access to the Interstate System. Specifically, the *Guide* references eight policy requirements that must be met for new or modified interchanges.[1] The goal of the *Guide* is to provide technical and policy support for access to the Interstate System.

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[1] U.S. Department of Transportation, Federal Highway Administration, *Access to the Interstate System*, Notice of revised policy statement, http://www.gpo.gov/fdsys/pkg/FR-2009-08-27/html/E9-20679.htm

2.0 DEMOGRAPHICS

This section provides an overview of the socioeconomic characteristics of the study area. Historic and recent trends in area demographics help define existing conditions and aid in forecasting techniques as there is a direct correlation between motor vehicle travel and socioeconomic indicators.

Demographic and socioeconomic information was reviewed to help determine recent trends in population, age distribution, employment, economic status, and commuting for area residents. Socioeconomic data sources do, however, often lag considerably behind the actual years of interest. This analysis presents the most current data and statistics available and indicates recent and potential changes in the area.

2.1 Population Characteristics

A review of demographics within the study area is appropriate to gain an understanding of historical trends in population, age, race, and ethnicity. Understanding population composition is necessary, as the data may influence the types of improvements identified. For example, an aging population may indicate a need for specific types of transportation improvements such as transit services and/or non-motorized infrastructure improvements. The presence of a disadvantaged population may warrant other considerations, especially during project development activities.

Table 2.1 shows total population and growth statistics for the city of Great Falls and Cascade County. A comparison of similar statistics for the state of Montana and the United States is also provided. Between 1990 and 2010, the population of the city of Great Falls increased at a higher rate than Cascade County during the same time. Both the city and the county experienced lower growth than the state of Montana and the United States over the same period.

Table 2.1: Current Population and Past Growth

Area	Population (1990)	Population (2000)	Population (2010)	Percent Growth (1990-2010)	Current Population (2013 Estimate)
City of Great Falls	55,097	56,690	58,505	6.2%	59,351
Cascade County	77,691	80,357	81,327	4.7%	82,384
State of Montana	799,065	902,195	989,415	23.8%	1,015,165
United States	248,709,873	281,421,906	308,745,538	24.1%	316,128,839

Source: U.S. Bureau of the Census, Census of the Population

Table 2.2 depicts race and ethnicity characteristics in the city of Great Falls, Cascade County, and the state of Montana at the time of the 2010 Census. The population of Great Falls is predominately white with percentages of minority populations slightly higher than for the state of Montana. The Census data show that Great Falls and Cascade County have roughly the same ethnic composition.

Table 2.2: Population Race and Ethnicity Data (2010)

Race / Ethnicity	City of Great Falls		Cascade County		State of Montana	
White	50,723	86.7%	71,100	87.4%	868,628	87.8%
Hispanic or Latino	1,978	3.4%	2,711	3.3%	28,565	2.9%
Black or African American	583	1.0%	958	1.2%	3,743	0.4%
American Indian and Alaska Native	2,753	4.7%	3,274	4.0%	59,902	6.1%
Asian	505	0.9%	665	0.8%	6,138	0.6%
Native Hawaiian and Other Pacific Islander	66	0.1%	78	0.1%	609	0.1%
Some Other Race	29	0.0%	45	0.1%	540	0.1%
Two or More Races	1,868	3.2%	2,496	3.1%	21,290	2.2%
Total	**58,505**		**81,327**		**989,415**	

Source: U.S. Bureau of the Census, Census of the Population

Table 2.3 presents the change in total population and age for the city of Great Falls and Cascade County since 1980. Between 1980 and 2010, the percentage of county and city residents age 65 or older showed a notable increase, while the percentage of those younger than 18 decreased over the same period. The median age in the city increased from 30.6 years in 1980 to 39.0 years in 2010. The county experienced a similar increase in median age, rising from 28.6 years in 1980 to 38.9 years in 2010. These statistics point to the aging of the population and follow similar trends within Montana and across the United States.

Table 2.3: Age Distribution (1980 to 2010)

Year	< 18 Years		18-64 Years		65+ Years		Total Population	Median Age
City of Great Falls								
1980	15,713	27.7%	34,489	60.8%	6,523	11.5%	56,725	30.6
1990	14,325	26.0%	32,507	59.0%	8,265	15.0%	55,097	34.4
2000	14,138	24.9%	33,654	59.4%	8,898	15.7%	56,690	37.8
2010	13,161	22.5%	35,648	60.9%	9,696	16.6%	58,505	39
Change (1980 to 2010)	-2,552	-16.2%	1,159	3.4%	3,173	48.6%	1,780	8.4
Cascade County								
1980	23,544	29.2%	49,164	60.9%	7,988	9.9%	80,696	28.6
1990	21,520	27.7%	46,304	59.6%	9,867	12.7%	77,691	32.7
2000	20,912	26.0%	48,197	60.0%	11,248	14.0%	80,357	36.7
2010	18,630	22.9%	50,007	61.5%	12,690	15.6%	81,327	38.9
Change (1980 to 2010)	-4,914	-20.9%	843	1.7%	4,702	58.9%	631	10.3

Source: U.S. Bureau of the Census, Census of the Population

Table 2.4 presents housing occupancy data for the city of Great Falls, Cascade County, and the state of Montana. The city of Great Falls has 26,602 housing units. Of those units, 24,660 are occupied. Cascade County has 37,260 housing units, of which 33,352 are occupied. The average household size for owner-occupied houses in the city of Great Falls, Cascade County, and the state of Montana is roughly the same at 2.45 individuals per household. For renter-occupied households, the city of Great Falls has a lower occupancy at 2.06 persons per household compared to Cascade County and the state of Montana, which both have approximately 2.20 persons per household.

Table 2.4: Housing Occupancy and Tenure

Housing	City of Great Falls	Cascade County	State of Montana
Total Housing Units	**26,602**	**37,260**	**481,401**
Occupied Housing Units	24,660	33,352	405,508
Owner-occupied	15,659	22,057	277,816
Average Household Size	*2.46*	*2.45*	*2.45*
Renter-occupied	9,001	11,295	127,692
Average Household Size	*2.06*	*2.21*	*2.20*

Source: 2008-2012 American Community Survey 5-Year Estimates

Table 2.5 portrays data for the availability of vehicles per household. This information can be used to identify alternative transportation-dependent populations. The city of Great Falls has a higher percentage of households with no vehicles available compared to Cascade County and the state of Montana with 9.3, 7.6, and 5.3 percent, respectively. Data indicate that 2,287 of the 2,536 households (90 percent) in Cascade County with no vehicle available are within the city of Great Falls.

Table 2.5: Vehicles Available

Vehicles	City of Great Falls		Cascade County		State of Montana	
Occupied Housing Units	**24,660**		**33,352**		**405,508**	
No Vehicles Available	2,287	9.3%	2,536	7.6%	21,329	5.3%
1 Vehicle Available	7,954	32.3%	9,856	29.6%	114,421	28.2%
2 Vehicles Available	8,904	36.1%	12,230	36.7%	153,045	37.7%
3 or More Vehicles Available	5,515	22.4%	8,730	26.2%	116,713	28.8%

Source: 2008-2012 American Community Survey 5-Year Estimates

2.2 Population Projections

The Montana Department of Commerce Census and Economic Information Center provides county-level population projections. The projections were developed by Regional Economic Models, Inc. (REMI) for the state of Montana using the firm's *eREMI* model. Projections of Cascade County based on the *eREMI* model show a population increase of approximately 19 percent by 2035. In comparison, the model projects that the state of Montana's population will grow by approximately 17 percent by 2035.

Table 2.6 shows the populations for Cascade County and the state of Montana in the 2010 Census, and it provides population estimates for key years from 2015 through 2035 based on the *eREMI* model. The projections suggest that Cascade County's population will have an average annual growth rate of approximately 0.7 percent per year.

Table 2.6: Population Projections through 2035

Area	2010	2015	2020	2025	2030	2035	Average Annual Growth Rate (2010-2035)
Cascade County	81,327	85,673	90,176	94,147	96,502	96,676	0.69%
State of Montana	989,415	1,043,653	1,094,712	1,134,324	1,156,494	1,162,253	0.65%

Source: U.S. Bureau of the Census, Census of the Population and eREMI for Montana and Counties by REMI.

2.3 Employment and Income Characteristics

Table 2.7 presents data on the estimated number of employees (age 16 years and older) and the industries in which they are employed within the city of Great Falls, Cascade County, and the state of Montana. The data in **Table 2.7**, taken from the 2008-2012 American Community Survey (ACS) profile for these geographies, also include employment estimates by industry. The data show that most employment in the county and in the city of Great Falls is associated with service industries, followed by the retail trade and construction industries.

Table 2.7: Employment by Industry

Industry	City of Great Falls		Cascade County		State of Montana	
Agriculture, Forestry, Fishing and Hunting, and Mining	472	1.7%	1,133	2.9%	34,024	7.1%
Construction	2,326	8.2%	3,156	8.0%	39,115	8.1%
Manufacturing	846	3.0%	1,282	3.2%	22,791	4.7%
Wholesale Trade	814	2.9%	1,143	2.9%	12,009	2.5%
Retail Trade	3,867	13.6%	5,171	13.0%	56,945	11.8%
Transportation, Warehousing, and Utilities	1,281	4.5%	1,939	4.9%	23,871	5.0%
Information	541	1.9%	609	1.5%	8,913	1.8%
Finance, Insurance, Real Estate, and Rental and Leasing	2,305	8.1%	2,770	7.0%	26,526	5.5%
Professional, Scientific, Management, Administrative, and Waste Management Services	2,213	7.8%	2,709	6.8%	39,353	8.2%
Educational Services, Health Care, and Social Assistance	6,075	21.4%	8,343	21.0%	108,970	22.6%
Arts, Entertainment, Recreation, Accommodation, and Food Services	3,345	11.8%	4,209	10.6%	53,023	11.0%
Other Services, Except Public Administration	1,266	4.5%	1,724	4.3%	22,361	4.6%
Public Administration	1,770	6.2%	2,586	6.5%	30,353	6.3%
Armed Forces	1,228	4.3%	2,865	7.2%	3,553	0.7%
Total Employed Population 16 Years and Over	**28,349**		**39,639**		**481,807**	

Source: 2008-2012 American Community Survey 5-Year Estimates

Unemployment rates are represented in **Table 2.8** and are current as of July 2014. The data show an unemployment rate for Cascade County that is lower than the rate for the state of Montana (4.0 percent versus 4.4 percent) and the United States (6.5 percent). Conversely, the unemployment rate for the city of Great Falls is higher than the rate for the state of Montana (6.1 percent versus 4.4 percent).

Table 2.8: Employment Status

Labor Force	Cascade County	State of Montana	United States
Labor Force	40,826	531,972	157,573,000
Employed	39,195	508,741	147,265,000
Unemployed	1,631	23,231	10,307,000
Unemployment Rate	4.0%	4.4%	6.5%

Source: Montana Department of Labor and Industry, Research and Analysis Bureau – Labor Force Statistics, July 2014 (data are not seasonally adjusted).

Information about the number of workers (16 years and older) and their commuting characteristics is available from the ACS. The ACS information provided estimates of the transportation modes used by commuters. **Table 2.9** presents mode choice characteristics for workers in the city of Great Falls, Cascade County, and the state of Montana. According to the ACS, more than 90 percent of the commuting workers in Cascade County and the city of Great Falls rely on personal vehicles or carpools for transportation to work destinations. The share of workers that drove alone from both the county and the city is greater than that seen statewide.

Table 2.9: Commuting to Work Statistics

Mode Choice	City of Great Falls		Cascade County		State of Montana	
Workers 16 Years and Over	**27,980**		**39,075**		**470,377**	
Car, Truck, or Van — Drove Alone	22,855	81.7%	31,142	79.7%	352,644	75.0%
Car, Truck, or Van — Carpooled	2,847	10.2%	4,273	10.9%	48,324	10.3%
Public Transportation (excluding taxicab)	316	1.1%	369	0.9%	4,369	0.9%
Walked	708	2.5%	1,211	3.1%	22,790	4.8%
Other means	561	2.0%	764	2.0%	11,779	2.5%
Worked at home	693	2.5%	1,316	3.4%	30,471	6.5%
Mean Travel Time to Work	**14.5**		**16.1**		**18.0**	

Source: 2008-2012 American Community Survey 5-Year Estimates

Table 2.10 presents income statistics for the city of Great Falls, Cascade County, and the state of Montana. The ACS shows estimated household incomes for the city of Great Falls and Cascade County to be $42,085 and $43,817, respectively. These values are below the median household income for the state of Montana, which is $45,456. The per capita income for both the city of Great Falls ($23,238) and Cascade County ($23,976) is lower than that of the state of Montana ($25,002).

Table 2.10 also contains poverty statistics for the city of Great Falls, Cascade County, and the state of Montana. According to the 2008-2012 ACS profile, the number of residents living below the poverty line was higher for the city of Great Falls than for Cascade County and the state. About 14.8 percent of all individuals living in Montana were estimated to be below the poverty line. The ACS estimates show that 16.9 percent of individuals living in the city of Great Falls and 14.9 percent in Cascade County are living in poverty.

The ACS data also show that the county and city likely had a greater percentage of persons under the age of 18 living in poverty than the percentage for same age group in the state. The share of persons over the age of 65 living in poverty is, however, similar among the city, the county, and the state.

Table 2.10: Income Statistics

Income	City of Great Falls	Cascade County	State of Montana
Median Household Income	$42,085	$43,817	$45,456
Median Family Income	$56,368	$56,958	$58,951
Per Capita Income	$23,238	$23,976	$25,002
Persons Living in Poverty (%)	16.9%	14.9%	14.8%
Persons Under 18 Living in Poverty (%)	27.8%	24.2%	19.9%
Persons over 65 Living in Poverty (%)	8.6%	8.5%	8.4%
Families Living in Poverty (%)	13.2%	11.4%	9.8%
Families with Children under 18 Living in Poverty (%)	24.1%	20.9%	17.0%

Source: 2008-2012 American Community Survey 5-Year Estimates

3.0 EXISTING TRANSPORTATION SYSTEM

I-15 is functionally classified as a principal arterial on the NHS Interstate System. The Interstate serves as the main north-south corridor through Montana and connects Canada to the southern border of California. The roadway was constructed or improved at various times, beginning in 1939 and extending to 2009. I-15 is part of the Canamex Trade Corridor, which Congress designated as a “High Priority Corridor” in the 1995 *National Highway Systems Designation Act*. The corridor’s main objective is to facilitate trade and strengthen the corridor’s position in the global economy.

I-315 begins at the 10th Avenue South junction with I-15 (RP 279). It was opened to traffic in late 1967. The corridor is currently signed as Business Loop 15, US 89, and MT 200. I-315 is one of the shortest Interstate highways in the country at 0.828 miles, and it terminates at the intersection of Fox Farm Road and 6th Street Southwest.

Primary users of the corridors consist of all types of individuals including locals, commuters, travelers, and freight operators. Interstate highways are considered part of the principal arterial freeway system. Freeways are characterized by having fully controlled access, high design speeds, and a high level of driver comfort and safety. For these reasons, freeways have separate geometric design criteria than those of a standard principal arterial highway.

3.1 Physical Features and Characteristics

This section discusses the physical features and characteristics of the study corridor. Information was gathered using publically available sources, field observations, GIS data, and MDT as-built drawings.

3.1.1 Hydraulics

I-15 crosses the Sun River at RP 279.35, between the 10th Avenue South Interchange and the Central Avenue West Interchange. The crossing consists of a concrete bridge structure. Additionally, a steel culvert is located along I-15 at RP 283.4 for drainage conveyance.

