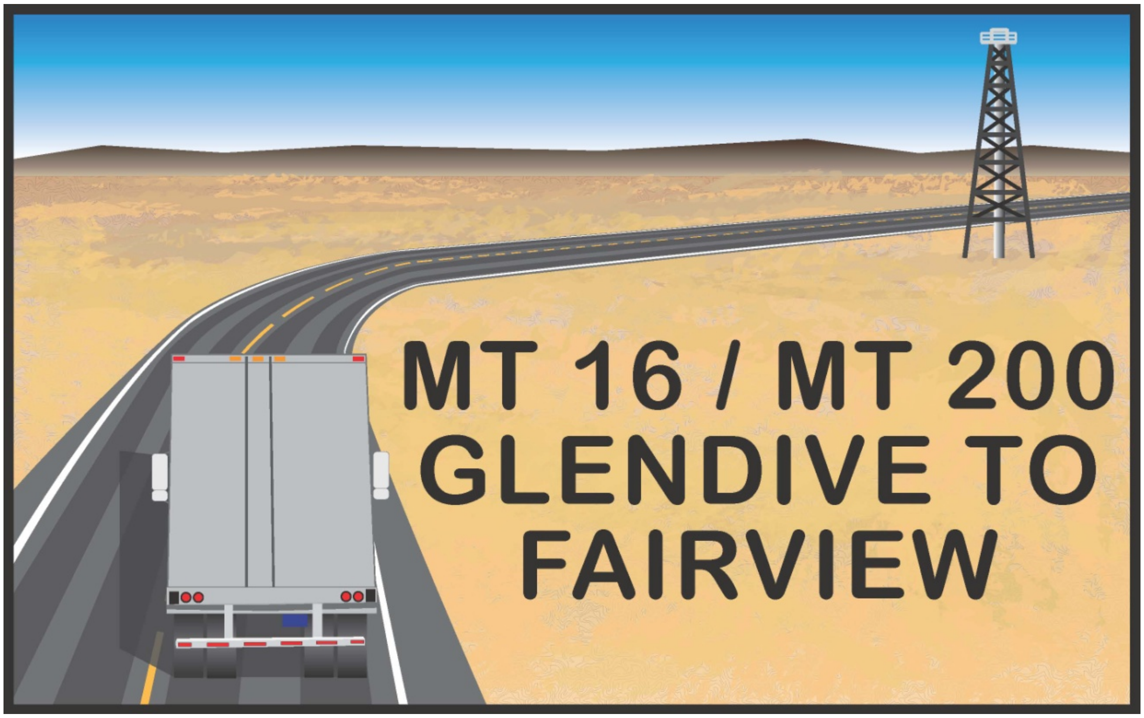

DRAFT
EXISTING AND PROJECTED CONDITIONS REPORT

PREPARED FOR:

MONTANA MDT DEPARTMENT OF TRANSPORTATION

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May 2012

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

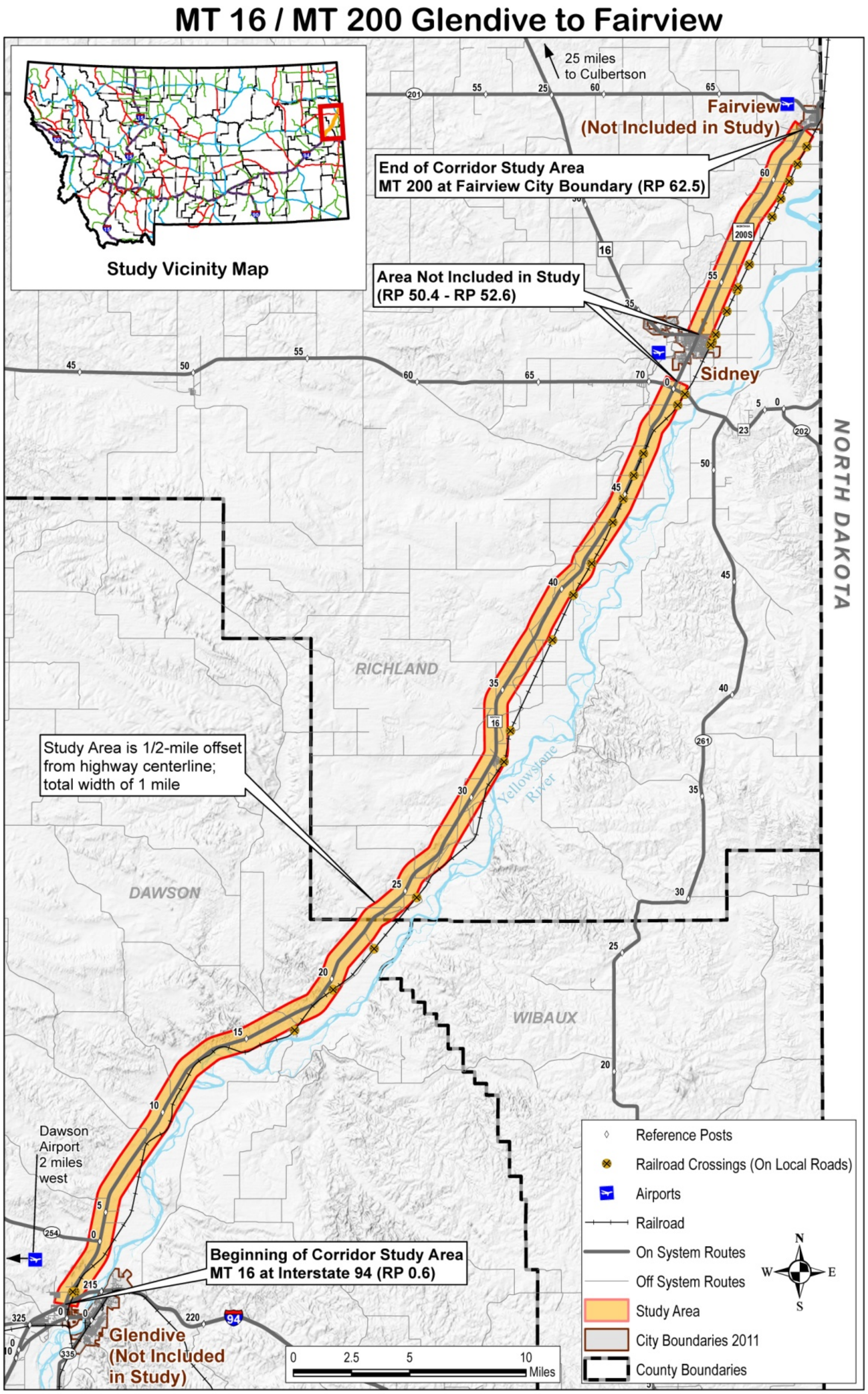
1.0 INTRODUCTION

The Montana Department of Transportation (MDT), in cooperation with Dawson and Richland Counties, has initiated a corridor planning study between Glendive and Fairview on MT Highway 16 (MT 16) and MT Highway 200 (MT 200). The study will assess traffic and safety concerns caused by increasing truck volumes associated with growth in the oil industry in the Bakken region in northeastern Montana and northwestern North Dakota. This report presents information about existing and projected conditions within the study area to assist in identifying constraints and improvement opportunities in the corridor.

The study area begins on MT 16 at approximate Reference Post (RP) 0.6 just north of the I-94 Interchange in Glendive and extends northeasterly to the intersection of County Road 123 (RP 50.4) south of Sidney. The study resumes at Sidney's northern city limit boundary (RP 52.6) north of the MT 200 intersection with Holly Street, and extends northeast on MT 200 to the Fairview city limits (RP 62.5). The study excludes areas within the city limits of Glendive, Sidney, and Fairview and extends one-half mile on each side of the highway centerline throughout the corridor.

Figure 1-1 illustrates the study area.

Figure 1-1 Study Area



Source: MDT, 2012; DOWL HKM, 2012.

2.0 EXISTING CONDITIONS

2.1 Transportation System Conditions

The highway transportation system within the study corridor is discussed in terms of its physical features, geometric characteristics, crash history, access points, traffic volumes, and operational characteristics.

2.1.1 Physical Features and Characteristics

Physical features and characteristics of the corridor were identified through field observation and a review of published statistics, documentation, GIS data, and MDT record drawings (also called as-built drawings). A field review of the corridor was conducted on January 31, 2012 to assist in identifying existing conditions and constraints. Appendix 1 contains a summary memorandum and a photo log documenting conditions observed in the field.

Roadway System and Functional Classification

Functional classification is used to characterize public roads and highways in accordance with Federal Highway Administration (FHWA) guidelines according to the type of service provided by the facility and the corresponding level of travel mobility and access to and from adjacent property. The MT 16 portion of the corridor from Glendive to Sidney (RP 0.6 to RP 50.4) and a short portion of MT 200 north of Sidney (RP 52.6 to RP 53.7) are classified as principal arterials on the Non Interstate-National Highway System (NINHS). The NHS includes highways Congress has determined to have the greatest national importance to transportation, commerce, and defense. The MT 200 portion of the corridor from Sidney to Fairview (RP 53.7 to RP 62.5) is classified as a minor arterial on the Primary Highway System, and is not part of the NHS.

Structures

The MDT Bridge Bureau identified 12 bridges and four major culvert crossings within the study area. Major culverts are treated similarly to bridges for inspection purposes. All 16 structures in the corridor are classified as not deficient and are not eligible for federal bridge funding.

A summary of the MDT bridge assessments is presented in Table 2.1.

Appendix 2 includes MDT bridge inspection forms containing additional information for each structure. A structural analysis of each bridge was not conducted for this planning-level study. The need for a structural analysis should be determined during project development, if improvement options are forwarded from this study.

Table 2.1 MDT Bridge Assessment Summary

Feature Crossed	Location (RP)	Sufficiency Rating	Year Built	Skew (degrees)	Deck Width (ft)	Roadway Width (ft)	Main Span Type	Main Span Design	No. of Main Spans	Length of Maximum Span (ft)	Total Length (ft)
Deer Creek	4.3	89.7	1964	0	43.0	40.0	Prestressed Concrete	Tee Beam	2	112.0	112.0
Three Mile Creek	7.0	89.7	1964	0	N/A	40.0	Steel Culvert	N/A	1	N/A	27.0
Lower Seven Mile Creek	10.1	89.7	1967	0	42.0	40.0	Prestressed Concrete	Tee Beam	2	132.0	132.0
Morgan Creek	12.5	90.8	1967	0	42.0	3.9	Prestressed Concrete	Tee Beam	2	122.0	122.0
Thirteen Mile Creek	15.5	90.8	1969	0	42.7	40.0	Steel Continuous	Girder	10	332.0	332.0
Burns Creek	25.1	89.9	2010	8	42.7	39.4	Prestressed Concrete	Girder	3	195.6	195.6
Garden Coulee / Stockpass	31.3	89.9	1975	0	N/A	40.0	Steel Culvert	N/A	2	N/A	23.0
USBR Main Canal	32.1	87.8	1974	30	46.4	43.5	Prestressed Concrete	Girder	1	95.0	95.0
Dunlap Creek	32.4	87.8	1974	0	46.4	43.5	Prestressed Concrete	Girder	3	122.0	122.0
USBR Main Canal	32.7	85.8	1974	12	54.4	51.5	Prestressed Concrete	Girder	1	75.0	75.0
USBR Main Canal	37.5	86.6	1984	38	42.4	39.4	Prestressed Concrete	Girder	1	94.0	94.0
Crane Creek	41.3	55.3	1986	0	N/A	25.0	Steel Culvert	N/A	2	N/A	31.0
Fox Creek	46.7	83	1974	0	46.4	43.6	Prestressed Concrete	Girder	3	183.0	183.0
Lone Tree Creek	51.6	89.8	1974	0	95.0	83.0	Concrete Continuous	Slab	4	90.0	90.0
First Hay Creek	59.5	94.9	1986	40	42.1	39.3	Concrete Continuous	Slab	4	109.5	109.5
Second Hay Creek	60.0	97	1986	38	N/A	52.0	Steel Culvert	N/A	1	N/A	29.0

Source: MDT, 2012.

Railroad Facilities

A BNSF Railway facility parallels MT 16 / MT 200 throughout the entire study area. There are no at-grade or grade separated railroad crossings along MT 16 / MT 200 within the study area. The location of the railroad in relation to the corridor southeast of MT 16 / MT 200 as is depicted in Figure 1-1.

Bicycle and Pedestrian Facilities

There are no dedicated bicycle or pedestrian facilities adjacent to MT 16 / MT 200. Seven-to eight foot shoulders are typical throughout the corridor, providing opportunity for non-motorized usage. No bicycle or pedestrian counts were collected for this study.

Drainage Conditions

MT 16 / MT 200 parallels the Yellowstone River through much of the study corridor and crosses several tributary streams and creeks. Highway run-off is directed to adjoining shoulders. Graded side slopes carry run-off to natural drainage conveyances through constructed ditches within the right-of-way or via natural drainage patterns formed by the topographic conditions of the adjacent lands.

Utilities

Table 2.2 lists major utility facilities observed or known to occur in the study area. Additional utilities are likely located within the corridor, including telephone, cable, and fiber optic lines. Irrigation canals and petroleum pipelines are also known to occur in the study area vicinity. A detailed utility investigation should be conducted during project development for any improvement options forwarded from this study.

