Montana Department of Transportation

PO Box 201001
Helena, MT 59620-1001

Memorandum

To: Bob Vosen, P.E. – Missoula District Administrator

From: Stan Brelin II, P.E. – Traffic Operations Engineer SB

Date: May 2, 2023

Subject: Speed Limit Recommendation
US 93 (N-7) - Hamilton to Missoula

Overview

In June, a request from Missoula County was made to review the speed limits along US 93 between Lolo and Missoula. Specific consideration was requested to be made when reviewing the speed limits around Cochise Drive. At the same time an internal review of the speed limits along US 93 from Hamilton to Lolo was begun. Only the speed limits within the rural areas would be reviewed and not within the communities of Victor, Stevensville Y, Florence, and Lolo. Special consideration to the speed limits around Bell Crossing and Woodside Cutoff was determined to be desirable. Numerous concerns with safety and the existing speed limits were brought up by Missoula County and internally within MDT. Therefore, in July of 2022 MDT entered into a contract to have KLJ conduct a speed study from milepost 49 to milepost 90 excluding the areas from milepost 59.1 to milepost 59.8, milepost 66.2 to milepost 67.8, milepost 74.0 to milepost 75.4, and milepost 82.7 to milepost 84.0. Attached is their report and recommendation. A summary of the recommendation can be found below.

Summary

Observed 85th percentile speeds are for the most part at least 5-mph above the posted 70-mph and 65-mph speed limits. Current speed limits are set around the 50th percentile speeds. The exception is around the Stevensville Y where prevailing speeds based on the 85th percentile and upper limit of the pace are just below the 70-mph speed limit. Roadway context recommends use of the 85th percentile and rounded down 85th percentile speeds. This would introduce a new 65-mph speed zone around Stevensville Y. However, to maintain a consistent speed limit and driver expectations, as well as how close the prevailing speeds are to the existing speed limit keeping the existing 70-mph speed limit is recommended. Another more in-depth speed study focusing on the Stevenville Y was completed as well by MDT. Observations show drivers have difficulty slowing down when transitioning into the more developed area. Therefore the 55-mph speed zones should be extended to be 2,700-feet in length. Furthermore, a new 55-mph transitional speed zone should be introduced between the 45-mph speed limit and the 65-mph speed limit south of Missoula. MDT agrees with the proposed changes by KLJ.

The proposed speed limits are as follows:

A 55-mph speed limit beginning at milepost 89.8, the existing 45/65-mph speed limit transition point, and continuing south to milepost 89.3, an approximate distance of 2,700-feet.

A 55-mph speed limit beginning at milepost 84.0, the existing 45/55-mph speed limit transition point, and continuing north to milepost 84.5, an approximate distance of 2,700-feet.

A 55-mph speed limit beginning at milepost 82.0, the existing 45/55-mph speed limit transition point, and continuing south to milepost 81.5, an approximate distance of 2,700-feet.

A 55-mph speed limit beginning at milepost 75.2, the existing 45/55-mph speed limit transition point, and continuing north to milepost 75.7, an approximate distance of 2,700-feet.

A 55-mph speed limit beginning at milepost 74.0, the existing 45/55-mph speed limit transition point, and continuing south to milepost 73.5, an approximate distance of 2,700-feet.

A 55-mph speed limit beginning at milepost 59.8, the existing 45/55-mph speed limit transition point, and continuing north to milepost 60.3 an approximate distance of 2,700-feet.

A 55-mph speed limit beginning at milepost 59.1, the existing 45/55-mph speed limit transition point, and continuing south to milepost 58.6, an approximate distance of 2,700-feet.

A 55-mph speed limit beginning at milepost 52.1, the existing 45/55-mph speed limit transition point, and continuing north to milepost 52.6, an approximate distance of 2,700-feet.

A 55-mph speed limit beginning at milepost 51.8, the existing 45/55-mph speed limit transition point, and continuing south to milepost 51.3, an approximate distance of 2,700-feet.

A 55-mph speed limit beginning at milepost 49.7, the existing 45/55-mph speed limit transition point, and continuing north to milepost 50.2, an approximate distance of 2,700-feet.

No Change to all other existing speed limits.

e-copies:

Gabe B. Priebe, P.E. – Traffic & Safety Engineer
Glen Cameron – Missoula District Traffic Engineer
David E. Relph, P.E. – Investigations Lead Worker

attachments:

Recommendation Report.pdf Lolo to Missoula Report.pdf Florence to Lolo Report.pdf
Stevensville to Florence Report.pdf Victor to Stevensville Report.pdf
Hamilton to Victor Report.pdf

KLJ

ENGINEERING, REIMAGINED

SPEED STUDY RECOMMENDATIONS

US Hwy 93 – Hamilton to Missoula

March 2023

Speed Study Recommendations

Hamilton to Missoula, Montana

March 2023

Prepared for:

Montana Department of Transportation

Prepared by:

KLJ Engineering

Table of Contents

1. Introduction 1
   Purpose 1
2. Study Location 1
   Study Area 1 – Lolo to Missoula 1
   Study Area 2 – Florence to Lolo 1
   Study Area 3 – Stevensville to Florence 1
   Study Area 4 – Victor to Stevensville 1
   Study Area 5 – Hamilton to Victor 2
3. Recommendation 2
   Study Area 1 – Lolo to Missoula 2
   Study Area 2 – Florence to Lolo 2
   Study Area 3 – Stevensville to Florence 3
   Study Area 4 – Victor to Stevensville 3
   Study Area 5 – Hamilton to Stevensville 3

1. Introduction

Speed limits are set to inform motorists of appropriate driving and safe operating speeds under favorable conditions. Speed limits are set to the statutory speed limit unless a traffic engineering investigation study has been conducted and (where applicable) approved by the Transportation Commission. The *Montana Department of Transportation* (MDT) has requested KLJ Engineering to review the posted speed limit along US Hwy 93 from Hamilton to Missoula.

Purpose

The purpose of this report is to provide speed limit recommendations along US Hwy 93 from Hamilton to Missoula. As part of this study, an evaluation and cataloging of existing roadway conditions, collection of historical *Annual Average Daily Traffic* (AADT), and crash data were completed.

2. Study Location

The study location is US Hwy 93 between Hamilton and Missoula in Missoula County, MT. The study location has been divided into five study areas as discussed below.

Study Area 1 – Lolo to Missoula

The nearly 6-mile study area was divided into three segments:

- Segment 1: Reference Point (RP) 87.7 – 90.0
- Segment 2: RP 85.6 – 87.7
- Segment 3: RP 84.0 – 85.6

US Hwy 93 from Lolo to Missoula has a commission approved speed limit of 65-mph for all vehicles. There are three speed transition zones in this study area. The speed transition zones are located at RP 89.8, RP 84.2, and RP 84.

Study Area 2 – Florence to Lolo

The nearly 7.3-mile study area consists of one segment from RP 75.4 to 82.7. US Hwy 93 from Florence to Lolo has a statutory speed limit of 70-mph for regular vehicles and 65-mph for trucks. There are four speed transition zones in this study area. The speed transition zones are located at RP 82.0, RP 81.9, RP 75.3, and RP 75.4.

Study Area 3 – Stevensville to Florence

The nearly 6.2-mile study area consists of one segment from RP 67.8 to 74.0. US Hwy 93 from Stevensville to Florence has a statutory speed limit of 70-mph for regular vehicles and 65-mph for trucks. There are three speed transition zones in this study area. The speed transition zones are located at RP 74.0, RP 73.6, and RP 67.8.

Study Area 4 – Victor to Stevensville

The nearly 6.1-miles study area was divided into two segments:

- Segment 1: RP 61.1 – 66.2
- Segment 2: RP 60.1 – 61.1

US Hwy 93 from Victor to Stevensville has a statutory speed limit of 70-mph for regular vehicles and 65-mph for trucks. There are three speed transition zones in this study area. The speed transition zones are located at RP 66.2, RP 60.0, and RP 59.8.

Study Area 5 – Hamilton to Victor

The nearly 8.5-miles study area was divided into four segments:

- Segment 1: RP 56.0 – 58.6
- Segment 2: RP 54.0 – 56.0
- Segment 3: RP 52.0 – 54.0
- Segment 4: RP 50.0 – 52.0

North of Woodside Cutoff Rd, US Hwy 93 in this study area has a statutory speed limit of 70-mph for regular vehicles and 65-mph for trucks. South of Woodside Cutoff Rd, this study area has a commission approved speed limit of 65-mph for all vehicles. There are eight speed transition zones in the Study Area 5. The speed transition zones are located at RP 59.1, 58.7, 52.5, 52.1, 51.8, 51.5, 50.1, and 49.7.

3. Recommendation

The speed limit recommendations in this study are based on the review of the roadway and environment conditions, crash history, speed characteristics, and NCHRP 17-76 Speed Limit Setting Tool. The minimum recommended spacing for a speed transition over 45-mph posted speed is 0.5-mile. The spacing between the speed transitions in US Hwy 93 between Hamilton and Missoula were all less than the minimum recommended spacings. It is recommended that all the speed transition spacings in the study areas be adjusted to the current MDT practice.

Study Area 1 – Lolo to Missoula

- The existing 65-mph speed limit for all vehicles, that was approved by the Highway Transportation Commission, is appropriate for the study area. No changes in the speed limit are recommended.
- There is a 20-mph speed drop in the transitions speed at RP 89.8 from 65-mph to 45-mph for vehicles travelling northbound to enter Missoula. Consideration for introducing a 55-mph transitional speed limit between the 45-mph speed limit and the 65-mph speed limit is recommended as it may assist in drivers slowing down prior to the 45-mph speed limit.
- A traffic calming device may also be an option to help lower the travelling speed of motorists travelling northbound at RP 89.8.
- No change in speed limit is recommended for other transition speed zones at RP 84.2 and 84.0.
- No change in speed limit is recommended at or near the intersection of US Hwy 93 with Cochise Drive.

Study Area 2 – Florence to Lolo

- The existing statutory speed limit of 70-mph for regular vehicles and 65-mph for trucks is appropriate for the study area. No changes in the speed limit are recommended.
- The 85th percentile speed for vehicles travelling northbound at RP 82.0 is 10-mph greater than the posted speed limit of 45-mph. Vehicles travelling northbound are entering the town of Lolo from another speed transition of 70-mph to 55-mph. No change in speed limit is recommended for traffic travelling in the northbound direction in this transition zone. However, a traffic calming device may be helpful to lower the travelling speed for traffic travelling northbound in this transition zone.

- The 85th percentile speed for vehicles travelling southbound at RP 75.2 is 20-mph greater than the posted speed limit of 45-mph. Vehicles travelling southbound are entering the town of Florence from another speed transition of 70-mph to 55-mph. No change in speed limit is recommended for traffic travelling in the southbound direction in this transition zone. However, a traffic calming device may be helpful to lower the travelling speed for traffic travelling southbound in this transition zone.
- No change in speed limit is recommended for other transition speed zones at RP 81.9 and 75.3.

Study Area 3 – Stevensville to Florence

- The existing statutory speed limit of 70-mph for regular vehicles and 65-mph for trucks is appropriate for the study area. No changes in the speed limit are recommended.
- The 85th percentile speed for vehicles travelling northbound at RP 74.0 is 26-mph greater than the posted speed limit of 45-mph. Vehicles travelling northbound are entering the town of Florence from another speed transition of 70-mph to 55-mph. No change in speed limit is recommended for traffic travelling in the northbound direction in this transition zone. However, a traffic calming device may be helpful to lower the travelling speed for traffic travelling northbound in this transition zone.
- The 85th percentile speed for vehicles travelling southbound at RP 67.8 is 12-mph greater than the posted speed limit of 55-mph. Vehicles travelling southbound are entering the town of Stevensville. No change in speed limit is recommended for traffic travelling in the southbound direction in this transition zone. However, a traffic calming device may be helpful to lower the travelling speed for traffic travelling southbound in this transition zone.
- No change in speed limit is recommended for transition zone at RP 73.6

Study Area 4 – Victor to Stevensville

- The existing statutory speed limit of 70-mph for regular vehicles and 65-mph for trucks may need to be modified to 65-mph for all vehicles. However, this could create inconsistent speed limit expectations along the study area for the unfamiliar users travelling between Hamilton and Missoula. Therefore, we recommend that the existing statutory speed limit be maintained.
- The 85th percentile speed for vehicles travelling southbound at RP 59.8 is 19-mph greater than the posted speed limit of 45-mph. Vehicles travelling southbound are entering the town of Victor. No change in speed limit is recommended for traffic travelling in the southbound direction in this transition zone. However, a traffic calming device may be helpful to lower the travelling speed for traffic travelling southbound in this transition zone.
- No change in speed limit is recommended for transition zone at RP 66.2, and 60.0.
- No change in speed limit is recommended at or near the intersection of US Hwy 93 with Bell Crossing.

Study Area 5 – Hamilton to Victor

- The existing statutory speed limit of 70-mph for regular vehicles and 65-mph for trucks north of Woodside Cutoff Rd, and commission approved speed limit of 65-mph for all vehicles south of Woodside Cutoff Rd are appropriate for the study area. No changes in speed limit are recommended.
- The 85th percentile speed for vehicles travelling southbound at RP 49.7 is 15-mph greater than the posted speed limit of 45-mph. No change in speed limit is recommended for traffic travelling in the southbound direction in this transition zone. However, a traffic calming device may be helpful to lower the travelling speed for traffic travelling southbound in this transition zone.

- No change in speed limit is recommended for transition zone at 59.1, 58.7, 52.5, 52.1, 51.8, 51.5, and 50.1.
- No change in speed limit is recommended at or near the intersection of US Hwy 93 with Woodside Cutoff Rd.

KLJ

ENGINEERING, REIMAGINED

SPEED STUDY

US Hwy 93 – Lolo to Missoula

Missoula County, MT

March 2023

Speed Study

Lolo to Missoula, Montana

Missoula County, MT

March 2023

Prepared for:

Montana Department of Transportation

Prepared by:

KLJ Engineering

Table of Contents

1. Introduction 3
2. Study Area 3
3. Vehicular Classification 5
4. Safety Characteristics 6
5. Speed Characteristics 9
6. Straight-Line Diagram 11
7. Recommendations 11

List of Figures

Figure 1 - Study Area 4
Figure 2 - Five-Year Crash Summary (2016-2020) 6
Figure 3 - Citation Summary by Year 8
Figure 4 - Citation Types Issued in the study area (2016 - 2020) 8

List of Tables

Table 1 - Speed Transition Zones in the Study area 5
Table 2 - Vehicular Classification 5
Table 3 - Crash Collision Type 7
Table 4 – Segment Wide Speed Study Summary 10
Table 5 - Speed Study Summary at Speed Transition Zones 10
Table 6 - Speed Differentials at Speed Transition Zones 11

List of Appendices

Appendix I - Segment Speed Studies I
Appendix II – Straight-Line Diagrams II

1. Introduction

Speed limits are set to inform motorists of appropriate driving and safe operating speeds under favorable conditions. Speed limits are set to the statutory speed limit unless a traffic engineering investigation study has been conducted and (where applicable) approved by the Transportation Commission. The *Montana Department of Transportation* (MDT) has requested KLJ Engineering to review the posted speed limit along US Hwy 93 from Lolo to Missoula.

Purpose

The purpose of this study is to evaluate the appropriate speed of the roadway. The primary tasks for the study included data collection, data analysis, and recommendations for speed limits along the study area. As part of this study, an evaluation and cataloging of existing roadway conditions, collection of historical *Annual Average Daily Traffic* (AADT), and crash data were completed.

2. Study Area

The study area is US Hwy 93 between Lolo and Missoula in Missoula County, MT. The nearly six-miles of roadway in the study area have varied roadway type and speed limits as shown in **Figure 1**. The AADT in the study area ranges between 24,762 in the south and 27,704 in the north. In 2009, the speed limit of US Hwy 93 from Lolo to Missoula was investigated and was Transportation Commission approved to be 65-mph. Missoula County officials believed that 65-mph may be justified given the level of access demand and crash experience in the corridor, as well as the roadway geometrics and the resulting effect on the travel speeds.

Segments

The study area was divided into three segments based on the roadway type and speed limit. Speed analysis was conducted individually for all three segments. The following are the study segments along the study area:

SEGMENT 1

This 2.3-mile segment represents the study area on US Hwy 93 from reference point (RP): 87.7 (just south of Hayes Creek Rd) to RP 90.0 (intersection with Bitterroot River). The segment is a four-lane roadway with a two-way-left-turn lane (TWLTL) in the center. The Transportation Commission approved speed limit of this segment is 65-mph for all vehicles.

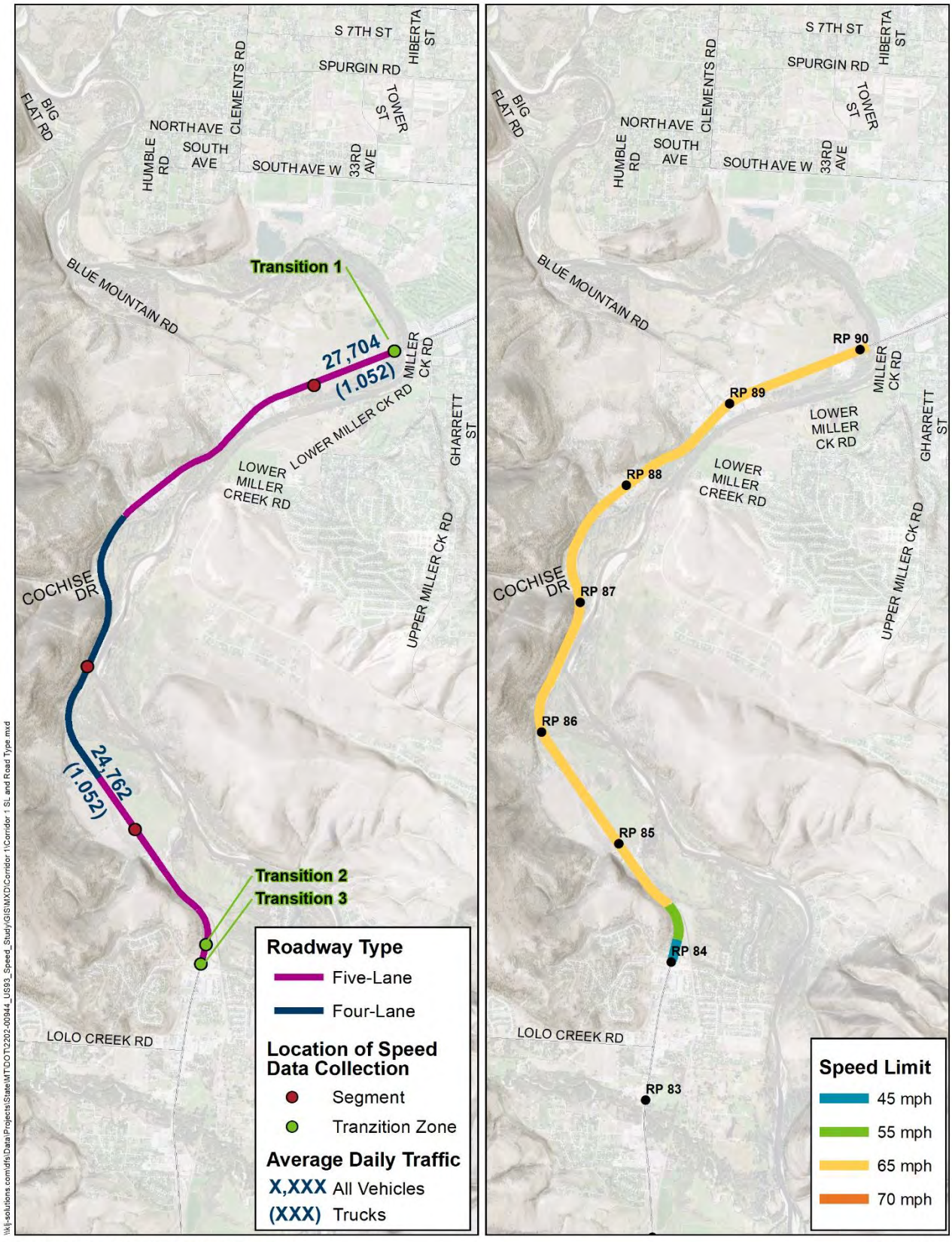
SEGMENT 2

This 2.1-mile segment represents the study area on US Hwy 93 from RP 85.6 (intersection with Bird Lane) to RP 87.7 (just south of Hayes Creek Rd). The segment is a four-lane divided roadway except at the intersection with Cochise Drive (RP 87 to RP 87.2). There is a painted median beginning around RP 85.5 which becomes a concrete median barrier around RP 85.9 and continues to RP 87.7. The Transportation Commission approved speed limit of this segment is 65-mph for all vehicles.

SEGMENT 3

This 1.6-mile segment represents the study area on US Hwy 93 from RP 84.0 (intersection with Ridgeway Drive/Glacier Drive) to RP 85.6 (intersection with Bird Lane). The segment is a four-lane roadway with a TWLTL in the center. The Transportation Commission approved speed limit of this segment is 65-mph for all vehicles.