3.1.2 Bridges

MDT’s Highway Bridge Program (HBP) emphasizes asset management and preservation. This emphasis promotes a “right treatment at the right time” philosophy in prioritizing and selecting projects on MDTs bridge system. MDT has defined the bridge program objectives and performance measures. The objectives and measures are intended to identify the right treatments for Montana’s bridge assets, as well as promoting cost-effective bridge preservation, appropriate safety-related work, and economic growth.

MDT uses a Structure Condition Performance Measure and a Deck Performance Condition Measure. These measures categorize bridge conditions as good, fair, or poor, based on the condition rating given to the bridge deck (riding surface), superstructure (generally beams underneath the riding surface), and substructure (support structure extending into the ground). Additionally, the Structure Condition Performance Measure assigns a poor rating to a bridge that is structurally deficient.

A bridge is considered structurally deficient if load-carrying elements have deteriorated enough to be considered in “poor condition” or the adequacy of the waterway opening provided by the bridge is insufficient, causing intolerable traffic interruptions. When a bridge is classified as structurally deficient, it does not mean that it is unsafe. A structurally deficient bridge typically requires increased maintenance and repair to remain in service and eventual rehabilitation or replacement to address overall deficiencies.

The deck condition performance measure uses the National Bridge Inventory (NBI) deck rating to give an indication of the deck condition and a planning level indication of needed preservation treatment. The deck condition ranking is a general indicator of the condition of any individual deck. The rankings are useful for planning purposes on a system wide basis.

There are 17 bridges within the study area. **Table 3.1** shows the bridge locations and condition ratings. All 17 bridges have a structure condition of "good," which indicates that they are candidates for continued preservation. The bridge deck ratings include "good" (possible candidate for sealing), "fair-1" (candidate for healer/sealer), and "fair-2" (candidate for resurfacing). Detailed bridge inspection reports are available in **Appendix A**.

Table 3.1 also lists the width of each bridge within the study area. According to the MDT *Bridge Design Standards*, a bridge on the Interstate System is recommended to consist of 12-foot travel lanes, 4-foot inside shoulder, and 10-foot outside shoulder. This recommendation results in a total bridge width of 50 feet for three travel lanes, 38 feet for two travel lanes, and 26 feet for one travel lane. A number of bridges on the Interstate System within the study area have widths narrower than the recommended standards, as noted in the table below. However, the recommended standards are for new bridges on the Interstate System. Bridges to remain in place that do not meet the recommended width may be considered for additional signing or widening depending on further engineering analysis[2].

Table 3.1: Bridge Locations and Condition

Location		Feature Crossed	Year Built	Width (feet)	Length (feet)	Structure Condition	Deck Condition
I-15	RP 279.98 (NB)	Sun River	1966	28[(a)]	485	Good	Good
	RP 279.98 (SB)	Sun River	1966	28[(a)]	485	Good	Good
	RP 280.09 (NB)	5th Ave SW	1967	37[(a)]	125	Good	Good
	RP 280.09 (SB)	5th Ave SW	1967	37[(a)]	125	Good	Good
	RP 282.55 (NB)	Vaughn Rd / BNSF RR	1967	28[(a)]	354	Good	Fair-1
	RP 282.55 (SB)	Vaughn Rd / BNSF RR	1967	28[(a)]	359	Good	Fair-1
I-315	RP 0.01	I-15	1967	45[(a)]	294	Good	Fair-1
	RP 0.34 (EB)	14th St SW	1967	36[(a)]	150	Good	Fair-2
	RP 0.34 (WB)	14th St SW	1967	45[(a)]	145	Good	Fair-1
	RP 0.34 (EB Off)	14th St SW	1997	23[(a)]	136	Good	Good
	RP 1.06 (EB)	BNSF RR	1946	45[(a)]	178	Good	Fair-2
	RP 1.06 (WB)	BNSF RR	1967	37[(a)]	208	Good	Fair-2
	RP 1.06 (WB Off)	BNSF RR	1996	23[(a)]	186	Good	Good
Central Ave	RP 0.16 (EB)	BNSF RR	1967	27	551	Good	Fair-1
	RP 0.16 (WB)	BNSF RR	1967	27	551	Good	Fair-1
10th Ave S	RP 94.61 (EB)	Missouri River	1983	40	2122	Good	Fair-1
	RP 94.61 (WB)	Missouri River	1951	28	2093	Good	Good

Source: MDT Bridge Management System, 2014.
[(a)] Interstate bridge width does not meet existing standards.

[2] MDT *Bridge Design Standards*, National Highway System (NHS) Interstate

3.1.3 Operations

The Interstate System within the study area is considered a Level I winter maintenance level according to the MDT *Maintenance Operations and Procedures Manual.*[3] A Level I roadway receives the highest level of maintenance and attention during inclement weather events. Level I routes are eligible to receive up to 24-hour-per-day coverage during storms. The primary objective is to keep at least one travel lane in each direction open to traffic and to provide intermittently bare pavement as soon as possible. Within the study area, there are additional operation controls aimed at improving the function of the transportation system.

- **Snow Fence:** There are multiple locations with snow fences at and near the 10th Avenue South Interchange. The snow fence is intended to trap and prevent snow from blowing across the roadway.
- **Variable Message Sign (VMS):** To address vehicle operations related to adverse weather conditions, portable VMSs are used to alert motorists of changes in weather conditions. The VMSs are commonly deployed near the Gore Hill Interchange during high wind events.
- **Bridges:** Bridges typically freeze quicker than the normal roadway surface, causing operational issues for motorists. Signing alerting motorists to watch for ice on the bridges are used during the winter months.
- **Detours:** Concerns have been noted about not having a viable detour route for the Gore Hill area. Incidents occurring near Gore Hill have resulted in closed lanes on the Interstate, as well as increases in vehicle delay and queuing.

3.1.4 Pavement Condition

MDT annually tracks and measures pavement condition indices in the corridor. MDTs Pavement Management System (PvMS) is used to analyze the collected data to determine the relative performance of the pavement. Items of primary interest include the presence and degree of cracking and rutting, as well as overall ride quality. By understanding the condition of the pavement, MDT can identify the most appropriate treatments and resources needed to extend pavement life. Several pavement condition indices are monitored through MDT’s PvMS. The performance measures and corresponding indices are such that the numerical value of 100 is assigned to a new pavement with no flaws, and zero is assigned to a highly degraded pavement. The following performance measures are routinely used to track pavement conditions:

- **Ride Index:** This is determined by using an internationally applied roughness index (IRI) in inches per mile and converting the number to a 0 to 100 scale.
- **Rut Index (RI):** This is calculated by converting rut depth to a 0 to 100 scale. Rut measurements are taken approximately every foot and averaged into one-tenth-mile reported depths.
- **Alligator Crack Index (ACI):** This is measured by combining all load-associated cracking and converting the index to a 0 to 100 scale.
- **Miscellaneous Cracking Index (MCI):** This is calculated by combining all non-load-associated cracking and converting the index into a 0 to 100 scale.
- **Overall Performance Index (OPI):** This is determined by combining and placing various weighting factors on the IRI, RI, ACI, and MCI figures and converting the index to a 0 to 100

[3] MDT *Maintenance Operations and Procedures Manual*, Chapter 9, Winter Maintenance Program, December 2009, http://www.mdt.mt.gov/publications/docs/manuals/mmanual/chapt9c.pdf

scale. The OPI is calculated to provide a single index describing the current general health of a particular route or system.

The most important performance measure is the OPI, as this index includes all the aforementioned indices. An OPI of 80 to 100 is considered “good,” 60 to 79.9 is “fair,” and 0 to 59.9 is “poor.” As shown in **Table 3.2**, the various pavement condition performance measures generally indicate good performance for I-15. Between RP 282.2 and RP 286.6 on I-15, however, the OPI indicates poor overall performance. A resurfacing project is planned for I-15 between RP 282.2 and RP 285.9. It is anticipated that this project would be let in 2017. Information for OPI on I-315 indicates a poor to fair pavement condition.

Table 3.2: Pavement Condition

Route	Begin RP	End RP	Surface Width	Last Surface	Last Treatment	Flexible Thickness (feet)	IRI	RI	ACI	MCI	OPI
I-15 NB	270.5	282.2	38	2007	2007	0.33	86.2	76.5	99.8	100.0	79.7
I-15 SB	270.5	282.2	38	2007	2007	0.33	88.8	78.7	99.2	100.0	82.6
I-15 NB	282.2	286.6	38	1999	2006	0.75	49.0	64.0	69.3	95.1	43.1
I-15 SB	282.2	286.6	38	1999	2006	0.75	44.0	72.0	88.0	96.2	51.0
I-315 EB	0.0	1.4	38	1996	1996	0.34	59.3	67.0	91.3	98.3	60.5
I-315 WB	0.0	1.4	38	1996	1996	0.34	83.0	73.0	80.1	99.8	57.6

Source: MDT Pavement Management System, 2014

3.1.5 Alternative Transportation Modes

There are currently no dedicated bicycle or pedestrian facilities along the study corridor. The *Great Falls Area LRTP* identifies a recommendation for a multi-use path adjacent to the study area near the junction of 6th Street SW and I-315. Spot improvements to the Central Avenue crossing of I-15 and the railroad are also recommended in the *LRTP* to accommodate bike lanes.[4]

3.1.6 Railroad

A service line for BNSF Railway runs within the study area. The Interstate crosses over the railroad at two locations within the study area: along I-15 Emerson Junction and along I-315 just east of 14th Street Southwest. Additionally, Central Avenue crosses over the railroad just west of Vaughn Road within the study area. More information about the bridge structures is provided in **Section 3.1.2**.

3.1.7 Air Service

The Great Falls International Airport is adjacent to the study area. Access to the airport is provided by Airport Drive, which connects to the Gore Hill Interchange. While it has been categorized as a “primary commercial service” airport by the National Plan of Integrated Airport Systems, it also has a military component. The airport is home to Great Falls Air National Guard Base and the Montana Air National Guard’s 120th Air Lift Wing, an Air National Guard unit employed in air defense. The airport also offers substantial infrastructure for the air cargo industry. FedEx operates a warehouse as a sorting and distribution hub for Montana. The U.S. Customs Border Patrol operates an office at the airport, which facilitates international travel.

[4] *Great Falls Area Long Range Transportation Plan – 2014*, page 219.

3.1.8 Utilities

I-15 in the study area includes overhead power and telephone crossings. Longitudinal occupancy of Interstate right-of-way is not permitted, and, as such, utility involvement is limited. Electric power and natural gas utilities are provided by Northwestern Energy. CenturyLink provides telecommunication services to the study area.

3.2 Geometric Conditions

Existing roadway geometrics were evaluated and compared to current MDT standards. Available as-built drawings were reviewed for the freeway system within the study area. Field reviews of the study corridor took place in July 2014 to confirm and supplement information contained in the as-built drawings, as well as to identify additional areas of concern within the study area.

The MDT *Road Design Manual* and *Traffic Engineering Manual* specifies general design principles and controls that determine the overall operational characteristics of the roadway. Of critical importance to determining design standards is the design speed. MDT's manuals provide guidance for design speed based on facility and operating characteristics; however, some judgment is necessary. A facility's design speed and its operating speed may differ. The design speed is a selected speed used to determine the various geometric design features of the roadway. The operating speed is the highest overall speed at which a driver may travel on a given section of roadway under favorable weather conditions and prevailing traffic conditions without at any time exceeding the safe speed as determined by the design speed. The design criteria for the study corridor are based on current MDT standards as described in the following sections.

3.2.1 Mainline Interstate

The mainline Interstate is characterized as a controlled access, four-lane, divided highway with high travel speeds. The key purpose of the mainline Interstate is to carry traffic over large distances quickly. The following subsections provide the analysis of the current geometric conditions along the Interstate within the study area. The evaluation compares the existing geometrics to current design standards. Note that design standards change over time. Locations that do not meet current design standards may have met standards in place during the time of construction. Additionally, it is possible that design exceptions may have been used during the initial design process.

Design Criteria

Table 3.3 lists current design standards for freeway (NHS-Interstate) routes according to MDT design criteria. The freeway design criteria depend on terrain and area context (i.e., urban or rural). Based on the definitions provided in MDT's *Road Design Manual*, most of I-15 within the study area appears to be of rural context with level terrain (70-miles-per-hour [mph] design speed) with some areas of rolling terrain (60-mph design speed). I-315 appears to be of urban context (50-mph design speed). For the purposes of this report, areas along I-15 that do not meet 70-mph design standards and areas along I-315 that do not meet 50-mph design standards were noted as being substandard. A final determination of design speed will ultimately be made during project development.

Table 3.3: Geometric Design Criteria (Freeway)

Category	Design Element		Rural	Urban
Design Controls	Design Forecast Year (Geometrics)		20 Years	20 Years
Design Controls	Design Speed[(a)]	Level	70 mph	50 mph
		Rolling	60 mph	
		Mountainous	50 mph	
Design Controls	Level of Service		B	B
Roadway Elements	Travel Lane Width[(a)]		4@12'	4@12'
Roadway Elements	Shoulder Width[(a)]	Outside Shoulder	10'	10'
		Inside Shoulder	4'	4'
Roadway Elements	Cross Slope	Travel Lane[(a)]	2%	2%
		Shoulder	2%	2%
Roadway Elements	Median Width	Level	Minimum: 36'	Desirable: 36' Minimum: 16'
		Rolling	Minimum: 36'	
		Mountainous	Minimum: 16'	
Earth Cut Sections	Ditch	Inslope	6:1 (Width: 6')	6:1 (Width: 6')
		Width	10' Min.	10'
		Slope	20:1 towards back slope	20:1 towards back slope
Earth Cut Sections	Back Slope; Cut Depth at Slope Stake	0' - 5'	5:1	5:1
		5' - 10'	Level/Rolling: 4:1; Mountainous: 3:1	3:1
		10' - 15'	Level/Rolling: 3:1; Mountainous: 2:1	2:1
		> 15'	Level/Rolling: 2:1; Mountainous: 1.5:1	1.5:1
Earth Fill Slopes	Fill Height at Slope Stake	0' - 10'	6:1	6:1
		10' - 20'	4:1	4:1
		20' - 30'	3:1	3:1
		> 30'	2:1	2:1

Category	Design Element		Rural			Urban
Alignment Elements	DESIGN SPEED		50 mph	60 mph	70 mph	50 mph
Alignment Elements	Stopping Sight Distance[(a)]		425'	570'	730'	425'
Alignment Elements	Minimum Radius (e=8.0%)[(a)] [(b)]		760'	1,200'	1,820'	760'
Alignment Elements	Superelevation Rate[(a)]		e_{max}=8.0%			e_{max}=8.0%
Alignment Elements	Vertical Curvature (K-Value)[(a)]	Crest	85	151	247	84
		Sag	96	136	181	96
Alignment Elements	Maximum Grade[(a)]	Level	3%			5%
		Rolling	4%			
		Mountainous	5%			
Alignment Elements	Minimum Vertical Clearance[(a)]		17.0'			17.0'

Source: MDT Road Design Manual, Chapter 12, Figure 12-3, "Geometric Design Criteria for Rural Principal Arterials" (National Highway System-Non-Interstate), 2008
[(a)] Controlling design criteria (see Section 8.8 of the MDT Road Design Manual)
[(b)] Super elevation rate (e)

Horizontal Alignment

Elements comprising horizontal alignment include curvature, superelevation (i.e., the bank on the road), and sight distance. These horizontal alignment elements influence traffic operation and safety and relate directly to the design speed of the corridor. MDT's standards for horizontal curves are defined in terms of curve radius, and they vary based on design speed. For a 70-mph design speed (level terrain), the minimum recommended radius is 1,810 feet with a minimum stopping sight distance (SSD) of 730 feet. The minimum recommended radius and SSD for a 60-mph design speed (rolling terrain) are 1,200 feet and 570 feet, respectively. For an urban freeway (50-mph design speed), a minimum radius of 760 feet and a minimum sight distance of 425 feet are recommended.