Table 2.2 Corridor Utilities

Location			Utility Type
RP	Distance from Centerline	Side of Roadway	
1.9 to 3.8	80 to 100 feet	East	Overhead Electric Transmission Line; single wood pole structures
4.1 to 5.6	80 to 90 feet	East	Overhead Electric Transmission Line; single wood pole structures
4.1	100 feet	West	Large Overhead Electric Transmission Line; large steel structure
4.5 to 4.8	120 feet	East	12-inch High Pressure Natural Gas Line
5.9 to 12.4	80 to 100 feet	Left	Overhead Electric Transmission Line; single wood pole structures
12.4 to 13.0	100 feet	East	Overhead Electric Transmission Line; single wood pole structures
13.4	Centerline Crossing	NA	12-inch High Pressure Natural Gas Line
13.6 to 13.8	110 feet	West	12-inch High Pressure Natural Gas Line
14.5	Centerline Crossing	NA	High Pressure Natural Gas Line
14.9	200 feet	East	Electric Substation
17.0	150 feet	West	Proposed Cell Tower
18.3 to 18.6	80 to 100 feet	East	Two 12-inch High Pressure Natural Gas Lines
18.6	Centerline Crossing	NA	Two 12-inch High Pressure Natural Gas Lines
18.6 to 20.1	80 to 120 feet	West	Two 12-inch High Pressure Natural Gas Lines
19.8 to 24.8	80 to 100 feet	West	Overhead Electric Transmission Line; single wood pole structures
20.1	Centerline Crossing	NA	Two 12-inch High Pressure Natural Gas Lines
20.1 to 20.4	90 to 120 feet	East	Two 12-inch High Pressure Natural Gas Lines
22.0 to 22.1	80 to 100 feet	East	Two 12-inch High Pressure Natural Gas Lines
22.1	Centerline Crossing	NA	Two 12-inch High Pressure Natural Gas Lines
22.1 to 23.1	80 to 120 feet	West	Two High Pressure Natural Gas Lines
40.3	Centerline Crossing	NA	Two High Pressure Natural Gas Lines
40.3 to 40.4	80 to 100 feet	West	One 12-inch High Pressure Natural Gas Line
44.5	Centerline Crossing	NA	One 12-inch High Pressure Natural Gas Line
44.5 to 44.7	80 to 120 feet	East	One 12-inch High Pressure Natural Gas Line

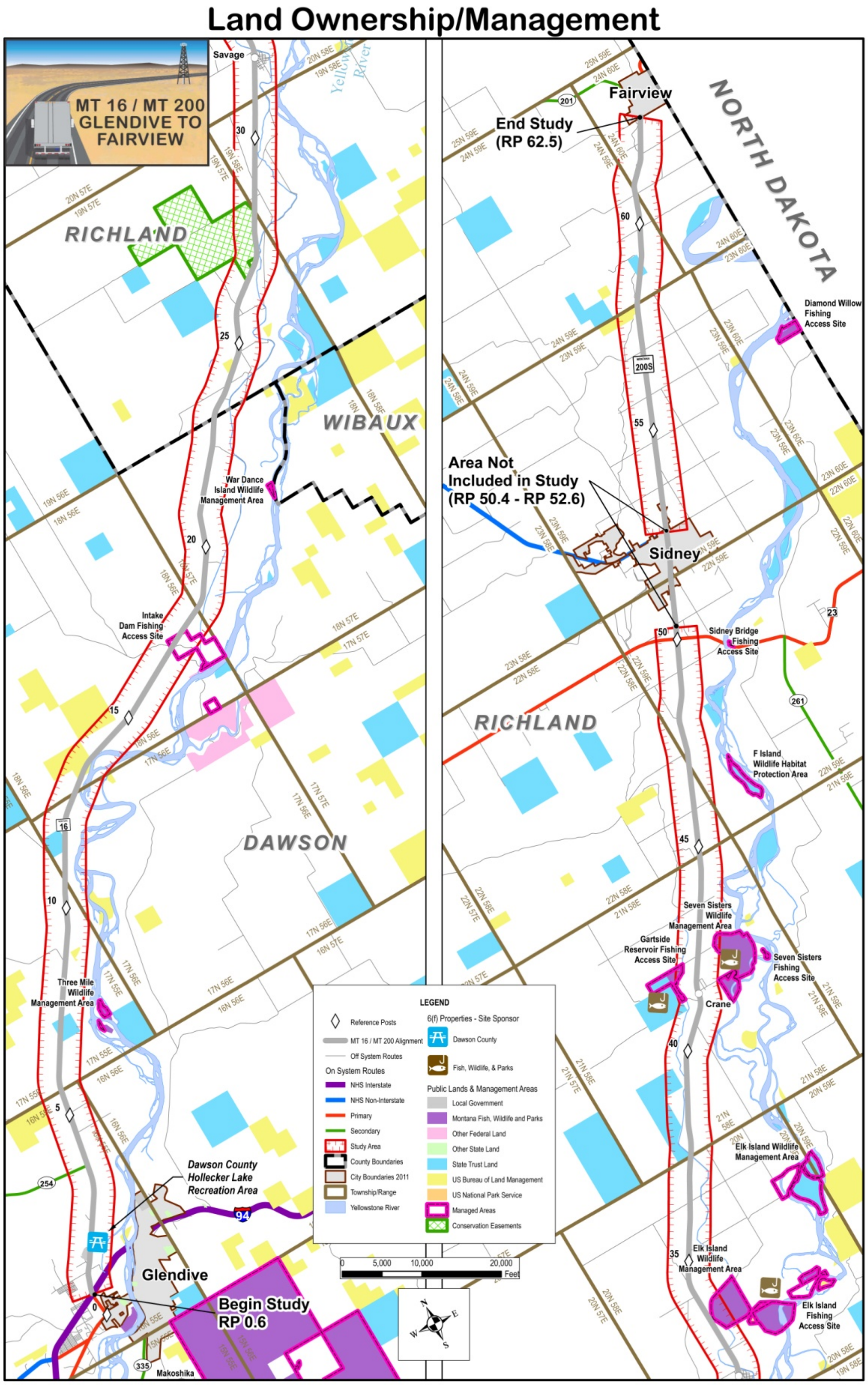
Source: MDT, 2012.

Right-of-Way and Land Ownership

Within the portion of the corridor from Glendive to Sidney (RP 0.6 to RP 50.4), MDT right-of-way typically extends 160 feet from the MT 16 / MT 200, 80 feet on each side of centerline. In intermittent portions of the corridor, MDT right-of-way extends upwards of 400 feet on one side of the centerline where adjacent slopes are cut or filled to accommodate the roadway alignment. Right-of-way within the portion of the corridor from Sidney to Fairview (RP 52.6 to RP 62.5) is narrower, ranging from 100 to 140 feet wide (50 to 70 feet on each side of the roadway centerline).

Land within the study corridor is predominantly held in private ownership and used for agricultural and ranching purposes. Public lands are dispersed throughout the corridor, including lands managed by the Bureau of Land Management (BLM) and the State of Montana. A number of land areas within the study corridor are managed for recreational or conservation purposes. Land ownership and management status is illustrated in Figure 2-1.

Figure 2-1 Land Ownership



Source: MDT, 2012; NRIS, 2012; DOWL HKM, 2012.

Pavement Condition

Geotechnical reports provided by MDT indicate MT 16 / MT 200 is generally composed of a four-inch layer of asphalt over 1.5 feet of crushed base course. The subgrade soils (or material below the base course) throughout the corridor are considered poor soils for roadway design due to moisture sensitivity. The following conditions were noted in the corridor during a field review conducted on January 31, 2012.

- Rutting – depressions parallel to the road centerline located within the travel lanes
- Transverse cracking – pavement cracks perpendicular to the roadway centerline
- Longitudinal cracking – pavement cracks parallel to the roadway centerline
- Shoulder failure – sloughing of the roadway shoulder; typically a result of unstable roadway embankment

Pavement conditions observed in the field are categorized into three regions: (1) an area of recent reconstruction (RP 18.6 to RP 24.7), (2) Sidney to Fairview (RP 52.6 to RP 62.5), and (3) the remaining portion of the corridor study area (RP 0.6 to RP 18.6, and RP 24.7 to RP 50.4). Table 2.3 summarizes pavement conditions for each area of the corridor.

Table 2.3 Summary of Pavement Conditions

Location (RP)	General Conditions
0.6 - 18.6	• Minor rutting (1/4 inch deep or less) • Transverse cracks (30 to 60 ft spacing) • Intermittent longitudinal cracking • Shoulder failure observed at approximately RP 14.3
18.6 - 24.7	• Recently reconstructed; no signs of pavement deterioration
24.7 - 50.4	• Minor rutting (1/4 inch deep or less) • Transverse cracks (30 to 60 ft spacing) • Intermittent longitudinal cracking
52.6 - 62.5	• Minor rutting (1/4 inch deep or less) • Sealed pavement cracks • Transverse cracks (approximate 30 ft spacing) • Continuous longitudinal cracking

Source: DOWL HKM, 2012.

2.1.2 Geometric Characteristics and Roadway Elements

Design Criteria and Guidelines

Within the study corridor, MT 16 from RP 0.6 to RP 50.4 and MT 200 from RP 52.6 to RP 53.7 are classified as Rural Principal Arterials (National Highway System – Non Interstate). MT 200 from RP 53.7 to RP 62.5 is classified as a Rural Minor Arterial (Non-NHS – Primary). Table 2.4 presents MDT geometric design criteria used to assess the study corridor.

The design speed used for analysis of the MT 16 / MT 200 study corridor is 60 to 70 miles per hour (mph) in combination with a level/rolling terrain type. Portions of the corridor, including RP 6.1 to RP 18.5 and RP 18.6 to RP 28.9, were designed to 60 mph, although the roadway facility generally meets 70 mph design speed criteria in these locations. The posted speed limit within the corridor is primarily 70 mph for passenger vehicles and 60 mph for trucks, with short sections of reduced speed zones (45 to 55 mph) near the boundaries of Sidney and Fairview and through the community of Savage. The existing roadway alignment generally exhibits level terrain characteristics, although portions of the corridor exceed maximum grades for level terrain.

Table 2.4 Design Criteria - Rural Minor and Rural Principal Arterials

Element			Criteria	
			Rural Minor Arterial	Rural Principal Arterial
Design Controls	Design Speed	70 mph	60 mph	70 mph
	Level of Service (LOS) (Level Terrain)		B	B
Roadway Elements	Travel Lane Width		12 ft	12 ft
	Shoulder Width		Varies	Varies
	Cross Slope	Travel Lane	2%	2%
		Shoulder	2%	2%
Earth Cut Sections	Ditch	Inslope	6:1 (Width: 10 ft)	6:1 (Width: 10 ft)
		Width	10 ft Minimum	10 ft Minimum
		Slope	20:1 towards back slope	20:1 towards back slope
	Backslope; Cut Depth at Slope Stake	0 to 5 ft	5:1	5:1
		5 ft to 10 ft	4:1	4:1
		10 ft to 15 ft	3:1	3:1
		15 ft to 20 ft	2:1	2:1
		> 20 ft	1.5:1	1.5:1
Earth Fill Slopes	Fill Height at Slope Stake	0 to 10 ft	6:1	6:1
		10 ft to 20 ft	4:1	4:1
		20 ft to 30 ft	3:1	3:1
		> 30 ft	2:1	2:1
Alignment Elements	Stopping Sight Distance		570 ft	730 ft
	Passing Sight Distance		2135 ft	2480 ft
	Minimum Horizontal Curve Radius (e_{max}=8%)		1200 ft	1810 ft
	Vertical Curvature (K-Value)	Crest Vertical Curve	151	247
		Sag Vertical Curve	136	181
	Maximum Grade	Level Terrain	3%	3%
		Rolling Terrain	4%	4%
	Minimum Vertical Clearance		17 ft	17 ft

Source: MDT Road Design Manual, Chapter 12, page 12(12), Figure 12-4, "Geometric Design Criteria for Rural Minor Arterials (National Highway System – Non Interstate) U.S. Customary," 2008, MDT Road Design Manual, Chapter 12, page 12(7), Figure 12-3, "Geometric Design Criteria for Rural Principal Arterials (National Highway System – Non Interstate) U.S. Customary," 2008

Roadway Width

Within the study area, MT 16 / MT 200 is a two-lane undivided highway with two 12-foot travel lanes and varying shoulder widths. Seven- to eight-foot shoulders are typical throughout the corridor. Table 2.5 provides information on the roadway width and surface thickness throughout the corridor. According to the MDT NHS Route Segment Map, the suggested roadway width for MT 16 / MT 200 is 40 feet or greater, which would allow two 12-foot travel lanes and two eight-foot shoulders. However, the Route Segment Plan no longer defines a standard roadway width. The MDT Roadway Width Committee would determine the appropriate width during project development if improvement options are forwarded from the study.

Table 2.5 Highway Width and Surface Thickness

Pavement Thickness (inches)	Base Course Thickness (inches)	Surface Width (feet)	Lanes	Lane Width (feet)	Shoulder Width (feet)
4.8 – 11.0	8.4 – 22.0	28 - 46	2	12	7 - 8

Source: MDT, 2011 and 2012.

Horizontal Alignment

Horizontal alignment is a measure of the degree of turns and bends in the road, and includes consideration of horizontal curvature, superelevation, curve type, and stopping and passing sight distance. Based on current MDT criteria and a review of as-built plans, it appears that seven (7) of the 57 horizontal curves within the corridor do not meet current MDT design standards for curve radius, stopping sight distance, and / or curve length. Appendix 3 presents horizontal alignment information for the corridor. It is MDT's practice to use a spiral curve when the curve radius is less than 3,820 ft. Because curve type is not listed in the MDT Road Design Manual as a design requirement, curve type is not considered in the Pass / Fail determination listed in Appendix 3. Superelevation was only assessed where sufficient as-built or record drawing data was available. Design elements listed in Appendix 3 are approximated, and determinations are based on the best available data provided by MDT.

Vertical Alignment

Vertical alignment is a measure of the elevation change on a roadway, and includes consideration of grade, vertical curve length, vertical curve type (either a sag curve or a crest curve), and K value. K value is the horizontal distance needed to produce a one percent change in gradient and is directly correlated to the roadway design speed and stopping sight distance.

Review of as-built plans indicates eight of the 147 vertical curves within the study corridor fail to meet current MDT design standards. Because minimum grade and curve length are not listed in the MDT Road Design Manual as design requirements, they are not considered in the vertical curve Pass / Fail determination. Appendix 3 presents vertical alignment information for the MT

16 / MT 200 corridor. Design elements listed in Appendix 3 are approximated, and determinations are based on the best available data provided by MDT.

Passing Zones

Passing zones are periodically provided within the corridor in locations with sufficient passing sight distance. Passing sight distance is defined as the minimum sight distance required to safely complete a passing maneuver. No sight distance issues were observed within striped passing zones or at intersections during a field review conducted in January 2012.

The MDT Traffic Engineering Manual states "at intersections of 2-lane, 2-way roadways, a no-passing zone should be marked in advance of the intersection or stop bar at a minimum distance of 500 ft (150 m) for rural facilities." MDT is currently considering an exception to this policy at intersections with low-volume minor approaches within MT 16/MT 200 corridor.

Table 2.6 lists the percent of each segment striped as no passing.

Table 2.6 Percent of Segment Striped as No Passing

Segment		Percent No Passing
Glendive to Savage	MT 16 Northbound	23 Percent
	MT 16 Southbound	23 Percent
Savage to Crane	MT 16 Northbound	31 Percent
	MT 16 Southbound	19 Percent
Crane to Sidney	MT 16 Northbound	24 Percent
	MT 16 Southbound	22 Percent
Sidney to Fairview	MT 200 Eastbound	17 Percent
	MT 200 Westbound	15 Percent

Source: DOWL HKM, 2012.