Figure 1 - Study Area



Source: MDT, ESRI, KLJ, NAIP Aerial from 2019

March 2023

Speed Transition Zones

Speed transition zones are sections of roadway where posted speed limit changes from higher to lower limits or vice-versa. Due to the sudden changes in posted speed limits and road environment, drivers usually do not adapt to the posted speed limits and underestimate their traveling speed. There are three speed transition zones within the study area (**Figure 1**). Speed data were collected and analyzed at all three locations in the study area. The speed transition zones where data were collected are summarized in **Table 1**.

Table 1 - Speed Transition Zones in the Study area

	Direction	Transition		
		1	2	3
Reference Point	-	89.8	84.2	84
Speed Change (mph)	NB	45	65	55
	SB	65	55	45

Cochise Drive /US Hwy 93 Intersection

Special consideration was given to the intersection of US Hwy 93 with Cochise Dr located near RP 87.2. The intersection is an undivided roadway with four through travelling lanes and dedicated northbound left turn lane along with southbound dedicated right turn lane. The intersection is controlled by side street stop control with stop signs on the Cochise Dr approach. The speed limit along US Hwy 93 at the intersection is 65-mph. There are no speed transition zones along US Hwy 93 at this intersection.

3. Vehicular Classification

Vehicular class data for 24-hour period were collected on August 3rd, 2022, for Segment 1 and 2, and September 9, 2022, for Segment 3. Vehicle types were categorized to two classifications:

- **Mid-size Vehicles** consisting of motorcycles, passenger vehicles, pickups, vans, buses, conventional vans, and city delivery trucks.
- **Large Vehicles** consisting of single unit four or more axle trucks.

The vehicular classifications in the study segment are summarized in **Table 2**.

Table 2 - Vehicular Classification

Segment	Classification	Northbound	Southbound	Total	Percent
Segment 1	Small to Mid-Size vehicles	11,470	10,560	22,030	93%
	Large vehicles	430	1,140	1,570	7%
	Total (Percent)	**11,900 (50%)**	**11,700 (50%)**	**23,600**	**100%**
Segment 2	Small to Mid-Size vehicles	11,200	10,795	22,005	94%
	Large vehicles	540	855	1,395	6%
	Total (Percent)	**11,750 (50%)**	**11,650 (50%)**	**23,400**	**100%**
Segment 3	Small to Mid-Size vehicles	10,950	11,030	21,980	95%
	Large vehicles	650	570	1,220	5%
	Total (Percent)	**11,600 (50%)**	**11,600 (50%)**	**23,200**	**100%**

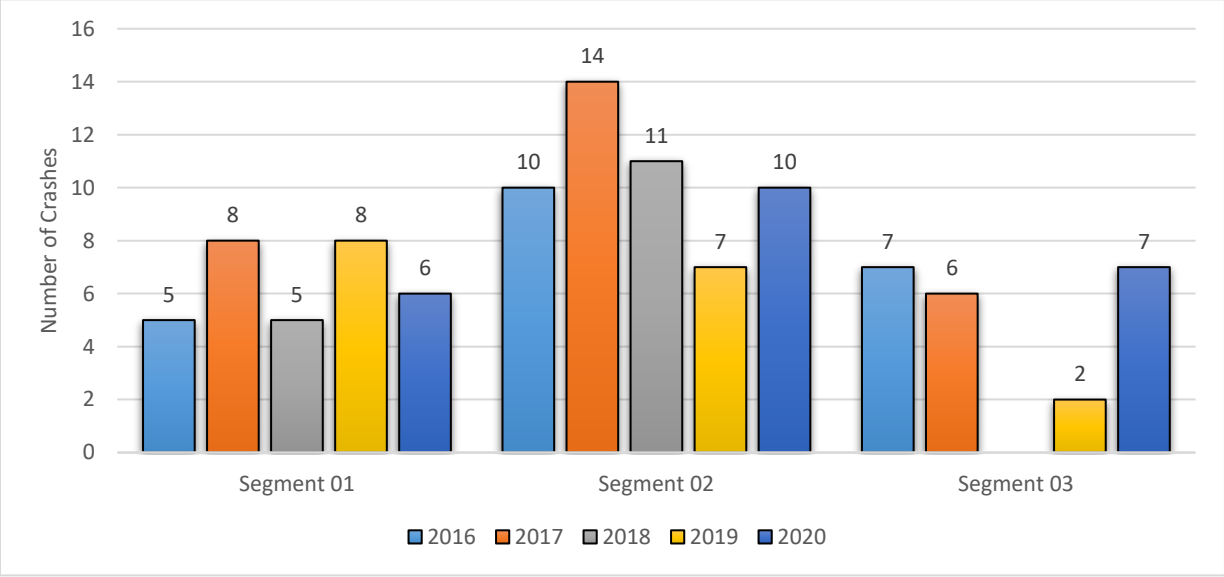
4. Safety Characteristics

Reviewing historic crash and citation information can help identify driver behavior issues that can provide additional information for setting the appropriate and safer speed limit.

Crash History

Five years of crash records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. MDT shared crash records in a spreadsheet format. The five-year crash summary by segment and year is shown in **Figure 2**. There were 106 crashes (three serious injury, eight minor injury, seven possible injury, 86 property damage only, and two unknown type crashes) reported during the analysis period. This corresponds to 21.2 crashes per year or 3.53-crashes per year per mile. Crash history by the individual roadway segments of the study area is included in **Appendix I**.

Figure 2 - Five-Year Crash Summary (2016-2020)



101 crashes or 95% of all the crashes were non-junction related. Crash summary by crash type is shown in **Table 3**. Crashes with wild animals (62%) were the most prominent crash types followed by roll over (12%), and collision with fixed objects (9%) in the study area. Crash types by the individual roadway segments of the study area is included in **Appendix I.**

Table 3 - Crash Collision Type

Type	# Crashes	% Crashes
Domestic Animal	1	1%
Fire/ Explosion	1	1%
Fixed Object	10	9%
Jackknife	1	1%
Left Turn, Same Direction	2	2%
Lost Control	1	1%
Not Fixed Object or Debris	1	1%
Other	2	2%
Rear-End	3	3%
Right Angle	1	1%
Right Turn, Same Direction	1	1%
Roll Over	13	12%
Sideswipe, Opposite Direction	3	3%
Wild Animal	66	62%
TOTAL	**106**	**100%**

COCHISE DR / US HWY 93 INTERSECTION

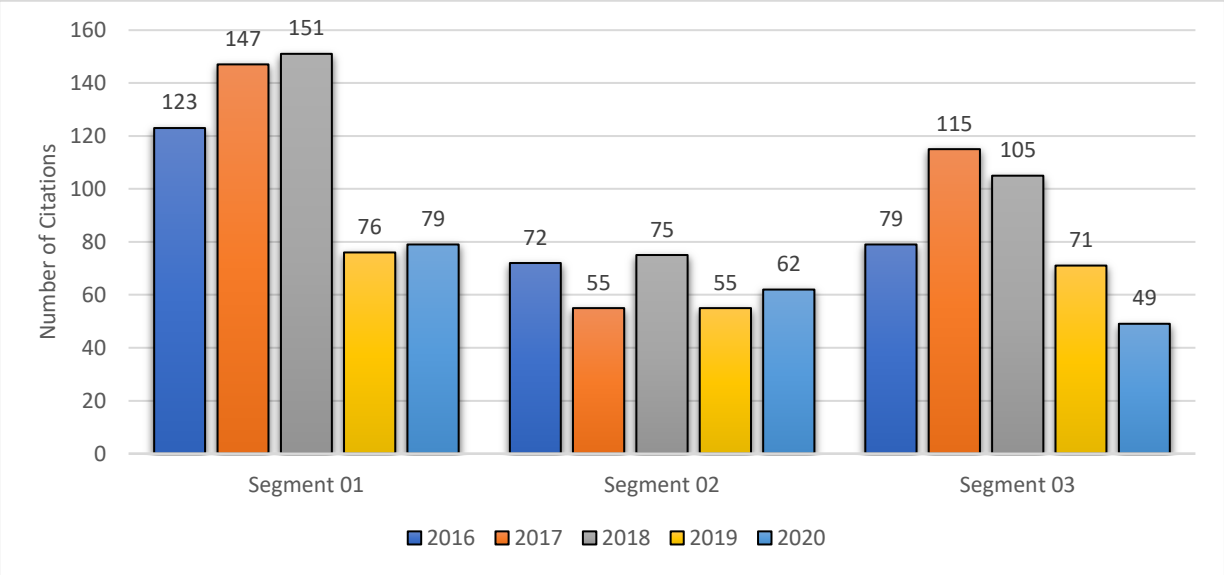
There were two crashes (One minor injury, and one property damage only crashes) reported during the analysis period. Limited to no data was available to identify if speeding was the primary contributor of these crashes at the intersection.

Citation History

The speeding law in Montana 1 § 61-8-303 (3) states: "Subject to the maximum speed limits set forth in subsection (above), a person shall operate a vehicle in a careful and prudent manner and at a reduced rate of speed no greater than is reasonable and prudent under the conditions existing at the point of operation, taking into account the amount and character of traffic, visibility, weather, and roadway conditions." It is critical to note that the law enforcement can issue a ticket for driving a vehicle at unsafe speeds, even if a driver is within the posted speed limit. For example, driving at the posted speed limit on the freeway when there is a blizzard or thick fog. Since these driving conditions are unsafe for you and other drivers, law enforcement is within their rights to issue a speeding ticket as per the speeding laws in Montana.

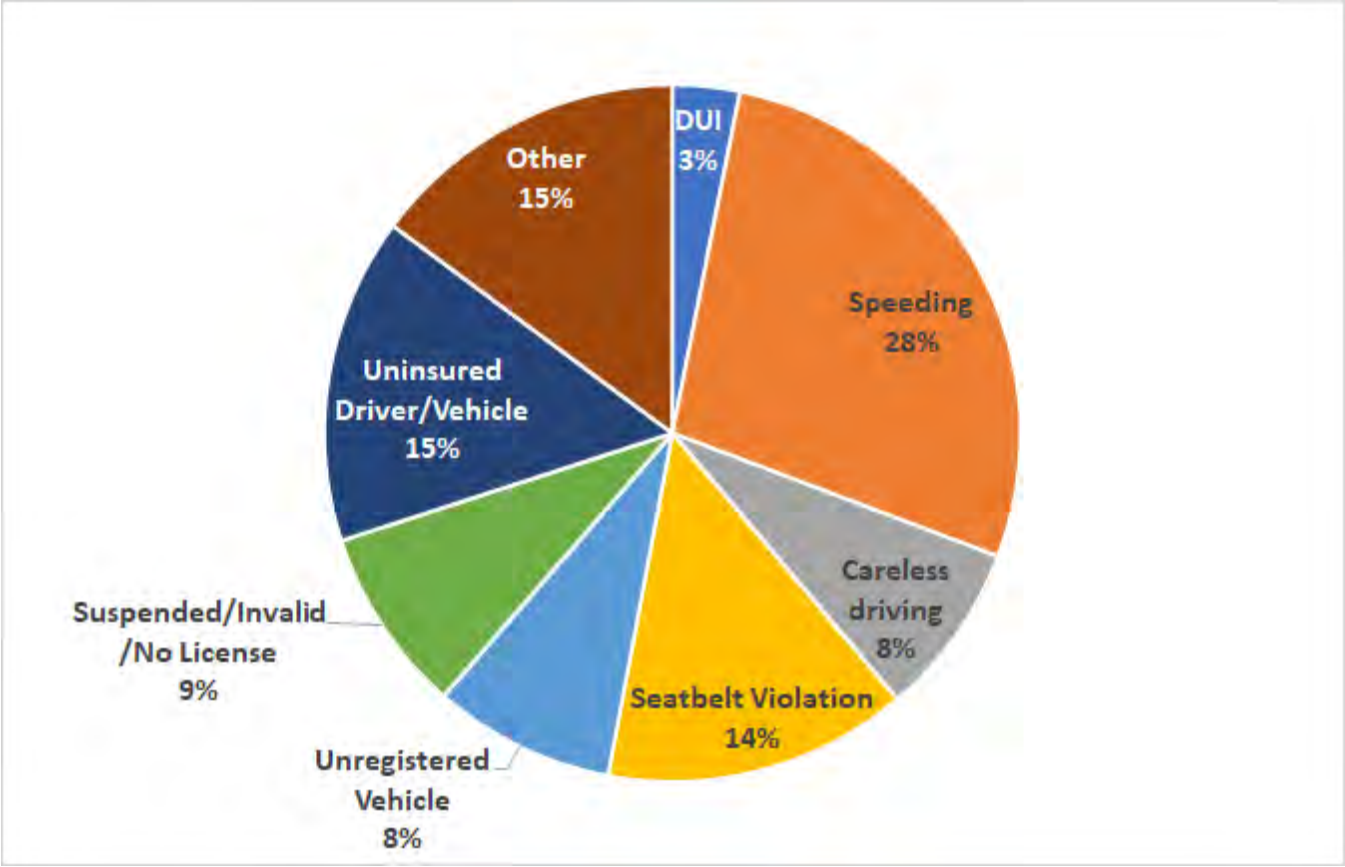
Five years of citation records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. The citation records are extracted in a spreadsheet format. The five-year citation summary in the segments is shown in **Figure 3**. There were 1,314 citations issued in the study area during the analysis period of which 363 citations (28%) were speeding violations.

Figure 3 - Citation Summary by Year



The types of citations issued in this study area are shown in **Figure 4**. Speeding (28%), Uninsured driver/vehicle (15%), and other type violations (15%) were the most prominent types of traffic violations in the study area.

Figure 4 - Citation Types Issued in the study area (2016 - 2020)



COCHISE DR / US HWY 93 INTERSECTION

There were four citations at the intersection during the analysis period. The types of citations issued at this intersection include two speeding, one careless driving, and one carrying invalid driver's license.

5. Speed Characteristics

Engineering Approach

The engineering approach is a two-step process based on operating conditions such as the 85th percentile speed. The 85th percentile is the speed at which 85% of free-flowing traffic is traveling at or below. Once the speed limit is established based on the 85th percentile speed, it can be adjusted (usually downward) based on other factors such as amount of non-motorized traffic, roadway characteristics, and crash history. MDT's procedures for setting speed limits are based on the engineering approach.

MDT uses 85th percentile, 50th percentile, and pace speed to evaluate speed data. The pace speed is a 10-mph increment in speeds that encompasses the highest portion of observed speeds.

Spot Speed Data

Spot speed studies typically consist of sample sizes totaling at least 100 vehicles with Free Flow Speed (FFS). FFS is the speed of motorists traveling as desired given prevailing conditions such that no preceding vehicle influences the motorists' speed. Unattended radars were placed along the three segments of the study area to collect vehicular speed samples for a 24-hour period from August 23 to 24, 2022 and September 9 to 10, 2022**.** The 24-hour data consisted of all vehicles that traveled along the study area with various speed profiles including vehicles that influenced a motorist's choice of speed such as vehicular deceleration to make turns, queuing during peak hour, or a platoon.

Speed data were collected at the three segments, three speed transition zones, and at the intersection of US Hwy 93 with Cochise Dr.

NCHRP

A recent research report from the *National Cooperative Highway Research Program* (NCHRP) has been completed. NCHRP report 17-76: *Development of a Posted Speed Limit Setting Procedure and Tool* collected insights into how the roadway environment influences operating speed and safety (crashes) through a review of literature and the collection and analysis of data from two states. Using those insights along with an understanding of different methods being used and currently being considered for the setting of posted speed limits, the research team developed a speed limit setting procedure along with a tool. The procedure uses fact-based decision rules that consider both driver speed choice and safety associated with the roadway.

There has been a nationwide push over the last several years for the consideration of 50th percentile speed, especially for developed areas. When the roadway conditions are optimal, the suggested speed limit should reflect the 85th percentile speed. When roadway conditions are not favorable to all users or when crashes are a significant concern, then the suggested speed limit should reflect the rounded down 85th or 50th percentile speed. Drivers frequently select speeds at certain increment above the posted speed limit, anticipating that they will not receive a ticket if they are below the assumed enforcement speed tolerance. Because of these reasons, 50th percentile speed data were also used in the analysis along with the 85th percentile speed data.

The NCHRP 17-76 Speed Limit Setting Tool was used to calculate the recommended speed limit for the study segment based on key factors such as: 85th percentile and 50th percentile speed, roadway characteristics, and crash history.

Speed Study Results

SEGMENTS

The summary of speed data for the segments for all vehicle types are shown in **Table 4**. Detailed information including the speed by type of vehicle and direction is provided in the individual segment reports that are included in the **Appendix I**.

Table 4 – Segment Wide Speed Study Summary

Segment	Existing Speed Limit	Calculated Speed %ile		10-mph Pace	% in Pace	NCHRP Recommendation
		85th	50th			
Segment 1	65-mph	69-mph	64-mph	59-69	60%	65-mph
Segment 2	65-mph	70-mph	65-mph	60-70	60%	65-mph
Segment 3	65-mph	75-mph	68-mph	62-72	67%	65-mph

SPEED TRANSITION ZONES

The summary of speed data for the speed transition zones are shown in **Table 5**.

Table 5 - Speed Study Summary at Speed Transition Zones

		Direction	Transition		
			1	2	3
Existing	Reference Point	-	89.8	84.2	84
	Speed Change (mph)	NB	45	65	55
		SB	65	55	45
Calculated	85th %-ile Speed (mph)	NB	60-mph	65-mph	50-mph
		SB	61-mph	66-mph	43-mph
		Both	60-mph	66-mph	48-mph
	50th %-ile Speed (mph)	NB	53-mph	59-mph	44-mph
		SB	56-mph	62-mph	34-mph
		Both	55-mph	60-mph	40-mph
	10-mph Pace Speed (mph)	NB	49-59 mph	55-65 mph	40-50 mph
		SB	51-61 mph	57-67 mph	32-42 mph
		Both	50-60 mph	56-66 mph	36-46 mph
	% in 10-mph Pace Speed (mph)	NB	58%	64%	59%
		SB	67%	68%	44%
		Both	62%	65%	47%

NB – Northbound; SB – Southbound

COCHISE DRIVE INTERSECTION

Spot speed data was collected at the intersection of US Hwy 93 with Cochise Drive on Friday, September 2, 2022, from 10:30AM to 11:30AM. Pocket radar device were used to collect speed data. Speed data of 653 vehicles were collected and analyzed for speed. The 85th percentile speed and 50th percentile speed was calculated to be 72-mph and 68-mph, respectively. The 10-mph pace was found to be between 63-mph and 73-mph, with 70% of the vehicles travelling within the 10-mph pace. The 85th percentile speed was found to be greater than the posted speed limit and near to the upper tail of the 10-mph pace. The 50th percentile speed was found to be greater than the posted speed limit and is within the 10-mph pace.

6. Straight-Line Diagram

Straight-line diagrams are linear graphical representations of features and characteristics along roadways on and some off the State Highway System and nearby surrounding area. These diagrams are prepared to support efforts in preparing for field surveys, planning construction projects, verifying Roadway Characteristics Inventory (RCI) data, and other related applications. The straight-line diagrams for the study area with the speed characteristics at the locations where data has been collected and analyzed are included in **Appendix II**.

7. Recommendations

Segment

Based on the review of the roadway and environment conditions, crash history, speed characteristics, and NCHRP 17-76 Speed Limit Setting Tool, the existing speed limits for each of the study segments are appropriate and no changes in speed limit is recommended.

Speed Transition Zones

The speed differentials between the posted speed limit and 85th percentile speed limit for the speed transition zones in this study area is summarized in **Table 6**. The minimum recommended spacing for a speed transition over 45-mph posted speed is 0.5-mile. The spacing between the speed transitions in this segment of US 93 between Lolo and Missoula were all less than the minimum recommended spacings. It is recommended that the speed transition spacings be adjusted to the current MDT practice procedures.

Table 6 - Speed Differentials at Speed Transition Zones

	Direction	Transition		
		1	2	3
Reference Point	-	89.8	84.2	84.0
85th %-ile Speed (mph)	NB	60	65	50
	SB	61	66	43
Speed Limit Change (mph)	NB	45	65	55
	SB	65	55	45
Δ in Speed (mph)	NB	15	0	-5
	SB	-4	11	-2

TRANSITION 1

- Northbound - The 85th percentile speed is 15-mph greater than the posted speed limit of 45-mph. Vehicles travelling northbound are entering the town of Missoula from a posted speed limit of 65 mph for all vehicles. There is a 20-mph speed drop in the transitions speed. Consideration for introducing a 55-mph transitional speed limit between the 45-mph speed limit and the 65-mph speed limit is recommended as it may assist in drivers slowing down prior to the 45-mph speed limit. A traffic calming device may also be an option to help lower the travelling speed of motorists.
- Southbound - The speed differentials between the posted speed limit and 85th percentile speed is four-mph less than the posted speed limit of 65-mph. The vehicles are entering rural high-speed roadway after leaving Missoula. The posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the southbound direction.