Table 3.4 summarizes each horizontal curve on the Interstate roadways within the study area. A determination of whether the curve met standards was noted based on the design criteria discussed previously. The controlling design criteria for the horizontal curves are radius and SSD. Stopping sight distance for a horizontal curve is evaluated based on the ability to see through the inside of the corner. Minimum sight obstruction distances were calculated based on the criteria contained in the *Traffic Engineering Manual.*[5] The minimum sight obstruction distance is measured from the center of the inside travel lane and defines the area that should be clear of obstructions to allow for the recommended SSD.

There are five existing horizontal curves along I-15 within the study area and two horizontal curves along I-315. Four of the five curves along I-15 meet the minimum standards for horizontal curvature based on a 70-mph design speed (level terrain). The failing curve, at RP 282.37, does not meet the minimum radius requirements at a 70-mph design speed; however, the curve does meet the radius requirements for a 60-mph design speed (rolling terrain). Along I-315, one horizontal curve does not meet urban freeway standards (50-mph speed) based on curve radius. All horizontal curves were found to have adequate SSD.

Table 3.4: Horizontal Curve Attributes

Curve Location (RP)		Length (feet)	Radius (feet)	Min. Sight Obstruction (feet)	Design Speed Met (mph)	Meets Standards	Comments
I-15	277.2	2,557	5,730	11.6	70	**YES**	
	278.9	4,334	5,732	11.6	70	**YES**	
	280.7	3,892	3,274	20.3	70	**YES**	
	282.4	986	1,637	40.5	60	**NO**	Does not meet level terrain standards based on curve radius.
	282.9	956	1,909	34.8	70	**YES**	
I-315	0.07	350	739	30.3	45	**NO**	Does not meet urban freeway standards based on curve radius.
	0.29	250	1,146	19.6	55	**YES**	

Vertical Alignment

Vertical alignment is a measure of the elevation change of a roadway. The length and steepness of grades directly affect the operational characteristics of the roadway. The controlling design limits for vertical curves are SSD, vertical curvature (K-value), and maximum grade. Vertical curves can be placed into two categories: crest and sag. A crest curve is created at the top of a hill or when the grade decreases. Conversely, a sag curve occurs at the bottom of a hill or when the grade increases.

[5] MDT *Traffic Engineering Manual*, Chapter 25, Section 25.5, Equation 25.5-1

Table 3.5 lists the location and controlling design features for each vertical curve along the Interstate roadways within the study area. According to the *Road Design Manual*, the maximum allowable grades are 3 percent for level terrain, 4 percent for rolling terrain, and 5 percent for mountainous terrain, although grades of up to 7 percent may be provided with approval. The rate of vertical curvature is expressed in terms of the K-value. The K-value is defined as a function of the length of the curve compared to the algebraic change in grade, which comprises either a sag or a crest vertical curve. For a 70-mph design speed (level terrain), minimum K-values of 247 and 181 are recommended for crest and sag vertical curves, respectively. A minimum SSD of 730 feet is recommended for a 70-mph design speed. For sag curves, SSDs only apply where overhead structures exist. No sag curves have existing overhead obstructions within the study area.

Within the study area, there are 19 vertical curves along I-15 and 2 vertical curves on I-315. Both vertical curves along I-315 meet urban freeway standards. Of the 19 vertical curves along I-15, 15 meet existing standards for a 70-mph design speed (level terrain). Two curves have maximum grades that do not meet level terrain standards; however, they do meet standards for mountainous terrain. One curve has a K-value below standards for level terrain, while another curve does not meet level terrain standards for K-value and SSD.

Table 3.5: Vertical Curve Attributes

Curve Location (RP)		Type	Length (feet)	Grade Back	Grade Ahead	K-value	SSD (feet)	Design Speed Met (mph)	Meets Standards	Comments
I-15	276.2	Crest	800	0.8%	0.1%	1,188.7	2,003	70	**YES**	
	276.7	Crest	800	0.1%	-0.6%	1,164.5	1,971	70	**YES**	
	277.1	Crest	1,000	-0.6%	-1.5%	1,127.4	1,717	70	**YES**	
	277.3	Sag	1,000	-1.5%	-0.2%	777.0	-	70	**YES**	
	277.6	Crest	800	-0.2%	-0.8%	1,232.9	2,063	70	**YES**	
	277.9	Crest	1,100	-0.9%	-5.0%	265.1	756	50	**NO**	Does not meet level terrain standards based on grade.
	278.8	Sag	1,000	-5.0%	-1.0%	250.0	-	50	**NO**	Does not meet level terrain standards based on grade.
	279.3	Crest	1,000	-1.0%	-2.9%	540.5	1,083	70	**YES**	
	280.0	Sag	1,100	-2.9%	0.9%	292.6	-	70	**YES**	
	280.2	Crest	1,100	0.9%	-0.8%	643.3	1,181	70	**YES**	
	280.5	Sag	400	-0.8%	1.5%	173.9	-	60	**NO**	Does not meet level terrain standards based on K-value.
	280.8	Crest	600	1.5%	-0.3%	329.7	893	70	**YES**	
	281.7	Sag	800	-0.2%	0.2%	2,000.0	-	70	**YES**	
	282.3	Sag	800	0.2%	2.5%	355.6	-	70	**YES**	
	282.5	Crest	750	2.5%	-1.0%	220.6	690	60	**NO**	Does not meet level terrain standards based on K-value and SSD.
	282.7	Sag	200	-1.0%	-0.2%	250.0	-	70	**YES**	
	282.7	Crest	200	-1.0%	-1.1%	5,000.0	2,708	70	**YES**	
	283.0	Crest	200	-0.2%	-0.9%	266.7	1,539	70	**YES**	
	283.0	Sag	200	-1.1%	-0.9%	1,333.3	-	70	**YES**	
I-315	0.09	Crest	800	1.0%	-4.5%	145	560	50	**YES**	
	0.28	Sag	400	-4.5%	-2.3%	180	-	50	**YES**	

3.2.2 Interchanges

The purpose of an interchange is to allow traffic to enter or exit the Interstate with minimal disturbance to its traffic stream. This is accomplished by using grade-separated intersections connected by ramps. There are four interchanges along I-15 and one interchange along I-315 within the study area. This section discusses the geometric conditions of the five interchanges.

Standards

The five interchanges within the study area were evaluated based on a variety of standards. The MDT *Road Design Manual* provides general geometric standards for horizontal and vertical curvature for interchange ramps, while the MDT *Traffic Engineering Manual* provides guidance for ramp lengths to allow for vehicle acceleration and deceleration. **Table 3.6** provides the interchange ramp standards used to evaluate the interchanges as defined by MDT.

Table 3.6: Interchange Ramp Standards

Type	Criteria		Standard
Exit Ramp	Taper Rate	Taper Design	2 to 5 degrees
		Parallel Design	215 feet
	Deceleration Length (L_d)		[a]
	Sight Distance in Advance of Gore		1,180 feet
Entry Ramp	Taper Rate	Taper Design	50:1 to 70:1
		Parallel Design	350 feet
	Acceleration Rate (L_a)		[b]
	Horizontal Curve Radius		1,000 feet
Spacing	Exit - Entrance		500 feet
	Entrance - Exit		2,000 feet
Auxiliary Lane Drop [c]	Within an Interchange		500 feet to 1,000 feet

Source: MDT Traffic Engineering Manual, Chapter 29, November 2007
[a] *MDT Traffic Engineering Manual, Section 29.5.1.3*
[b] *MDT Traffic Engineering Manual, Section 29.5.2.3*
[c] *An auxiliary lane should be provided where the distance between the end of the entrance terminal and the beginning of an exit terminal is less than 1,500 feet. An auxiliary lane may be dropped at an exit if properly signed and designed.*

Ensuring adequate ramp lengths and proper geometrics is necessary to provide for safe vehicle interaction at Interstate entrance and exit points. Additionally, the spacing between interchange ramps affects vehicle interactions and can influence traffic flow and safety. Ramps that are too close together can result in additional vehicle conflicts due to merging and diverging traffic. An additional concern regarding ramp spacing is vehicle lane-shifting patterns. Closely spaced interchanges and/or intersections may require vehicles to shift between lanes to reach their intended lane. Traffic flow and safety issues may result if enough length is not provided for in areas where lane shifts are necessary to enter or exit the Interstate.

Horizontal Alignment

The horizontal alignment of a ramp is controlled by the radius of any curve on the ramp, super elevation, taper angle, taper length, gap acceptance length (L_g), and deceleration/acceleration lengths (L_d/L_a). The limiting values for these characteristics are functions of the design speed for a given ramp. For this analysis, the minimum design speed was determined based on the super elevation and radius for each given curve. **Table 3.7** presents the horizontal geometric attributes for each of the ramps.

Table 3.7: Interchange Horizontal Alignment Attributes

Curve Location		Radius (feet)	Super-elevation	Taper Rate	L_d/L_a (feet)	L_g (feet)	Design Speed Met (mph)	Meets Standards	Comments
Gore Hill	SB ON	2,865	0.04	50:1	1,513	300	50	NO	Does not meet standards based on acceleration length.
	SB OFF	2,953	0.05	4°30'00"	358	-	50	YES	
		3,773	0.03[a]	-	-	-	45	YES	
	NB ON	2,865	0.04[a]	50:1	1,604	300	50	NO	Does not meet standards based on acceleration length.
	NB OFF	2,865	0.04	4°30'00"	323	-	50	NO	Does not meet standards based on deceleration length.
10th Ave S	SB ON	764	0.08	-	-	-	50	YES	
		764	0.07	[b]	-	[b]	50	YES	
	SB OFF	5,730	0.03	5°00'00"	463	-	60	NO	Does not meet standards based on deceleration length.
		385	0.08	-	-	-	35	YES	
		198	0.08	-	-	-	25	YES	
		358	0.08	-	-	-	35	YES	
	WB OFF	382	0.08	4°30'00"	310	-	35	YES	
	NB ON			[b]	590[c]	590[c]		NO	Does not meet standards based on acceleration length.
	NB OFF	5,730	0.03	4°30'00"	-	-	60	YES	
		2,339	0.03	-	740	-	35	YES	
Central Ave	NB OFF	3,274	0.03[a]	4°30'00"	1,388	-	45	YES	
		5,730	0.03[a]	-	-	-	60	YES	
	NB ON	7,640	0.02[a]	50:1	1,491	428	55	NO	Does not meet standards based on acceleration length.
	SB ON	1,359	0.06[a]	50:1	1,379	300	45	NO	Does not meet standards based on acceleration length.
	SB OFF	3,204	0.03[a]	7°43'00"	1,144	-	45	NO	Does not meet standards based on taper rate.
		1,637	0.03[a]	-	-	-	30	YES	
Emerson Junction	NB ON	1,433	0.05[a]	-	-	-	40	YES	
		1,146	0.04[a]	50:1	266	266	30	NO	Does not meet standards based on acceleration length.
	SB OFF	1,910	0.06[a]	4°30'00"	0	-	50	NO	Does not meet standards based on deceleration length.
		1,146	0.08[a]	-	-	-	55	NO	
14^{th} St SW	EB OFF	230	0.08[a]	4°34'26"	503	-	30	YES	
	EB SHARED	246	0.06[a]	-	-	-	30	YES	
	EB ON	382	0.02[a]	3°48'51"	930	790	<25	YES	
	WB ON	170	0.08[a]	3°49'00"	505	305	25	NO	Does not meet standards based on acceleration and gap acceptance length.
		170	0.08[a]	-	-	-	25	YES	
	WB OFF	521	0.02[a]	4°34'26"	714	-	<25	YES	
		382	0.07[a]	-	-	-	35	YES	

[a] *Value measured in the field.*
[b] *Information unavailable.*
[c] *Estimated based on aerial photography.*

Vertical Alignment

The vertical alignment of a ramp is expressed in terms of the rate of curvature (K-value) and vertical grade. For a crest curve, the minimum curvature depends on the SSD for a given design speed. For sag curves, the minimum curvature depends on rider comfort at a given design speed. The vertical curves on the interchange ramps were evaluated based on a 50-mph design speed. The minimum K-value for a crest or sag vertical curve is 84 or 96, respectively. The maximum grade for a 50-mph design speed is 5 percent.

Table 3.8 presents the vertical geometric design attributes of the each interchange ramp within the study area. Many of the vertical curves fail to meet the minimum curvature required for a 50-mph design speed. A lower design speed may, however, result in acceptable curvature values. The design speed met based on the K-value is shown in the table. In addition, there are some ramps with grades exceeding 5 percent.

Interchange Spacing

Providing for proper interchange spacing is necessary to accommodate vehicular maneuvers, for all signing, and to achieve optimal capacity. In urban areas such as Great Falls, interchanges are more likely to be spaced closer together than in rural areas. The recommended spacing from an exit ramp to an entrance ramp is 500 feet. Conversely, 2,000-foot spacing is recommended between an entrance ramp and an exit ramp.[6] These are initial recommendations, and further traffic analysis should be conducted according to procedures outlined in the *Highway Capacity Manual*. **Table 3.9** shows the interchange spacing attributes within the study area.

For locations where recommended spacing lengths are unachievable, auxiliary lanes may be used to accommodate weaving and merging/diverging traffic characteristics. Auxiliary lanes should be provided where the distance between entrance and exit ramps is less than 1,500 feet.[7] No auxiliary lanes are currently provided within the study area.

The 10th Avenue South and 14th Street Southwest Interchanges along I-315 are spaced closer than 1,500 feet. This location has weaving and merging/diverging characteristics that result in reduced capacity and operational concerns (**See Section 3.3.3**).