Clear Zones

The MDT Road Design Manual specifies an offset distance from the edge of the travel way (ETW) to be free of any obstructions. The ETW is delineated by the white pavement marking located on the right-hand side of the travel lane. This offset distance, known as the "clear zone," includes the roadway shoulder and is defined based on design speed, Average Annual Daily Traffic (AADT), the slope of cut / fill sections, and offsets from the ETW. A cut section occurs when a roadway facility is located below natural ground elevation and excavation of earthen materials is required. A fill section occurs when a roadway facility is located above natural ground elevation and addition of earthen materials is required.

Within cut sections, a roadside ditch is required by MDT for drainage. The dimensions of the ditch also provide a recovery area within the required clear zone for vehicles exiting the travel way. All cut slope sections within the MT 16 / MT 200 corridor should meet current MDT design standards.

Criteria listed in Table 2.7 were used to analyze fill slopes and dimensions throughout the MT 16 / MT 200 corridor. The slopes and dimensions within the clear zone provide a recovery area for vehicles exiting the travel way. If the specified dimensions cannot be achieved, a roadway barrier (guardrail) should be provided.

Table 2.7 Fill Slope Clear Zone Distances

Design Speed	Design AADT	Fill Slope			
		6:1 or Flatter	5:1	4:1	<3:1
60 mph	1500-6000	26’	32’	40’	Barrier Warranted
	>6000	30’	36’	44’	
70 mph	1500-6000	30’	36’	42’	
	>6000	32’	38’	46’	

MDT Road Design Manual, Chapter 14, page 14.2(2), "US Customary Units" 2008.

Fill slope locations identified as possible safety concerns due to inadequate recovery area adjacent to the travel way are summarized in Table 2.8.

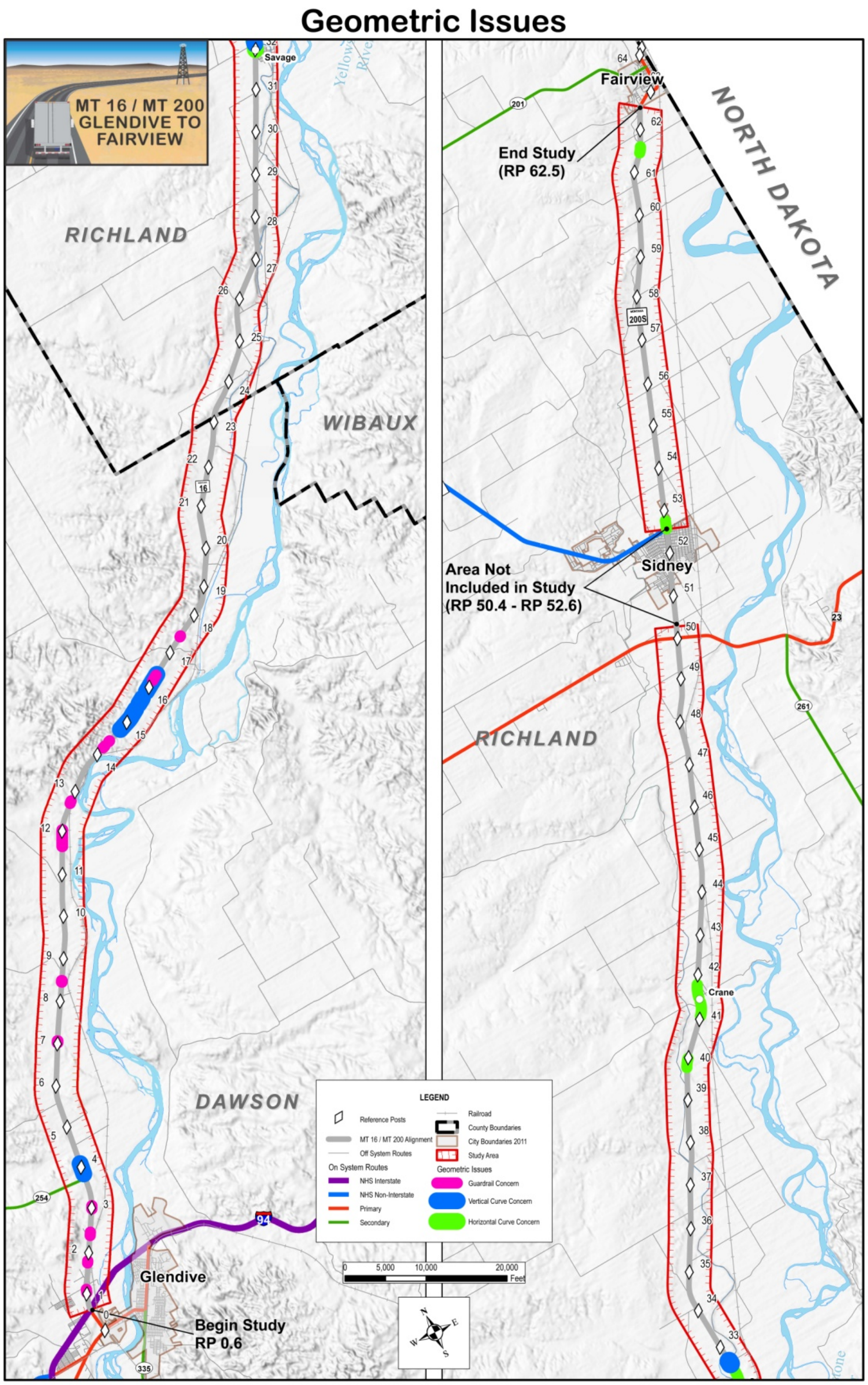
Table 2.8 Clear Zone Concerns for Fill Slope Locations

RP	Side of Road	Description
1.1	East	• 3:1 fill slope transitions to 2:1, 13 ft from ETW
1.8	West	• 4:1 fill slope transitions to 2:1, 20 ft from ETW
2.4	East	• 4:1 fill slope transitions to 2:1, 18 ft from ETW • Box culvert opening located 30 ft from ETW
3.0	East	• 5:1 fill slope transitions to 2:1, 18 ft from ETW
7.0	East & West	• 4:1 fill slope to entrance/exit of double CMP culverts, 25 ft from ETW
8.5	East & West	• 4:1 fill slope transitions to 2:1, 18 ft from ETW
11.8	East & West	• 4:1 fill slope transitions to 2:1, 17 ft from ETW
12.7	West	• 4:1 fill slope transitions to 2:1, 20 ft from ETW
14.2	West	• 4:1 fill slope transitions to 1.5:1, 23 ft from ETW
14.4	West	• 4:1 fill slope transitions to 2:1, 20 ft from ETW
16.3	West	• 5:1 fill slope transitions to 3:1 and steeper, 17 ft from ETW
17.4	East	• 4:1 fill slope transitions to 2:1, 20 ft from ETW prior to guardrail section
29.7	East & West	• 5:1 fill slope transitions to 3:1, 28 ft from ETW

Source: DOWL HKM, 2012.

Figure 2-2 presents the location of existing horizontal curve, vertical curve, and clear zone / guardrail concerns within the corridor. Additional guardrail concern locations may occur if traffic volumes reach projected values for the portion of the corridor from Glendive to Sidney.

Figure 2-2 Summary of Geometric Concerns within the Study Area



Source: MDT, 2012; DOWL HKM, 2012.

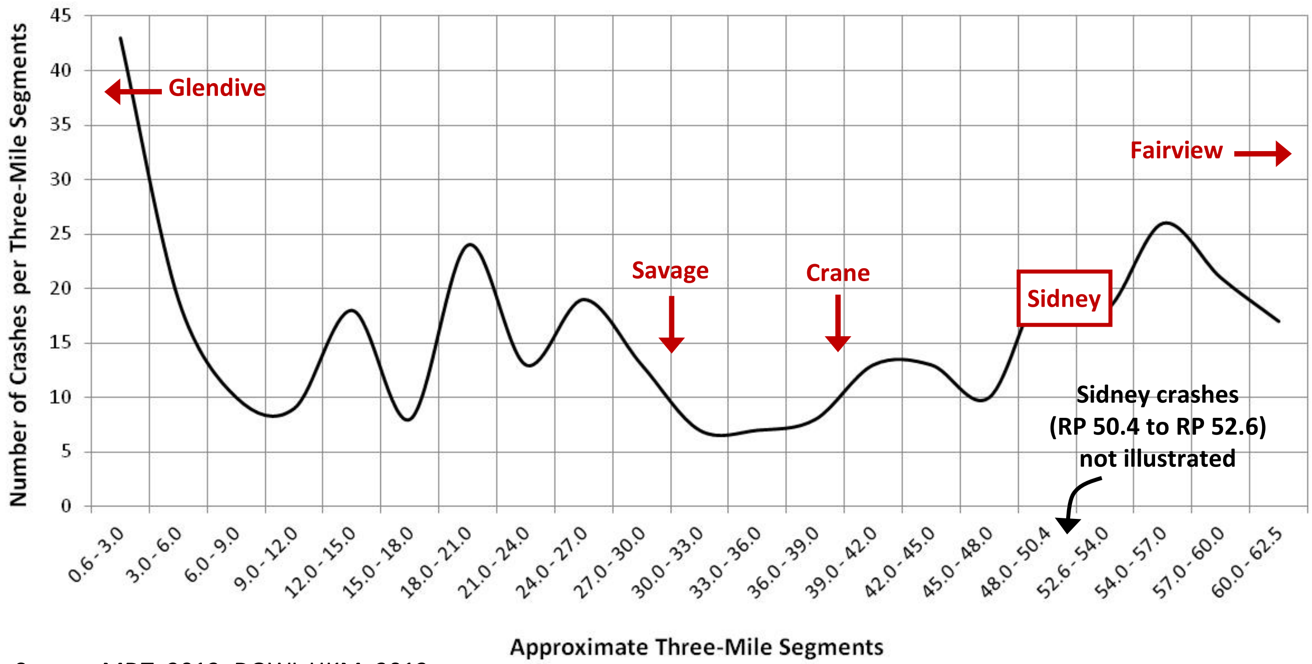
2.1.3 Crash Analysis

MDT conducted a corridor safety audit to assess safety conditions within the MT 16 / MT 200 corridor. As part of this process, MDT held an audit workshop on February 1 and 2, 2012. MDT representatives presented a summary of crash data information, followed by a field review of potential safety concerns. The corridor safety audit process identified the following concerns relevant to this corridor study:

- Commercial vehicle speed differential, which may lead to large vehicle queues and aggressive passing maneuvers
- Higher occurrence of crashes involving large vehicles
- Higher occurrence of unbelted crashes
- Higher occurrences of crashes involving vehicles with out-of-state registration
- Fatigued and impaired driver crashes
- Ability of the existing transportation network to handle projected regional growth
- Increased driveway/intersection related crashes between Sidney and Fairview
- Moving sight distance concerns at the intersection of County Road 126
- Minimal guidance to drivers approaching the intersection of MT 16/MT 23/MT 200. Concern was also expressed regarding the speed limit through this area.
- Head-on and single vehicle run off the road (SVROR) crashes

The safety audit considered crash data for the portion of the MT 16 / MT 200 corridor from RP 0.0 to RP 64.2 for the five-year period from July 1, 2006 to June 30, 2011. A total of 337 crashes occurred within the MT 16 / MT 200 study corridor (RP 0.6 to RP 50.4 and RP 52.6 to RP 62.5). Crash locations within the study corridor are illustrated in Figure 2-3.

Figure 2-3 Crash Locations in Study Corridor (2006 – 2011)



Source: MDT, 2012; DOWL HKM, 2012.

Rural Crash Rate, Severity Index, and Severity Rate for Study Corridor

MDT provided crash rate, severity index, and severity rate data for the MT 16 / MT 200 study corridor (RP 0.6 to RP 50.4 and RP 52.6 to RP 62.5) for the five-year period from January 1, 2006 to December 31, 2010. At the time of this study, 2011 traffic volumes were not available for use in calculating these figures.

Crash rate is a measure of the number of crashes in a roadway corridor per million vehicle miles (MVM) travelled. Since a higher number of crashes can generally be expected on roadway corridors with higher traffic volumes, this measurement offers an objective way to compare crash statistics for roadways with varying traffic volumes (which is also described as vehicle exposure). MDT calculates the crash rate as follows:

$$\text{Crash Rate} = \frac{(\text{Total Number of Crashes})}{(\text{Traffic Volume})(\text{Analysis Time Period})(\text{Segment Length})/(1{,}000{,}000 \text{ vehicles})}$$

The severity index is a weighted measure of crashes occurring in a roadway corridor, with fatal crashes and crashes resulting in incapacitating injuries weighted more heavily (using a multiplier of 8) as compared to crashes resulting in less serious injuries (multiplier of 3) or property damage only (multiplier of 1). The severity index is calculated as follows:

$$\text{Severity Index} = \frac{8(\text{Fatal \& Incapacitating Injury}) + 3(\text{Other Injury}) + 1(\text{Property Damage})}{\text{Total Number of Crashes}}$$

Finally, the severity rate is a measure of the severity of crashes per million vehicle miles (MVM) travelled and is calculated as follows:

$$\text{Severity Rate} = (\text{Crash Rate})(\text{Severity Index})$$

The corridor crash rate, severity index, and severity rate were similar to or lower than statewide averages for similar facilities during this period, as presented in Table 2.9.

Table 2.9 Crash History Comparison (Statewide Average vs. MT 16 / MT 200 Corridor)

Criteria	Rural NINHS		Rural Primary	
	Statewide Average for Rural NINHS (2006 – 2010)	MT 16 RP 0.6 – RP 50.4 MT 200 RP 52.6 – 53.7 (2006 – 2010)	Statewide Average for Rural Primary Highway (2006 – 2010)	MT 200 RP 53.7 – RP 62.5 (2006 – 2010)
Crash Rate (All Vehicles)	1.04	1.27	1.18	1.16
Severity Index (All Vehicles)	2.09	1.57	2.29	2.03
Severity Rate (All Vehicles)	2.18	1.99	2.71	2.35

Source: MDT, 2012.
Note: Crash statistics are calculated using Annual Average Daily Traffic Volumes (AADT) and reflect currently available data as of the date of this report. Statistics will be updated upon receipt of 2011 AADT volumes.