TRANSITION 2

- Northbound - The 85th percentile speed is at the posted speed limit of 55-mph. Vehicles travelling northbound are entering rural high-speed roadway after undergoing another speed transition. The existing

posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the northbound direction.

- Southbound - The 85th percentile speed is 11-mph greater than the posted speed limit of 55-mph. Vehicles travelling southbound are transitioning from 65-mph to 55-mph. The existing posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the southbound direction.

TRANSITION 3

- Northbound - The 85th percentile speed is five-mph less than the posted speed limit of 55-mph. Vehicles travelling northbound are transitioning from 45-mph to 55-mph after leaving the town of Lolo. The existing posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the northbound direction
- Southbound - The 85th percentile speed is two-mph less than the posted speed limit of 45-mph. Vehicles travelling southbound are transitioning from 55-mph to 45-mph before entering the town of Lolo. The existing posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the southbound direction.

Cochise Drive Intersection

The intersection is a side street stop control with stop signs on Cochise Drive approach. The speed differentials between the 85th percentile speed limit and the posted speed is not significantly high. Increasing the posted speed limit could lead to increase in rear-end crashes. The existing posted speed limit is appropriate. No change in speed limit is recommended at the intersection.

APPENDIX I - SEGMENT SPEED STUDIES

ENGINEERING, REIMAGINED

SPEED STUDY

US Hwy 93 – Lolo to Missoula

Reference Point: 87.7 to 90.0

Ravalli County, MT

March 2023

Speed Study

Lolo to Missoula, Montana

RP: 87.7 to 90.0

March 2023

Prepared for:

Montana Department of Transportation

Prepared by:

KLJ Engineering

Table of Contents

1. Introduction 1
2. Methodology 2
3. Roadway Characteristics 2
4. Vehicular Classification 3
5. Safety Characteristics 4
6. Speed Characteristics 6
7. Conclusion 8

List of Figures

Figure 1 - Study Segment 1
Figure 2 - Representative Section of US Hwy 93 from RP 87.7 to 90.0 2
Figure 3 - Five-Year Crash Summary (2016-2020) 4
Figure 4 - Citation Summary by Year 5
Figure 5 - Speed Profile 7

List of Tables

Table 1 - Vehicular Classification 3
Table 2 - Crash Collision Type 4
Table 3 - Speed Study Profile 7

List of Appendices

Appendix A – Pictures ..... A
Appendix B – Speed Study Profiles ..... B
Appendix C – NCHRP Report C

1. Introduction

Speed limits are set to inform motorists of appropriate driving and safe operating speeds under favorable conditions. Speed limits are set at the statutory speed limit unless a traffic engineering investigation study has been conducted and (where applicable) approved by the Transportation Commission. The *Montana Department of Transportation* (MDT) has requested KLJ Engineering to review the posted speed limit along US Hwy 93 from Lolo to Missoula.

Study Location

The study segment is US Hwy 93 beginning at Reference Point (RP) 87.7 (just south of Hayes Creek Rd) to RP 90.0 (intersection with Bitterroot River). The 2.3-mile segment is a paved four-lane roadway with a two-way-left-turn lane (TWLTL) in the center. The segment has a Transportation Commission approved speed limit of 65-mph. There is an annual average daily traffic (AADT) of 27,704 to the north and 24,762 to the south of Blue Mountain Rd along this segment as per 2021 counts reported in MDT's Transportation Data Management System (TDMS). The location of the study segment is shown in **Figure 1**.

Figure 1 - Study Segment

Objective

The purpose of this study is to evaluate the appropriate speed of the roadway. The primary tasks for the study included data collection, data analysis, and recommendations for speed limits along the study segment. As part of this study, an evaluation and cataloging of existing roadway conditions, collection of historical AADT, and crash data will be completed.

Procedures

The steps for setting speed limits include planning, coordination, data collection and analysis, review, and presentation to the stakeholders, and finally, determination or implementation of the speed limits. Quality data and good documentation provides support for the judgments that are made.

Five years of the most recent crash and citation data was also requested and received from the MDT Traffic & Safety Bureau for the analysis.

2. Methodology

For determining the appropriate speed limit, the following parameters were reviewed:

- Roadway Condition/Characteristics
- Crash and Citation History
- Speed Characteristics, and
- Vehicular classes

When considering whether to establish a new posted speed limit or not, surveying and analysis of existing travel speeds is crucial to determining a reasonable posted speed limit. Motorist usually drive at speeds which they perceive as safe, based on the observable roadway conditions. A flat and straight roadway may result in a different travel speed than the posted speed limit due to the driver's observation of the roadway condition.

3. Roadway Characteristics

While speed samples (actual speed measurements of vehicles) are a large part of the necessary data, roadway characteristics should also be considered. Roadway characteristics such as pavement type/conditions, access points, vertical grades, and clear zone assessments data were collected during the field visit in August 2022. **Figure 2** shows the most representative typical section of the study segment. Additional pictures of the study segment are available in **Appendix A**.

Figure 2 - Representative Section of US Hwy 93 from RP 87.7 to 90.0

Lanes and Shoulders

The typical cross section for this study section consists mainly of four bituminous traveling lanes (outside lanes are 12-ft wide, the inside lanes are 14-ft wide), one 16-ft bituminous TWLTL in the center, and two 10-ft bituminous shoulders. The pavement is generally in good condition. The shoulders are wide enough for safe parking of disabled vehicles.

Rumble Strips

There are shoulder rumble strips present throughout the segment. There are no centerline rumple strips present for most of the segment. There is a short segment of centerline rumble strips around the Blue Mountain Road intersection and when approaching the concrete barrier.

Access Points per Mile

An access point refers to public roads, a business driveway, a private driveway, or a farm field access. Fewer access points per mile means drivers are responding to a reduced number and variety of events. The study section

has a combined 35 accesses (four public, 28 private, and three field access) within the 2.3-mile segment that corresponds to 16 accesses points per mile. The recommended primary full-movement and secondary intersection spacing for a rural principal arterial is one-mile and half-mile, respectively. The recommended and maximum density for driveways per mile for a 65-mph roadway is no more than 8.2 based on Stopping Sight Distance tables documented in *MDT Geometric Design Standards (Sept 2016)*.

Vertical Grades

Grade is the rate of change of the vertical alignment. Grade affects vehicle speed and vehicle control, particularly for large trucks. The study segment can be described as generally flat.

Roadside Hazard Assessment

The segment generally comprises of both fill and cut section with a clear zone that is partially obstructed by fixed objects. There are sections of roadway with agricultural fence within the clear zone. There is a trail that runs parallel to the roadway on the west side of the roadway that has agricultural fence within the clear zone.

In-slope

The in-slope measured at the representative section is generally flat. The in-slope was measured at 6:1 which is considered a recoverable slope. There are driveways along the study segment that have steep slopes because of culverts crossing them. These steep slopes appear to be non-traversable.

Adjacent Development

The area around the segment is mostly rural undeveloped land with some private businesses in the segment.

Statutory and Advisory Speeds

The Transportation Commission approved speed limit, which was approved in 2009, is 65-mph for all vehicles throughout this segment. There are no advisory speeds along the segment.

Traffic Control

The intersection of US Hwy 93 with Blue Mountain Rd is traffic signal controlled.

4. Vehicular Classification

Vehicular class data for 24-hour period were collected on August 3, 2022. Vehicle types were categorized to two classifications:

- **Mid-size Vehicles** consisting of motorcycles, passenger vehicles, pickups, vans, buses, conventional vans, and city delivery trucks.
- **Large Vehicles** consisting of single unit four or more axle trucks.

There are 22,030 and 1,570 daily small to mid-size and large vehicles, respectively that travel in the segment. The daily distribution is 50% along northbound and 50% along southbound direction. The vehicular classifications in the study segment are summarized in **Table 1**.

Table 1 - Vehicular Classification

Classification	Northbound	Southbound	Total	Percent
Small to Mid-Size vehicles	11,470	10,560	22,030	93%
Large vehicles	430	1,140	1,570	7%
Total (Percent)	**11,900 (50%)**	**11,700 (50%)**	**23,600**	**100%**

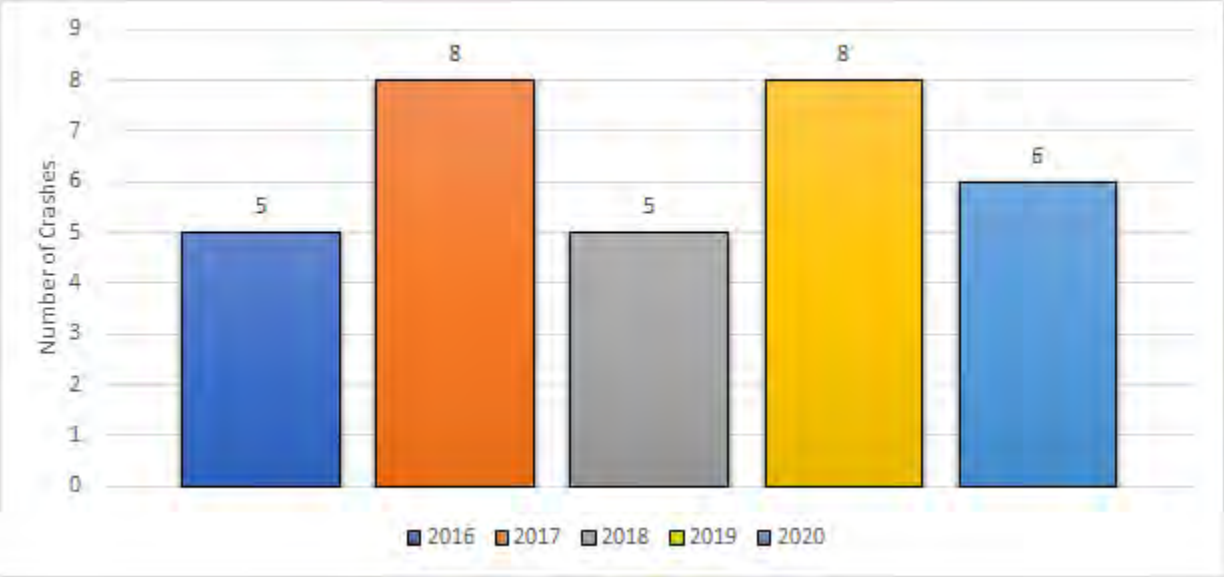
5. Safety Characteristics

Reviewing historic crash and citation information can help identify driver behavior issues that can provide additional information for setting the appropriate and safer speed limit.

Crash History

Five years of crash records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. MDT shared crash records in a spreadsheet format. The five-year crash summary by year is shown in **Figure 3**. There were 32 crashes (no fatal, no serious injury, no minor injury, four possible injury, 27 property damage only, and one unknown type crashes) reported during the analysis period. This corresponds to 6.4 crashes per year or 2.8 crashes per year per mile.

Figure 3 - Five-Year Crash Summary (2016-2020)



All the crashes were non-junction related. Crash summary by crash type is shown in **Table 2**.

Table 2 - Crash Collision Type

Type	# Crashes	% Crashes
Domestic Animal	1	3%
Fixed Object	5	16%
Not Fixed Object or Debris	1	3%
Roll Over	2	6%
Sideswipe, Opposite Direction	1	3%
Wild Animal	**22**	69%
TOTAL	**32**	**100%**

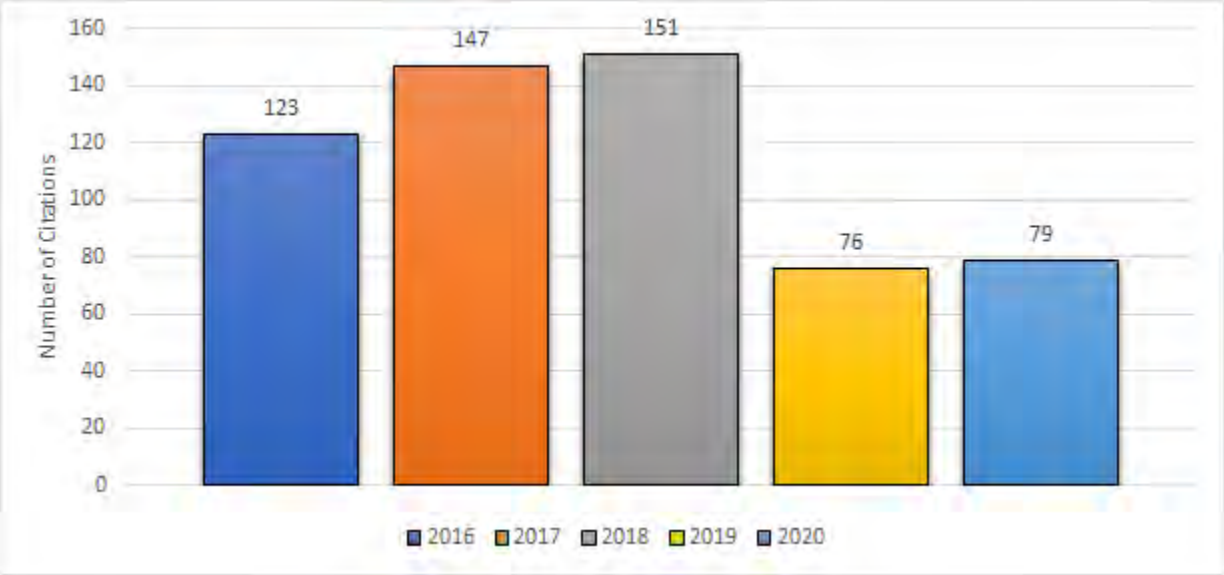
Crashes with wild animals (69%) were the most prominent crash type followed by crashes with fixed objects (16%) in the study segment. The crash data had no supplement officer narratives to identify if speeding was the contributing factor for any of these crashes.

Citation History

The speeding law in Montana 1 § 61-8-303 (3) states: "Subject to the maximum speed limits set forth in subsection (above), a person shall operate a vehicle in a careful and prudent manner and at a reduced rate of speed no greater than is reasonable and prudent under the conditions existing at the point of operation, taking into account the amount and character of traffic, visibility, weather, and roadway conditions." It is critical to note that the law enforcement can issue a ticket for driving a vehicle at unsafe speeds, even if a driver is within the posted speed limit. For example, driving at the posted speed limit on the freeway when there is a blizzard or thick fog. Since these driving conditions are unsafe for you and other drivers, law enforcement is within their rights to issue a speeding ticket as per the speeding laws in Montana.

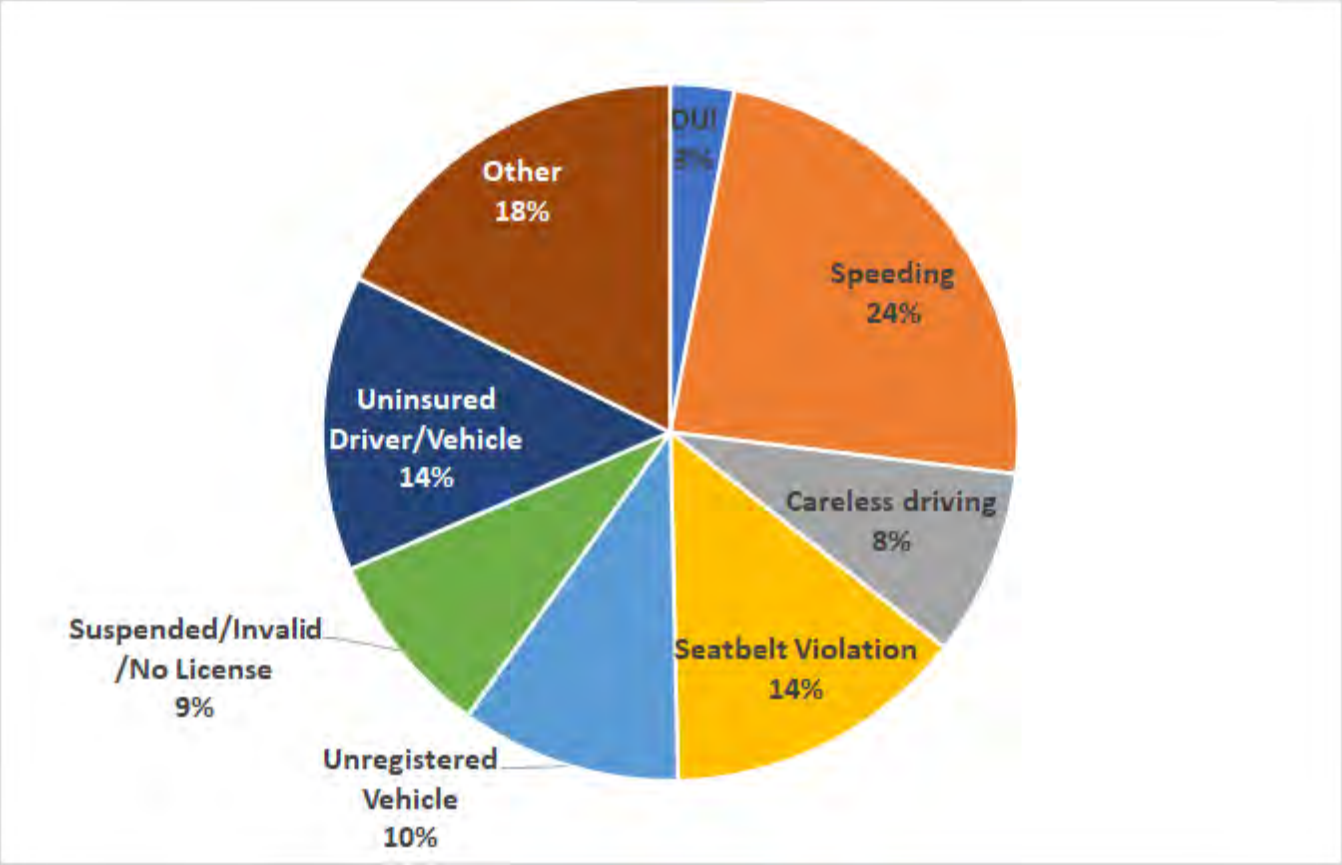
Five years of citation records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. The citation records were in a spreadsheet format. The five-year citation summary in the segment is shown in **Figure 4**. There were 576 citations issued in the study segment during the analysis period of which 138 citations (24%) were speeding violations.

Figure 4 - Citation Summary by Year



The greatest number of citations were given in the month of March (12%). The types of citations issued in this segment are shown in **Figure 5**. Speeding (24%) was the most prominent type of traffic violation in the study area.

Figure 5 - Citation Types Issued (2016 - 2020)



6. Speed Characteristics

Engineering Approach

The engineering approach is a two-step process based on operating conditions such as the 85th percentile speed. The 85th percentile is the speed at which 85% of free-flowing traffic is traveling at or below. Once the speed limit is established based on the 85th percentile speed, it can be adjusted (usually downward) based on other factors such as amount of non-motorized traffic, roadway characteristics, and crash history. MDT's procedures for setting speed limits are based on the engineering approach.

MDT uses 85th percentile, 50th percentile, and pace speeds. The pace speed is a 10-mph increment in speeds that encompasses the highest portion of observed speeds.

Spot Speed Data

Spot speed studies typically consist of sample sizes totaling at least 100 vehicles with Free Flow Speed (FFS). FFS is the speed of motorists traveling as desired given prevailing conditions such that no preceding vehicle influences the motorists' speed. Unattended radars were placed along the study segment to collect vehicular speed samples for a 24-hour period from August 3rd to 4th, 2022 near RP 89.4**.** The 24-hour data consisted of all vehicles that traveled along the study segment with various speed profiles including vehicles that influenced a motorist's choice of speed such as vehicular deceleration to make turns, queuing during peak hour, or a platoon.

The road and shoulder surface were clear of surface water or snow during the period when data were recorded. The result of the speed profile in the study segment is shown in **Figure 6** and **Table 3**. For details please see **Appendix B**. The 85th percentile speed was found to be 69-mph and the 50th percentile speed was found to be

64-mph. The 10-mph pace was found to be between 59-mph and 69-mph comprising of 60% of daily vehicles within that 10-mph pace. The 85th percentile is higher than the posted speed limit and 50th percentile speed is lower than the posted speed limit. The 85th percentile speed is at the upper tail-end of the 10-mph pace range, whereas the 50th percentile speeds were within the 10-mph pace range.