[6] MDT *Traffic Engineering Manual*, Chapter 29, Section 29.3.6
[7] MDT *Traffic Engineering Manual*, Chapter 29, Section 29.3.7

Table 3.8: Interchange Vertical Alignment Attributes

Curve Location (RP)		Type	Length (feet)	Grade Back	Grade Ahead	K Value	Stopping Sight Distance (feet)	Design Speed Met (mph)	Meets Standards	Comments
Gore Hill	SB ON	Sag	200	-1.0%	2.3%	60.4	-	40	**NO**	Does not meet standards based on rate of curvature.
	SB OFF	Crest	450	-0.9%	-5.8%	93.2	448	50	**NO**	Does not meet standards based on grade.
	NB ON	Crest	300	-1.3%	-5.0%	80.4	439	45	**NO**	Does not meet standards based on rate of curvature.
	NB OFF	Sag	300	-1.0%	3.9%	60.7	-	35	**NO**	Does not meet standards based on rate of curvature.
		Crest	300	3.9%	0.0%	76.5	425	45	**NO**	Does not meet standards based on rate of curvature.
10th Ave S	SB ON	Sag	700	-5.5%	1.0%	107.4	-	50	**NO**	Does not meet standards based on grade.
	SB OFF	Crest	300	-1.0%	-6.8%	51.7	336	40	**NO**	Does not meet standards based on rate of curvature and grade.
		Sag	350	-6.8%	-3.2%	97.2	-	50	**NO**	Does not meet standards based on grade.
	NB ON	Crest	600	2.1%	-0.2%	260.9	769	70	**YES**	
	NB OFF	Sag	400	-4.7%	-0.8%	102.0	-	50	**YES**	
		Crest	500	-0.8%	-5.0%	119.0	507	55	**YES**	
Central Ave	NB OFF	Sag	300	-0.6%	3.5%	74.1	-	40	**NO**	Does not meet standards based on rate of curvature.
		Crest	200	3.5%	0.0%	57.1	408	40	**NO**	Does not meet standards based on rate of curvature.
	NB ON	Crest	300	-2.0%	-4.0%	150.0	690	55	**YES**	
		Sag	400	-4.0%	1.3%	75.8	-	40	**NO**	Does not meet standards based on rate of curvature.
	SB ON	Sag	400	-1.2%	2.0%	127.0	-	55	**YES**	
	SB OFF	Crest	300	0.0%	-1.5%	200.0	869	65	**YES**	
		Sag	400	-1.5%	1.7%	123.5	-	55	**YES**	
Emerson Junction	NB ON	Sag	500	-0.7%	4.3%	100.0	-	50	**YES**	
		Crest	400	4.3%	-1.0%	76.2	406	45	**NO**	Does not meet standards based on rate of curvature.
	SB OFF	Sag	250	0.0%	4.5%	55.6	-	35	**NO**	Does not meet standards based on rate of curvature.
		Crest	400	4.5%	-0.2%	84.4	428	50	**YES**	
I-315 Exit 0 (14th St)	EB OFF	Crest	300	-2.3%	-3.9%	187.4	824	60	**YES**	
		Crest	300	-3.9%	-5.0%	271.2	1126	70	**YES**	
	EB SHARED	Sag	300	-5.0%	-0.4%	65.4	-	40	**NO**	Does not meet standards based on rate of curvature.
	EB ON	Crest	400	5.0%	0.3%	85.3	430	50	**YES**	
		Crest	200	0.3%	-2.0%	88.1	575	50	**YES**	
	WB ON	Crest	250	-3.1%	-5.6%	99.5	555	50	**NO**	Does not meet standards based on grade.
	WB OFF	Crest	500	3.0%	-4.2%	69.4	387	45	**NO**	Does not meet standards based on rate of curvature.

Table 3.9: Interchange Spacing Attributes

	Location	Type	Length (feet)	Meets Standards	Comments
I-15 NB	Gore Hill	Exit - Entrance	2,500	**YES**	
	Gore Hill to 10th Ave S	Entrance - Exit	3,640	**YES**	
	10th Ave S	Exit - Entrance	2,250	**YES**	
	10th Ave S to Central Ave	Entrance - Exit	5,960	**YES**	
	Central Ave	Exit - Entrance	2,475	**YES**	
I-15 SB	Central Ave	Exit - Entrance	2,440	**YES**	
	Central Ave to 10th Ave S	Entrance - Exit	7,760	**YES**	
	10th Ave S	Exit - Entrance	1,400	**YES**	
	10th Ave S to Gore Hill	Entrance - Exit	2,700	**YES**	
	Gore Hill	Exit - Entrance	2,640	**YES**	
I-315 EB	I-15 to 14th St SW	Entrance - Exit	570	**NO**	Does not meet interchange spacing standards.
	14th St SW	Exit - Entrance	1,100	**YES**	
I-315 WB	14th St SW	Exit - Entrance	1,340	**YES**	
	14th St SW to I-15	Entrance - Exit	780	**NO**	Does not meet interchange spacing standards.

Access

The FHWA *Interstate System Access Informational Guide* provides technical and policy support for evaluating new or modified access to the Interstate System. The *Guide* provides information and methods for analyzing Interstate access to support planning, design, and safety analysis. Included in the *Guide* are eight policy requirements that must be addressed when requesting access to the Interstate. One of the policy requirements states that new or revised access points should provide for all traffic movements.[8] Note that the Emerson Junction is currently configured as a partial interchange. According to current policy, new construction of partial interchanges are not supported by FHWA except in extreme circumstances.

3.2.3 Intersections

The placement of intersections at the termini of ramps can affect the operation of the Interstate and the crossing roadway. If the intersections were placed too close to each other, they could generate queuing issues that could back up onto the Interstate mainline. Queuing can also affect the operation of the crossroad by creating unnecessary delay. As such, intersection locations must be carefully considered to allow enough space for the necessary turn bays needed to alleviate possible queuing issues. The geometric design of an intersection can also cause unnecessary delay if large vehicles cannot make left- or right-hand turns without interfering with traffic. Interchange ramps and intersections should be designed to accommodate a standard semi-truck with a 67-foot wheelbase (WB-67).

Table 3.10 presents the analysis of the left-turn bays, when present, at the intersections within the study area. Included in the table are values for the recommended length based on MDT standards, as well as the 95th percentile queue based on the existing peak hour traffic analysis. The 95th percentile queue is the length at which queue lengths are shorter 95 percent of the time. For example, if the 95th percentile

[8] FHWA *Interstate Access Guidelines Informational Guide*, August 2010, page 6.

queue is 100 feet, queue lengths would be shorter than 100 feet 95 percent of the time and longer than 100 feet 5 percent of the time.

Table 3.10: Left-Turn Bay Lengths

Intersection	Peak Hour Turning Volume (vph)	Recommended Length (feet)	95th Percentile Queue (feet)	Existing Length (feet)	Meets Standards	Comments
14th St SW / EB Ramps	102	70	25	300	**YES**	
14th St SW / WB Ramps	638	[a]	330	115	**NO**	Vehicle queuing along interchange ramp.
Fox Farm Rd / 10th Ave S (EB)	242	280	310	200	**NO**	Does not meet turn-bay length standards.
Fox Farm Rd / 10th Ave S (WB)	486	325[b]	310	350	**YES**	
Central Ave / NB Ramps (EB)	6	50	0	50	**YES**	
Central Ave / SB Ramps (WB)	230	192	20	105	**NO**	Does not meet turn-bay length standards.
Vaughn Road / Central Ave (EB)	71	59	10	150	**YES**	

[a] Outside of the range of standards.
[b] Existing dual-turn lanes

Gore Hill Interchange

Four intersections exist within the immediate vicinity of the Gore Hill Interchange. The southbound off-ramp terminates at a four-legged, two-way, stop controlled intersection with Airport Road and I-15 Frontage Road. Traffic turning from the off-ramp to Airport Road has a free-flowing dedicated right-turn lane. One concern at this intersection is the possibility that drivers traveling northbound on I-15 Frontage Road may travel straight and enter the southbound off-ramp traveling in the wrong direction. Another concern is the proximity of this intersection to the intersection of Airport Road and the southbound on-ramp, a distance of approximately 60 feet. Vehicles attempting to make a left turn onto the southbound on-ramp have to contend with any oncoming traffic leaving the southbound off-ramp intersection.

The intersection of Airport Road and the northbound on- and off-ramps is a typical two-way, stop-controlled intersection. This intersection is located approximately 80 feet from the intersection of Airport Road and Tri-Hill Frontage Road. Traffic performing a left-hand turn onto Tri-Hill Frontage Road has to contend with traffic making a right turn off of the northbound off-ramp, in addition to the traffic traveling southeast across the interchange. The distance between the southbound on-ramp and the northbound ramps is approximately 370 feet.

14th Street Southwest Interchange

The intersections at the ramp termini at 14th Street Southwest are both four-legged signalized intersections. They are approximately 925 feet apart and appear to meet geometric spacing standards. Left-turn bays are provided at both intersections. The intersection of 14th Street Southwest and the westbound ramps has a high volume of left-turning vehicles along the east leg. During the PM peak-hour, left-turn volume exceeds the range of recommended turn bay lengths provided by MDT. Vehicle queuing was noted along the interchange ramp approaching the mainline Interstate.

Fox Farm Road

The intersection of Fox Farm and 10th Avenue South is a four-legged, stop-controlled intersection. This intersection is at the terminus of I-315. A single left-turn bay is provided along the eastbound leg, and dual left-turn lanes are provided along the westbound leg. The left-turn bay along the eastbound leg does not appear to meet existing standards. During the on-site evaluation, observers noted that the queue length from the eastbound left-turn lane often exceeded available storage during the PM peak hour.

Central Avenue Interchange

The Central Avenue Interchange is a diamond interchange with stop-controlled intersections at the ramp terminals and raised medians to provide protected turn-bays. The intersections are spaced approximately 450 feet apart, and they appear to meet geometric design standards. Both on-ramps include channelized right-turn lanes, which require vehicles to merge at the entrance to the ramp.

The intersection along the northbound ramps includes an eastbound left-turn bay that appears to meet minimum length standards. The southbound ramp intersection has a dedicated westbound left-turn lane for vehicles accessing the Interstate. The existing turn-bay length does not appear to meet existing standards; however, minimal vehicle queuing was shown by the traffic analysis.

The southbound off-ramp has a channelized right-turn lane and a dedicated receiving lane along Central Avenue. However, a stop sign requires vehicles to stop before entering Central Avenue. At the intersection of the southbound off-ramp and Central Avenue, three westbound lanes merge to a single lane within approximately 300 feet. There does not appear to be proper signage and/or markings indicating the dropping of two travel lanes.

Emerson Junction

The intersections located at Emerson Junction are both three-legged, unsignalized intersections and are spaced approximately 750 feet apart. The northbound on-ramp intersection with Vaughn Road has a right-turn slip lane for traffic traveling westbound on Vaughn Road. Eastbound traffic has a 40-foot, left-turn storage area between Vaughn Road and the northbound on-ramp. The southbound off-ramp has a single lane serving both left- and right-turning traffic. The southbound off-ramp intersection is scheduled for reconstruction, which will result in a shift to the northwest to provide a more standard “T” intersection.

3.3 Traffic Characteristics

An evaluation of traffic characteristics was completed using available data provided by MDT, as well as field-collected data. Peak-hour, turning-movement counts were conducted at 12 intersections within the study area. Mainline traffic volume counts were also completed at nine locations along the Interstate. Additional traffic information for vehicle speeds, driving patterns, and lane-changing interactions was also documented at various locations along the corridor. The following sections provide details about the existing traffic characteristics of the corridor. Detailed data is included in the **Appendices B**, **C**, and **D**. **Figure 3.1** shows the existing traffic conditions of the study area.

3.3.1 Traffic Volumes

MDT administers annual traffic count data at 12 locations within the study area. MDT, the city of Great Falls, or Cascade County conducts the annual traffic counts, which are adjusted to represent yearly averages for traffic. In addition, an automatic traffic recorder (ATR) is located outside of the study area approximately 3 miles to the northwest of Emerson Junction. The ATR collects traffic data year-round from sensors embedded in the roadway. Data from the other traffic count sites are collected annually at limited times by using pneumatic tube counters.

In addition to existing conditions, MDT provided historic data for the traffic count sites within the study area. The average annual daily traffic (AADT) on I-15 ranges from 5,950 vehicles per day (vpd) north of Central Avenue, to as high as 14,670 vpd north of Gore Hill. Volumes on I-315 approach 25,000 vpd west of Fox Farm Road. The AADT on the non-interstate roads ranges from 4,555 vpd on the Vaughn Frontage Road to 29,800 vpd on 10th Avenue South. **Table 3.11** shows the growth rates experienced within the study area over various time intervals.

Table 3.11: Historic Average Annual Growth Rates

Location		2013 AADT	1994-2013	2000-2013	2007-2013
I-15	S of Gore Hill	6,370	1.4%	0.4%	0.1%
I-15	N of Gore Hill	14,670	1.6%	1.3%	-0.1%
I-15	N of 10th Ave	10,550	1.5%	1.3%	0.3%
I-15	N of Central Ave	5,950	1.2%	0.5%	-1.8%
I-15	N of Emerson	9,090	0.9%	0.1%	-1.2%
I-315	W of 14th St SW	15,140	(a)	(a)	0.8%
I-315	W of Fox Farm	24,680	4.2%	1.8%	0.1%
31st St SW	S of Interchange	8,360	5.6%	4.7%	-0.8%
Airport Dr	N of Interchange	3,640	-0.1%	0.7%	2.3%
10th Ave S	Warden Bridge	29,800	1.5%	1.5%	0.4%
Central Ave	E of Interchange	12,514	0.0%	0.5%	3.0%
Central Ave	W of Interchange	7,746	0.6%	1.5%	4.4%
Vaughn Rd	E of Interchange	6,530	0.0%	-0.4%	1.5%
Vaughn Rd	W of Interchange	4,555	0.4%	0.7%	7.4%

Source: MDT Data and Statistics Bureau, Traffic Data Collection Section, 2014
(a) Data unavailable

3.3.2 Mainline Operation

The operational condition of a mainline Interstate highway is often characterized by the level of service (LOS). LOS is a qualitative description of a driver's experience on a highway or facility, as defined in the 2010 Highway Capacity Manual (HCM). LOS of a mainline freeway segment is affected by geometric and traffic characteristics. LOS is determined based on the traffic density of the highway in terms of passenger cars per mile per lane (pc/mi/ln). The inputs used to calculate traffic density include traffic volume, free-flow speed, percentage of trucks and busses, driver population, peak-hour factors, number of travel lanes, and the terrain. LOS can range from A to F with A representing free flow conditions and F representing heavily congested conditions. Analysis of I-15 was performed using Highway Capacity Software (HCS) 2010. The LOS was evaluated during AM and PM peak hour conditions. **Table 3.12** shows the results of the LOS analysis.

Table 3.12: Mainline Level of Service

Location		Direction	AM Peak Hour LOS	AM Peak Hour Density (pc/mi/ln)	PM Peak Hour LOS	PM Peak Hour Density (pc/mi/ln)
I-15	South of Gore Hill	Northbound	**A**	2.1	**A**	2.1
		Southbound	**A**	2.3	**A**	3.3
	North of Gore Hill	Northbound	**A**	4.8	**A**	7.3
		Southbound	**A**	4.7	**A**	6.0
	South of Central Ave	Northbound	**A**	3.0	**A**	4.6
		Southbound	**A**	3.0	**A**	4.5
	North of Central Ave	Northbound	**A**	3.2	**A**	3.0
		Southbound	**A**	2.0	**A**	3.2
	North of Emerson Junction	Northbound	**A**	2.8	**A**	5.9
		Southbound	**A**	5.0	**A**	4.3
I-315	West of 14th St SW	Eastbound	**A**	5.7	**A**	7.5
		Westbound	**A**	5.6	**A**	6.5
	East of 14th St SW	Eastbound	**A**	10.9	**A**	10.7
		Westbound	**A**	6.0	**B**	12.4

The MDT *Traffic Engineering Manual* states that a LOS of B or better is recommended for both urban and rural freeways. I-15 is shown to operate at LOS A during the existing peak hours within the study area. I-315 also operates at LOS A, with the exception of the westbound lane east of 14th Street Southwest, which operates at LOS B during the PM peak hour.

Vehicle Speeds

Vehicle speed data was collected along the I-15 southbound mainline between the 10th Avenue South and Gore Hill Interchanges. This location has a steep upgrade, and it has been noted to have speed differentials between the left and right travel lanes in the southbound direction. The speed data were collected over 24 hours in July 2014. The existing speed limit at this location is 65 mph.

Table 3.13 shows the results of the speed data collection. Included in the table are the 85th percentile speed, the average speed, and the pace. The primary speed data factor for determining the validity of the posted speed limit is the 85th percentile speed. The 85th percentile speed is that speed at or below which 85 percent of vehicles are traveling. For example, if the 85th percentile speed is 65 mph, it means that 85 percent of vehicles are traveling 65 mph or below. The pace is also an important factor, and it represents the 10-mph range within which most vehicles travel.