Safety Audit Analysis – Rural Crashes

A total of 353 crashes were reported within areas designated as rural, defined as the portions of the corridor from RP 0.0 to RP 51.3, RP 52.6 to RP 62.5, and RP 63.9 to RP 64.2 (i.e., outside the city limits of Glendive, Sidney, and Fairview). Approximately 24% of rural crashes resulted in injuries, and three fatal crashes occurred. Single vehicle run off the road (SVROR) crashes accounted for over 35% of all crashes within the rural portions of the corridor. Table 2.10 lists rural injury and fatal crashes attributed to various collision types.

Table 2.10 Collision Type (Rural Injury and Fatal Crashes Only, 2006 to 2011[1])

Collision Type (Injury and Fatal Crashes Only)	Rural Injury Crashes	Rural Fatal Crashes
Roll Over	27	1
Collision with Fixed Object	25	0
Head On	5	1
Right Angle	7	1
Left Turn Opposite Direction	3	0
Left Turn Same Direction	0	0
Sideswipe Opposite Direction	4	0
Sideswipe Same Direction	2	0
Pedestrian	0	0
Rear End	7	0
Loss of Control	1	0
Domestic Animal	1	0
Parked Vehicle	0	0
Wild Animal	2	0
Totals	**84**	**3**

Source: MDT, 2012.

[1] Data is provided for the period July 1, 2006 to June 30, 2011, reflecting currently available data as of the date of this report.

Crash Trends

The corridor safety audit process identified crash trends over the following four stretches of highway:

- *RP 0.0 to RP 4.0*
  - Main collision types: fixed object and wild animal
  - Total of 58 crashes resulting in 7 injury crashes (1 incapacitating injury, 2 non-incapacitating injury and 4 possible injury) and 51 property damage only
- *RP 12.0 to RP 28.0*
  - Main collision types: fixed object, wild animal, and roll over
  - Total of 87 crashes resulting in a fatal crash, 24 injury crashes (6 incapacitating injury, 10 non-incapacitating injury and 8 possible injury) and 62 property damage only
- *RP 49.0 to RP 51.3*
  - Main collision types: right angle, sideswipe, and wild animal
  - Total of 27 crashes resulting in a fatal crash, 6 injury crashes (1 incapacitating injury, 3 non-incapacitating injury and 2 possible injury) and 21 property damage only

- *RP 53.0 to RP 63.0*
  - Main collision types: fixed object, rear end, right angle, roll over, and head on
  - Total of 73 crashes resulting in a fatal crash, 30 injury crashes (5 incapacitating injury, 16 non-incapacitating injury and 9 possible injury) and 42 property damage only

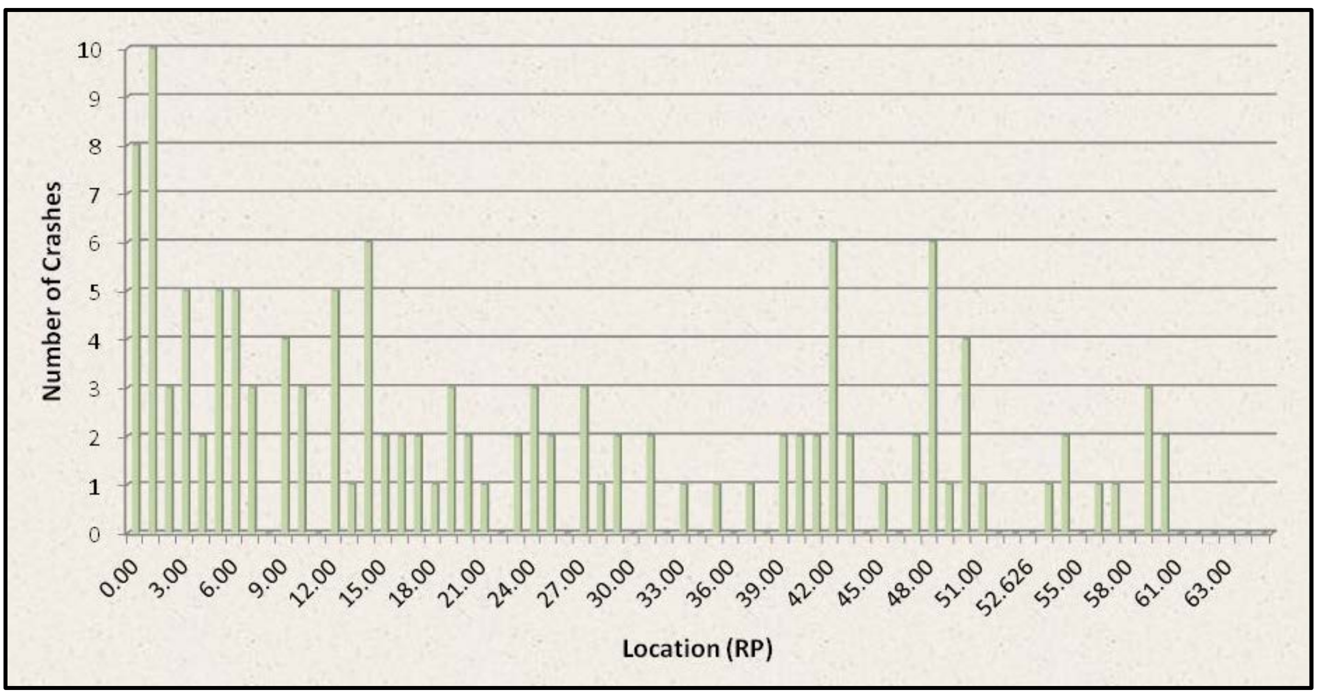
Light and Road Conditions

The highest percentage of crashes in the rural portion of the corridor occurred with dry road conditions (67%, or 238 of 353) and during daylight (48%, or 168 of 353).

Rural Crashes Involving Wild Animals

Wild animals were involved in 37% (130 out of 353) of reported rural crashes, although additional unreported crashes involving wild animals may have occurred during the 2006 to 2011 analysis period. Crashes involving wild animals were dispersed throughout the corridor, with higher numbers occurring near RP 0.0 (8 crashes), RP 1.0 (10 crashes), and RPs 14.0, 42.0, and 48.0 (6 crashes in each location). Seven deer and several bird carcasses were observed during a field survey on January 31, 2012. Figure 2-4 illustrates wild animal collisions in the rural portion of the corridor.

Figure 2-4 Rural Crashes Involving Wild Animals (2006 – 2011)

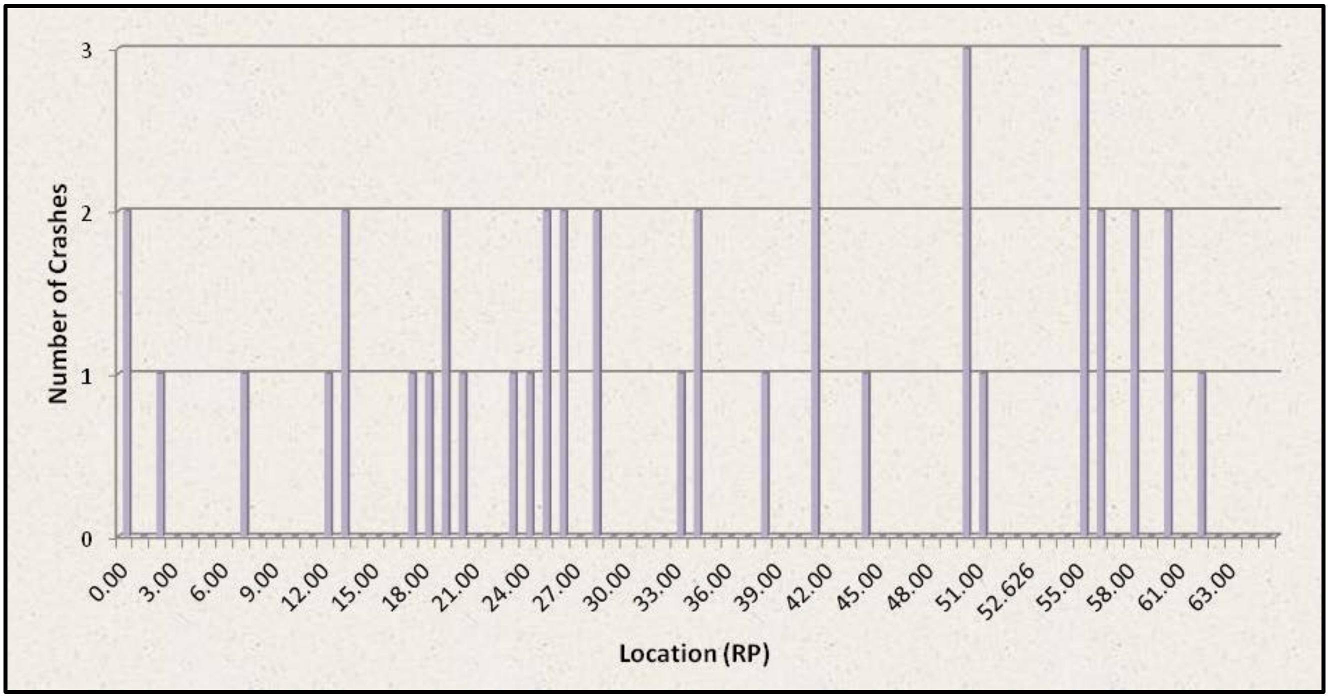


Source: MDT, 2012.

Rural Crashes Involving Large Vehicles

Large vehicles include vans, buses, school buses, truck / truck-tractors, motor homes, ambulances, fire trucks, wreckers in transit, and working construction vehicles. Approximately 12% (42 of 353) of rural crashes involved large vehicles. Crashes involving large vehicles were relatively evenly spread throughout the corridor, as illustrated in Figure 2-5.

Figure 2-5 Rural Crashes Involving Large Vehicles (2006 – 2011)



Source: MDT, 2012.

2.1.4 Access Analysis

High resolution aerial imagery and Google Street View were used to review access points within the corridor. A total of 528 access points were identified, with 264 (50%) located on the west side of the roadway and 264 (50%) located on the east side of the roadway. Approximately 95% (500 out of 528) of all access points are unpaved. The most common types of access points are private driveways (231 out of 528 or 44%) and farm field accesses (164 out 528 or 31%). Table 2.11 presents access point data in the corridor.

Table 2.11 Access Points within Study Corridor

	Private Driveways[1]		Commercial Access[2]		Road Access[3]		Farm Field Access[4]	Total
	Unpaved	Paved	Unpaved	Paved	Unpaved	Paved	Unpaved	
West Side of Roadway	119	3	6	2	40	7	87	264
East Side of Roadway	108	1	13	3	50	12	77	264
Combined Total	227	4	19	5	90	19	164	528
Percent Total	43%	1%	3%	1%	17%	4%	31%	100%

Source: DOWL HKM, 2012.
[1] The Private Driveways category includes access points originating from a private residence.
[2] The Commercial Access category includes access points originating from a commercial business.
[3] The Road Access category includes access points originating from county roads, city streets, and rural roads.
[4] The Farm Field Access category includes access points originating from a farm field.

Access point density is calculated by dividing the total number of unsignalized intersections and driveways on both sides of the roadway segment by the length of the segment in miles. Access point locations throughout the corridor are provided in Appendix 4. Access point densities are listed in Table 2.12.

Table 2.12 Access Density per Segment

Segment				Total Access Points	Total Length (Miles)	Access Point Density (Access Points Per Mile)	Reduction in FFS [1] (mph)
Number	Name	Start RP	End RP				
1	Glendive to Savage	0.0	31.5	156	30.9	5.0	0.0 to 2.5
2	Savage to Crane	31.5	41.5	107	10.0	10.7	
3	Crane to Sidney	41.5	50.4	110	8.9	12.4	2.5 to 5.0
4	Sidney to Fairview	52.6	62.5	155	9.9	15.7	

Source: DOWL HKM, 2012, HCM 2010, Exhibit 15-8 Adjustment Factor for Access-Point Density.
[1] Free-flow speed (miles/hour).

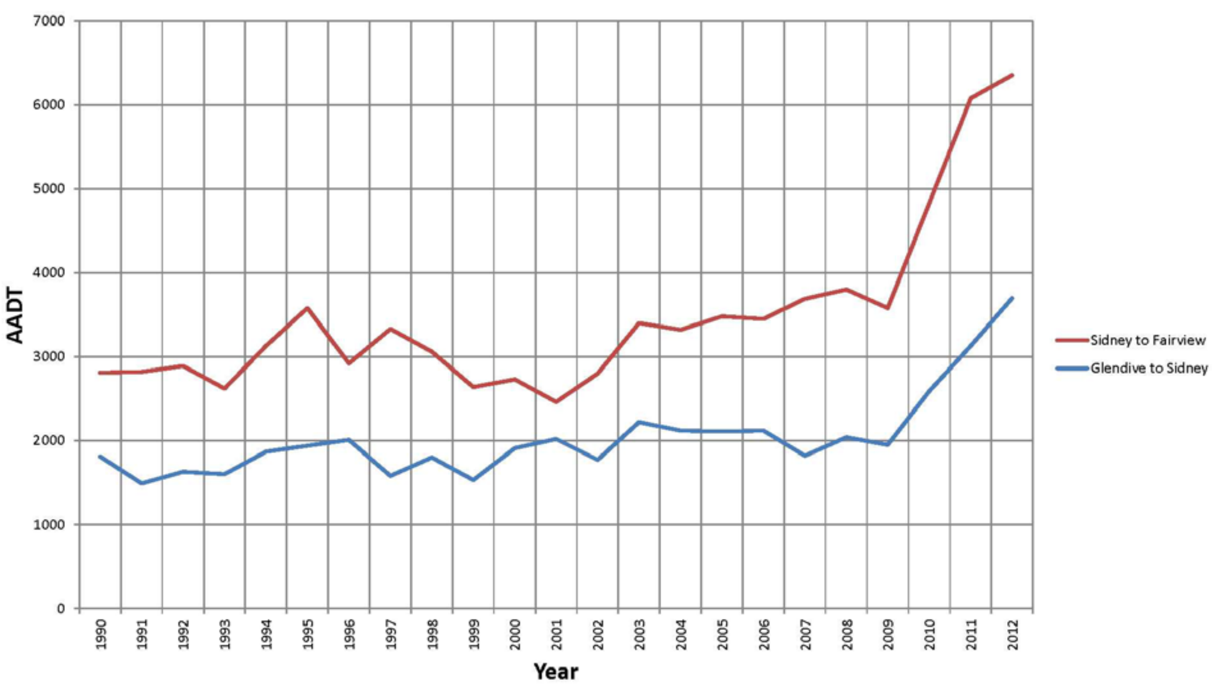
2.1.5 Traffic Volumes

Annual Average Daily Traffic (AADT) Volumes

Annual Average Daily Traffic (AADT) is the total of all motorized vehicles traveling in both directions on a highway on an average day. Traffic count data within the MT 16 / MT 200 corridor was collected using short-term counters. MDT collects a minimum of 36 hours of traffic count data during each short-term count setting. Short-term counts can be collected only when weather permits (usually April through September), unlike permanent counters which collect traffic data year-round. Short-term counts reflect a "snapshot" of traffic conditions during a particular 36-hour period and must be seasonally adjusted to provide a better representation of traffic conditions on an average day of the year.