Figure 6 - Speed Profile for All Vehicle Types in Both Direction of Travel

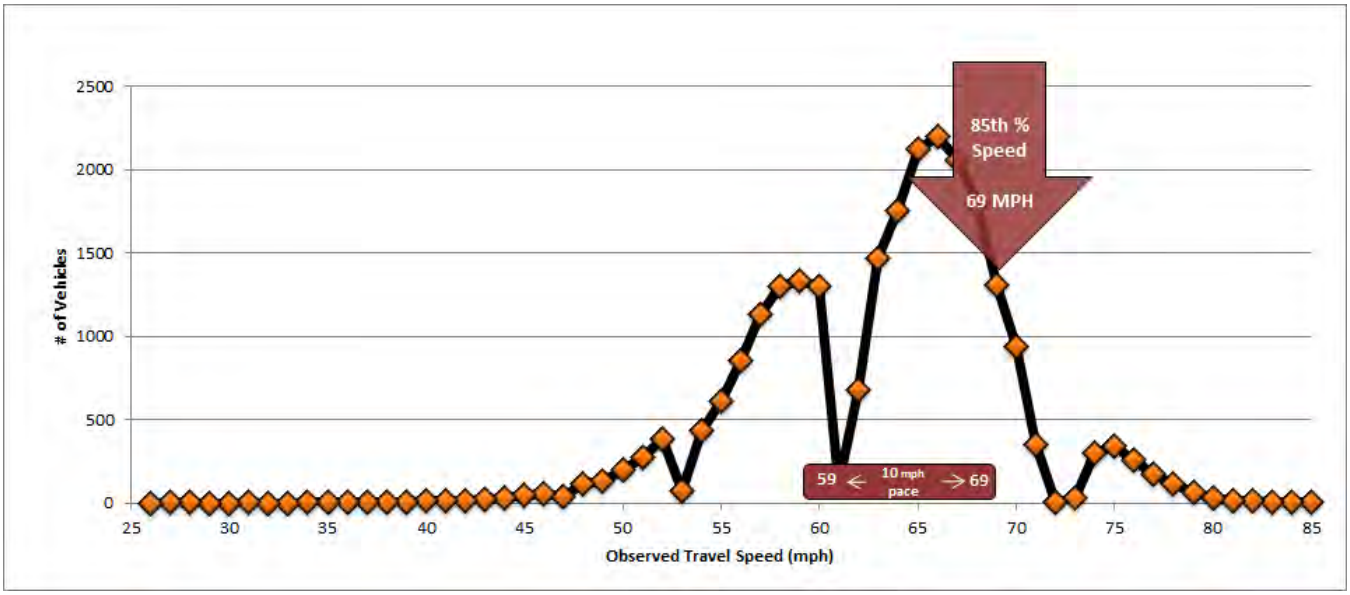


Table 3 - Speed Study Profile

Vehicle Type	Direction	10-mph Pace	% In Pace	85th Percentile Speed	50th Percentile Speed
Small to Mid-size	NB	62-72 mph	63%	69-mph	65-mph
	SB	59-69 mph	59%	69-mph	64-mph
	Both	60-70 mph	61%	69-mph	64-mph
Large	NB	57-67 mph	59%	67-mph	62-mph
	SB	58-68 mph	58%	68-mph	64-mph
	Both	58-68 mph	58%	68-mph	63-mph
All	NB	62-72 mph	62%	69-mph	65-mph
	SB	59-69 mph	59%	68-mph	64-mph
	Both	59-69 mph	60%	69-mph	64-mph

NCHRP

A recent research report from the *National Cooperative Highway Research Program* (NCHRP) has been completed. NCHRP report 17-76: *Development of a Posted Speed Limit Setting Procedure and Tool* collected insights into how the roadway environment influences operating speed and safety (crashes) through a review of literature and the collection and analysis of data from two states. Using those insights along with an understanding of different methods being used and currently being considered for the setting of posted speed limits, the research team developed a speed limit setting procedure along with a tool. The procedure uses fact-based decision rules that consider both driver speed choice and safety associated with the roadway.

There has been a nationwide push over the last several years for the consideration of 50th percentile speed, especially for developed areas. When the roadway conditions are optimal, then the suggested speed limit should reflect the 85th percentile speed. When roadway conditions are not favorable to all users or when crashes are a

significant concern, then the suggested speed limit should reflect the rounded down 85th percentile or the 50th percentile speed. Drivers frequently select speeds a certain increment above the posted speed limit, anticipating that they will not receive a ticket if they are below the assumed enforcement speed tolerance. Because of these reasons, 50th percentile speed data were also used in the analysis along with the 85th percentile speed data.

The NCHRP 17-76 Speed Limit Setting Tool was used to calculate the recommended speed limit for the study segment based on key factors such as: 85th percentile and 50th percentile speed, roadway characteristics, and crash history. The recommended speed for the study segment based on NCHRP 17-76 was found to be 65-mph along in this segment. Details of the NCHRP 17-76 report is available in **Appendix C**.

7. Conclusion

Vehicular Classification

There are 22,030 and 1,570 daily small to mid-size and large vehicles, respectively that travel in the segment. The daily distribution is 50% along northbound and 50% along southbound direction.

Safety Characteristics

There were 32 crashes (no fatal, no serious injury, no minor injury, four possible injury, 27 property damage only, and one unknown type crashes) reported during the analysis period. Crashes with wild animals (69%) were the most prominent crash type followed by crashes with fixed objects (16%) in the study segment.

There were 576 citations issued in the study segment during the analysis period of which 138 citations (24%) were speeding violations.

Roadway Characteristics

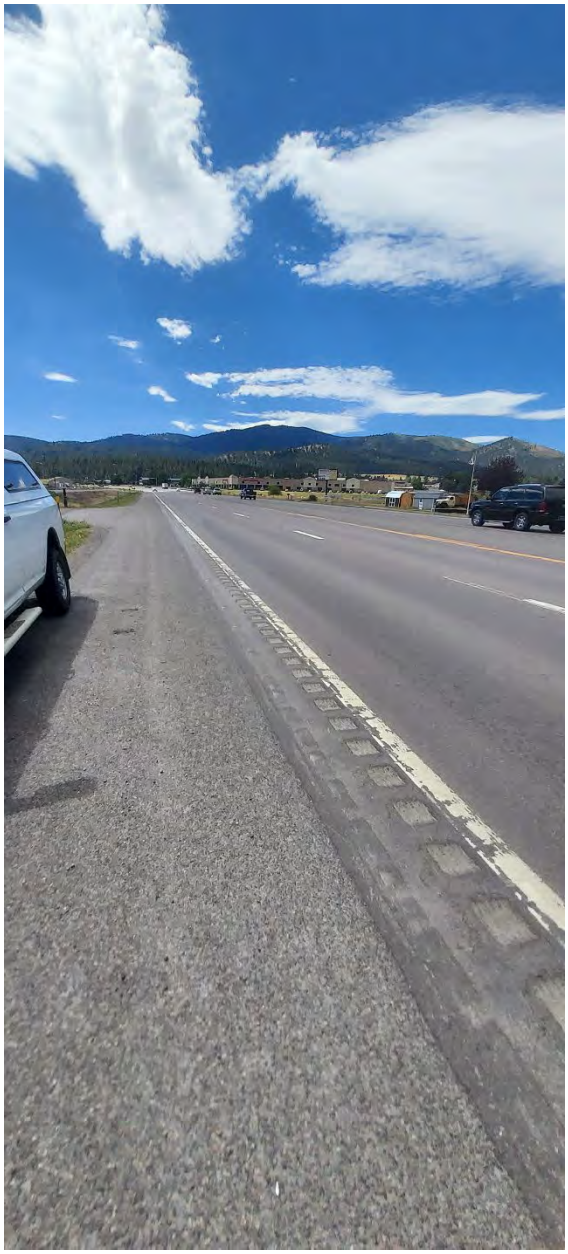
The segment, RP 87.7 to RP 90.0, has a Transportation Commission approved speed limit of 65-mph for all vehicles. The 2.3-mile segment is a paved four-lane roadway with a TWLTL in the center. The segment generally comprises of both fill and cut section with a clear zone that is partially obstructed by fixed objects. There are no centerline rumple strips present for most of the segment. There is a short segment of centerline rumble strips around the Blue Mountain Road intersection and when approaching the concrete barrier. The shoulders are wide enough on both sides of the roadway for safe parking of disabled vehicles. The vertical grades and in-slopes are generally flat in the segment. The road conditions are generally in good condition. The area around the segment is mostly rural undeveloped land with some private businesses in the segment. The driveway density in the study segment is more than the maximum number of driveway thresholds for similar type of facility.

Speed Characteristics

The 85th percentile speed was found to be 69-mph and the 50th percentile speed was found to be 64-mph. The 10-mph pace was found to be between 59-mph and 69-mph comprising of 60% of daily vehicles within that 10-mph pace. The recommended speed for the study segment based on NCHRP 17-76 was found to be 65-mph along in this segment. This indicates that the existing posted speed limit of 65-mph in this segment is reasonable.

APPENDIX A – PICTURES

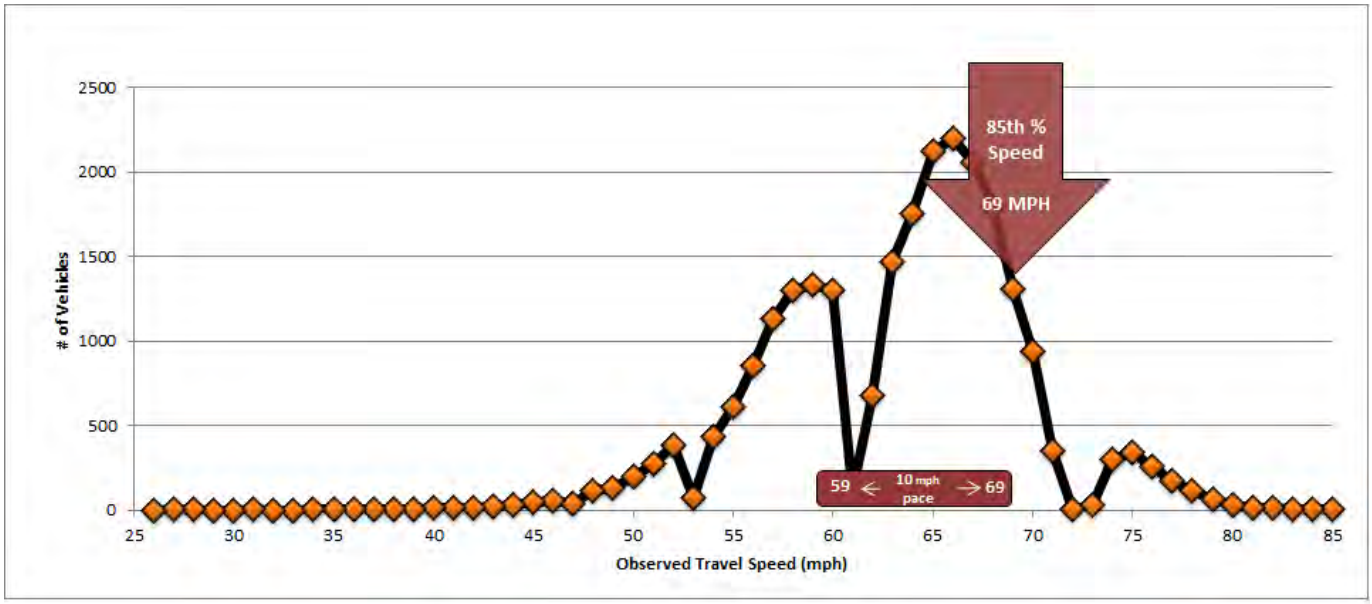

CENTER
LANE
ONLY

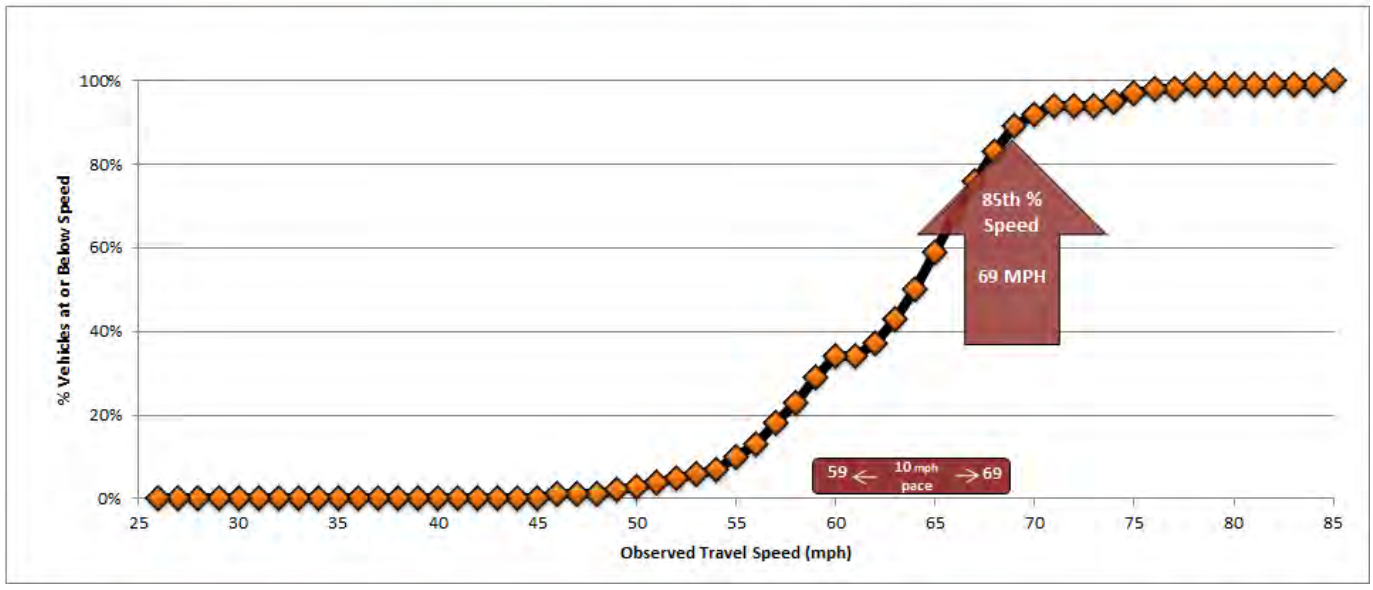


APPENDIX B – SPEED STUDY PROFILES

SPEED SAMPLE SUMMARY (ALL VEHICLES)

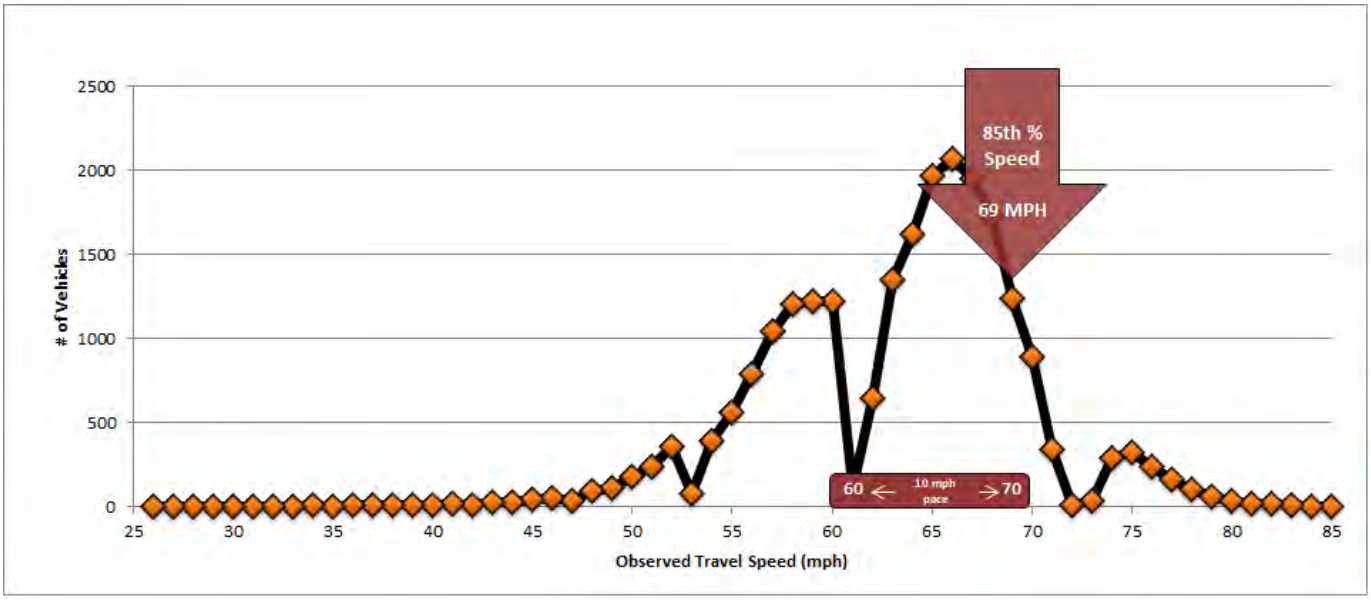
ID:	A1-Seg-01	Speed Limit	65 MPH	Day/Date	Wednesday, August 3, 2022
Roadway:	US 93	Seg. Length:	2.3 MILES	Time:	24-hours
Study Limits:	Lolo to Missoula	Road Type:	Five-Lane, Two way	Sample Loc	46.826897, -114.068101
City/County:	Missoula	ADT Range:	NB-11900 SB-11700	Weather:	-
RP:	87.7 to 90	Truck ADT:	NB-430 SB-1140	Observer(s):	KLJ
85th % Speed:	69	10 mph pace	59-69	Machine:	Echo Radar
50th % Speed:	64	% in pace	60%		

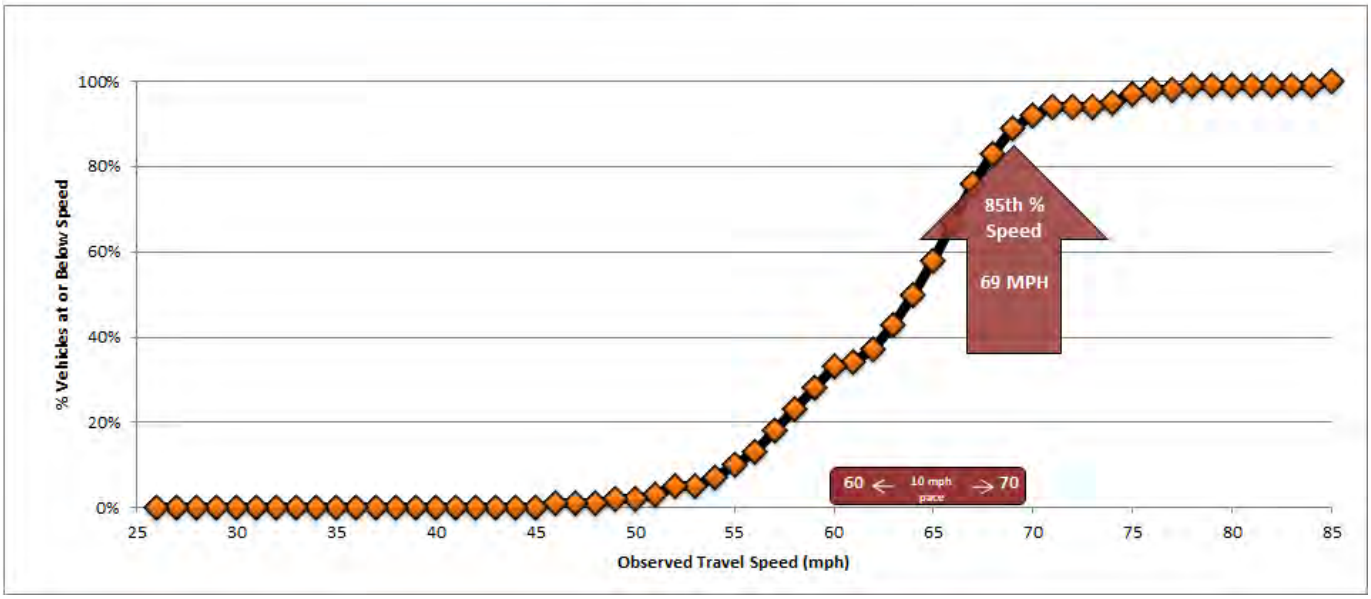




SPEED SAMPLE SUMMARY (PASSENGER VEHICLES)