Table 3.13: Vehicle Speed Data

Location		Volume	Speed Limit (mph)	85th Percentile Speed (mph)	Average Speed	Pace (mph)	
I-15 SB	Right Lane	7,039	65	68.2	59.9	60 - 70	49%
	Left Lane	855	65	74.4	60.6	65 - 75	57%

As shown in the table, it appears that vehicles are generally traveling at higher speeds in the left lane than in the right lane. The 85th percentile speed for the right lane is more than 6 mph lower than the left lane. The pace of the left lane is also shown to be higher than in the right lane. Due to the steep upgrade and the mix of vehicle types, there are often slow-moving vehicles mixed with faster ones at this location. A higher percentage of vehicles in the pace represents fairly even travel speeds, while a lower percent within the pace may point to high-speed variations. At this location, the percentage of vehicles within the pace is relatively low. This is an indicator of large distribution of vehicle speeds. The varying vehicle speeds is likely a result of a mixture of slower moving heavy truck traffic combined with faster moving passenger vehicles.

10th Avenue South / Gore Hill Origin-Destination

An origin-destination (OD) study was conducted between the 10th Avenue South and Gore Hill Interchanges. The intent of the study was to evaluate the travel patterns between the 10th Avenue South and Gore Hill Interchanges in the southbound direction. The study found that during the AM peak hour approximately 65 percent of vehicles that enter the Interstate at 10th Avenue South immediately exit at Gore Hill. During the PM peak hour, this percentage was found to be approximately 48 percent.

3.3.3 Interchange Ramps

Connection between the mainline Interstate highway and local roads is provided by a dedicated ramp road. Similar to the Interstate mainline, the performance of the interchange ramps can be evaluated for LOS. As with traditional roadways, interchange ramps are impacted by the amount of traffic congestion present. For on-ramps, the capacity of the ramp roadway is rarely an issue due to generally free-flowing conditions with no traffic control. For off-ramps, however, congestion on the ramp can cause queuing that may cause failure at the ramp-to-freeway junction. **Table 3.14** provides the results of the LOS analysis for the interchange ramps.

As with the Interstate mainline, a LOS of B or better is recommended for the interchange ramps. Each of the ramps along I-15 within the study area is shown to function at LOS A and appear to have available capacity. All ramps along I-315 function at LOS B or better during the peak hours.

Table 3.14: Interchange Ramp Level of Service

Location		AM Peak Hour		PM Peak Hour	
		LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)
Gore Hill	NB On-ramp	**A**	3.9	**A**	8.7
	NB Off-ramp	**A**	3.7	**A**	3.7
	SB On-ramp	**A**	0.0	**A**	0.0
	SB Off-ramp	**A**	6.2	**A**	7.1
10th Ave S	NB On-ramp	**A**	6.5	**A**	8.6
	NB Off-ramp	**A**	2.9	**A**	5.7
	SB On-ramp	**A**	3.2	**A**	4.7
	SB Off-ramp	**A**	3.4	**A**	5.1
14th St SW	EB On-ramp	**B**	13.5	**B**	12.9
	EB Off-ramp	**A**	5.1	**A**	6.9
	WB On-ramp	**A**	8.3	**A**	9.2
	WB Off-ramp	**A**	3.4	**B**	10.1
Central Ave	NB On-ramp	**A**	0.0	**A**	0.2
	NB Off-ramp	**A**	0.0	**A**	0.0
	SB On-ramp	**A**	1.5	**A**	3.6
	SB Off-ramp	**A**	0.0	**A**	0.0
Emerson Junction	NB On-ramp	**A**	2.8	**A**	8.0
	SB Off-ramp	**A**	6.8	**A**	5.9

I-315 Interchanges

The I-315 Interstate has unique urban traffic characteristics. The Interstate mainline is less than a mile long and begins at the 10th Avenue South Interchange. The 14th Street Southwest Interchange is located close to the 10th Avenue South Interchange, which causes traffic flow issues related to vehicle weaving and merging/diverging. A video of the I-315 Interstate was recorded during the peak hours to evaluate the influence of traffic movements to the area. From the video, traffic movement volumes were counted during the peak hours.

Table 3.15 shows the peak hour volumes along the influencing ramps, as well as the destination of the vehicles expressed as a percentage. For example, during the AM peak hour, 338 vehicles traveled along the I-15 northbound off-ramp at the 10th Avenue South Interchange. Of those 338 vehicles, 10 percent exited at 14th Street Southwest, 58 percent stayed on I-315 in the right lane, and 32 percent merged to the left lane on I-315.

Table 3.15: I-315 Interchange Volumes

Location		AM Peak Hour	PM Peak Hour
10th Ave S	**I-15 NB Off**	**338**	**436**
	14th St SW Off	*10%*	*22%*
	I-315 Right Lane	*58%*	*57%*
	I-315 Left Lane	*32%*	*21%*
	I-15 SB Off	**192**	**239**
	14th St SW Off	*12%*	*35%*
	I-315 Right Lane	*10%*	*10%*
	I-315 Left Lane	*78%*	*55%*
14th St SW	**I-315 EB On**	**498**	**523**
	I-315 Right Lane	*48%*	*55%*
	I-315 Left Lane	*52%*	*45%*
	I-315 WB On	**122**	**161**
	I-15 NB On	*62%*	*49%*
	I-15 SB On, Right Lane	*33%*	*46%*
	I-15 SB On, Left Lane	*5%*	*5%*

3.3.4 Intersections

A LOS analysis was performed at 12 intersections within the study area. The LOS analysis was completed using PTV Vistro software during the AM and PM peak hours. For intersections, LOS is based on vehicle delay, which is influenced by the number of stops, available gaps, and impediments caused by other vehicles. A LOS of A represents little to no delay, while a LOS of F represents substantial delay. A LOS of C or better is generally recommended. The results of the peak-hour, intersection LOS analysis are shown in **Table 3.16**.

For signalized intersections, the LOS is based on the average stopped delay per vehicle. The procedures used to evaluate signalized intersections are based on detailed information on geometry, lane-use, signal timing, peak-hour volumes, arrival types, and other parameters. This information is then used to calculate delays and determine the capacity of each intersection.

LOS for two-way, stop-controlled intersections is based on the delay experienced by each movement within the intersection, rather than on the overall stopped delay per vehicle at the intersection. LOS is defined by the movement with the highest amount of delay. As a result, the intersection LOS may not accurately reflect the performance of the intersection as a whole. For example, a single, left-turning vehicle along the minor, stop-controlled approach may experience high amounts of delay due to a lack of available gaps. This movement may, however, only represent a small portion of the total intersection volume.

Table 3.16: Intersection Level of Service

Intersection Name	Control Type	AM Peak Hour		PM Peak Hour	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
Tri Hill and Frontage Airport Rd	Two-way stop	13.5	**B**	14.5	**B**
I-15 NB and Airport Rd	Two-way stop	16.9	**C**	55.4	**F**
I-15 SB On and Airport Rd	Two-way stop	8.6	**A**	11.0	**B**
I-15 SB Off and Airport Rd	Two-way stop	12.7	**B**	35.3	**E**
14th St SW and I-315 EB	Signalized	14.4	**B**	13.0	**B**
14th St SW and I-315 WB	Signalized	23.0	**C**	19.4	**B**
Fox Farm and I-315	Signalized	45.3	**D**	38.5	**D**
Central Ave and I-15 SB	Two-way Stop	28.0	**D**	42.0	**E**
Central Ave and I-15 NB	Two-way Stop	19.9	**C**	29.1	**D**
Central Ave and Vaughn Rd	Two-way Stop	27.1	**D**	65.0	**F**
Vaughn Rd and I-15 SB	Two-way Stop	10.1	**B**	10.1	**B**
Vaughn Rd and I-15 NB	Two-way Stop	7.3	**A**	7.3	**A**

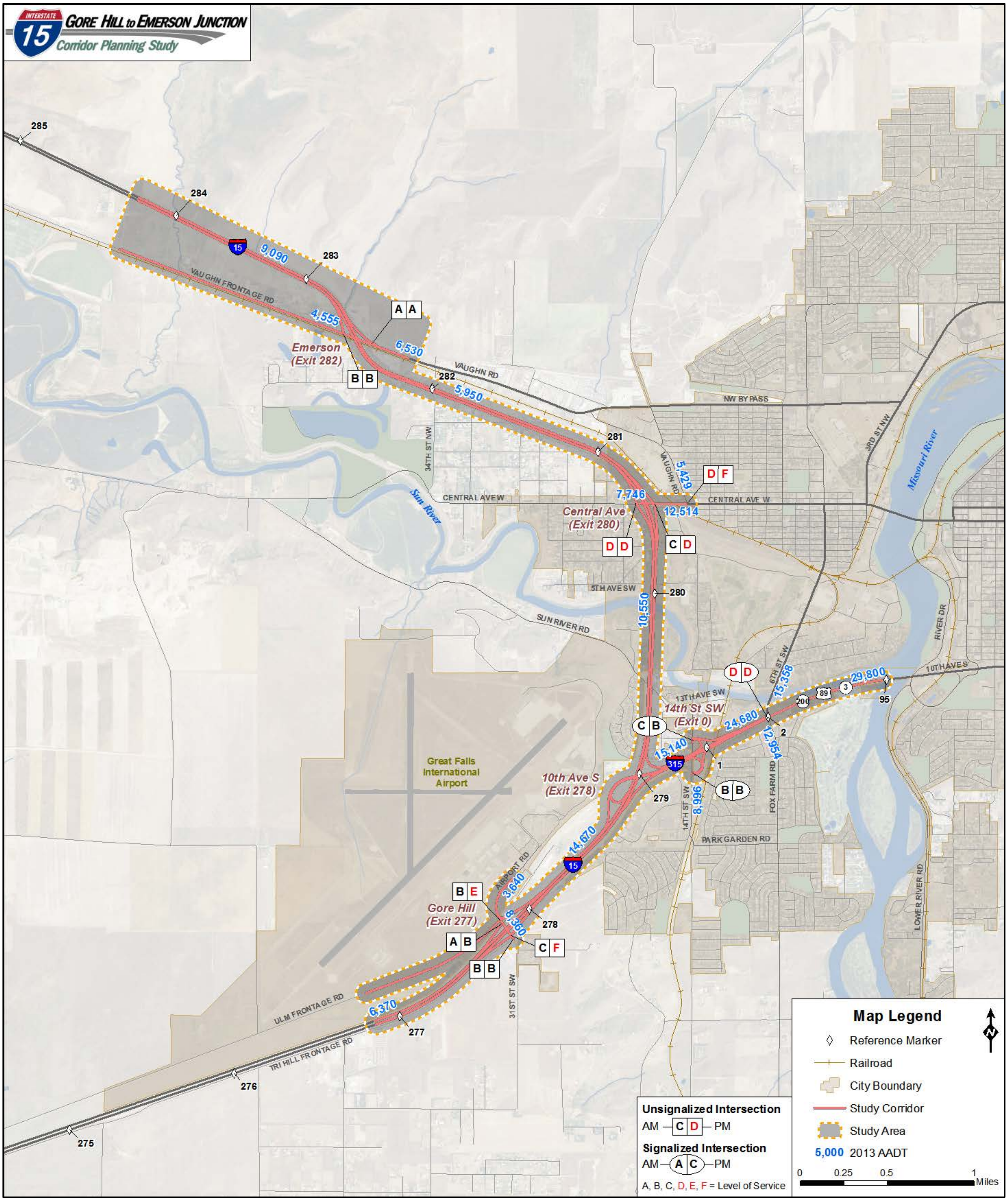

Figure 3.1: Existing Traffic Conditions

3.4 Safety

The MDT Traffic and Safety Bureau provided crash data for all of Cascade County from January 1, 2009, to December 31, 2013. Crash data for the study area were selected using GIS. Records show 525 crashes occurring within the study area during the crash analysis period. Four crashes resulted in fatalities, eight crashes resulted in incapacitating injuries, 41 crashes produced non-incapacitating evident injuries, and 71 crashes resulted in possible injuries. An incapacitating injury is defined as an injury, other than a fatality, which prevents the injured person from walking, driving, or normally continuing the activities the person was capable of performing before injury. **Figure 3.2** presents the spatial distribution of the crash data for the five-year analysis period.

Table 3.17 provides a comparison of the crash rate, crash severity index, and crash severity rate within the study area. The crash data presented in the table are based on crashes occurring from calendar year 2009 through 2013. Crash rates are defined as the number of crashes per million vehicle miles of travel. The crash severity index is the ratio of the sum of the level of crash degree to the total number of crashes. Crash severity rate is determined by multiplying the crash rate by the crash severity index.

Between 2008 and 2012, the statewide average rural crash rate, severity index, and severity rate for the Interstate system was 0.90, 1.83, and 1.65, respectively. For urban Interstates during this same time period, the statewide average crash rate, severity index, and severity rate was 1.21, 1.72, and 2.08, respectively.

Table 3.17: Crash Statistics

	Segment	Begin RP	End RP	# Fatal	# Incap	Total Crashes	AADT 3-year Average	Crash Rate	Severity Index	Severity Rate
I-15	Southwest of Gore Hill	270.4	277.8	0	0	18	6,360	1.55	1.00	1.55
	Northeast of Gore Hill	277.8	278.9	1	2	70	13,474	2.85	1.16	3.29
	10th Ave South to Central Ave	279.9	280.5	0	1	32	9,786	1.79	1.06	1.90
	Central Ave to Emerson Junction	280.5	282.5	0	0	48	6,486	4.06	1.00	4.06
	North of Emerson Junction	282.5	286.5	2	1	43	9,470	2.49	1.37	3.41
I-315	10th Ave South to 14th St Southwest	0	0.3	0	0	13	15,890	0.45	1.00	0.45
	14th St Southwest to Fox Farm	0.3	1.4	0	2	114	25,870	2.41	1.04	2.50
	East of Fox Farm	94.4	95.7	0	0	137	30,890	2.43	1.00	2.43