MDT calculated weighted AADT traffic volumes along MT 16 between Glendive and Sidney (RP 0.6 to RP 50.4) and along MT 200 from Sidney to Fairview (RP 52.6 to RP 62.5). A single AADT traffic volume was calculated for each of these portions of the corridor by weighting volumes from multiple count locations by the length in miles of each roadway count segment. For the years 1990 to 2011, traffic data was collected in nine locations between Glendive and Sidney and five locations between Sidney and Fairview. Traffic volumes were collected for this corridor study in March 2012 in three locations between Glendive and Sidney and one location between Sidney and Fairview. Figure 2-6 illustrates weighted AADT volumes for the portions of the corridor between Glendive and Sidney and from Sidney to Fairview from 1990 to 2012. Additional information is provided in Appendix 5.

Figure 2-6 Weighted AADT Volumes (1990 – 2012)



Source: MDT, 2012.
Note: Traffic volumes were not collected in 2010 for the portion of the corridor from Sidney to Fairview. The 2010 Sidney to Fairview volume represents an average between 2009 and 2011 data.

Figure 2-6 demonstrates the recent increase in traffic volumes in the study corridor. Observed traffic volumes increased for the portion of the corridor from Glendive to Sidney during the period 2009 to 2010 and 2010 to 2011 by 33 percent and 21 percent, respectively. Observed traffic volumes increased by 70 percent for the portion of the corridor between Sidney and Fairview during the period 2010 to 2011.

For the portion of the corridor from Glendive to Sidney, large trucks comprised 16 percent of the total traffic volume in 2011, representing an 82 percent increase from 2010. For the portion of the corridor from Sidney to Fairview, large trucks comprised 17 percent of the total traffic volume in 2011, representing a 245 percent increase from 2010.

Peak Hour Traffic Volumes

Counts for this analysis were collected by MDT in March 2012. Data from the March 2012 field count collection effort was used to identify the highest peak hour of the day (defined as the four consecutive 15-minute periods with the highest volumes during the count period). A seasonal adjustment factor was applied to the respective month and day of the counts to calculate annual average hourly traffic volumes. MDT calculates statewide seasonal adjustment factors based on the functional classification of a roadway and the month and day of the week associated with traffic volume data collected by permanent counter locations throughout the state. There are no permanent counter locations within the study corridor. Seasonal adjustments specific to the MT 16 and MT 200 corridor were not identified for this study.

2.1.6 Operational Characteristics

Methodology

Traffic conditions on transportation facilities are commonly defined using the Level of Service (LOS) concept. The Highway Capacity Manual (HCM) 2010 defines LOS based on a variety of factors to provide a qualitative assessment of the driver's experience. Within the study corridor, MT 16 and MT 200 fall under the HCM classification of a Class I two-lane highway. Class I two-lane highways are major intercity routes, primary connectors of major traffic generators, daily commuter routes, or major links in state or national highway networks where motorists expect to travel at relatively high speeds. These facilities serve mostly long-distance trips or provide connections between facilities that serve long-distance trips. The HCM defines LOS for Class I two-lane highway on the basis of the percent time-spent-following (PTSF) concept. PTSF represents the freedom to maneuver and the comfort and convenience of travel. It reflects the average percentage of time that vehicles must travel in platoons behind slower vehicles due to an inability to pass. The two major factors affecting PTSF include passing capacity and passing demand. The concept of passing capacity for a two-lane highway reflects that the ability to pass is limited by the opposing flow rate and by the distribution of gaps in the opposing flow. The concept of passing demand reflects that the demand for passing maneuvers increases as more drivers are caught in a platoon behind a slow-moving vehicle (i.e., as PTSF increases in a given direction). Both passing capacity and passing demand are related to flow rates. When flow in each direction increases, passing demand increases and passing capacity decreases.

For a Class I two-lane highway, six (6) LOS categories ranging from A to F are used to describe traffic operations, with LOS A representing the best conditions and LOS F representing the worst. LOS F exists whenever demand flow in one or both directions exceeds the capacity of the segment, operating conditions are unstable, and heavy congestion exists. Table 2.13 presents LOS criteria for Class I two-lane highway segments.

Table 2.13 LOS Criteria for Class I Two-lane Highways

Level of Service	Class I Two-lane Highways PTSF[1] (%)
A	≤35.0
B	>35.0 to 50.0
C	>50.0 to 65.0
D	>65.0 to 80.0
E	>80
F	Demand Exceeds Capacity

Source: HCM 2010, Exhibit 15-3 Automobile LOS for Two-lane Highways.
[1] Percent time-spent-following.

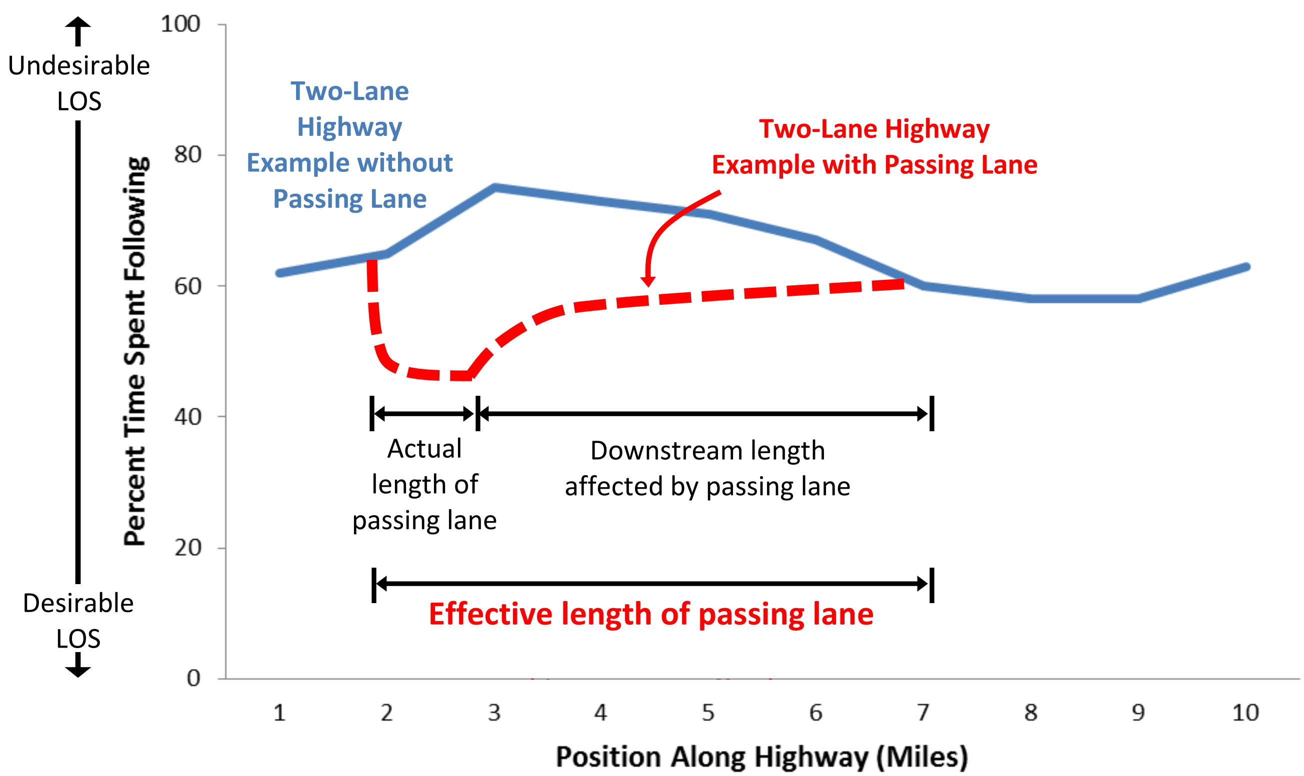
Highway Capacity Software (HCS) Version 2010 was used to analyze LOS for a Class I two-lane highway in the corridor.

The percentage of heavy vehicles in the traffic stream was considered as part of the HCS analysis. Heavy vehicles are defined as vehicles that have more than four tires touching the pavement. Trucks, buses, and recreational vehicles (RVs) are examples of heavy vehicles. Trucks cover a wide range of vehicles, from lightly loaded vans and panel trucks to the most heavily loaded haulers.

An amendment to the contract (change order) for the 30 km NE of Glendive – NE project includes passing lanes from approximate RP 20.0 to RP 22.0, which will decrease PTSF and improve LOS over the length of the passing lanes and for some distance downstream before PTSF returns to its former level. These passing lanes are included in the HCS analysis conducted for this study.

Figure 2-7 illustrates the operational effect of a passing lane in terms of the PTSF measurement. Passing lanes provide operational benefits for some distance downstream before PTSF returns to its former level (without the passing lane).

Figure 2-7 Operational Effect of Passing Lane



Source: HCM 2010, Exhibit 15-22 Operational Effect of a Passing Lane on PTSF.

Table 2.14 presents the downstream roadway length affected by passing lanes on highways with varying traffic volumes. Passing lanes constructed on highways with lower traffic volumes result in longer downstream affected lengths. This is due primarily to fewer vehicles downstream of the passing lane resulting in fewer following situations. Due to the downstream effect on PTSF, LOS for a two-lane highway may be improved by the addition of a passing lane.

Table 2.14 Downstream Length of Roadway Affected by Passing Lanes

Directional Demand Flow Rate[1] (passenger cars per hour)	Downstream Length of Affected Roadway (miles)
≤200	13.0
300	11.6
400	8.1
500	7.3
600	6.5
700	5.7
800	5.0
900	4.3
≥1,000	3.6

Source: HCM 2010, Exhibit 15-23 Downstream Length of Roadway Affected by Passing Lanes on Directional Segments in Level and Rolling Terrain.
(1) The traffic volume flow rate of a highway in one direction.
Note: Interpolation to the nearest 0.1 is recommended.

Analysis Results

Table 2.15 presents the results of the operational analysis for existing (2012) conditions. LOS values represent estimated operational conditions within each specified corridor segment. Appendix 6 contains HCS operational analysis worksheets.

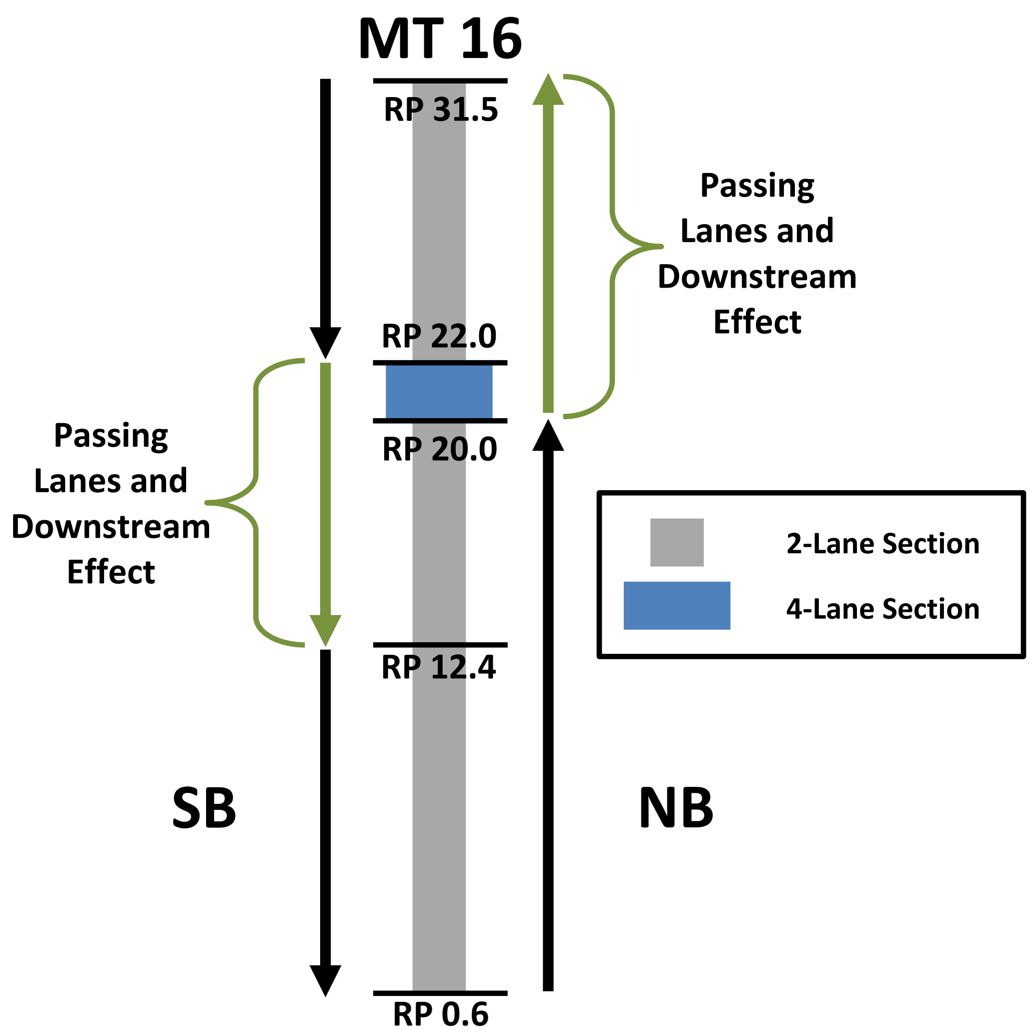
Table 2.15 Class I Two-lane Highway Operational Analysis Results (2012)

Location			PTSF[1] (%)	LOS
Corridor Segment	Glendive to Savage	MT 16 Northbound RP 0.6 to RP 20.0	39.6	B
		MT 16 Southbound RP 0.6 to RP 12.4	39.5	B
		MT 16 Northbound RP 20.0 to Savage	26.5	A
		MT 16 Southbound RP 12.4 to RP 22.0	25.2	A
		MT 16 Southbound RP 22.0 to Savage	40.1	B
	Savage to Crane	MT 16 Northbound	37.9	B
		MT 16 Southbound	42.5	B
	Crane to Sidney	MT 16 Northbound	38.0	B
		MT 16 Southbound	50.2	C
	Sidney to Fairview	MT 200 Eastbound	51.1	C
		MT 200 Westbound	49.3	B

Source: DOWL HKM, 2012.
[1] Percent time-spent-following.
Note: The Glendive to Savage segment is divided to accurately reflect LOS resulting from passing lanes located from RP 20.0 to RP 22.0 in the northbound and southbound directions. Passing lanes will be constructed as part of the 30 km NE of Glendive – NE project, which is anticipated to be completed in August 2012.