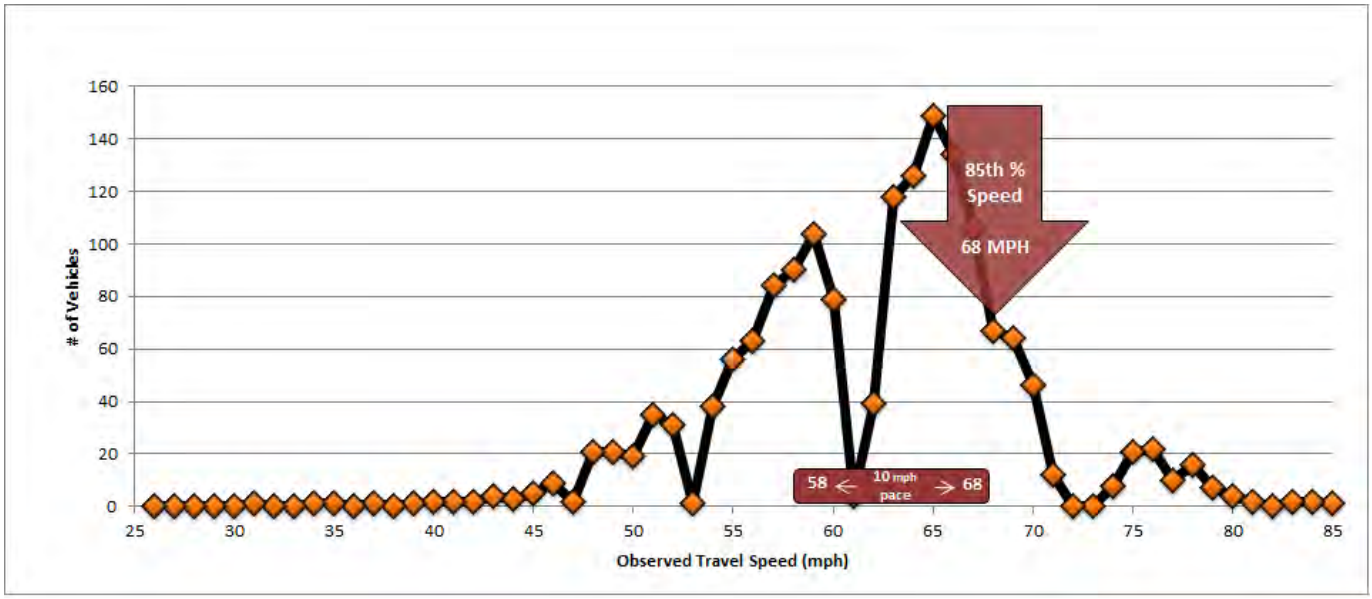
ID:	A1-Seg-01	Speed Limit	65 MPH	Day/Date	Wednesday, August 3, 2022
Roadway:	US 93	Seg. Length:	2.3 MILES	Time:	24-hours
Study Limits:	Lolo to Missoula	Road Type:	Five-Lane, Two way	Sample Loc	46.826897, -114.068101
City/County:	Missoula	ADT Range:	NB-11900 SB-11700	Weather:	-
RP:	87.7 to 90	Truck ADT:	NB-430 SB-1140	Observer(s):	KLJ
85th % Speed:	69	10 mph pace	60-70	Machine:	Echo Radar
50th % Speed:	64	% in pace	61%		

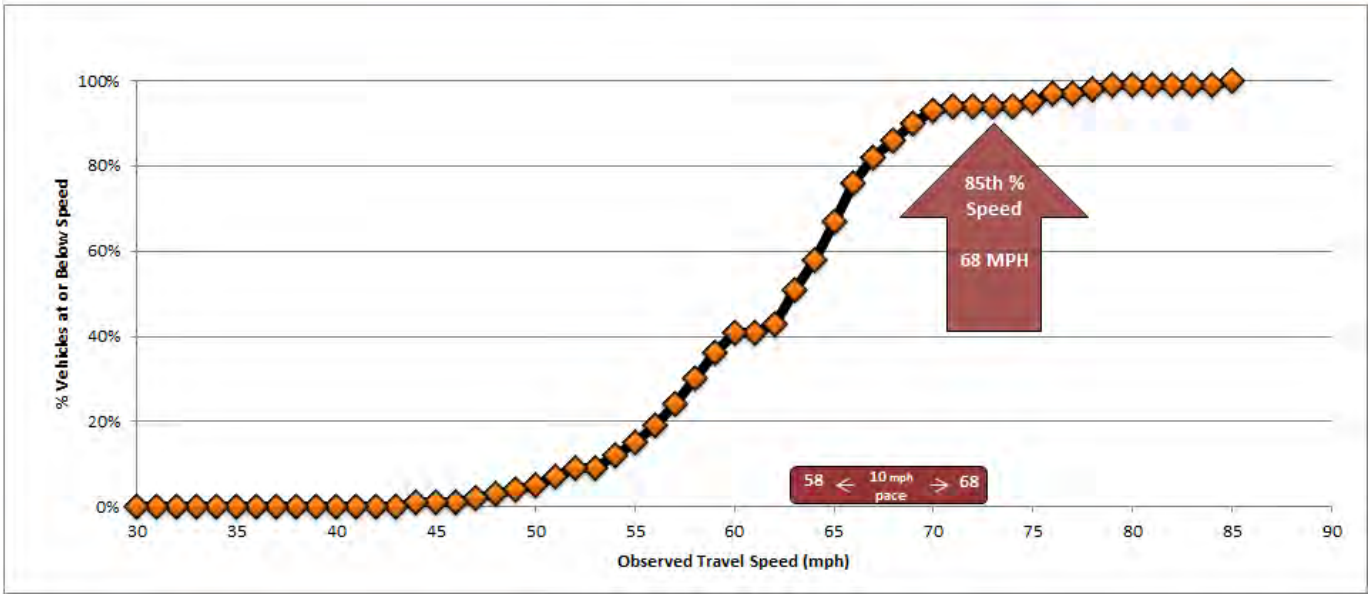




SPEED SAMPLE SUMMARY (TRUCKS)

ID:	A1-Seg-01	Speed Limit	65 MPH	Day/Date	Wednesday, August 3, 2022
Roadway:	US 93	Seg. Length:	2.3 MILES	Time:	24-hours
Study Limits:	Lolo to Missoula	Road Type:	Five-Lane, Two way	Sample Loc	46.826897, -114.068101
City/County:	Missoula	ADT Range:	NB-11900 SB-11700	Weather:	-
RP:	87.7 to 90	Truck ADT:	NB-430 SB-1140	Observer(s):	KLJ
85th % Speed:	68	10 mph pace	58-68	Machine:	Echo Radar
50th % Speed:	63	% in pace	58%		





APPENDIX C – NCHRP REPORT

NCHRP 17-76 Speed Limit Setting Tool		
Input Cells	*Description*	*Output Cells*
Site Description Data		
Rural	Roadway context	
Principal arterial	Roadway type	
Yes	Are crash data available?	
Ben F	Analyst	
12/7/2022	Date	
US 93	Roadway name	
A1-Seg-01	Description	
65	Current speed limit (mph)	
	Notes	
Analysis Results		
	Speed limit setting group	Undeveloped
	Suggested speed limit (mph)	**65**
Speed Data		
65	Maximum speed limit (mph)	
69	85th-percentile speed (mph)	
64	50th-percentile speed (mph)	
Site Characteristics		
2.3	Segment length (mi)	
26,235	AADT (two-way total) (veh/d)	
5	Number of lanes (two-way total)	
Undivided	Median type	
35	Number of access points (total of both directions)	
12	Lane width (ft)	
10	Shoulder width (ft)	
No	Adverse alignment present?	
Crash Data		
5	Number of years of crash data	
26,235	Average AADT for crash data period (veh/d)	
32	All (KABCO) crashes for crash data period	
4	Fatal & injury (KABC) crashes for crash data period	
	Average KABCO crash rate (crashes / 100 MVMT)	
	Average KABC crash rate (crashes / 100 MVMT)	
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	161.9
	1.3 x average KABC crash rate (crashes / 100 MVMT)	53.5
	Critical KABCO crash rate (crashes / 100 MVMT)	142.5
	Critical KABC crash rate (crashes / 100 MVMT)	51.6

ENGINEERING, REIMAGINED

SPEED STUDY

US Hwy 93 – Lolo to Missoula

Reference Point: 85.6 to 87.7

Missoula County, MT

March 2023

Speed Study

Lolo to Missoula, Montana

RP: 85.6 to 87.7

March 2023

Prepared for:

Montana Department of Transportation

Prepared by:

KLJ Engineering

Table of Contents

1. Introduction 1
2. Methodology 2
3. Roadway Characteristics 2
4. Vehicular Classification 3
5. Safety Characteristics 4
6. Speed Characteristics 7
7. Conclusion 8

List of Figures

Figure 1 - Study Segment 1
Figure 2 - Representative Section of US Hwy 93 from RP 85.6 to 87.7 2
Figure 3 - Five-Year Crash Summary (2016-2020) 4
Figure 4 - Citation Summary by Year 6
Figure 5 - Speed Profile 7

List of Tables

Table 1 - Vehicular Classification 4
Table 2 - Crash Collision Type 5
Table 3 - Speed Study Profile 7

List of Appendices

Appendix A – Pictures ..... A
Appendix B – Speed Study Profiles ..... B
Appendix C – NCHRP Report C

1. Introduction

Speed limits are set to inform motorists of appropriate driving and safe operating speeds under favorable conditions. Speed limits are set at the statutory speed limit unless a traffic engineering investigation study has been conducted and (where applicable) approved by the Transportation Commission. The *Montana Department of Transportation* (MDT) has requested KLJ Engineering to review the posted speed limit along US Hwy 93 from Lolo to Missoula.

Study Location

The study segment is US Hwy 93 beginning from Reference Point (RP) 85.6 (intersection with Bird Lane) to RP 87.7 (just south of Hayes Creek Rd). The 2.1-mile segment is a paved four-lane divided roadway. The segment has a Transportation Commission approved speed limit of 65-mph for all vehicles. There is an annual average daily traffic (AADT) of 24,762 along this segment as per 2021 counts reported in MDT's Transportation Data Management System (TDMS). The location of the study segment is shown in **Figure 1**.

Figure 1 - Study Segment

Objective

The purpose of this study is to evaluate the appropriate speed of the roadway. The primary tasks for the study included data collection, data analysis, and recommendations for speed limits along the study segment. As part of this study, an evaluation and cataloging of existing roadway conditions, collection of historical AADT, and crash data will be completed.

Procedures

The steps for setting speed limits include planning, coordination, data collection and analysis, review, and presentation to the stakeholders, and finally, determination or implementation of the speed limits. Quality data and good documentation provides support for the judgments that are made.

Five years of the most recent crash and citation data was also requested and received from the MDT Traffic & Safety Bureau for the analysis.

2. Methodology

For determining the appropriate speed limit, the following parameters were reviewed:

- Roadway Condition/Characteristics
- Crash and Citation History
- Speed Characteristics, and
- Vehicular classes

When considering whether to establish a new posted speed limit or not, surveying and analysis of existing travel speeds is crucial to determining a reasonable posted speed limit. Motorist usually drive at speeds which they perceive as safe, based on the observable roadway conditions. A flat and straight roadway may result in a different travel speed than the posted speed limit due to the driver's observation of the roadway condition.

3. Roadway Characteristics

While speed samples (actual speed measurements of vehicles) are a large part of the necessary data, roadway characteristics should also be considered. Roadway characteristics such as pavement type/conditions, access points, vertical grades, and clear zone assessments data were collected during the field visit in August 2022. **Figure 2** shows the most representative typical section of the study segment. Additional pictures of the study segment are available in **Appendix A**.

Figure 2 - Representative Section of US Hwy 93 from RP 85.6 to 87.7

Lanes and Shoulders

The typical cross section for this study section consists mainly of four 12-ft wide bituminous traveling lanes divided by a concrete median, and two seven-ft bituminous shoulders. The pavement is generally in good condition. The shoulders are wide enough for safe parking of disabled vehicles.

Rumble Strips

There are shoulder rumble strips present throughout the segment. There are no centerline rumple strips present for most of the segment. The centerline rumble strips are present immediately before the barrier ends.

Access Points per Mile

An access point refers to public roads, a business driveway, a private driveway, or a farm field access. Fewer access points per mile means drivers are responding to a reduced number and variety of events. The study section has a combined nine accesses (two public, two private, and five field access) within the 2.1-mile segment that corresponds to 4.3 accesses points per mile. The recommended primary full-movement and secondary intersection spacing for a rural principal arterial is one-mile and half-mile, respectively. The recommended and maximum density for driveways per mile for a 65-mph roadway is no more than 8.2 based on Stopping Sight Distance tables documented in *MDT Geometric Design Standards (Sept 2016)*.

Vertical Grades

Grade is the rate of change of the vertical alignment. Grade affects vehicle speed and vehicle control, particularly for large trucks. The study segment can be described as a rolling terrain.

Roadside Hazard Assessment

The segment generally comprises of cut section on the west and fill section on the east side with a clear zone that is mostly obstructed by fixed objects. Most of the segment has guardrail present within the clear zone on both or either side of the roadway. There is a trail that runs parallel to the roadway on the east side of the roadway that is within the clear zone.

In-slope

The in-slope measured at the representative section is generally rolling terrain. The in-slope was measured at 5:1 which is considered a recoverable slope. There are driveways along the study segment that have steep slopes because of culverts crossing them. These steep slopes appear to be non-traversable.

Adjacent Development

The area around the segment is mostly rural undeveloped land with some agricultural and residential land uses.

Statutory and Advisory Speeds

The Transportation Commission approved speed limit, which was approved in 2009, is 65-mph for all vehicles throughout this segment. There are no advisory speeds along the segment.

Traffic Control

There are no traffic stops on the mainline of US 93 in this segment.

4. Vehicular Classification

Vehicular class data for 24-hour period were collected on August 3, 2022. Vehicle types were categorized to two classifications:

- **Mid-size Vehicles** consisting of motorcycles, passenger vehicles, pickups, vans, buses, conventional vans, and city delivery trucks.
- **Large Vehicles** consisting of single unit four or more axle trucks.

There are 22,005 and 1,395 daily small to mid-size and large vehicles, respectively that travel in the segment. The daily distribution is 50% along northbound and 50% along southbound direction. The vehicular classifications in the study segment are summarized in **Table 1**.

Table 1 - Vehicular Classification

Classification	Northbound	Southbound	Total	Percent
Small to Mid-Size vehicles	11,210	10,795	22,005	94%
Large vehicles	540	855	1,395	6%
Total (Percent)	**11,750 (50%)**	**11,650 (50%)**	**23,400**	**100%**

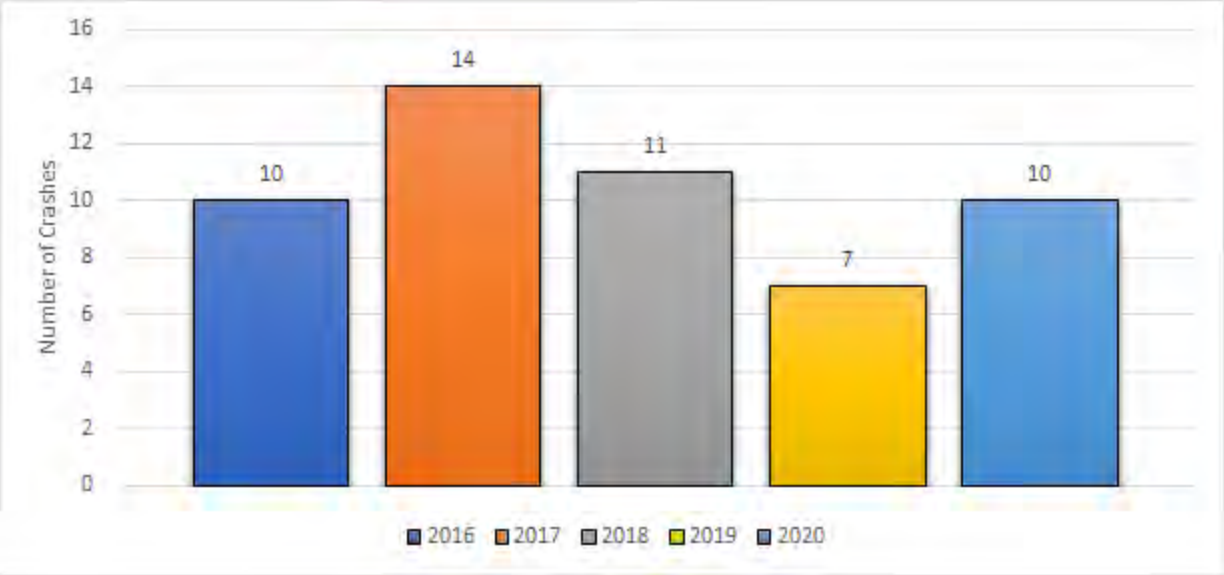
5. Safety Characteristics

Reviewing historic crash and citation information can help identify driver behavior issues that can provide additional information for setting speed the appropriate and safer speed limit.

Crash History

Five years of crash records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. MDT shared crash records in a spreadsheet format. The five-year crash summary by year is shown in **Figure 3**. There were 52 crashes (no fatal, two serious injury, four minor injury, two possible injury, and 44 property damage only type crashes) reported during the analysis period. This corresponds to 10.4 crashes per year or 5 crashes per year per mile.

Figure 3 - Five-Year Crash Summary (2016-2020)



Forty-eight crashes or 92% of all the crashes were non-junction related. Crash summary by crash type is shown in **Table 2**.

Table 2 - Crash Collision Type

Type	# Crashes	% Crashes
Fire/ Explosion	1	2%
Fixed Object	3	6%
Jackknife	1	2%
Left Turn, Same Direction	1	2%
Lost Control	1	2%
Other	2	4%
Rear-End	3	6%
Right Angle	1	2%
Right Turn, Same Direction	1	2%
Roll Over	7	13%
Sideswipe, Opposite Direction	2	4%
Wild Animal	29	56%
TOTAL	**52**	**100%**

Crashes with wild animals (56%) were the most prominent crash type followed by roll over crashes (13%) in the study segment. The crash data had no supplement officer narratives to identify if speeding was the contributing factor for any of these crashes.

Citation History

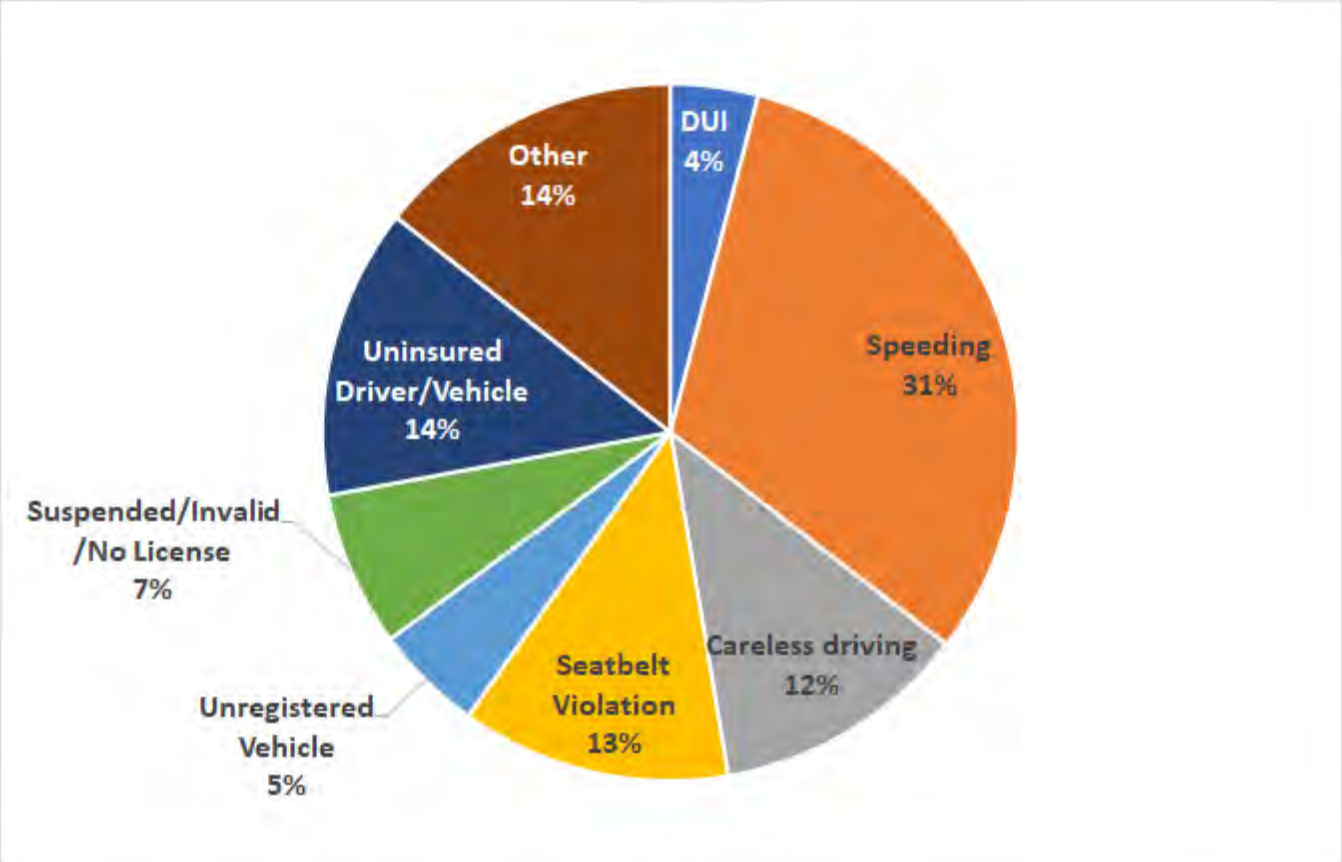
The speeding law in Montana 1 § 61-8-303 (3) states: "Subject to the maximum speed limits set forth in subsection (above), a person shall operate a vehicle in a careful and prudent manner and at a reduced rate of speed no greater than is reasonable and prudent under the conditions existing at the point of operation, taking into account the amount and character of traffic, visibility, weather, and roadway conditions." It is critical to note that the law enforcement can issue a ticket for driving a vehicle at unsafe speeds, even if a driver is within the posted speed limit. For example, driving at the posted speed limit on the freeway when there is a blizzard or thick fog. Since these driving conditions are unsafe for you and other drivers, law enforcement is within their rights to issue a speeding ticket as per the speeding laws in Montana.