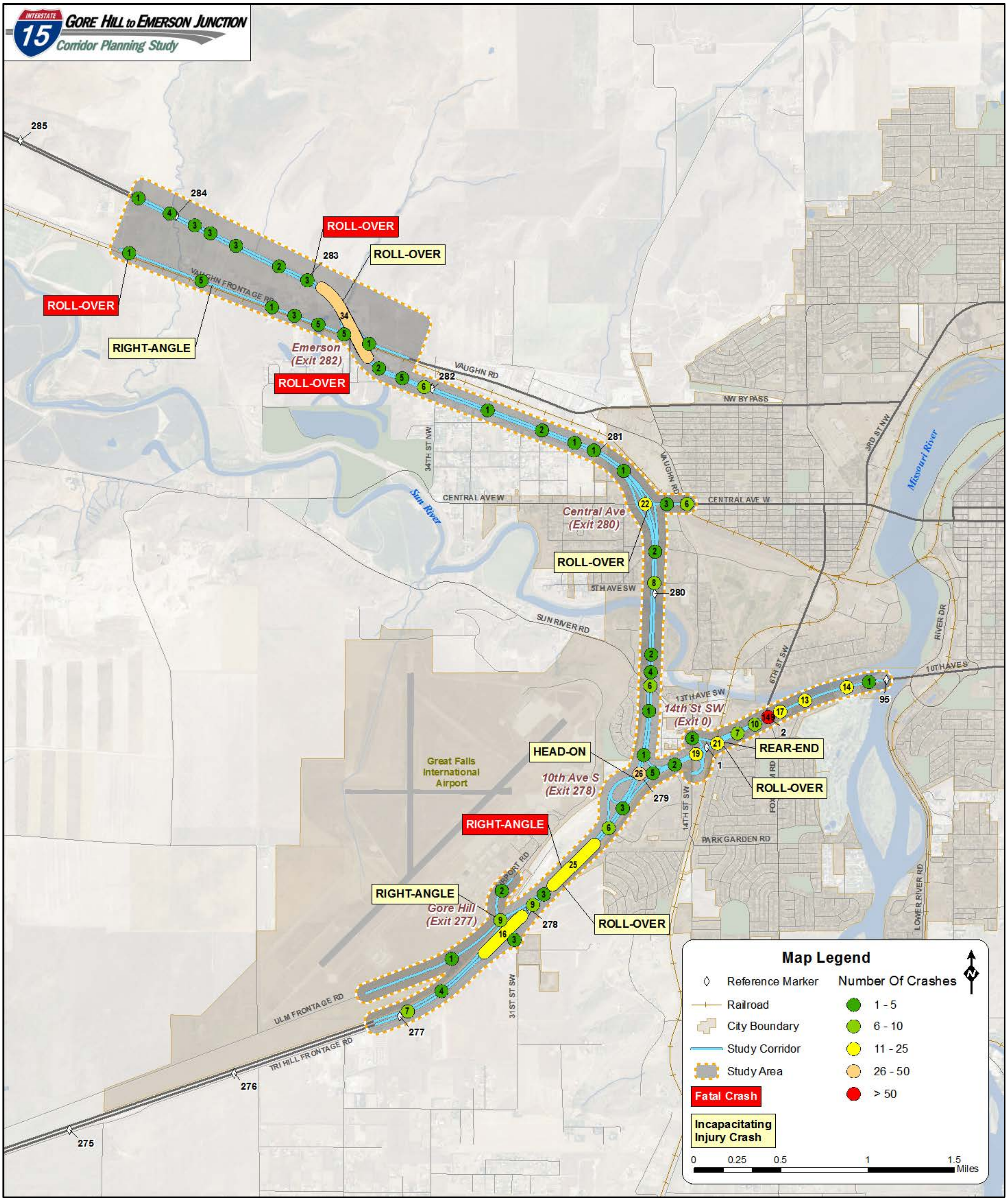

Figure 3.2: Crash Locations

3.4.1 Safety Trends, Contributing Factors, and Crash Clusters

On average, approximately 105 crashes occurred each year during the crash analysis period. Multi-vehicle crashes accounted for nearly 53 percent of crashes, with approximately 62 percent of all crashes occurring in dry conditions. Furthermore, 61 percent of crashes occurred during daylight. Approximately 38 percent of crashes during the analysis period happened when roads were icy, snowy, or wet. The primary contributing factors listed in crashes during the analysis period included careless driving (32 percent of crashes), driving too fast for conditions (21 percent of crashes), disregarding traffic markings/signs/signals (16 percent of crashes), and driving under the influence of alcohol/drugs (14 percent of crashes).

Of the vehicles involved in a crash, 92 percent were passenger vehicles (automobiles, pickups, SUVs, etc.). Records show 15 crashes involving motorcycles, 38 crashes involving heavy trucks with trailers, and 2 crashes involving buses.

The main observed crash trends are rear-end collisions (178) followed by fixed-object collisions (138). Of the fixed-object collisions, 90 of the collisions list contact with guardrails, median barriers, bridge rails, or impact attenuators as the first harmful event. Rear-end collisions are clustered on I-315 and 10th Avenue South. Clusters of fixed-object collisions are present between the Gore Hill and 10th Avenue South Interchanges (11 crashes), I-15 underpass of Sun River Road (7 crashes), I-15 bridge over the Sun River (5 crashes), Central Avenue Interchange (7 crashes), Emerson Junction Interchange (15 crashes), and I-315 from RP 0 to RP 1 (21 crashes).

Approximately 8 percent of reported crashes resulted in rollovers (44 crashes). Two clusters were identified between the Gore Hill and 10th Avenue South Interchanges (7 crashes) and at the Emerson Junction Interchange (10 crashes). Each of the seven rollover crashes between the Gore Hill and the 10th Avenue South Interchanges occurred with dry road conditions.

The road condition was listed as icy or snow-covered in 138 crashes. These crashes appear to be clustered between the Gore Hill and 10th Avenue South Interchanges (12 crashes), I-15 underpass of Sun River Road (6 crashes), Emerson Junction Interchange (19 crashes), and I-315 between 14th Street Southwest Interchange and Fox Farm (60 crashes).

4.0 PROJECTED TRANSPORTATION SYSTEM

Projected transportation conditions were analyzed to estimate how traffic patterns and characteristics may change compared to existing conditions. The analysis was based on known existing conditions and anticipated land development expected to occur out to 2035. The travel demand model developed for the *Great Falls Area LRTP – 2014* was used to determine growth rates for the study area. **Table 4.1** shows the average annual growth rate (AAGR) up to 2035, as defined by the traffic demand model. The AAGR values were applied to known traffic count locations to project 2035 AADT volumes.

Table 4.1: Projected Traffic Volumes

Location		2013 AADT	Traffic Model Projected AAGR [(a)]	2035 Projected AADT
I-15	S of Gore Hill	6,370	0.9%	7,681
I-15	N of Gore Hill	14,670	1.9%	22,358
I-15	N of 10th Ave	10,550	2.1%	16,693
I-15	N of Central Ave	5,950	0.6%	6,804
I-15	N of Emerson	9,090	0.9%	10,998
I-315	W of 14th St SW	15,140	0.8%	17,979
I-315	W of Fox Farm	24,680	0.7%	28,546
31st St SW	S of Interchange	8,360	2.3%	13,678
Airport Dr	N of Interchange	3,640	4.6%	9,887
10th Ave S	Warden Bridge	29,800	0.7%	34,630
Central Ave	E of Interchange	12,514	2.4%	21,270
Central Ave	W of Interchange	7,746	0.1%	7,974
Vaughn Rd	E of Interchange	6,530	1.4%	8,835
Vaughn Rd	W of Interchange	4,555	1.1%	5,762

[(a)] AAGRs were calculated from the traffic model developed for the Great Falls Area LRTP – 2014.

The growth rates from the travel demand model were used to project Interstate mainline peak hour volumes. A LOS analysis was conducted for the Interstate under projected 2035 conditions. **Table 4.2** presents the resulting LOS values for both the AM and PM peak hours. As indicated in the table, all segments along I-15 and I-315 are projected to remain at a LOS B or better under 2035 conditions.

The traffic volumes along the interchange ramps were similarly projected to 2035 using growth rates defined in the travel demand model. The projected LOS of the interchange ramps is presented in **Table 4.3**. All of the interchange ramps are projected to remain within the acceptable bounds of LOS B put forth by MDT.

Table 4.2: Projected Mainline LOS

Location		Direction	AM Peak Hour		PM Peak Hour	
			LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)
I-15	South of Gore Hill	Northbound	**A**	2.6	**A**	2.6
		Southbound	**A**	3.1	**A**	4.0
	North of Gore Hill	Northbound	**A**	7.4	**B**	11.3
		Southbound	**A**	7.2	**A**	9.3
	South of Central Ave	Northbound	**A**	4.8	**A**	7.4
		Southbound	**A**	4.8	**A**	7.2
	North of Central Ave	Northbound	**A**	3.7	**A**	3.4
		Southbound	**A**	2.4	**A**	3.7
	North of Emerson Junction	Northbound	**A**	3.4	**A**	6.5
		Southbound	**A**	6.1	**A**	5.2
I-315	West of 14th St SW	Eastbound	**A**	6.7	**A**	8.9
		Westbound	**A**	6.3	**A**	7.3
	East of 14th St SW	Eastbound	**A**	10.9	**B**	12.5
		Westbound	**A**	6.7	**B**	13.8

Table 4.3: Projected Interchange Ramp LOS

Location		AM Peak Hour		PM Peak Hour	
		LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)
Gore Hill	NB On-Ramp	**A**	9.3	**B**	17.5
	NB Off-Ramp	**A**	5.7	**A**	5.6
	SB On-Ramp	**A**	0.3	**A**	1.2
	SB Off-Ramp	**A**	9.1	**B**	11.5
10th Ave S	NB On-Ramp	**A**	8.4	**B**	11.5
	NB Off-Ramp	**A**	5.9	**B**	10.3
	SB On-Ramp	**A**	6.2	**A**	8.3
	SB Off-Ramp	**A**	6.5	**A**	9.7
14th St SW	EB On-Ramp	**B**	16.1	**B**	15.4
	EB Off-Ramp	**A**	6.1	**A**	8.2
	WB On-Ramp	**A**	9.1	**B**	10.1
	WB Off-Ramp	**A**	4.0	**B**	11.4
Central Ave	NB On-Ramp	**A**	0.0	**A**	1.3
	NB Off-Ramp	**A**	0.0	**A**	0.0
	SB On-Ramp	**A**	6.3	**B**	10.1
	SB Off-Ramp	**A**	0.0	**A**	0.0
Emerson Junction	NB On-Ramp	**A**	3.7	**B**	10.3
	SB Off-Ramp	**A**	8.0	**A**	7.0

Intersection volumes were projected to 2035 by applying growth rates along each intersection approach leg as defined by the travel demand model. The projected intersection LOS results are presented in **Table 4.4**. Similar to the existing LOS, many of the poor-performing intersections are two-way, stop-controlled intersections. All intersections on Central Avenue are projected to operate at a LOS of F if no changes are made before 2035. At Gore Hill, all but the southbound on-ramp intersections are expected to operate at a poor LOS. The three signalized intersections are projected to continue operating at levels similar to their current performance.

Table 4.4: Projected Intersection LOS

Intersection Name	Control Type	AM Peak Hour		PM Peak Hour	
		Delay (s/veh)	LOS	Delay (s/veh)	LOS
Tri Hill and Frontage Airport Rd	Two-way stop	27.3	D	43.7	E
I-15 NB and Airport Rd	Two-way stop	44.2	E	[a]	F
I-15 SB On and Airport Rd	Two-way stop	10.4	B	23.5	C
I-15 SB Off and Airport Rd	Two-way stop	121.8	F	3138.9	F
14th St SW and I-315 EB	Signalized	13.3	B	12.4	B
14th St SW and I-315 WB	Signalized	22.2	C	19.6	B
Fox Farm and I-315	Signalized	39.0	D	35.6	D
Central Ave and I-15 SB	Two-way Stop	178.9	F	314.9	F
Central Ave and I-15 NB	Two-way Stop	113.1	F	445.2	F
Central Ave and Vaughn Rd	Two-way Stop	406.0	F	1422.7	F
Vaughn Rd and I-15 SB	Two-way Stop	11.0	B	11.0	B
Vaughn Rd and I-15 NB	Two-way Stop	7.3	A	7.4	A

[a] Outside the bounds of the software.

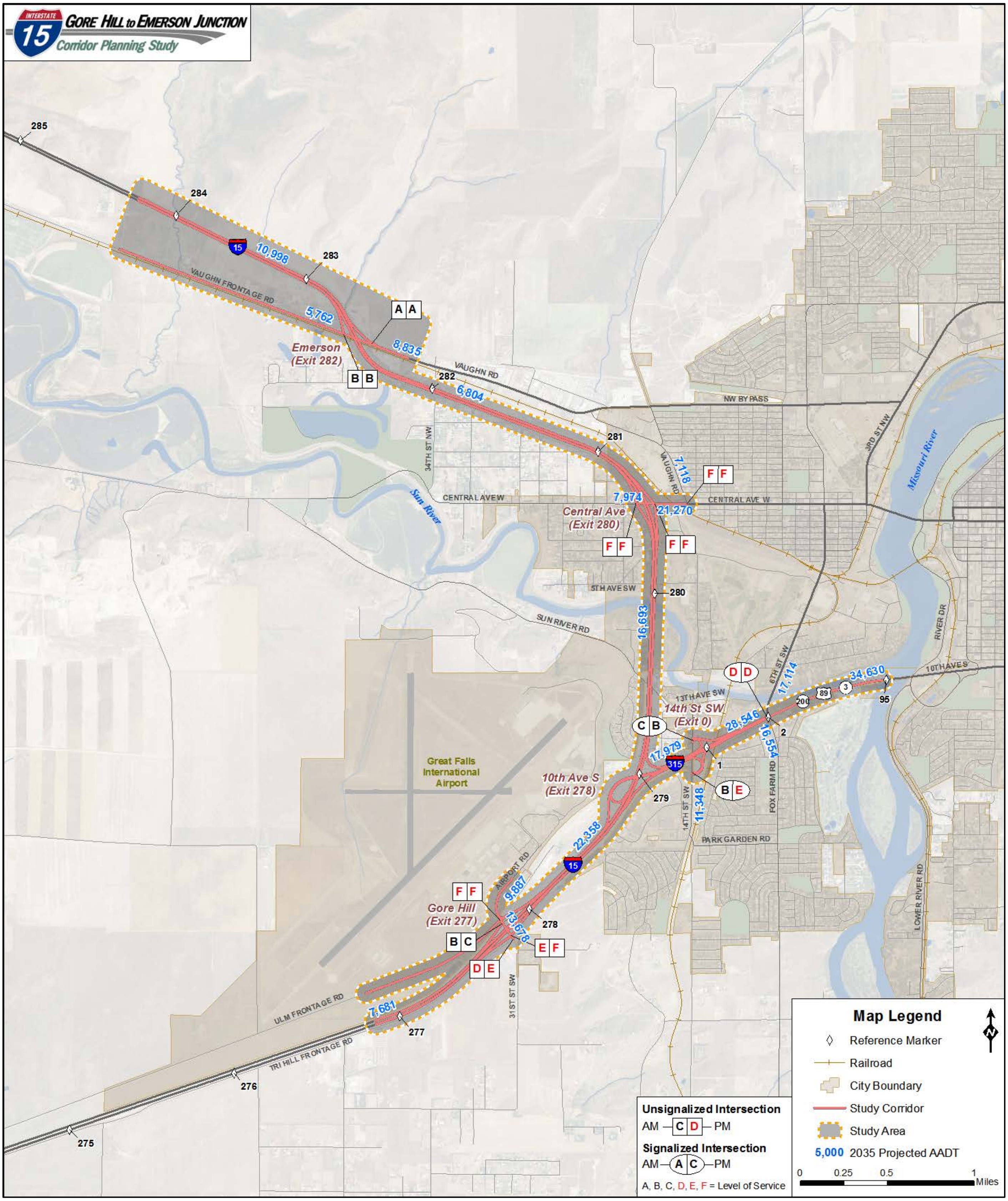

Figure 4.1: Projected Traffic Conditions

5.0 ENVIRONMENTAL SETTING

This section provides a summary of the *Environmental Scan* developed by MDT.[9] The primary objective of the *Environmental Scan* is to determine potential constraints and opportunities within the study area. As a planning-level scan, the information is obtained from various publicly available reports, websites, and other documentation, as well as a "windshield survey" conducted by MDT staff. This scan is not a detailed environmental investigation. Refer to the MDT *Environmental Scan* for more detailed information.

5.1 Physical Environment

The following subsections present an overview of items related to the physical environment.

5.1.1 Soil Resources and Prime Farmland

Information obtained on soils is used to determine the presence of prime and unique farmland in the study area to demonstrate compliance with the Farmland Protection Policy Act. Farmland includes prime farmland, some prime if irrigated farmland, unique farmland, and farmland (other than prime or unique farmland) that is of statewide or local importance. Prime farmland soils are those that have the best combination of physical and chemical characteristics for producing food, feed, and forage; the area must also be available for these uses. Prime farmland can be either non-irrigated or lands that would be considered prime if irrigated. Farmland of statewide importance is defined as follows: land, in addition to prime and unique farmlands, that is of statewide importance for the production of food, feed, fiber, forage, and oilseed crops.