In the northbound direction, two LOS values are reported between Glendive (RP 0.6) and Savage (RP 31.5). The first LOS value represents the two-lane condition from RP 0.6 to RP 20.0, and the second LOS value represents the passing lane and downstream effect from RP 20.0 to Savage (RP 31.5). Reduced posted speed limits in the town of Savage truncate the downstream effect of the northbound passing lane. In the southbound direction, three LOS values are reported between Glendive (RP 0.6) and Savage (RP 31.5). The first LOS values represents the two-lane highway condition from Glendive (RP 0.6) to RP 12.4, the second value represents the passing lane and downstream effect from RP 12.4 to RP 22.0, and the third value represents conditions from RP 22.0 to Savage (RP 31.5). Figure 2-8 illustrates these conditions.

Figure 2-8 Passing Lanes and Downstream Effect



The MDT Traffic Engineering Manual defines desirable operations for principal and minor arterial facilities in level terrain as LOS B. The MT 16 / MT 200 corridor currently operates at LOS B or better throughout the corridor, with the exception of the MT 16 southbound Crane to Sidney segment and the MT 200 eastbound Sidney to Fairview, which are currently operating at LOS C.

2.2 Demographic and Economic Conditions

The study corridor includes portions of Dawson and Richland counties on the eastern border of Montana. The region has long been somewhat depressed economically and has tended towards negative population growth in past years. However, recent economic activity has reversed this trend, bringing more workers and traffic to the region. Historic and recent trends in population and economic activity are discussed in the following sections.

2.2.1 Population and Housing Characteristics

Table 2.16 summarizes data from the 2010 Census. Richland and Dawson counties are similar by most measures. Richland County is slightly more populated than Dawson County due in part to the larger population of Sidney compared to Glendive.

The Native American population of both counties is approximately 3 percent, compared to 7.9 percent for the state. This percentage is similar to other counties in Montana without Reservation lands. The nearest Indian Reservations are the Fort Peck Reservation to the north and the Northern Cheyenne Reservation to the south. In terms of ethnicity, the Hispanic population is 2 to 3 percent, which is comparable to the state percentage.

Vacancy rates for the counties ranged from 8 to 11% at the time of the 2010 Census. Vacancy rate is the proportion of the homeowner inventory that is vacant "for sale." Vacancy rates do not include rental units or hotel / motel rooms.

Field reports suggest an influx of workers has put increasing pressure on the housing markets in the region since the 2010 Census counts and vacancy rates may be lower now than previously reported. Recent permit applications for temporary housing units (e.g., RV parks or "man camps") indicate continued scarcity of permanent housing units.

Table 2.16 2010 Census Data

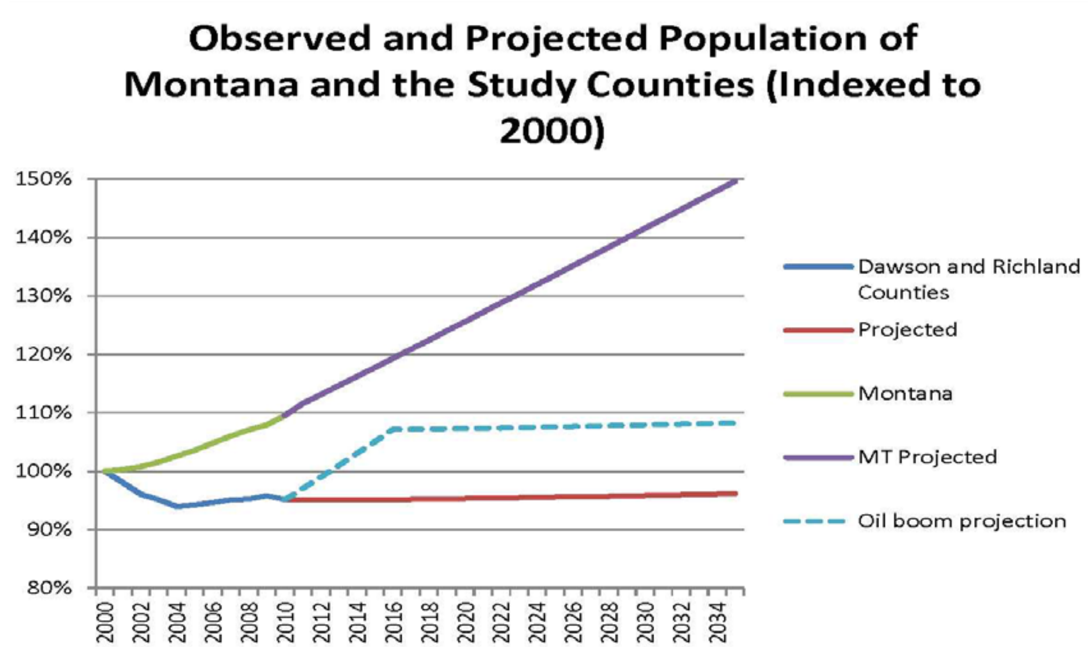
Category		Montana	Richland County	Dawson County
Population	County / State	989,415	9,746	8,966
	Largest City in County Sidney (Richland County) Glendive (Dawson County)	NA	5,191	4,491
Race	White	89%	97%	97%
	American Indian	7%	3%	3%
Ethnicity	Hispanic or Latino	3%	3%	2%
Housing	Total housing units	482,825	4,550	4,233
	Owner-occupied	58%	64%	63%
	Renter-occupied	27%	28%	26%
	Vacant	15%	8%	11%

Source: U.S. Census Bureau, 2010.

Figure 2-9 illustrates historic and projected populations for Montana, Dawson County, and Richland County from 2000 to 2035. Montana experienced moderate positive growth from 2000 to 2010 and is expected to grow at a similar pace into the future, increasing to about 150 percent of the state's 2000 population by the year 2030.

From 2000 to 2004, Richland and Dawson Counties experienced a combined population decline of over 1,000 people. Rebounding population growth occurred from 2004 to 2010, and the area finished with a small net positive population growth for the decade. The solid red line indicates study area population projections based on historical trends from the last decade. More recently, analysts have revised population projections based on the current oil development boom. The blue dashed line indicates a sharp increase in population in the near-term. As energy exploration and development activity eventually decline, population and job growth are expected to flatten. The exact length, rate, and long-term impacts of this population influx are unknown.

Figure 2-9 Historic and Projected Population



Source: NPS Data Services, 2012; Montana Census and Economic Information Center (CEIC), 2012.

2.2.2 Economy

The energy industry comprised the largest share of the regional economic base according to data provided for the 2008 to 2010 period by the University of Montana Bureau of Business and Economic Research (BBER). Agriculture, manufacturing, and transportation sectors also play large roles in the regional economy. The economic base is rounded out by government activities, health care, and other industries including tourism.

The most recent unemployment figures from state and federal labor departments suggest favorable employment conditions in the study area. As of November 2011, unemployment in Richland and Dawson Counties was approximately 3%, less than half the statewide rate of 6.6% and nearly two-thirds lower than the national rate of 8.6%. Unemployment data is presented in Table 2.17.

Table 2.17 November 2011 Unemployment Figures (not seasonally adjusted)

Location	Labor Force	Employed	Unemployed	Rate
Montana	498,322	465,573	32,749	6.6%
Richland County	6,201	6,042	159	2.6%
Dawson County	4,357	4,222	135	3.1%

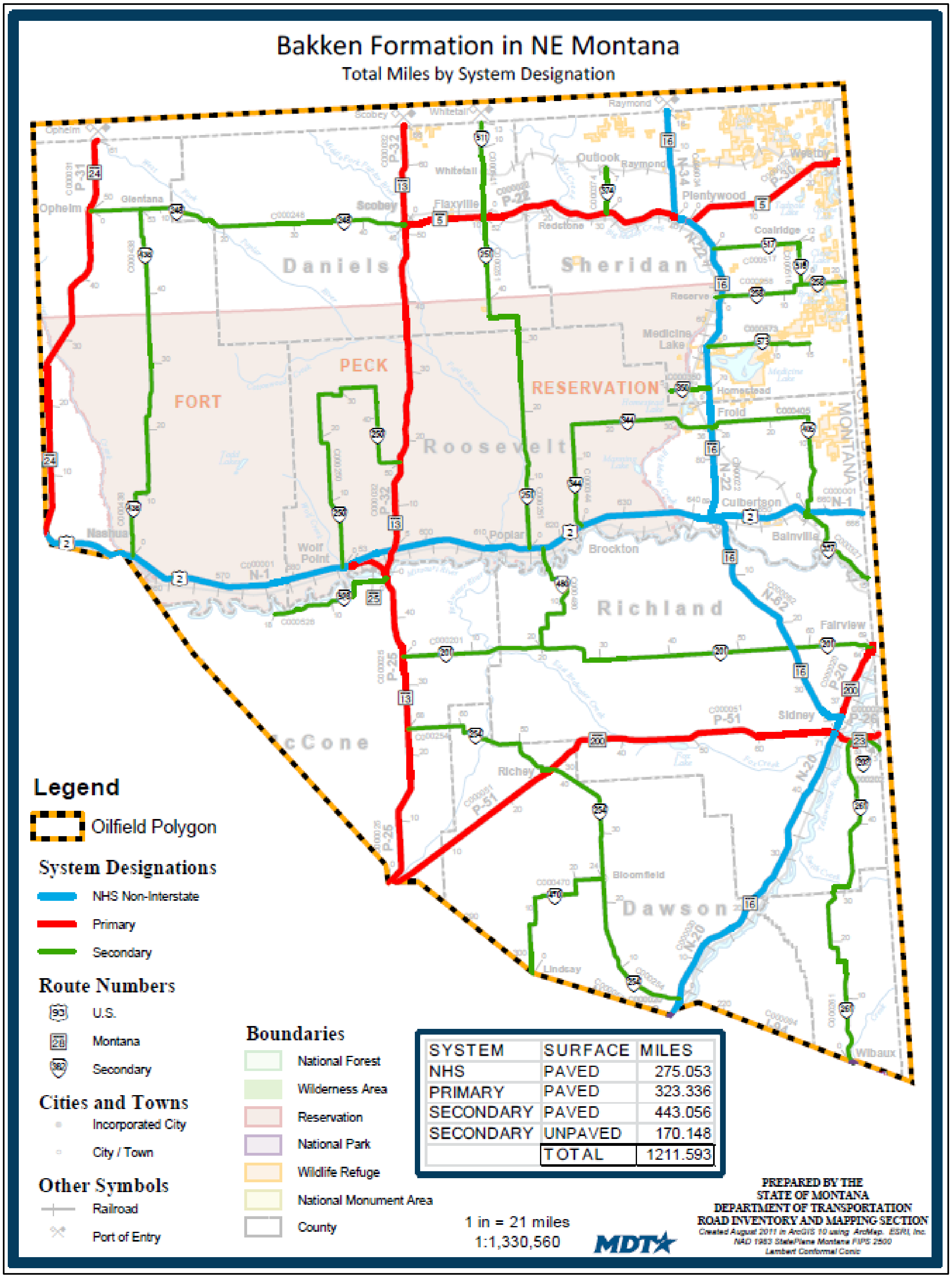
Source: MDT, 2012.

Energy Industry

The study area is located within the Bakken formation, which is currently experiencing a boom in oil development. That boom has generated growth in freight and other traffic in recent months, making eastern Montana and northwestern North Dakota among the fastest growing economic areas in the United States. Within the study area, the MT 16 / MT 200 corridor is a major service route connecting Interstate 90 to the Bakken region.

Figure 2-10 illustrates the Bakken formation within Montana, along with political boundaries and state-managed roads. The Bakken extends well into North Dakota and Saskatchewan. Much of the recent increase in traffic volumes within the study area may be the product of commerce across these boundaries. Apart from drilling activities, economic activity may be generated by transport to and from drilling sites, rail facilities, and transmission stations and performing value-added work such as engineering, processing, marketing, and other labor.

Figure 2-10 Bakken Formation in Montana

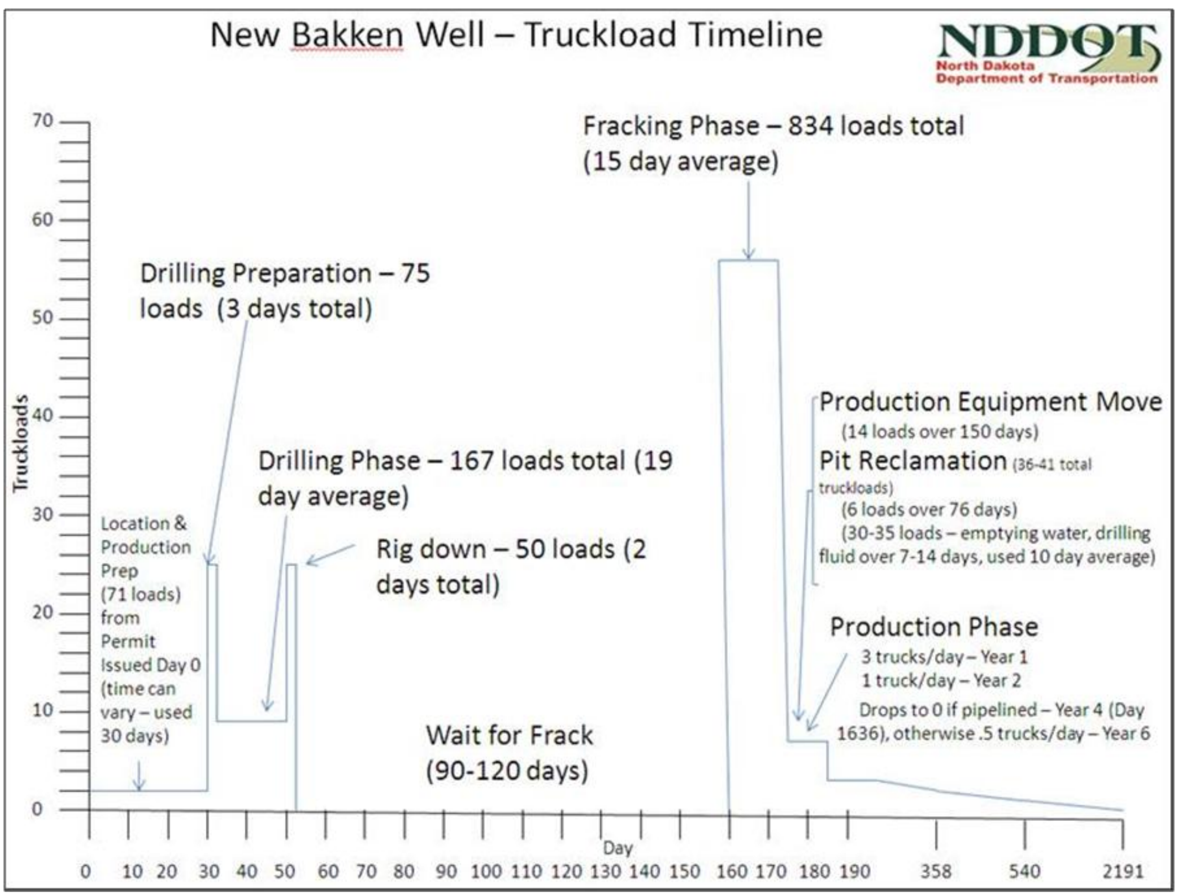


Source: MDT, 2012.