Five years of citation records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. The citation records were in a spreadsheet format. The five-year citation summary in the segment is shown in **Figure 4**. There were 319 citations issued in the study segment during the analysis period of which 100 citations (31%) were speeding violations.

Figure 4 - Citation Summary by Year

The greatest number of citations were given in the month of September (12.5%). The types of citations issued in this segment are shown in **Figure 5**. Speeding (31%) was the most prominent type of traffic violation in the study area.

Figure 5 - Citation Types Issued (2016 - 2020)



6. Speed Characteristics

Engineering Approach

The engineering approach is a two-step process based on operating conditions such as the 85th percentile speed. The 85th percentile is the speed at which 85% of free-flowing traffic is traveling at or below. Once the speed limit is established based on the 85th percentile speed, it can be adjusted (usually downward) based on other factors such as amount of non-motorized traffic, roadway characteristics, and crash history. MDT's procedures for setting speed limits are based on the engineering approach.

MDT uses 85th percentile, 50th percentile, and pace speeds. The pace speed is a 10-mph increment in speeds that encompasses the highest portion of observed speeds.

Spot Speed Data

Spot speed studies typically consist of sample sizes totaling at least 100 vehicles with Free Flow Speed (FFS). FFS is the speed of motorists traveling as desired given prevailing conditions such that no preceding vehicle influences the motorists' speed. Unattended radars were placed along the study segment to collect vehicular speed samples for a 24-hour period from August 11th to 12th, 2022 near RP 86.5**.** The 24-hour data consisted of all vehicles that traveled along the study segment with various speed profiles including vehicles that influenced a motorist's choice of speed such as vehicular deceleration to make turns, queuing during peak hour, or a platoon.

The road and shoulder surface were clear of surface water or snow during the period when data were recorded. The result of the speed profile in the study segment is shown in **Figure 6** and **Table 3**. For details please see **Appendix B**. The 85th percentile speed was found to be 70-mph and the 50th percentile speed was found to be 65-mph. The 10-mph pace was found to be between 60-mph and 70-mph comprising of 60% of daily vehicles within that 10-mph pace. The 85th percentile is higher than the posted speed limit and 50th percentile speed is at the posted speed limit. The 85th percentile speed is at the upper tail-end of the 10-mph pace range, whereas the 50th percentile speeds were within the 10-mph pace range.

Figure 6 - Speed Profile for All Vehicle Types in Both Direction of Travel

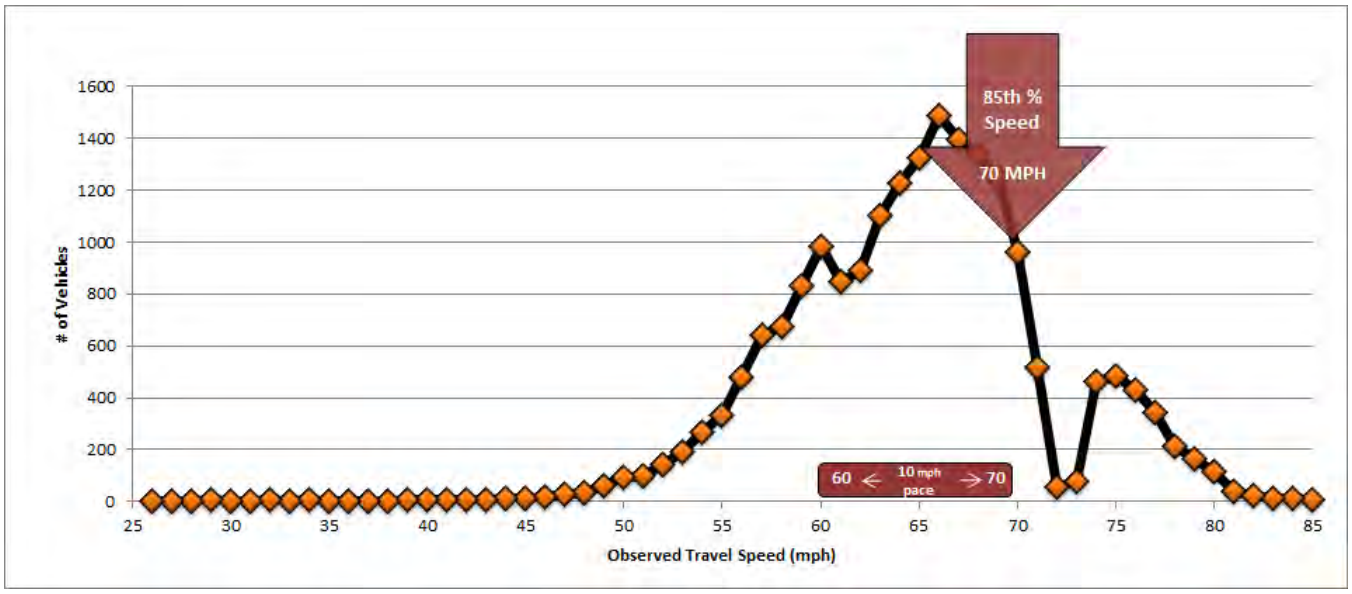


Table 3 - Speed Study Profile

Vehicle Type	Direction	10-mph Pace	% In Pace	85th Percentile Speed	50th Percentile Speed
Small to Mid-size	Northbound	62-72 mph	69%	75-mph	68-mph
	Southbound	57-67 mph	70%	66-mph	61-mph
	Both	61-71 mph	60%	71-mph	65-mph
Large	Northbound	62-72 mph	68%	70-mph	66-mph
	Southbound	56-66 mph	72%	64-mph	60-mph
	Both	59-69 mph	63%	68-mph	63-mph
All	Northbound	62-72 mph	69%	75-mph	68-mph
	Southbound	57-67 mph	70%	66-mph	61-mph
	Both	60-70 mph	60%	70-mph	65-mph

NCHRP

A recent research report from the *National Cooperative Highway Research Program* (NCHRP) has been completed. NCHRP report 17-76: *Development of a Posted Speed Limit Setting Procedure and Tool* collected insights into how the roadway environment influences operating speed and safety (crashes) through a review of literature and the collection and analysis of data from two states. Using those insights along with an understanding of different methods being used and currently being considered for the setting of posted speed limits, the research team developed a speed limit setting procedure along with a tool. The procedure uses fact-based decision rules that consider both driver speed choice and safety associated with the roadway.

There has been a nationwide push over the last several years for the consideration of 50th percentile speed, especially for developed areas. When the roadway conditions are optimal, then the suggested speed limit should reflect the 85th percentile speed. When roadway conditions are not favorable to all users or when crashes are a significant concern, then the suggested speed limit should reflect the rounded down 85th percentile or the 50th percentile speed. Drivers frequently select speeds a certain increment above the posted speed limit, anticipating that they will not receive a ticket if they are below the assumed enforcement speed tolerance. Because of these reasons, 50th percentile speed data were also used in the analysis along with the 85th percentile speed data.

The NCHRP 17-76 Speed Limit Setting Tool was used to calculate the recommended speed limit for the study segment based on key factors such as: 85th percentile and 50th percentile speed, roadway characteristics, and crash history. The recommended speed for the study segment based on NCHRP 17-76 was found to be 65-mph along in this segment. Details of the NCHRP 17-76 report is available in **Appendix C**.

7. Conclusion

Vehicular Classification

There are 22,005 and 1,395 daily small to mid-size and large vehicles, respectively that travel in the segment. The daily distribution is 50% along northbound and 50% along southbound direction.

Safety Characteristics

There were 52 crashes (no fatal, two serious injury, four minor injury, two possible injury, and 44 property damage only type crashes) reported during the analysis period. Crashes with wild animals (56%) were the most prominent crash type followed by roll over crashes (13%) in the study segment.

There were 319 citations issued in the study segment during the analysis period of which 100 citations (31%) were speeding violations.

Roadway Characteristics

The segment, RP 85.6 to RP 87.7, being reviewed has a Transportation Commission approved speed limit of 65-mph for all vehicles. The 2.1-mile segment is a paved four-lane roadway divided by a concrete median barrier in the center. The segment generally comprises of cut section on the west and fill section on the east side with a clear zone that is mostly obstructed by fixed objects. There are shoulder rumble strips present throughout the segment. There are no centerline rumple strips present for most of the segment. The centerline rumble strips are present immediately before the barrier ends. The shoulders are wide enough on both sides of the roadway for safe parking of disabled vehicles. The vertical grades and in-slopes are generally rolling terrain in the segment. The road conditions are generally in good condition. The area around the segment is mostly rural undeveloped lands with some agricultural and residential land uses. The driveway density in the study segment is less than the maximum number of driveway thresholds for similar type of facility.

Speed Characteristics

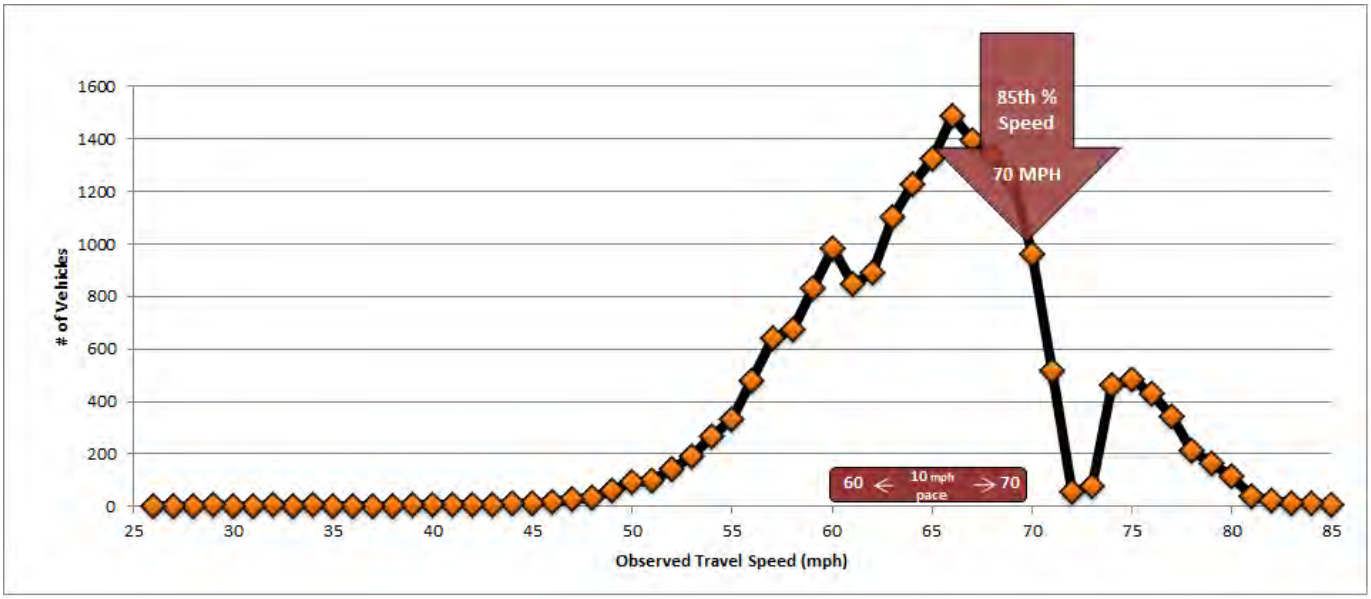
The 85th percentile speed was found to be 70-mph and the 50th percentile speed was found to be 65-mph. The 10-mph pace was found to be between 60-mph and 70-mph comprising of 60% of daily vehicles within that 10-mph pace. The recommended speed for the study segment based on NCHRP 17-76 was found to be 65-mph along in this segment. This indicates that the existing posted speed limit of 65-mph in this segment is reasonable.

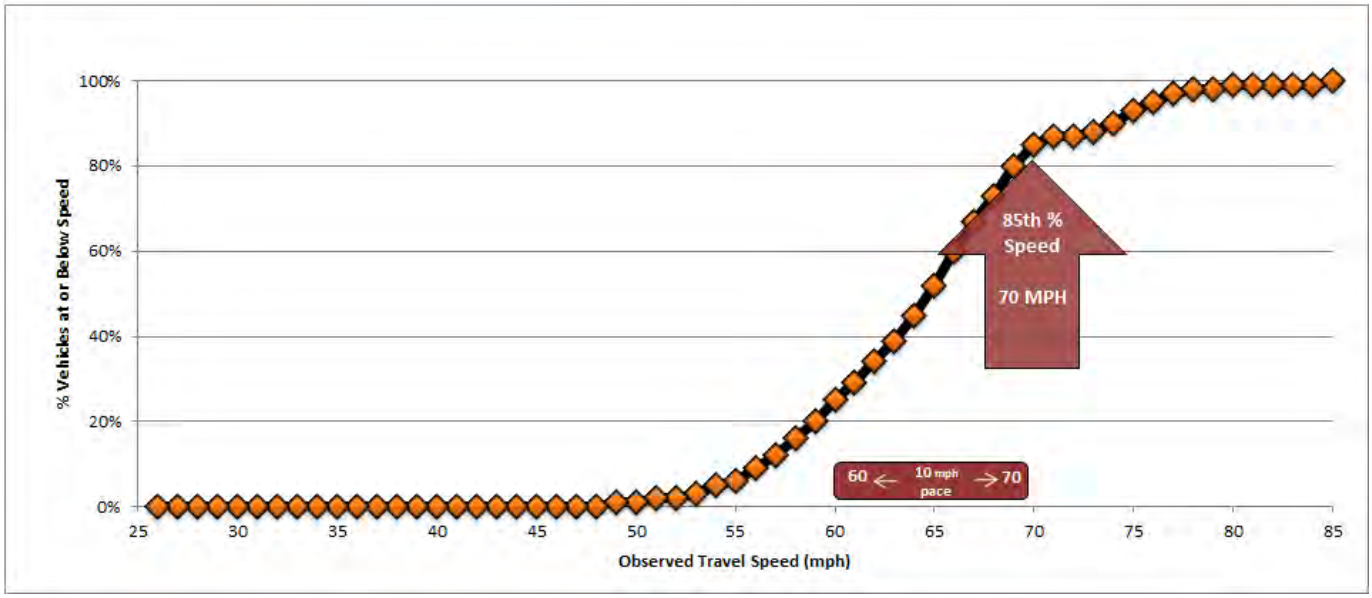
APPENDIX A – PICTURES

APPENDIX B – SPEED STUDY PROFILES

SPEED SAMPLE SUMMARY (ALL VEHICLES)

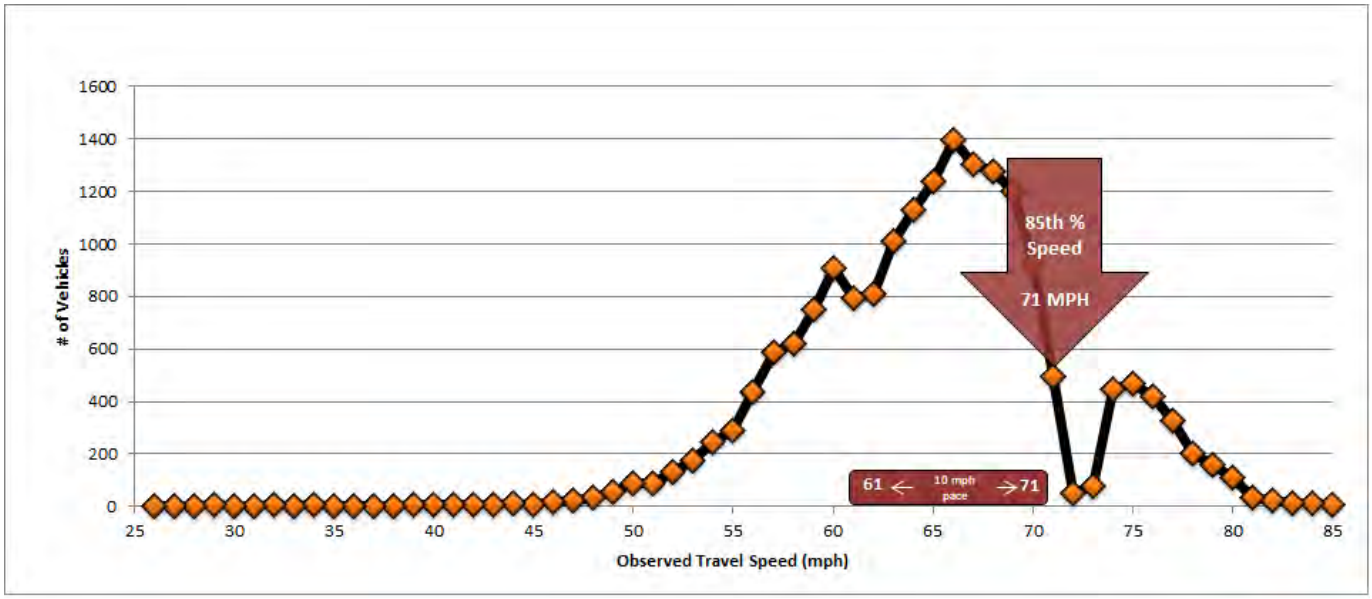
ID:	A1-Seg-02	Speed Limit	65 MPH	Day/Date	Thursday, August 11, 2022
Roadway:	US 93	Seg. Length:	2.1 MILES	Time:	24-hours
Study Limits:	Lolo to Missoula	Road Type:	Four-Lane, Two way	Sample Loc	46.796201, -114.099977
City/County:	Missoula	ADT Range:	NB-9500 SB-6400	Weather:	-
RP:	85.6 to 87.7	Truck ADT:	NB-610 SB-430	Observer(s):	KLJ
85th % Speed:	70	10 mph pace	60-70	Machine:	NB - Echo, SB - Houston
50th % Speed:	65	% in pace	60%		

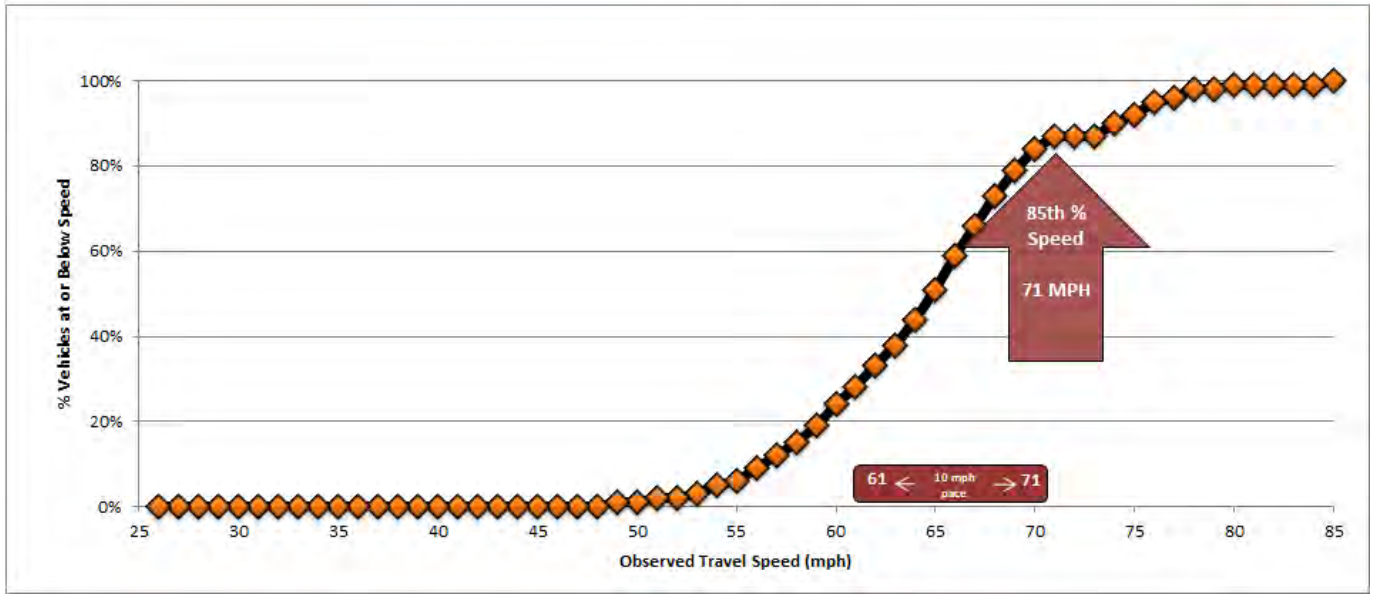




SPEED SAMPLE SUMMARY (PASSENGER VEHICLES)