Soil surveys of the study area are available from the U.S. Department of Agriculture, Natural Resource Conservation Service (NRCS). NRCS indicates that prime if irrigated farmlands and farmlands of statewide importance are present in this corridor. Land from approximately RP 278.8 to 279.0 and 280.5 to 284.3 is considered prime if irrigated farmland. The approximate location of farmlands of statewide importance is from RP 266.8 to 278.0, 279.5 to 280.5, and 282.5 to 284.3.

If a federally funded improvement option forwarded from the study will require acquisition of lands from these areas, MDT will have to complete a CPA-106 Farmland Conversion Impact Rating Form for Linear Projects and coordinate with NRCS. NRCS will use information from that form to keep an inventory of the prime and important farmlands within the state. Some areas designated as prime farmland have previously been developed. Previously developed land designated as prime farmland is no longer subject to the Farmland Protection Policy Act and should not be an impact to future improvement options.

5.1.2 Geologic Resources

Information on the geology and seismicity in the area of the corridor study was obtained from several published sources. Geologic mapping was reviewed for rock types, the presence of unconsolidated material, and fault lines. The seismicity and potential seismic hazards were also reviewed. This geologic information can help determine potential design and construction issues related to embankments and road design.

[9] MDT Environmental, *I-15 Gore Hill to Emerson Junction Corridor Study – Environmental Scan*, August 2014

Hillside slopes between the uplands and valley floor appear to be marginally stable at a maximum approximate slope of 2H:1V. There are numerous visible signs of instability, but most are relatively small and presently inactive. MDT exerted considerable effort stabilizing the cuts through Gore Hill in the 1980s; several landslides required regrading, and a substantial network of pipes and drains was installed. Appropriate cut slope and drainage design will minimize the risk of destabilizing these hillside slopes again.

Settlement of embankment fills on valley floor deposits poses some risk through the proposed corridor. This risk may be mitigated by using a combination of methods, which include preloading embankments, lowering fill heights, and using wick drains to speed settlement.

Improvements brought forward from the study will be subject to a more detailed analysis of the above-mentioned geotechnical risk factors. Part of this detailed analysis may involve taking advance borings to evaluate soil characteristics at exact project locations. This is standard procedure for most MDT road projects. The design of any improvements should consider specific requirements that come from the detailed analysis.

5.1.3 Surface Waters

Maps and GIS data were reviewed to identify the location of surface water bodies within the study area, including rivers, streams, lakes, or reservoirs. The Sun River is the main surface water in the corridor. Additionally, various surface waters, including streams, natural drainages, and wetlands, are also present in the area, but in small numbers. Impacts on these surface waters may occur from project improvements such as culverts under the roadway or rip rap armoring of banks. Effects on those water bodies will have to be identified and coordinated with applicable agencies during any future project design.

Much of the study area is also located within the Great Falls Municipal Separate Storm Sewer System (MS4) area. Under the Small MS4 General Permit, new development or redevelopment projects greater than or equal to 1 acre must implement, when practicable, low-impact development (LID) practices that infiltrate, evapo-transpire, or capture for reuse the runoff generated from the first half-inch of rainfall from a 24-hour storm preceded by 48 hours of no measurable precipitation. MS4 issues, including potential applicability of LID requirements, will have to be further evaluated during any future project design.

Total Maximum Daily Load Information

Section 303, subsection d (303d) of the Clean Water Act requires the state of Montana to develop a list, subject to U.S. Environmental Protection Agency (EPA) approval, of water bodies that do not meet water quality standards. When water quality fails to meet state standards, the Montana Department of Environmental Quality (DEQ) determines the causes and sources of pollutants in a subbasin assessment and sets maximum pollutant levels, called total maximum daily load (TMDL).

A TMDL sets maximum pollutant levels in a watershed. The TMDLs become the basis for implementation plans to restore the water quality to a level that supports its designated beneficial uses. The implementation plans identify and describe pollutant controls and management measures (such as best management practices), the mechanisms by which the selected measures are to be put into action, and the individuals and entities responsible for implementation projects.

The study corridor travels through the Sun River Watershed. The Sun River crosses I-15 under a bridge within the study area and runs parallel to, and north of, 10th Avenue South on the eastern edge of the corridor. In this segment of the Sun River, bank erosion and channel alterations decrease the quality of the instream habitat. Water coming from Muddy Creek upstream of the corridor augments flows in the

Sun River during the irrigation season; the Muddy Creek water is high in nutrients and suspended sediments.

According to a 2014 DEQ report, the Sun River fully supports the beneficial use of drinking water. The creek does not support aquatic life (cold-water fishery and warm water fishery) use based on numerous reports indicating severe impairment. Macroinvertebrate and periphyton sampling results indicate moderate to severe impairment. Aquatic life habitat is severely impaired due to siltation, flow alteration, bank erosion, and habitat degradation. Aquatic life chemistry is severely impaired due to high nutrient concentrations, turbidity, and temperatures. Agricultural uses are severely impaired due to relatively high total dissolved solids that decrease suitability for irrigation. The lack of support for recreation use is due to high amounts of nutrients that increase the risk of nuisance algal blooms.

The 2014 Integrated 303(d)/305(b) Water Quality Report for Montana by DEQ lists the Sun River watershed as impaired. The water bodies within the Sun River watershed that are located in the study area are Category 4A. Category 4A water bodies are waters where one or more applicable beneficial uses are impaired, threatened, or not supported, and a TMDL has been completed and approved to address the factors causing the impairment or threat. Any construction practices will have to comply with the requirements set forth in the TMDL plan.

Wild and Scenic Rivers

The Wild and Scenic Rivers Act Congress created in 1968 provided for the protection of certain selected rivers, as well as their immediate environments, that possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values. At this time, neither the Sun River, nor any of its tributaries, carries the wild and scenic designation. The Missouri River at the east terminus of the corridor study also does not carry the wild and scenic designation.

5.1.4 Groundwater

There are currently 6,105 wells on record in Cascade County; some of these wells exist within the study area. There are three State Monitoring Network wells and 28 public water supply wells in Cascade County. The wells in Cascade County have many different uses, the most common being domestic use. The typical setback for a public water supply well is a 100-foot isolation zone in which no source of pollutant should be inside, making a public well an item of avoidance. If either a private or public well is to be impacted, standard right-of-way procedures would need to be followed. Impacts on existing wells should be considered if a project is forwarded from this study.

5.1.5 Wetlands

The U.S. Army Corps of Engineers (COE) defines wetlands as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

Formal wetland delineations according to standard COE- and MDT-defined procedures will have to be conducted during the project development process. Additionally, impacts on wetlands will have to be avoided and minimized to the greatest extent possible through conscientious project design. Documentation of avoidance and minimization measures will have to be included in the project development. Unavoidable wetland impacts will have to be mitigated in accordance with COE regulations and Executive Order 11990: Protection of Wetlands. During any project development process, evaluation of potential stream impacts according to COE's May 2013 Stream Mitigation Procedure (or revised version) will be necessary.

5.1.6 Floodplains and Floodways

Executive Order 11988, Floodplain Management, requires federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. In accomplishing this objective, "each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by flood plains in carrying out its responsibilities" for the following actions:

- Acquiring, managing, and disposing of federal lands and facilities
- Providing federally undertaken, financed, or assisted construction and improvements
- Conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulation, and licensing activities

Federal-Aid Policy Guide, 23 CFR 650, Bridges, Structures, and Hydraulics, provides "policies and procedures for the location and hydraulic design of highway encroachments on flood plains, including direct Federal highway projects administered by the FHWA." This document defines the "Base Flood" as the "flood or tide having a 1 percent chance of being exceeded in any given year" and the "Base Flood Plain" as the "area subject to flooding by the base flood."

Federal Emergency Management Agency Issued Flood Maps for Cascade County indicate that the Zone AE 100-Year Flood with base flood elevations exists along only two small portions of the study area. The remainder of the study area is Zone X, which is the 500-Year Flood, or is not within a floodplain at all. Forwarding of improvement options from the study that result in the placement of fill within the regulatory floodplain will require identifying and evaluating impacts on the floodplains. Project development could require coordination with Cascade County and the City of Great Falls to minimize floodplain impacts and obtain necessary floodplain permits for project construction.

5.1.7 Irrigation

Irrigated grazing land exists within the study area. Depending on the improvement option(s) proposed, there is a potential to impact irrigation facilities. Project development may require redesigning, modifying existing, and/or constructing new irrigation canals, ditches, or pressurized systems in consultation with the owners to minimize impacts on agricultural operations. Additional expenses may occur if impacts on irrigation facilities will occur based on study findings.

5.1.8 Air Quality

EPA designates communities that do not meet National Ambient Air Quality Standards (NAAQS) as "non-attainment areas." States are then required to develop plans to control source emissions and ensure future attainment of NAAQS. Great Falls was designated non-attainment for carbon monoxide (CO) in 1980, and eventually the limits of the non-attainment area were mapped as the 10th Avenue South Corridor. In 2002, Great Falls received designation to attainment status for carbon monoxide. Great Falls is now under a December 2000 Carbon Monoxide Limited Maintenance Plan (CO LMP). The Montana DEQ submitted an updated Great Falls CO LMP in 2011, and revisions to the State Implementation Plan that would include some alternative CO monitoring strategies were laid out in the 2011 LMP. However, until EPA acts on these submittals, the December 2000 CO LMP is the controlling document for current air quality conformity determinations. The former non-attainment area is not located within the study area, so no further transportation conformity analysis will be necessary.

Depending on the scope of the project under consideration along this corridor, an evaluation of mobile source air toxics (MSATs) may be required. MSATs are compounds emitted from highway vehicles and off-road equipment that are known or suspected to cause cancer or other serious health and environmental effects. The expectation that special air-quality design considerations will be required is low when considering future project design.

5.1.9 Hazardous Substances

The Natural Resource Information System database was searched for underground storage tank (UST) sites, leaking underground storage tank (LUST) sites, abandoned mine sites, remediation response sites, landfills, National Priority List sites, hazardous waste, crude oil pipelines, and toxic release inventory sites within the study area.

USTs and LUSTs

There is a cluster of UST and LUST sites at the Airport Interchange and numerous tank sites along Terminal Drive with facilities associated with the airport. None of these sites is likely to result in added cost or resources to any project that is forwarded from the study, however.

There is one unresolved LUST site near 34th St Southwest, referred to as the Ruth Graham Property, and two other LUST sites along the Northwest Bypass both east and west of 34th St Northwest. Both of those sites are also currently unresolved. One is the Yellowstone Truck Stop, and the other is N&H Transportation. Construction near these leaking tank sites may result in handling and disposal of contaminated soils, which will increase costs.

Water Quality Act/State Superfund Sites (Comprehensive Environmental Cleanup and Responsibility Act)

There are four Water Quality Act (WQA) or State Superfund Sites listed in DEQ's on-line database; only one of the four is active. The active site, Western by Products, is located near the north end of the study area between I-15 and Vaughn Road. Information available for this site indicates that it is currently an "Active" site; however, a No Further Action status was issued in 1984. If a project encroaches onto this facility, there may be additional costs associated with contaminated soil and groundwater. Efforts should be made to avoid impacts on this site if possible as it is still listed on the WQA Ranking list.

5.2 Biological Environment

The following information applies to natural resources within the study area and reflects a baseline natural resource condition. Depending on the level of detail available through the high-level baseline scan, some of the information is presented at the county level, some at the study-area level, and some at the corridor level.

5.2.1 Mammals

Wildlife species inhabiting or traversing the project study area are typical of those that occur in developed and disturbed areas of central Montana. Most species habituate to disturbed areas and, as a result, are predominately generalist species.

Common mammals occupying habitats in, traversing, or having a distribution range that overlaps the study area are white-tail deer, mule deer, and coyote. Other common mammals potentially occurring in the project area include, but are not limited to, porcupine, raccoon, striped skunk, badger, bobcat, red fox, muskrat, Richardson's ground squirrel, deer mouse, and meadow vole.

A review of the MDT Maintenance Animal Incident Database for from January 2004 through December 2013 shows 39 records of animal carcasses within the study area. With the exception of only a few other animals, white-tail deer and mule deer account for most of the recorded wildlife mortality within the study area. One elk, one pronghorn antelope, one mountain lion, and two coyotes comprise the other records. The majority of the carcass pickups were located around the bridge over the Sun River and to the north, from RP 279.5 to RP 284.

5.2.2 Birds

Trees or structures that will be impacted by any project resulting from this corridor study should be removed outside of the nesting season (typical nesting season is from April 15 to August 15) or when active nests are not present. Any projects forwarded from this study will have to include consideration of potential constraints that may result from nesting times of migratory birds.

No bald eagle or golden eagle nests were identified within one-half mile of the study area. Review of the corridor for eagle nests will have to occur during project design and before construction to verify that no new nests are present.

5.2.3 Threatened and Endangered Species

The U.S. Fish and Wildlife Service (USFWS) maintains the federal list of threatened and endangered species. Species on this list receive protection under the Endangered Species Act. An "endangered" species is one that is in danger of extinction throughout all or a significant portion of its range. A "threatened" species is one that is likely to become endangered in the foreseeable future. USFWS also maintains a list of species that are candidates or proposed for possible addition to the federal list. According to USFWS, five threatened, endangered, or candidate species are listed as occurring in Cascade County (see **Table 5.1**).

Table 5.1: Threatened and Endangered Species in Cascade County

Common Name	Status
Canada Lynx	Threatened
Red Knot	Proposed
Wolverine	Proposed*
Sprague's Pipit	Candidate
Whitebark Pine	Candidate

**Note that the wolverine has since been removed as a proposed threatened and endangered species.*

The Montana Natural Heritage Program - Natural Heritage Map Viewer (report generated May 15, 2014) database records and maps documents observations of species in a known location. According to the database (report generated May 15, 2014), there are no records of any threatened, endangered, proposed, or candidate species within the boundaries of the corridor study.

As the federal status of protected species changes over time, reevaluation of the listing status and a review for the potential occurrence of these species in the project area should take place before issuing a determination of effect relative to potential project impacts. If a project moves forward from this study, completion of an evaluation of potential effects on any of the species listed above has to occur during the project development process.

5.2.4 Species of Concern

Montana Species of Concern (SOCs) are native animals breeding in the state that are considered to be at risk due to declining population trends, threats to their habitats, and/or restricted distribution. Designation of a species as an SOC is not a statutory or regulatory classification. Instead, these designations provide a basis for resource managers and decision-makers to direct limited resources to priority data collection needs and to address conservation needs proactively.

According to the Montana Natural Heritage Program - Natural Heritage Map Viewer (report generated May 15, 2014) database, which records and maps documented observations of SOCs in a known location, there is one historic record of many-headed sedge within the study area. This record is from 1891, and there is no expectation for this species to occur within the study area due to development of Great Falls since 1891.

Conducting a reevaluation for the presence of SOCs is important during the project design phase. If present, developers should consider adding special conditions to the project design and/or construction documents to avoid or minimize impacts to these species.