While oil well development and production have contributed to the local economy for many years, technological advances have resulted in substantial increases in the amount of recoverable oil. Historically, oil wells consisted of a single, vertically drilled shaft. Newer oil extraction techniques involve directional / horizontal drilling within the oil bearing deposit from a single vertical shaft. Hydraulic fracturing technology is used to crack the oil bearing material along the horizontally drilled shafts. A mixture of water and sand is injected under high pressure, "fracturing" the rock to release captured oil and increasing the amount of recoverable oil from each well. Use of this technology began in the Bakken fields in mid 2000s and is now the predominant form of oil well development throughout the region.

The North Dakota Department of Transportation (NDDOT) developed a Bakken Well Truckload Timeline demonstrating the number of truckloads believed to be associated with hydraulic fracturing technology. This timeline is illustrated in Figure 2-11. NDDOT estimates nearly 2,400 truckloads in the first year of development and production for a single well, with almost 36% of those truckloads occurring during a 15-day "fracking" phase.

Figure 2-11 NDDOT Bakken Well Truckload Timeline



In 1995, the US Geological Survey (USGS) estimated 151 million barrels of recoverable oil in the Bakken. A revised estimate released by USGS in April 2008 increased the estimate of recoverable oil from 3.0 to 4.3 billion barrels. Current estimates continue to fluctuate, with some oil company estimates reaching 20 billion barrels of recoverable oil. The average life expectancy of an oil well in the Bakken can extend up to 20 years, although production is highest in the first year. Analysts estimate oil exploration and development in the Bakken may continue for ten to twenty years.

Agriculture

Agricultural activities are also a major component of the local economy. The 2010 Montana State Rail Plan identifies three shuttle loading facilities in northeastern Montana, one of which is located in Glendive. An additional 100-car grain elevator loading facility is currently being constructed in Culbertson, Montana. Historically, Montana producers relied on smaller, local elevators providing rail service in 52- or 26-car units. The new shuttle loading facilities are designed to load 110 rail cars, double to quadruple previous industry standards.

With fewer and more centralized grain loading facilities, the distance from farm to elevator has generally increased. Market research conducted by MDT indicates the typical distance within which the shuttle facilities attract business from producers is a 60-mile radius. Haul trucks are often larger, heavier, and travel longer distances to reach grain loading facilities, with potential impacts on pavement condition and roadway maintenance costs.

2.2.3 Other Planning Documents

Planning documents prepared by MDT, Dawson County, and Richland County relevant to the MT 16 / MT 200 corridor planning effort are listed below. Review of existing plans provides an understanding of conditions within the corridor and encourages consistency with local planning efforts.

Culbertson Corridor Planning Study (ongoing) – Culbertson, MT is located approximately 35 miles north / northwest of Sidney via MT 16. The Culbertson area has experienced similar growth in traffic along US 2 and MT 16 as is being experienced along the MT 16 / MT 200 corridor. The Culbertson Corridor Planning Study is primarily focused on truck traffic on US 2 and MT 16 which intersect in Culbertson.

Sidney Truck Route Study (2009) – MDT completed a study to assess the need for a bypass route that would allow truck traffic on the MT 16 / MT 200 corridor to avoid Central Avenue in downtown Sidney. The study identified an eastern truck route as having the greatest potential for diverting truck traffic from Central Avenue. The recommended improvement intersects the MT 200 corridor north of Sidney within the limits of the MT 16 / MT 200 corridor planning study area.

<u>Growth Policy for Richland County, Sidney and Fairview (2007)</u> – The Richland County Growth Policy is intended to provide long-range planning for the county and the communities of Sidney and Fairview. The plan identifies agriculture as the predominant land use within the county, with approximately 90% of the county's land mass in privately held farms and ranches. The plan acknowledges the impact of Bakken oil development, noting approximately 200 wells were developed between 2000 and plan adoption in 2007. Surface impacts of energy production include drill sites, transportation system impacts, and land conversion for industrial purposes to stockpile and house equipment and supplies.

There is no zoning in Richland County outside the Sidney and Fairview city limits. Richland County, Sidney, and Fairview have established joint City-County planning areas with the intent of extending zoning up to one mile beyond city limits. Draft Future Land Use Maps (FLUM) have been prepared for the joint Sidney and Fairview City-County planning areas and are being reviewed through the public hearing process prior to being adopted as elements of the Growth Policy.

The draft Sidney FLUM shows highway business and commercial zoning southwest of Sidney along the MT 16 corridor. Industrial uses extend to the east and residential uses extend to the west of proposed highway business / commercial zoning areas. Zoning proposed northeast of Sidney along MT 200 includes a mix of residential and commercial uses. The draft Fairview FLUM indicates a majority of commercial zoning within the city limits, with residential zoning extending southwest of town along the MT 200 corridor. Implementation of proposed zoning could increase development along the MT 16 / MT 200 corridor.

<u>Dawson County / Glendive Growth Policy (2006)</u> –The Dawson County / Glendive Growth Policy is intended to serve as a planning guide for local officials and citizens throughout the planning period from its adoption in 2006 through 2025. It is a long-range statement of local public policy providing guidance for accommodating development within the county.

The plan highlights a need to preserve agricultural land as a primary resource within the county, with future commercial, industrial, and residential development proposed in the area surrounding Glendive. Agriculture is identified as the predominant use along the MT 16 corridor. The plan identifies strip commercial and industrial development along MT 16 extending approximately one mile north / northeast of I-94. Moving north, land use designations transition to rural residential development along MT 16 for approximately one mile, and then predominantly agricultural use to the county line. Land use designations within the first two miles of the study area (RP 0.6 to 2.6) may facilitate future commercial, industrial, and residential development within the corridor.

2.3 Environmental and Physical Setting

MDT prepared an Environmental Scan Report for the MT 16 / MT 200 Corridor Planning Study to identify environmental resource constraints and opportunities within the study corridor. Information was gathered from previously-published documents, websites, and GIS data. Key information from the Environmental Scan Report is summarized in the following sections.

2.3.1 Physical Environment

Soil Resources and Prime Farmland

Some areas within the corridor are classified as prime and important farmlands. If improvement options are forwarded from this study, a U.S. Department of Agriculture Natural Resource Conservation Service Farmland Conversion Impact Rating Form for Linear Projects (form CPA-106) would need to be completed to document any impacts to farmlands.

Geologic Features and Hazards

The MT 16 / MT 200 alignment generally follows a highland terrace of the Yellowstone River, occasionally traversing lowland floodplain areas. Alluvium typically consists of unconsolidated deposits of gravel, sand, silt, and clay.

Surface Water

The study corridor is located in the Lower Yellowstone Watershed. The Yellowstone River from its confluence with the Powder River (near Terry, MT) to the North Dakota border is listed in the 2012 Integrated 303(d / 305(b) Water Quality Report for Montana by the Montana Department of Environmental Quality (DEQ). Within the study area, the Yellowstone River has been classified as Category 5 and Category 4C. Category 5 water bodies are waters where one or more applicable beneficial use has been assessed as being impaired or threatened, and a Total Maximum Daily Loads (TMDL) is required to address the factors causing the impairment or threat. Category 4C water bodies are waters where TMDLs are not required as no pollutant-related use impairment is identified. TMDLs have not yet been written for water bodies in this watershed. When TMDLs are prepared and implementation plans are in place, any construction practices would have to comply with the requirements set forth in the plan.

Groundwater and Sourcewater Points

Numerous groundwater and sourcewater access points are located within the study corridor. Dawson County and Richland County have not developed Local Water Quality Districts (LWQD). If improvement options are forwarded from this study, water quality protection measures may need to be addressed during project development.

Irrigation

Irrigated farmland exists in Dawson County and Richland County adjacent to the study corridor. If improvement options are forwarded from this study, operators of irrigation facilities would need to be contacted for flow requirements during project development to minimize impacts to farming operations. Irrigation facilities would need to be assessed to determine if they are considered Waters of the U.S. and subject to jurisdiction by the U.S. Army Corps of Engineers (USACE).

Wetlands

The study area encompasses portions of the Yellowstone River and associated tributaries and wetland areas. If improvement options are forwarded from this study, wetland delineations and jurisdictional determinations would need to be conducted during project development according to standard USACE procedures.

Floodplains

Designated flood zones occur within the study corridor. If improvement options are forwarded from this study, coordination with the County Floodplain Administrator would be conducted during the project development process to minimize floodplain impacts and obtain any necessary floodplain permits.

Hazardous Materials

There are a number of underground storage tank (UST) sites, leaking underground storage tank (LUST) sites, and remediation response sites within the study corridor. If improvement options are forwarded from this study, handling and disposing of any contaminated materials encountered during construction activities would be conducted in accordance with applicable state, federal, and local laws and rules.

Air Quality

The study corridor is not located in or adjacent to a non-attainment area and is exempt from a Mobile Source Air Toxics Analysis under the conformity exemption for planning studies.

Noise

Noise receptors may be located within the study area. If improvement options are forwarded from this study, noise studies may need to be conducted for Type I projects during project development.

Visual Resources

The study corridor contains an array of environmental resources which contribute to the rural landscape. There are no properties or view corridors within the study area listed on the Department of Interior's National Landscape Monument System.

2.3.2 Biological Resources

Fish and Wildlife

Threatened and Endangered Wildlife Species

Six (6) endangered, threatened, proposed, or candidate animal species are expected to occur in Dawson and Richland Counties. These species are listed in Table 2.18.

If improvement options are forwarded from this study, an evaluation of potential impacts to all endangered, threatened, proposed, or candidate species would need to be completed during the project development process.

Table 2.18 Threatened and Endangered Wildlife Species in Richland and Dawson Counties

Category	Scientific Name	Common Name	Federal Status
Fish	*Scaphirhynchus albus*	Pallid Sturgeon	Listed Endangered
Bird	*Charadrius melodus*	Piping Plover	Listed Threatened, Critical Habitat
	Sterna antillarum athalassos	Interior Least Tern	Listed Endangered
	Grus Americana	Whooping Crane	Listed Endangered
	Centrocercus urophasianus	Greater Sage Grouse	Candidate
	Anthrus spragueii	Sprague's Pipit	Candidate

Source: USFWS, 2011.

Wildlife and Fish Species of Concern

Forty-five (45) animal species of concern are expected to occur in Dawson and Richland Counties. If improvement options are forwarded from this study, on-site surveys would need to be completed during the project development process.

Vegetation

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

Threatened and Endangered Plant Species

No endangered, threatened, proposed, or candidate plant species are listed for Dawson or Richland Counties, and none are currently expected to occur in the study area.

Plant Species of Concern

A single plant species of concern is anticipated to occur in Dawson County. If improvement options are forwarded from this study, on-site surveys would need to be completed during the project development process.

Noxious Weeds

There are 32 noxious weeds in Montana, as designated by the Montana Statewide Noxious Weed List (effective April 15, 2008). If a project is forwarded from the improvement option(s), the study area would need to be surveyed for noxious weeds during the project development process.

2.3.3 Social and Cultural Resources

Cultural and Archaeological Resources

Resources identified within the study corridor including historic irrigation canals, bridges, residences, mining operations and trash deposits, and archaeological sites. If improvement options are forwarded from this study, on-site surveys would need to be completed during the project development process.

Section 6(f) Resources

Five Section 6(f) resources are located within the study corridor and are listed in Table 2.19.

Table 2.19 Section 6(f) Resources within the Project Area

Name	Type of Resource	Location
Dawson County Hollecker Lake	Recreational Lake Area	On MT 16, approximately 0.2 Miles North of the MT 16 / I-94 Junction
Gartside Reservoir	Fishing Access	Approximately 0.5 miles west of Crane, MT
Seven Sisters Island	Fishing Access	Approximately 0.5 miles east of Crane, MT
Intake Dam Fishing Access Site	Fishing Access	On MT 16, approximately 17.0 Miles North of Glendive
Elk Island Wildlife Management Area / Fishing Access Site	Wildlife Management Area / Fishing Access Site	On MT 16, approximately 1.5 Miles North of Savage, MT

Source: MDT, 2012.

Section 4(f) Resources

Known historic sites within the corridor include the Northern Pacific Railway (now BNSF Railway), portions of the Bureau of Reclamation's Lower Yellowstone Irrigation Project, and potentially several steel pony truss bridges in the vicinity of Savage that were built in the second decade of the twentieth century and are associated with the irrigation project. The old wagon road between Fort Keogh (outside Miles City) and Fort Buford in North Dakota is also likely located within the corridor as are sections of the Red Trail auto trail from the late 1910s and 1920s. Resources listed in the Section 6(f) discussion are also considered Section 4(f) resources. If improvement options are forwarded from this study, on-site surveys would need to be completed during the project development process to identify additional Section 4(f) resources in the corridor. Known and potential Section 4(f) resources are listed in Table 2.20.