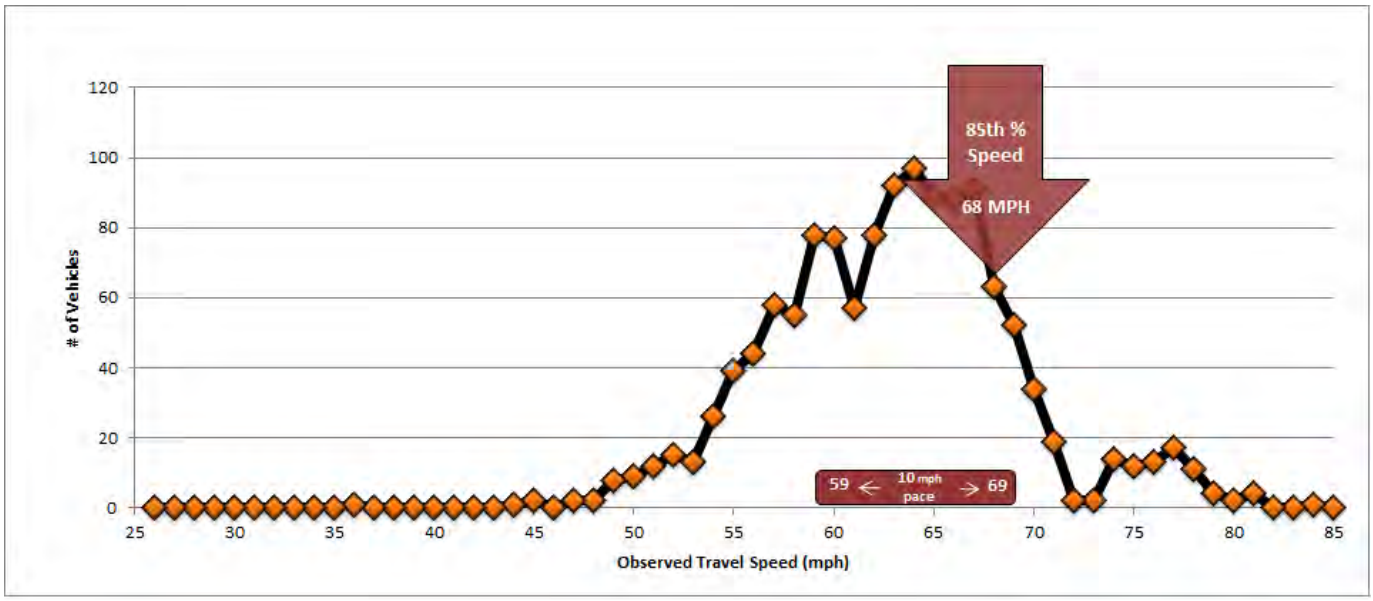
ID:	A1-Seg-02	Speed Limit	65 MPH	Day/Date	Thursday, August 11, 2022
Roadway:	US 93	Seg. Length:	2.1 MILES	Time:	24-hours
Study Limits:	Lolo to Missoula	Road Type:	Four-Lane, Two way	Sample Loc	46.796201, -114.099977
City/County:	Missoula	ADT Range:	NB-9500 SB-6400	Weather:	-
RP:	85.6 to 87.7	Truck ADT:	NB-610 SB-430	Observer(s):	KLJ
85th % Speed:	71	10 mph pace	61-71	Machine:	NB - Echo, SB - Houston
50th % Speed:	65	% in pace	60%		

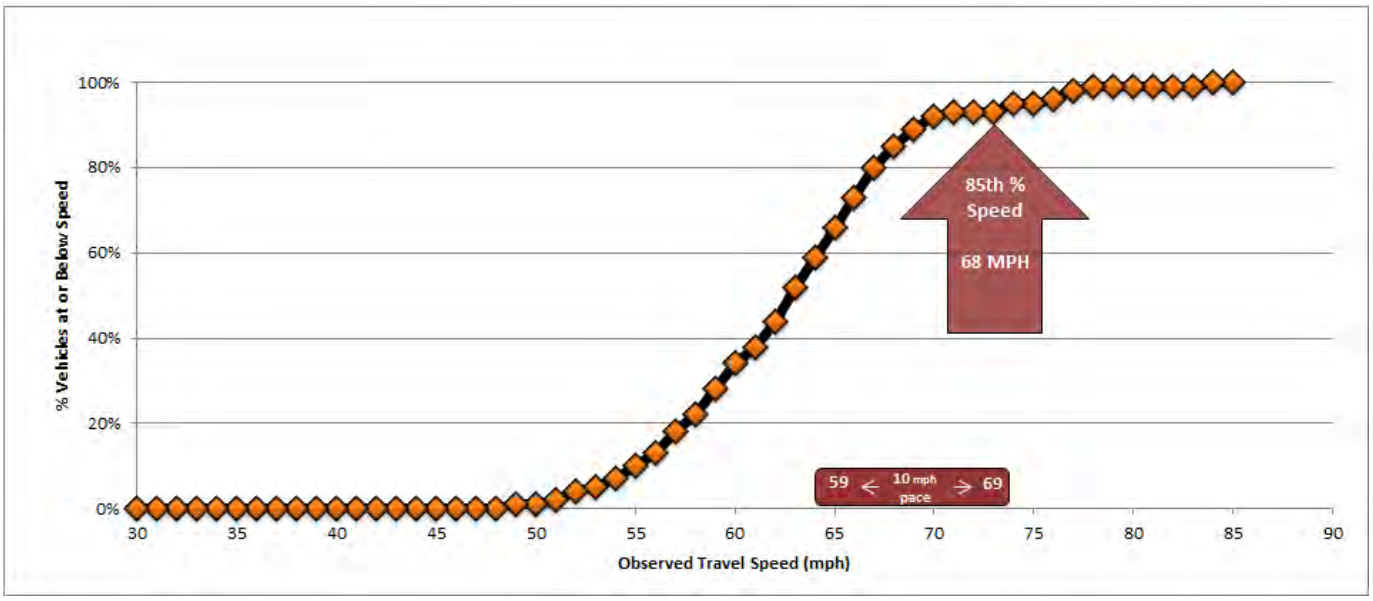




SPEED SAMPLE SUMMARY (TRUCKS)

ID:	A1-Seg-02	Speed Limit	65 MPH	Day/Date	Thursday, August 11, 2022
Roadway:	US 93	Seg. Length:	2.1 MILES	Time:	24-hours
Study Limits:	Lolo to Missoula	Road Type:	Four-Lane, Two way	Sample Loc	46.796201, -114.099977
City/County:	Missoula	ADT Range:	NB-9500 SB-6400	Weather:	-
RP:	85.6 to 87.7	Truck ADT:	NB-610 SB-430	Observer(s):	KLJ
85th % Speed:	68	10 mph pace	59-69	Machine:	NB - Echo, SB - Houston
50th % Speed:	63	% in pace	63%		





APPENDIX C – NCHRP REPORT

NCHRP 17-76 Speed Limit Setting Tool		
Input Cells	*Description*	*Output Cells*
Site Description Data		
Rural	Roadway context	
Principal arterial	Roadway type	
Yes	Are crash data available?	
Ben F	Analyst	
12/9/2022	Date	
US 93	Roadway name	
A1-Seg-02	Description	
65	Current speed limit (mph)	
	Notes	
Analysis Results		
	Speed limit setting group	Undeveloped
	Suggested speed limit (mph)	**65**
Speed Data		
65	Maximum speed limit (mph)	
70	85th-percentile speed (mph)	
65	50th-percentile speed (mph)	
Site Characteristics		
2.1	Segment length (mi)	
24,770	AADT (two-way total) (veh/d)	
4	Number of lanes (two-way total)	
Divided	Median type	
9	Number of access points (total of both directions)	
12	Lane width (ft)	
7	Shoulder width (ft)	
No	Adverse alignment present?	
Crash Data		
5	Number of years of crash data	
12,900	Average AADT for crash data period (veh/d)	
52	All (KABCO) crashes for crash data period	
8	Fatal & injury (KABC) crashes for crash data period	
	Average KABCO crash rate (crashes / 100 MVMT)	
	Average KABC crash rate (crashes / 100 MVMT)	
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	96.1
	1.3 x average KABC crash rate (crashes / 100 MVMT)	27.0
	Critical KABCO crash rate (crashes / 100 MVMT)	95.0
	Critical KABC crash rate (crashes / 100 MVMT)	32.4

ENGINEERING, REIMAGINED

SPEED STUDY

US Hwy 93 – Lolo to Missoula

Reference Point: 84.0 to 85.6

Missoula County, MT

March 2023

Speed Study

Lolo to Missoula, Montana

RP: 84.0 to 85.6

March 2023

Prepared for:

Montana Department of Transportation

Prepared by:

KLJ Engineering

Table of Contents

1. Introduction 1
2. Methodology 2
3. Roadway Characteristics 2
4. Vehicular Classification 3
5. Safety Characteristics 4
6. Speed Characteristics 6
7. Conclusion 8

List of Figures

Figure 1 - Study Segment 1
Figure 2 - Representative Section of US Hwy 93 from RP 84.0 to 85.6 2
Figure 3 - Five-Year Crash Summary (2016-2020) 4
Figure 4 - Citation Summary by Year 5
Figure 5 - Citation Types Issued (2016 - 2020) 6
Figure 6 - Speed Profile for All Vehicle Types in Both Direction of Travel 7

List of Tables

Table 1 - Vehicular Classification 4
Table 2 - Crash Collision Type 5
Table 3 - Speed Study Profile 7

List of Appendices

Appendix A – Pictures ..... A
Appendix B – Speed Study Profiles ..... B
Appendix C – NCHRP Report C

1. Introduction

Speed limits are set to inform motorists of appropriate driving and safe operating speeds under favorable conditions. Speed limits are set at the statutory speed limit unless a traffic engineering investigation study has been conducted and (where applicable) approved by the Transportation Commission. The *Montana Department of Transportation* (MDT) has requested KLJ Engineering to review the posted speed limit along US Hwy 93 from Lolo to Missoula.

Study Location

The study segment is US Hwy 93 beginning from Reference Point (RP) 84.0 (intersection with Ridgeway Drive/Glacier Drive) to RP 85.6 (Bird Lane). The 1.6-mile segment is a paved four-lane undivided roadway with a two-way-left-turn-lane (TWLTL) in the center. The segment has a Transportation Commission approved speed limit of 65-mph for all vehicles. There is an annual average daily traffic (AADT) of 24,762 along this segment as per 2021 counts reported in MDT's Transportation Data Management System (TDMS). The location of the study segment is shown in **Figure 1**.

Figure 1 - Study Segment

Objective

The purpose of this study is to evaluate the appropriate speed of the roadway. The primary tasks for the study included data collection, data analysis, and recommendations for speed limits along the study segment. As part of this study, an evaluation and cataloging of existing roadway conditions, collection of historical AADT, and crash data will be completed.

Procedures

The steps for setting speed limits include planning, coordination, data collection and analysis, review, and presentation to the stakeholders, and finally, determination or implementation of the speed limits. Quality data and good documentation provides support for the judgments that are made.

Five years of the most recent crash and citation data was also requested and received from the MDT Traffic & Safety Bureau for the analysis.

2. Methodology

For determining the appropriate speed limit, the following parameters were reviewed:

- Roadway Condition/Characteristics
- Crash and Citation History
- Speed Characteristics, and
- Vehicular classes

When considering whether to establish a new posted speed limit or not, surveying and analysis of existing travel speeds is crucial to determining a reasonable posted speed limit. Motorist usually drive at speeds which they perceive as safe, based on the observable roadway conditions. A flat and straight roadway may result in a different travel speed than the posted speed limit due to the driver's observation of the roadway condition.

3. Roadway Characteristics

While speed samples (actual speed measurements of vehicles) are a large part of the necessary data, roadway characteristics should also be considered. Roadway characteristics such as pavement type/conditions, access points, vertical grades, and clear zone assessments data were collected during the field visit in August 2022. **Figure 2** shows the most representative typical section of the study segment. Additional pictures of the study segment are available in **Appendix A**.

Figure 2 - Representative Section of US Hwy 93 from RP 84.0 to 85.6

Lanes and Shoulders

The typical cross section for this study section consists mainly of four 12-ft wide bituminous traveling, one 16-ft TWLTL in the center, and two 12-ft bituminous shoulders. The pavement is generally in good condition. The shoulders are wide enough for safe parking of disabled vehicles.

Rumble Strips

There are shoulder and centerline rumble strips present throughout the segment. The centerline rumble strips are present within the TWLTL striping area.

Access Points per Mile

An access point refers to public roads, a business driveway, a private driveway, or a farm field access. Fewer access points per mile means drivers are responding to a reduced number and variety of events. The study section has a combined ten accesses (two public, two privates, and six field access) within the 1.6-mile segment that corresponds to 6.3 accesses points per mile. The recommended primary full-movement and secondary intersection spacing for a rural principal arterial is one-mile and half-mile, respectively. The recommended and maximum density for driveways per mile for a 65-mph roadway is no more than 8.2 based on Stopping Sight Distance tables documented in *MDT Geometric Design Standards (Sept 2016)*.

Vertical Grades

Grade is the rate of change of the vertical alignment. Grade affects vehicle speed and vehicle control, particularly for large trucks. The study segment can be described as generally flat.

Roadside Hazard Assessment

The segment generally comprises of fill and cut section on the west side, and only fill section on the east side with a clear zone that is mostly obstructed by fixed objects. The segment has guardrail present on the east side of the roadway from RP 84.0 to RP 84.3. There is a trail that runs parallel to the roadway on the east side of the roadway that is within the clear zone.

In-slope

The in-slope measured at the representative section is generally flat. The in-slope was measured at 5:1 which is considered a recoverable slope. There are driveways along the study segment that have steep slopes because of culverts crossing them. These steep slopes appear to be non-traversable.

Adjacent Development

The area around the segment is mostly rural agricultural with a short section of industrial land use in the southern end of the segment near the town of Lolo.

Statutory and Advisory Speeds

The Transportation Commission approved speed limit, which was approved in 2009, is 65-mph for all other vehicles throughout this segment. There are no advisory speeds along the segment.

Traffic Control

The intersection of US Hwy 93 with Glacier Dr/Ridgeway Dr, at the south terminal of the segment, is controlled by a traffic signal.

4. Vehicular Classification

Vehicular class data for 24-hour period were collected on September 9, 2022. Vehicle types were categorized to two classifications:

- **Mid-size Vehicles** consisting of motorcycles, passenger vehicles, pickups, vans, buses, conventional vans, and city delivery trucks.
- **Large Vehicles** consisting of single unit four or more axle trucks.

There are 21,980 and 1,220 daily small to mid-size and large vehicles, respectively that travel in the segment. The daily distribution is 50% along northbound and 50% along southbound direction. The vehicular classifications in the study segment are summarized in **Table 1**.

Table 1 - Vehicular Classification

Classification	Northbound	Southbound	Total	Percent
Small to Mid-Size vehicles	10,950	11,030	21,980	95%
Large vehicles	650	570	1,220	5%
Total (Percent)	**11,600 (50%)**	**11,600 (50%)**	**23,200**	**100%**

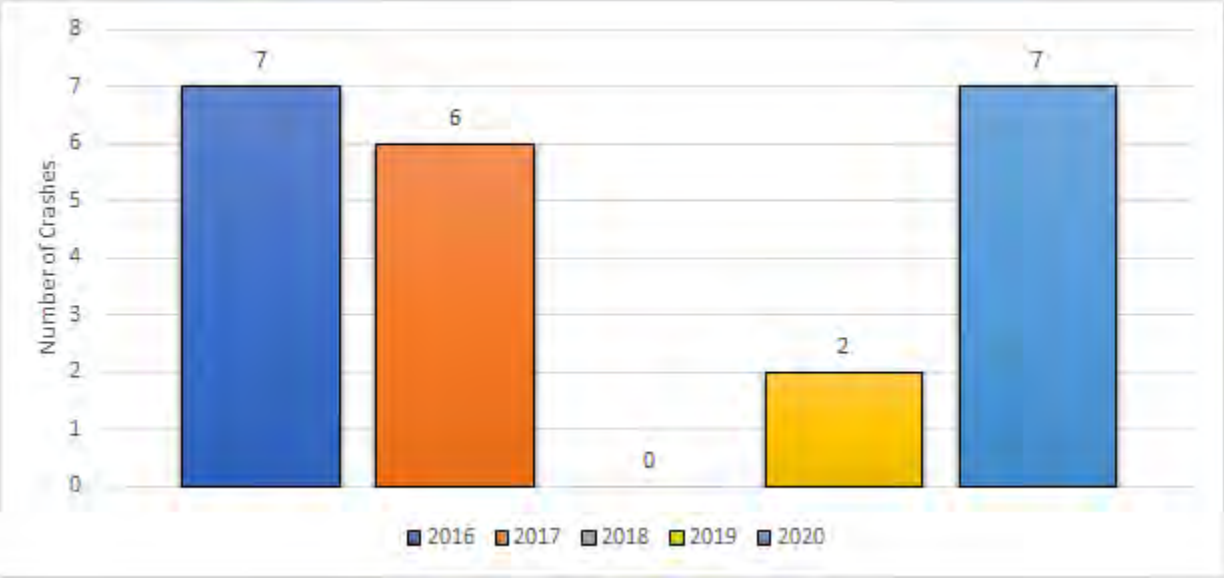
5. Safety Characteristics

Reviewing historic crash and citation information can help identify driver behavior issues that can provide additional information for setting speed the appropriate and safer speed limit.

Crash History

Five years of crash records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. MDT shared crash records in a spreadsheet format. The five-year crash summary by year is shown in **Figure 3**. There were 22 crashes (no fatal, one serious injury, four minor injury, one possible injury, 15 property damage only, and one unknown type crashes) reported during the analysis period. This corresponds to 4.4 crashes per year or 2.8 crashes per year per mile. There were no crashes reported in 2018 for this segment.

Figure 3 - Five-Year Crash Summary (2016-2020)



Twenty-one crashes or 95% of all the crashes were non-junction related. Crash summary by crash type is shown in **Table 2**.

Table 2 - Crash Collision Type

Type	# Crashes	% Crashes
Fixed Object	2	9%
Left Turn, Same Direction	1	5%
Roll Over	4	18%
Wild Animal	15	68%
TOTAL	**22**	**100%**

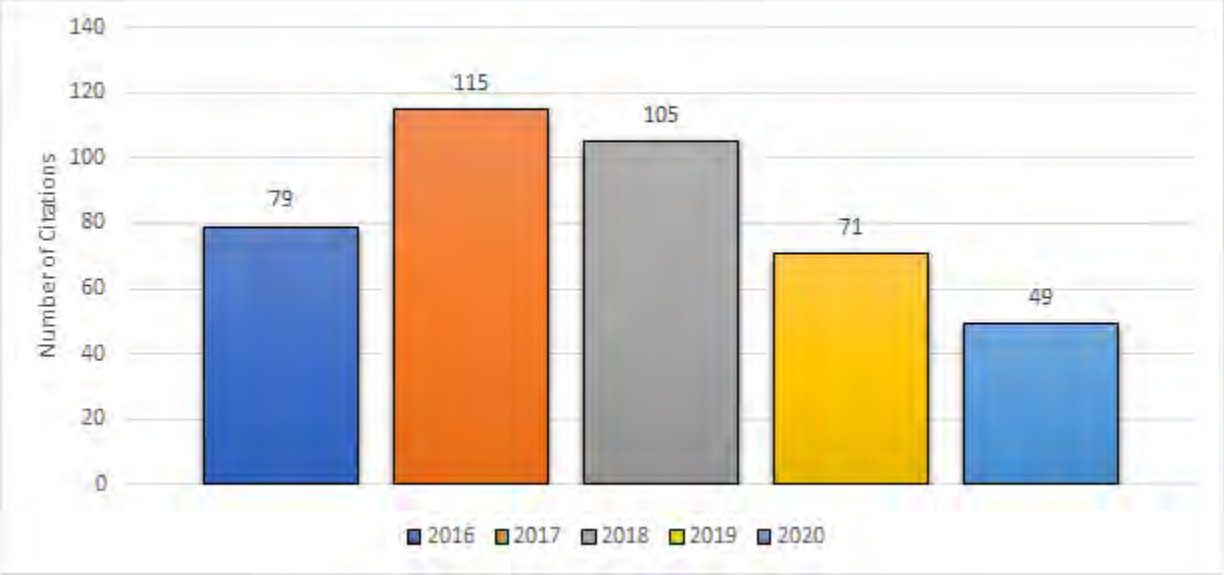
Crashes with wild animals (68%) were the most prominent crash type followed by roll over crashes (18%) in the study segment. The crash data had no supplement officer narratives to identify if speeding was the contributing factor for any of these crashes.

Citation History

The speeding law in Montana 1 § 61-8-303 (3) states: "Subject to the maximum speed limits set forth in subsection (above), a person shall operate a vehicle in a careful and prudent manner and at a reduced rate of speed no greater than is reasonable and prudent under the conditions existing at the point of operation, taking into account the amount and character of traffic, visibility, weather, and roadway conditions." It is critical to note that the law enforcement can issue a ticket for driving a vehicle at unsafe speeds, even if a driver is within the posted speed limit. For example, driving at the posted speed limit on the freeway when there is a blizzard or thick fog. Since these driving conditions are unsafe for you and other drivers, law enforcement is within their rights to issue a speeding ticket as per the speeding laws in Montana.