5.2.5 Vegetation

According to the Montana National Heritage Program Landcover Report, the dominate land cover near the study area is developed land consisting of major roads, including the Interstate, residential, and commercial land. Outside the developed land in the city of Great Falls are some cultivated crops, including hay land south of the Gore Hill Interchange and north of the Emerson Junction, as well as a minor amount of grassland, wetlands, and riparian habitat near the Sun River crossing. All land types in the project area are disturbed to some extent. If forwarding a project from the study, following practices outlined in Standard Specification 201 and any related supplemental specifications will help minimize adverse impacts on vegetation.

5.2.6 Fisheries Information

Montana Fish, Wildlife, and Parks (FWP) listed the Sun River as a substantial fishery resource value and manages the Sun River as a trout water. I-15 crosses the Sun River within the study area. According to the Montana Fisheries Information System (MFISH) database (report generated May 15, 2014), fish species commonly occurring within the Sun River within the study area are as follows:

- Brown trout
- Longnose sucker
- Longnose dace
- Stonecat
- Walleye
- White sucker

Rare fish species within the study area include the following:

- Mottled sculpin
- Rainbow trout
- Mountain whitefish

- Burbot
- Common carp
- Flathead chub
- Northern pike

FWP listed the Missouri River as a substantial fishery resource value and manages the Missouri River as a non-trout water. 10th Avenue South crosses the Missouri River at the east terminus of the study area.

Forwarding any projects that affect the Sun River or Missouri River will likely require incorporation of design measures to facilitate aquatic species passage. Notification to FWP is necessary for impacts on the Sun River aquatic resources.

5.2.7 Noxious Weeds

Noxious weeds can degrade native vegetative communities, choke streams, compete with native plants, create fire hazards, degrade agricultural and recreational lands, and pose threats to the viability of livestock, humans, and wildlife. Areas with a history of disturbance, like highway rights-of-way, are at particular risk of weed encroachment. The Invaders Database System lists 28 exotic plant species and 10 noxious weed species documented in Cascade County, some of which may be present within the study area.

Seeding disturbed areas with desirable plant species will reduce the spread and establishment of noxious weeds and allow reestablishing permanent vegetation. If forwarding a project from the study, field surveys for noxious weeds should begin before any ground disturbance.

5.2.8 Crucial Areas Planning System

The Crucial Areas Planning System (CAPS) is a resource intended to provide useful and non-regulatory information during the early planning stages of development projects, conservation opportunities, and environmental review. The finest data resolution within CAPS is at the square-mile section scale or water body. Use of these data layers at a more localized scale is not appropriate and may lead to inaccurate interpretations since the classification may or may not apply to the entire square-mile section. This scale is too broad for use during MDT's assessment of potential impacts at the project level. The CAPS system provides a general overview of the study area. CAPS results are presented in the *Environmental Scan*.

CAPS provides general recommendations and recommendations specific to transportation projects for both terrestrial and aquatic species and habitat. These recommendations of the CAPS system can have a generic application to possible project locations moving forward from the study. Coordination with the FWP wildlife biologist should occur during project development.

5.3 Social and Cultural Environment

The following subsections present an overview the social and cultural environment within the study area.

5.3.1 Demographic and Economic Conditions

Under the National and Montana Environmental Policy Acts and associated implementing regulations, state and federal agencies must assess potential social and economic impacts resulting from proposed actions. FHWA guidelines recommend consideration of impacts on neighborhoods and community cohesion, social groups including minority populations, and local and/or regional economies, as well as growth and development induced by transportation improvements. **Section 2.0** presents demographic and economic information to assist in identifying human populations that improvements may affect within the study area.

Title VI of the U.S. Civil Rights Act of 1964, as amended (USC 2000(d)) and Executive Order 12898 require that no minority, or, by extension, low-income person shall be disproportionately adversely impacted by any project receiving federal funds. For transportation projects, this means that no particular minority or low-income person may be disproportionately isolated, displaced, or otherwise subjected to adverse effects. If forwarding a project from the improvement option(s) occurs, an Environmental Justice evaluation will have to occur during the project development process.

5.3.2 Land Ownership and Land Use

Ownership of the land within the study area is a mix of private and public. MDT and State Trust are the only holders of public land within the corridor. Most of the public land is in the form of right-of-way or state parklands. Most of the land in the study area is either residential rural and/or urban. The other land uses within the corridor are commercial, industrial, agricultural, and recreational.

Additional research and coordination will be required to ascertain the specific encumbrances associated with particular parcels of land. Any projects that move forward from this study will have to consider adjacent land use.

5.3.3 Recreational Resources

The intent of Section 4(f) is to protect publically owned parks, recreation areas, wildlife and waterfowl refuges, and public and private historic sites of local, state, and national significance. Transportation projects using federal funds cannot use properties that are protected by Section 4(f) unless there are no feasible and prudent avoidance alternatives and all possible planning to minimize harm has occurred.

Various recreational resources exist within and near the study area. A green belt on the northeast corner of 10th Avenue South and 6th St SW, owned by MDT, is not protected under Section 4(f) per 23CFR774.13(H)(2014). According to the Montana FWP resources list, there are two state-owned parks inside the study area, Westside Viaduct Park and West Hill Park. Currently the only development on either of these two parks is a lift station in West Hill Park. The remainder of this parkland is undeveloped and not currently available for public use. There is also one City of Great Falls park located, Community Hill Park, within the study area. The Community Hill Park is currently being used as a community garden / orchard that has standard access hours, outside of which it is locked preventing access by the public.

If a project is forwarded that may impact these parks, a reevaluation should take place to determine what the parks availability for use by the public is at that time. If these parks become available for full time public use in the future, additional investigation and coordination with the officials having jurisdiction over the parks will be necessary to determine whether the parks are “significant” and protected by Section 4(f) of the U.S. Department of Transportation Act.

Section 6(f) of the National Land and Water Conservation Fund Act is another federal measure intended to preserve, develop, and assure the quality and quantity of outdoor recreation resources. Section 6(f) protection applies to all projects that impact recreational lands purchased or improved with land and water conservation funds. At this time, there are no Section 6(f) resources identified in the study area. If a project were to be developed outside of the study area, reevaluation of 6(f) resources would have to occur, as they exist close to the study area limits. Avoiding impacts on 6(f) resources is a priority. Approval for a 6(f) use is a lengthy process involving rigorous mitigation requirements and approvals from several resource agencies.

5.3.4 Cultural Resources

If a project is federally funded, MDT will conduct a cultural resource survey of the area of potential effect for this project, as specified in Section 106 of the National Historic Preservation Act (36 CFR 800). Section 106 requires federal agencies to “take into account the effects of their undertakings on historic properties.” The purpose of the Section 106 process is to identify historic and archaeological properties that could be affected by the undertaking, assess the effects of the project, and investigate methods to avoid, minimize, or mitigate any adverse effects on historic properties. Special protections for these properties are also afforded under Section 4(f) of the Transportation Act.

A file search of the study area through the Montana State Historic Preservation Office revealed one historic property located within 0.15 mile of the existing alignment, the Missouri River/Warden Bridge. In addition, five National Registry of Historic Places (NRHP) listed historic districts and properties are located within a mile of the study corridor, but are outside the study area (see **Table 5.2**). An examination of the Montana Cadastral Survey information indicates that at least 33 historic age properties are located within 0.2 mile of the existing corridor. The study area contains many cultural resources, all of which consist of historic sites. Cultural resources will not likely be a substantial issue, but the issue is important to address as planning progresses.

Table 5.2: Historic Properties

Site	Site No.	NRHP Eligibility
Missouri River/Warden Bridge	24CA0401	Listed
Cascade County Courthouse	24CA0233	Listed
Great Falls Central Business District	24CA0977	Listed
C.M. & St. P. Passenger Depot	24CA0271	Listed
Great Falls Railroad Historic District	24CA0335	Listed
Great Falls West Bank Historic District	24CA1527	Listed

If a project is forwarded from the study, a cultural resource survey for unrecorded historic, pre-historic, and archaeological properties within the area of potential effect will be completed during the project development process. Flexibility in design will be important to avoid and/or minimize impacts on historically significant sites.

5.3.5 Noise

Traffic noise may have to be evaluated for planned improvements to the study corridor. Noise analysis is necessary for “Type I” projects. If the roadway improvements are limited (e.g., the horizontal and vertical alignments are not changed, and the highway remains a two-lane facility), then the project would not be considered a Type I project.

If the improvements planned for the road would include a substantial shift in the horizontal or vertical alignments, increasing the number of through-lanes, passing lanes, or turning lanes, or increasing the traffic speed and volume, then the project would be considered a Type I project, which would require a detailed noise analysis. The analysis would include measuring ambient noise levels at selected receivers and modeling design-year noise levels using projected traffic volumes.

Noise abatement measures would be considered for the project if noise levels would approach or substantially exceed the noise abatement criteria. The noise abatement measures must be considered reasonable and feasible before implementation. If noise abatement measures were deemed necessary, they could increase costs of proposed future Type I roadway improvements.

5.3.6 Visual Resources

The visual resources of an area include landforms, vegetation, water features, and physical modifications caused by human activities that give the landscape its visual character and aesthetic qualities. Visual resources are typically assessed based on the landscape character (what is seen), visual sensitivity (human preferences and values regarding what is seen), scenic integrity (degree of intactness and wholeness in landscape character), and landscape visibility (relative distance of seen areas) of a geographically defined view shed. The study area is a blended landscape that has been developed with islands of natural beauty persevering. An evaluation of the potential effects on visual resources may be necessary, depending on the improvement options forwarded from this study.

6.0 AREAS OF CONCERN AND CONSIDERATION SUMMARY

This section provides a list and description of areas of concern and consideration within the study area. These areas were identified through review of as-built drawings, field review, public databases, and other resources. More discussion has been provided in the previous sections, and it is reiterated here as appropriate. **Figure 6.1** provides a graphical summary of the areas of concern.

6.1 TRANSPORTATION SYSTEM

Bridges

- Bridges along the Interstate within the study area have surface widths that do not meet current standards.

Operations

- The Interstate System is considered a Level I winter maintenance level.
- Snow fence and VMS are currently used to address vehicle operations related to adverse weather conditions.

Pavement Condition

- A segment of I-15 currently has poor surfacing conditions. A resurfacing project is planned for this location in 2017.
- I-315 had poor to fair surfacing conditions.

Railroad

- The Interstate crosses over the railroad at two locations within the study area.

Air Service

- The Great Falls International Airport is adjacent to the study area and is accessed primarily by the Gore Hill Interchange.

Mainline Interstate

- One location on I-15 has a vertical grade that does not meet current standards.
- Two vertical curves on I-15 do not meet current standards.
- One horizontal curve on I-15 and one horizontal curve on I-315 do not meet current standards.

Interchanges

- Seven of eight interchange on-ramps do not appear to meet current standards for acceleration length.
- Three of seven interchange off-ramps do not appear to meet current standards for deceleration length.

- Spacing between the 10th Avenue South and 14th Street SW Interchanges does not appear to meet current standards.
- Emerson Junction is a partial interchange and does not support full vehicle movements.

Intersections

- Six of the twelve intersections evaluated have a LOS of D or worse during one or both peak hours.

Safety

- Four fatal crashes and eight incapacitating injury crashes occurred during the five-year analysis period.
- A trend of fixed-object collisions was noted occurring along the Interstate.

6.2 Environmental Considerations

Physical Environment

- Areas of prime farmland if irrigated and farmlands of statewide importance exist within the study area.
- There are signs of instability and past landslides near the Gore Hill area.
- Much of the study area is located within the Great Falls MS4 area.
- I-15 crosses over the Sun River.

Biological Environment

- Thirty-nine animal carcasses were recorded over the past ten years.
- Five threatened, endangered, or candidate species are listed within Cascade County.
- Seven rare fish species are listed within the study area.
- Twenty-eight exotic plant species and ten noxious weed species are documented within Cascade County.

Social and Cultural Environment

- Two 4(f) resources are located within the study area.
- The Missouri River/Warden Bridge is listed as a historic property.

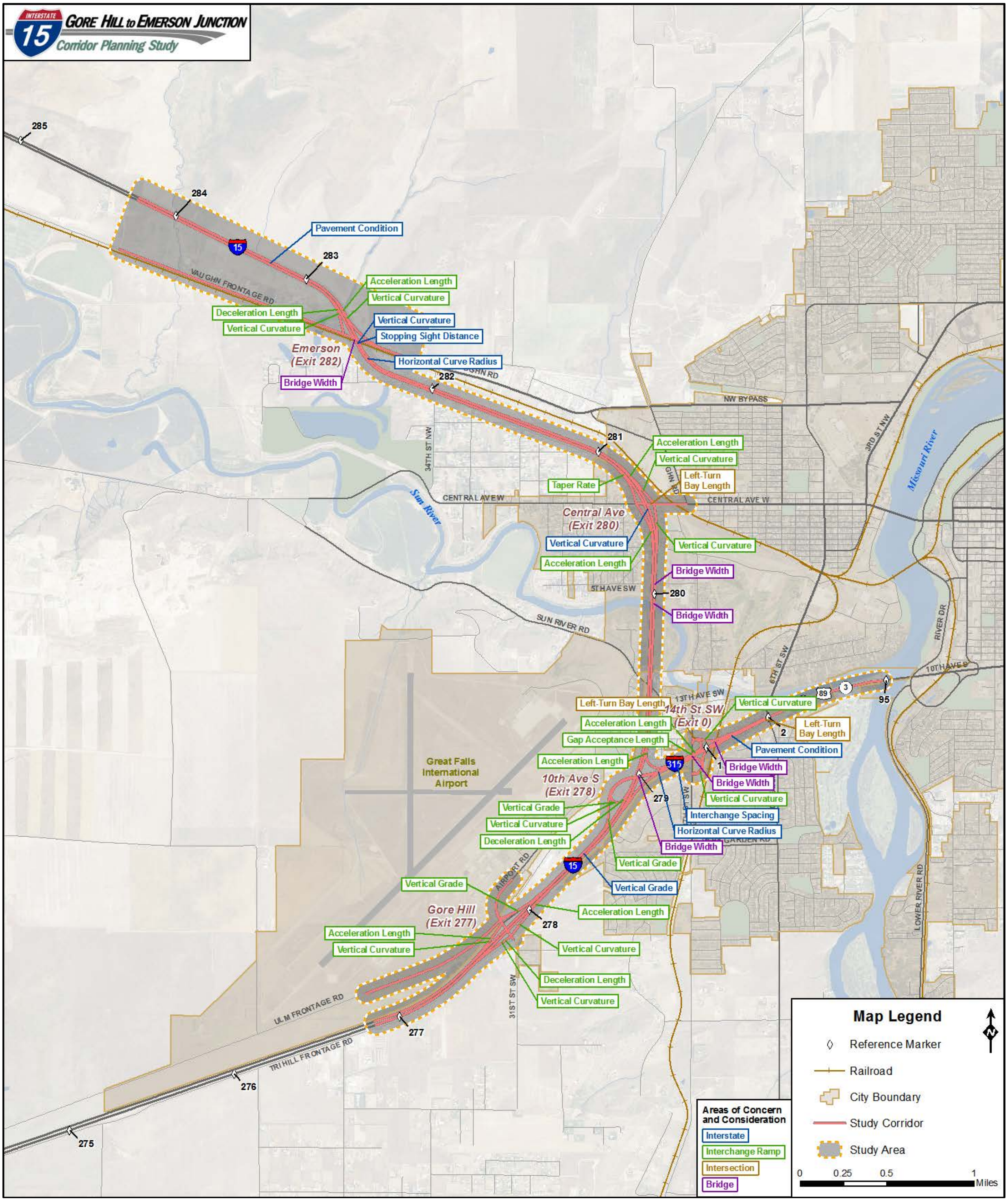

Figure 6.1: Areas of Concern and Consideration