Table 2.20 Known and Potential Section 4(f) Resources within the Study Area

Name	Type of 4(f) Resource	Location
Northern Pacific Railway (BNSF)	Historic Railway	Throughout Corridor
Lower Yellowstone Irrigation Project	Historic Canal	Various Locations Throughout Corridor
Fort Keogh to Fort Buford Wagon Trail	Historic Roadway	
Red Trail auto trail from the late 1910s and 1920s	Historic Roadway	

Source: MDT, 2012. Section 6(f) resources from Table 2.19 are not duplicated.

Environmental Justice

Minority and low-income persons may live within the study corridor. If a project is forwarded from the study, environmental justice issues will need to be further evaluated during the project development process.

3.0 PROJECTED CONDITIONS

Projected highway transportation system conditions within the study corridor are discussed in terms of anticipated future growth rates, which impact traffic volumes and operational characteristics.

3.1 Growth Rates

Community members stated during a safety audit meeting facilitated by MDT in February 2012 that traffic volumes along MT 16 / MT 200 corridor have increased substantially since 2008. Compound annual growth rates for the two portions of the corridor (MT 16 from RP 0.6 to RP 50.4, and MT 200 from RP 52.6 to RP 62.5) were calculated based on weighted AADT volumes over the period 1990 to 2008 and again for the period 2008 to 2012. The compound annual growth rate calculated for the period 1990 to 2008 is assumed to be reflective of historical background growth, while the compound annual growth rate calculated for the period 2008 to 2012 is assumed to be reflective of increases in traffic associated with recent economic activity in the region.

The general calculation for identifying a compound annual growth rate is presented below, followed by calculations using data for the two portions of the corridor for the years 1990 to 2008 and 2008 to 2012. A minimum period of five years is generally used to identify trends in traffic volumes to minimize potential volatility from an unusual traffic volume observed in a single year.

Compound Annual Growth Rate Calculation Formula

$$[(\text{Ending Volume}/\text{Starting Volume})^{(1/(\text{Ending Year}-\text{Starting Year}))}] - 1 = \text{Compound Annual Growth Rate}$$

Glendive to Sidney (RP 0.6 to RP 50.4)

Historical Background Growth Calculation (1990 to 2008)

$$[(2{,}040/1{,}810)^{(1/(2008-1990))}] - 1 \approx \mathbf{0.7\%}$$

Recent Growth Calculation (2008 to 2012)

$$[(3{,}697/2{,}040)^{(1/(2012-2008))}] - 1 \approx \mathbf{16.0\%}$$

Sidney to Fairview (RP 52.6 to RP 62.5)

Historical Background Growth Calculation (1990 to 2008)

$$[(3{,}800/2{,}810)^{(1/(2008-1990))}] - 1 \approx \mathbf{1.7\%}$$

Recent Growth Calculation (2008 to 2012)

$$[(6{,}357/3{,}800)^{(1/(2012-2008))}] - 1 \approx \mathbf{13.7\%}$$

Historical background growth is an increase in traffic volumes over time attributed to population growth and general economic expansion within a study corridor. The traffic volume growth rates of 0.7% (Glendive to Sidney) and 1.7% (Sidney to Fairview) were calculated using a compound annual growth rate for the period 1990 to 2008, and are assumed to be reflective of historical background growth.

Discussions with community members during the MDT safety audit meeting in February 2012 suggested increasing traffic volumes since 2008 are likely due to recent economic activity associated with oil development in the region. The traffic volume growth rates of 16.0% (Glendive to Sidney) and 13.7% (Sidney to Fairview) were calculated using a compound annual growth rate for the period 2008 to 2012, and are assumed to be reflective of the current period of rapid economic expansion.

Growth rates observed during the recent 2008 to 2012 period are not expected to sustain throughout the study horizon year of 2035. The exact period of rapid economic expansion in the region is not known. Traffic volumes may continue to grow at higher growth rates observed in recent years for an additional period of time before returning to historic background growth rates. A range of three to five years of continued rapid economic expansion was assumed for this study. Traffic volume levels attained during this initial period of rapid economic expansion are expected to remain through the study horizon year of 2035. Following the initial period of rapid growth in traffic volumes associated with mobilization to the area, traffic volumes could be expected to equalize towards growth rates consistent with historical annual growth rates for the remainder of the planning horizon. Traffic volumes may begin to decline past the study horizon year of 2035 as development activity slows in the region.

3.2 Projected Traffic Volumes

The formula for calculating projected traffic volumes is shown below.

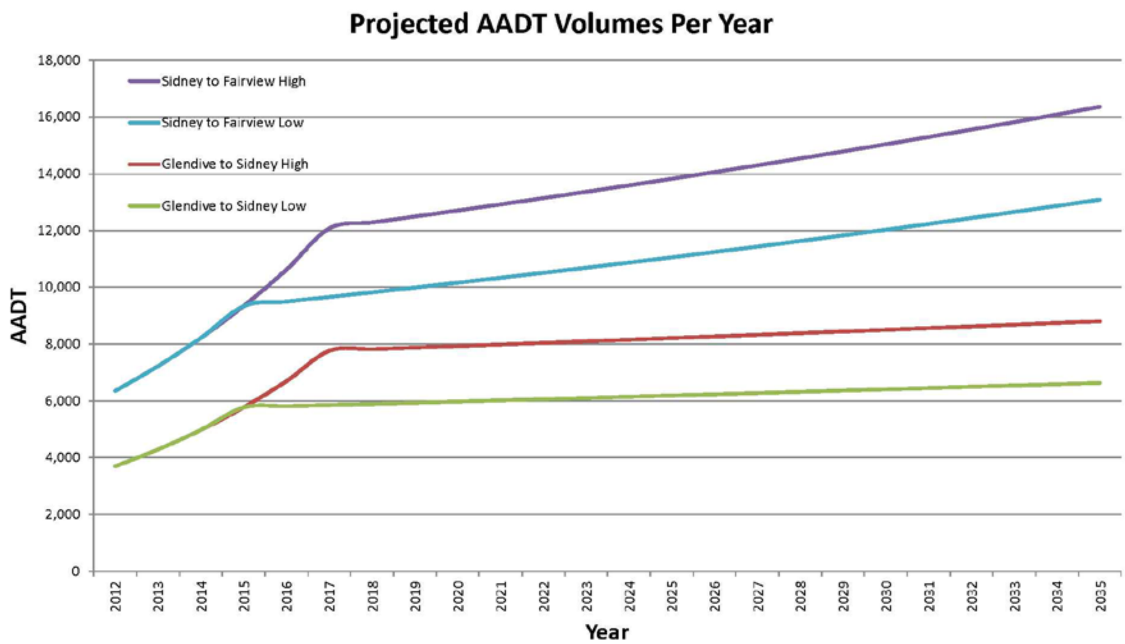
Projected Traffic Volume Calculation Formula

$$(\text{Current Volume})*(1+[\text{Growth Rate in Decimal Form}])^{\text{Number of Years}} = \text{Future Year Volume}$$

Projected traffic volumes were calculated assuming a period of continued rapid growth ranging from three to five years, followed by a return to a consistent historic background growth. Projected 2035 AADT volumes range from approximately 6,600 to 8,800 vehicles per day in the Glendive to Sidney portion of the corridor, and approximately 13,100 to 16,400 vehicles per day in the Sidney to Fairview portion of the corridor. Projections represent planning-level estimates and do not reflect annual traffic volume fluctuations likely to occur throughout the planning horizon.

Projected AADT volumes are illustrated in Figure 3-1. Additional information is presented in Appendix 5.

Figure 3-1 Projected AADT



Source: DOWL HKM, 2012.

3.3 Projected Operational Characteristics

Analysis Results

Table 3.1 presents the results of the operational analysis for anticipated 2035 conditions.

Table 3.1 Projected Operational Analysis Results (2035)

Location			Low Estimate[1]		High Estimate[2]	
			PTSF[3] (%)	LOS	PTSF[3] (%)	LOS
Corridor Segment	Glendive to Savage	MT 16 Northbound RP 0.6 to RP 20.0	54.6	C	60.3	C
		MT 16 Southbound RP 0.6 to RP 12.4	54.9	C	61.7	C
		MT 16 Northbound RP 20.0 to Savage	39.3	B	47.3	B
		MT 16 Southbound RP 12.4 to RP 22.0	37.7	B	45.7	B
		MT 16 Southbound RP 22.0 to Savage	55.3	C	60.1	C
	Savage to Crane	MT 16 Northbound	51.3	C	59.2	C
		MT 16 Southbound	57.3	C	64.7	C
	Crane to Sidney	MT 16 Northbound	52.2	C	59.5	C
		MT 16 Southbound	64.7	C	72.8	D
	Sidney to Fairview	MT 200 Eastbound	71.3	D	77.4	D
		MT 200 Westbound	69.2	D	75.9	D

Source: DOWL HKM, 2012.
(1) Low estimate indicates three years of rapid traffic volume growth, followed by twenty years of historical background growth.
(2) High estimate indicates five years of rapid traffic volume growth, followed by eighteen years of historical background growth.
(3) Percent time-spent-following

The HCM defines LOS for Class I two-lane highway on the basis of the percent time-spent-following (PTSF) concept. PTSF represents the freedom to maneuver and the comfort and convenience of travel. It reflects the average percentage of time that vehicles must travel in platoons behind slower vehicles due to an inability to pass. The two major factors affecting PTSF include passing capacity and passing demand. The concept of passing capacity for a two-lane highway reflects that the ability to pass is limited by the opposing flow rate and by the distribution of gaps in the opposing flow. The concept of passing demand reflects that the demand for passing maneuvers increases as more drivers are caught in a platoon behind a slow-moving vehicle (i.e., as PTSF increases in a given direction). Both passing capacity and passing demand are related to flow rates. When flow in each direction increases, passing demand increases and passing capacity decreases.

The MDT Traffic Engineering Manual defines desirable operations for principal and minor arterial facilities in level terrain as LOS B. The MT 16 / MT 200 corridor is projected to operate at LOS C or worse throughout the majority of the corridor, with the exception of the MT 16 segments from RP 20.0 to Savage in the northbound direction and RP 12.4 to RP 22.0 in the southbound direction, which are projected to operate at LOS B.

4.0 RECENT AND PROPOSED PROJECTS

Recent and planned MDT projects in the study area vicinity are described below.

CT 200 / CR 129 Intersection Signing involved installation of signing at the intersection of MT 200 & County Road 129 from approximately RP 56.9 to approximately RP 57.2. The project was completed in 2012.

30 km NE of Glendive – NE involved reconstruction of MT 16 from approximately RP 18.6 to approximately RP 28.9. The project began in April 2011 and completion is estimated in August 2012. An amendment to the contract (change order) for this project includes northbound and southbound passing lanes on MT 16 from approximately RP 20.0 to RP 22.0. The project began in April 2011 and completion is estimated in August 2012.

Sidney – Southwest is a major rehabilitation project from approximately RP 50.0 to RP 52.6 consisting of a mill, overlay, and seal and cover. The project was let in February 2011.

Slide Repair – NE of Glendive / MT11-1 is a slide repair project from approximately RP 13.0 to approximately RP 13.5. The project is anticipated to start in March 2012 and will include removing the slide area extending to the roadway shoulder.

Fairview Intersection Improvements is an intersection improvement project extending from approximately RP 63.1 to approximately RP 63.8. The project includes installation of a traffic signal on MT 200 at 6th, pedestrian crossing on Western Avenue, Street and improvement to the intersection of MT 200 / Secondary 201 to better accommodate truck turning movements. The project is anticipated to start in May 2012.

SF 119-Glendive Rumble Strips is a safety project to install shoulder and centerline rumble strips at various locations on MT 16 from approximately RP 1.5 to approximately RP 49.9. The anticipated project start date is May 2013.

5.0 SUMMARY OF ISSUES AND CONCERNS

Table 5.1 summarizes issues and concerns related to transportation system and environmental conditions in the corridor.

Table 5.1 Summary of Issues and Concerns

<table>
<tr><th colspan="2">Condition</th><th>Issue / Concern</th></tr>
<tr><td rowspan="4">Transportation System Conditions</td><td>Physical Features</td><td><u>Utilities</u>
• High pressure natural gas pipelines cross the corridor in seven (7) locations.
<u>Pavement Condition</u>
• There is evidence of minor rutting, transverse cracking, longitudinal cracking, and shoulder failure within study area.</td></tr>
<tr><td>Geometric Conditions</td><td><u>Horizontal Alignment</u>
• Seven (7) locations do not meet current MDT standards.
<u>Vertical Alignment</u>
• Thirteen (13) locations do not meet current MDT standards.
<u>Clear Zones</u>
• Twelve (12) locations do not meet current MDT standards.</td></tr>
<tr><td>Crash History</td><td>• Commercial vehicle speed differential, which may lead to large vehicle queues and aggressive passing maneuvers
• Higher occurrence of crashes involving large vehicles
• Higher occurrence of unbelted crashes
• Higher occurrences of crashes involving vehicles with out-of-state registration
• Fatigued and impaired driver crashes
• Ability of the existing transportation network to handle projected regional growth
• Increased driveway/intersection related crashes between Sidney and Fairview
• Moving sight distance concerns at the intersection of County Road 126
• Minimal guidance to drivers approaching the intersection of MT 16/MT 23/MT 200. Concern was also expressed regarding the speed limit through this area.
• Head-on and single vehicle run off the road (SVROR) crashes</td></tr>
<tr><td>Operational Conditions</td><td>• Portions of MT 16 and MT 200 currently operate at an undesirable LOS C.
• The MT 16 / MT 200 corridor is projected to operate at LOS C or worse by 2035 throughout the majority of the corridor.</td></tr>
</table>

Condition	Issue / Concern
Environmental Conditions	Prime Farmland • Prime and important farmlands are located within the study area Surface Water Impairment • Within the study corridor, the Yellowstone River is listed in DEQ's Integrated 303(d) / 305(b) Water Quality Report Wetlands • The study area includes portions of the Yellowstone River, its tributaries, and associated wetlands Hazardous Materials • USTs, LUSTs and remediation response sites located within study area Floodplains • The corridor crosses mapped floodplains Fish and Wildlife • Six (6) endangered, threatened, proposed or candidate animal species and 45 species of concern are expected to occur in Dawson and Richland Counties. Vegetation • One plant species of concern is expected to occur in Dawson and Richland Counties Cultural and Archaeological Resources • Resources within the study corridor include historic irrigation canals, bridges, residences, mining operations and trash deposits, and archaeological sites. Section 4(f) / Section 6(f) Resources • Several Section 4(f) and Section 6(f) resources are located within the corridor