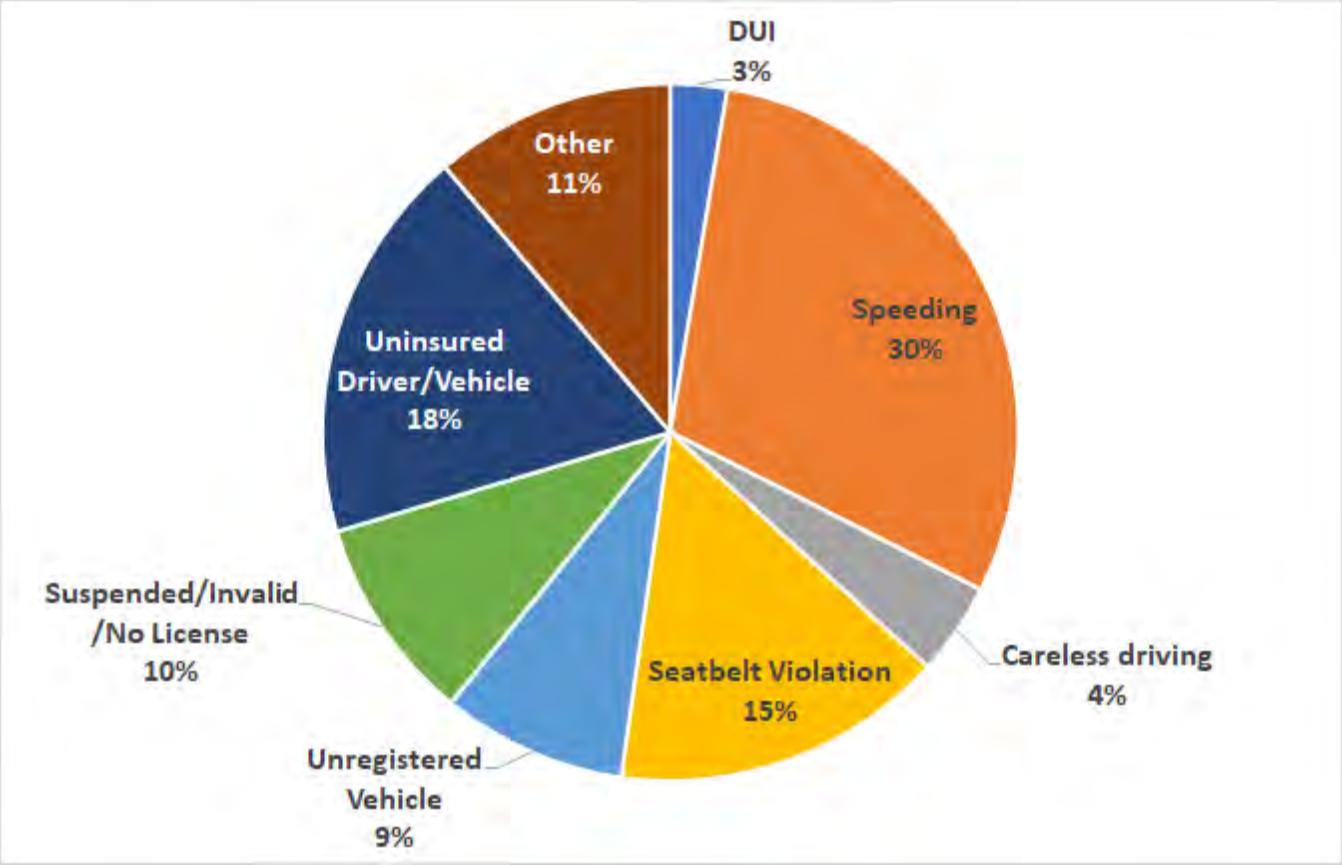
Five years of citation records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. The citation records were in a spreadsheet format. The five-year citation summary in the segment is shown in **Figure 4**. There were 419 citations issued in the study segment during the analysis period of which 125 citations (30%) were speeding violations.

Figure 4 - Citation Summary by Year



The greatest number of citations were given in the month of July (13.1%). The types of citations issued in this segment are shown in **Figure 5**. Speeding (30%) was the most prominent type of traffic violation in the study area.

Figure 5 - Citation Types Issued (2016 - 2020)



6. Speed Characteristics

Engineering Approach

The engineering approach is a two-step process based on operating conditions such as the 85th percentile speed. The 85th percentile is the speed at which 85% of free-flowing traffic is traveling at or below. Once the speed limit is established based on the 85th percentile speed, it can be adjusted (usually downward) based on other factors such as amount of non-motorized traffic, roadway characteristics, and crash history. MDT's procedures for setting speed limits are based on the engineering approach.

MDT uses 85th percentile, 50th percentile, and pace speeds. The pace speed is a 10-mph increment in speeds that encompasses the highest portion of observed speeds.

Spot Speed Data

Spot speed studies typically consist of sample sizes totaling at least 100 vehicles with Free Flow Speed (FFS). FFS is the speed of motorists traveling as desired given prevailing conditions such that no preceding vehicle influences the motorists' speed. Unattended radars were placed along the study segment to collect vehicular speed samples for a 24-hour period from September 8 to 9, 2022 near RP 85.3**.** The 24-hour data consisted of all vehicles that traveled along the study segment with various speed profiles including vehicles that influenced a motorist's choice of speed such as vehicular deceleration to make turns, queuing during peak hour, or a platoon.

The road and shoulder surface were clear of surface water or snow during the period when data were recorded. The result of the speed profile in the study segment is shown in **Figure 6** and **Table 3**. For details please see **Appendix B**. The 85th percentile speed was found to be 75-mph and the 50th percentile speed was found to be

68-mph. The 10-mph pace was found to be between 62-mph and 72-mph comprising of 67% of daily vehicles within that 10-mph pace. The 85th percentile and 50th percentile speeds are higher than the posted speed limit. The 85th percentile speed is greater than the upper tail-end of the 10-mph pace range, whereas the 50th percentile speeds were within the 10-mph pace range.

Figure 6 - Speed Profile for All Vehicle Types in Both Direction of Travel

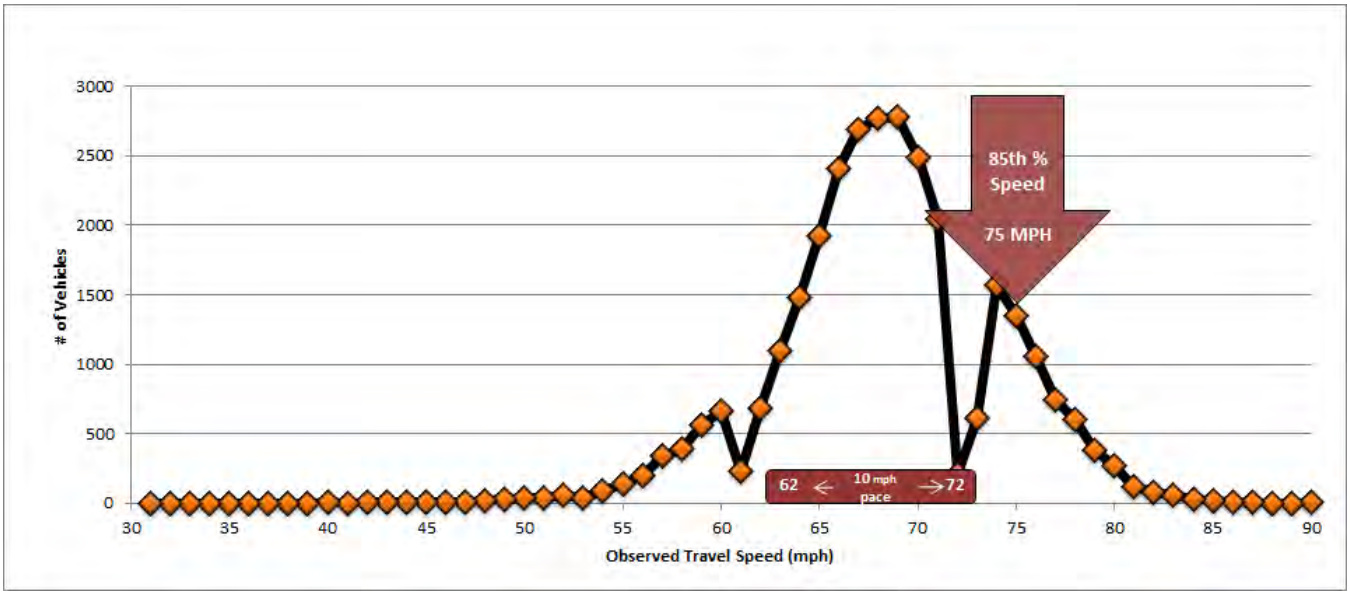


Table 3 - Speed Study Profile

Vehicle Type	Direction	10-mph Pace	% In Pace	85th Percentile Speed	50th Percentile Speed
Small to Mid-size	Northbound	62-72 mph	65%	75-mph	69-mph
	Southbound	62-72 mph	68%	74-mph	68-mph
	Both	62-72 mph	67%	75-mph	68-mph
Large	Northbound	62-72 mph	73%	69-mph	66-mph
	Southbound	59-69 mph	70%	69-mph	65-mph
	Both	62-72 mph	70%	69-mph	65-mph
All	Northbound	62-72 mph	66%	75-mph	68-mph
	Southbound	62-72 mph	68%	74-mph	68-mph
	Both	62-72 mph	67%	75-mph	68-mph

NCHRP

A recent research report from the *National Cooperative Highway Research Program* (NCHRP) has been completed. NCHRP report 17-76: *Development of a Posted Speed Limit Setting Procedure and Tool* collected insights into how the roadway environment influences operating speed and safety (crashes) through a review of literature and the collection and analysis of data from two states. Using those insights along with an understanding of different methods being used and currently being considered for the setting of posted speed limits, the research team developed a speed limit setting procedure along with a tool. The procedure uses fact-based decision rules that consider both driver speed choice and safety associated with the roadway.

There has been a nationwide push over the last several years for the consideration of 50th percentile speed, especially for developed areas. When the roadway conditions are optimal, then the suggested speed limit should reflect the 85th percentile speed. When roadway conditions are not favorable to all users or when crashes are a

significant concern, then the suggested speed limit should reflect the rounded down 85th percentile or the 50th percentile speed. Drivers frequently select speeds a certain increment above the posted speed limit, anticipating that they will not receive a ticket if they are below the assumed enforcement speed tolerance. Because of these reasons, 50th percentile speed data were also used in the analysis along with the 85th percentile speed data.

The NCHRP 17-76 Speed Limit Setting Tool was used to calculate the recommended speed limit for the study segment based on key factors such as: 85th percentile and 50th percentile speed, roadway characteristics, and crash history. The recommended speed for the study segment based on NCHRP 17-76 was found to be 65-mph along in this segment. Details of the NCHRP 17-76 report is available in **Appendix C**.

7. Conclusion

Vehicular Classification

There are 21,980 and 1,220 daily small to mid-size and large vehicles, respectively that travel in the segment. The daily distribution is 50% along northbound and 50% along southbound direction.

Safety Characteristics

There were 22 crashes (no fatal, one serious injury, four minor injury, one possible injury, 15 property damage only, and one unknown type crashes) reported during the analysis period. There were no crashes reported in 2018 for this segment. Crashes with wild animals (68%) were the most prominent crash type followed by roll over crashes (18%) in the study segment

There were 419 citations issued in the study segment during the analysis period of which 125 citations (30%) were speeding violations. Speeding (30%) was the most prominent type of traffic violation in the study area.

Roadway Characteristics

The segment, RP 84.0 to RP 85.6, being reviewed has an approved speed limit of 65-mph for all vehicles. The 1.6-mile segment is a paved four-lane roadway with TWLTL in the center. The segment generally comprises of fill and cut section on the west side, and only fill section on the east side with a clear zone that is mostly obstructed by fixed objects. There are shoulder rumble strips present throughout the segment. There are centerline rumble strips present within the TWLTL striping area. The shoulders are wide enough on both sides of the roadway for safe parking of disabled vehicles. The vertical grades and in-slopes are generally flat in the segment. The road conditions are generally in good condition. The area around the segment is mostly rural agricultural with a short section of industrial land use in the southern end of the segment near the town of Lolo. The driveway density in the study segment is less than the maximum number of driveway thresholds for similar type of facility.

Speed Characteristics

The 85th percentile speed was found to be 75-mph and the 50th percentile speed was found to be 68-mph. The 10-mph pace was found to be between 62-mph and 72-mph comprising of 67% of daily vehicles within that 10-mph pace. The recommended speed for the study segment based on NCHRP 17-76 was found to be 65-mph along in this segment. This indicates that the existing posted speed limit of 65-mph in this segment is reasonable.

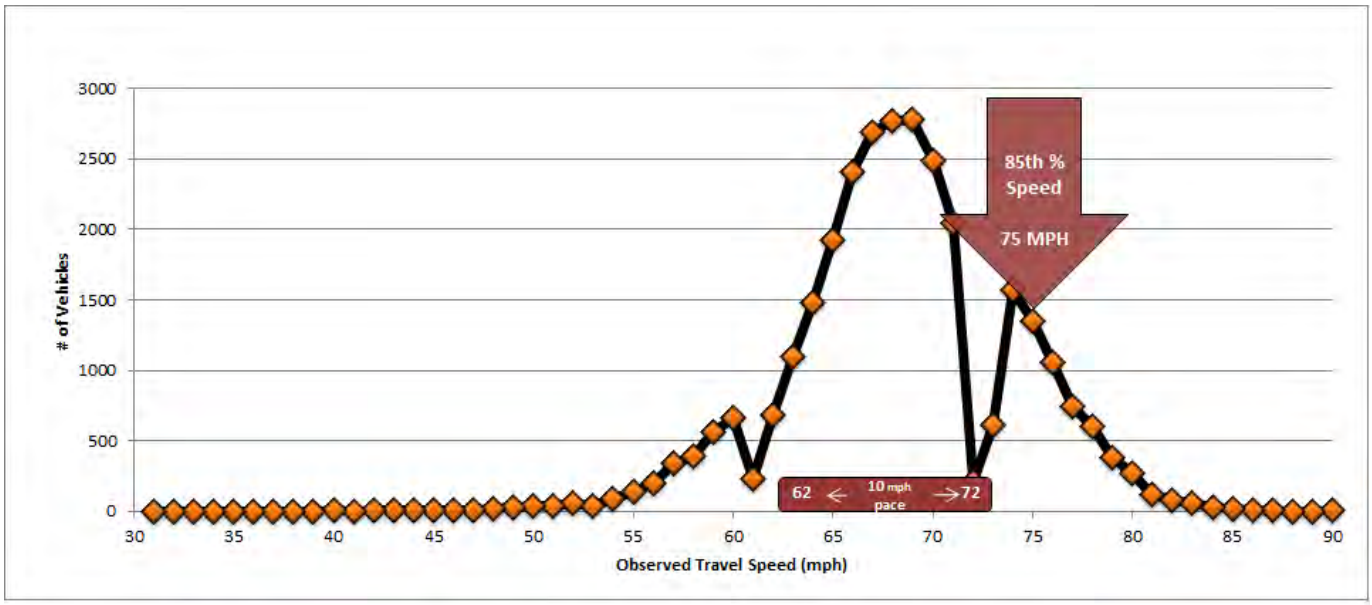
APPENDIX A – PICTURES

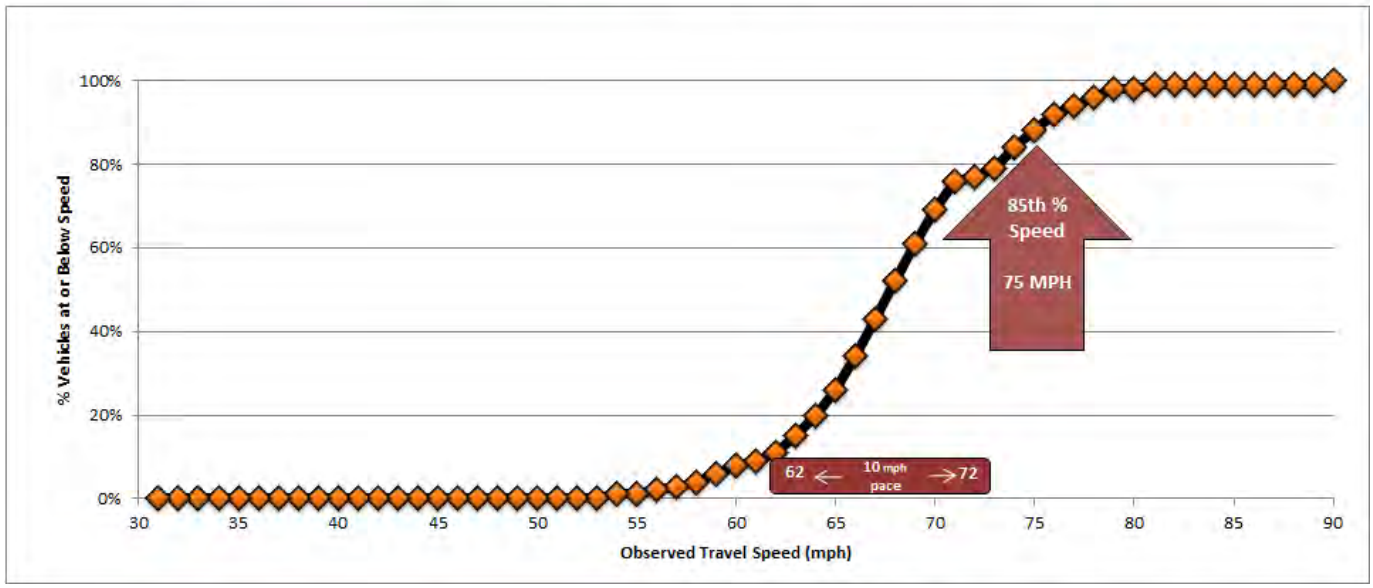

CENTER
LANE
ONLY
DISCOVER YOUR TRAIL
BOB WARD'S
SPORTING & OUTDOORS

APPENDIX B – SPEED STUDY PROFILES

SPEED SAMPLE SUMMARY (ALL VEHICLES)

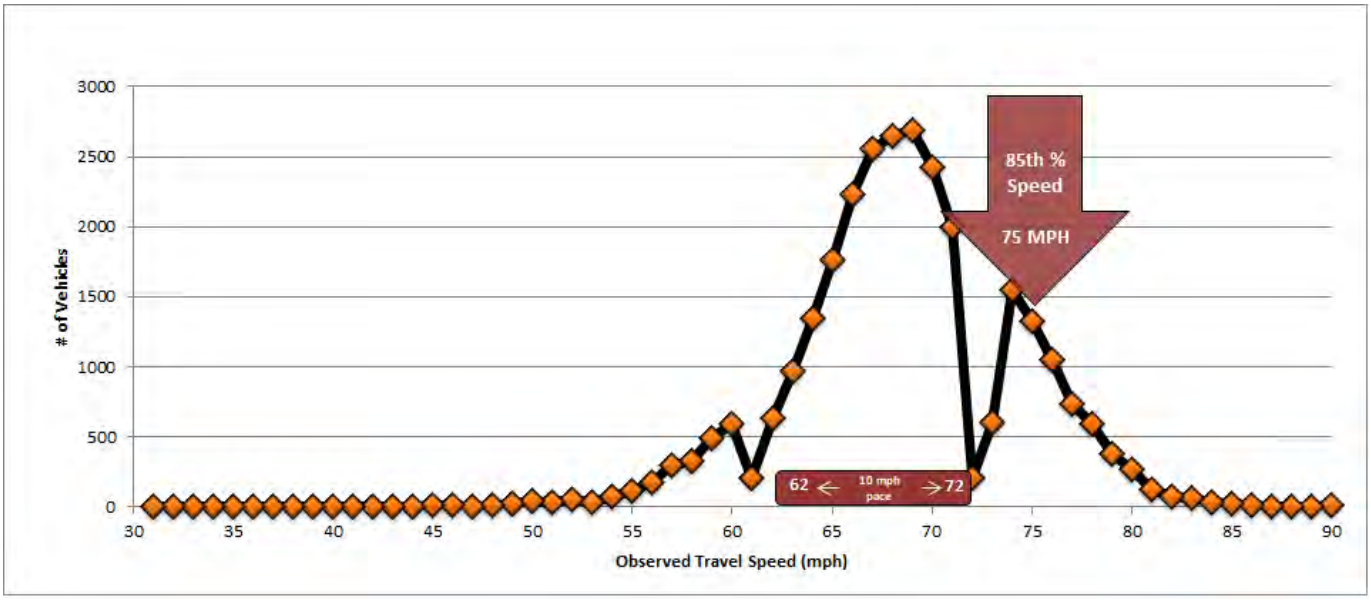
ID:	A1-Seg-03	Speed Limit	65 MPH	Day/Date	Friday, September 9, 2022
Roadway:	US 93	Seg. Length:	1.6 MILES	Time:	24-hours
Study Limits:	Lolo to Missoula	Road Type:	Five-Lane, Two way	Sample Loc	46.779518, -114.091301
City/County:	Missoula	ADT Range:	NB-11600 SB-11600	Weather:	-
RP:	84.0 to 85.6	Truck ADT:	NB-650 SB-570	Observer(s):	KLJ
85th % Speed:	75	10 mph pace	62-72	Machine:	Echo Radar
50th % Speed:	68	% in pace	67%		

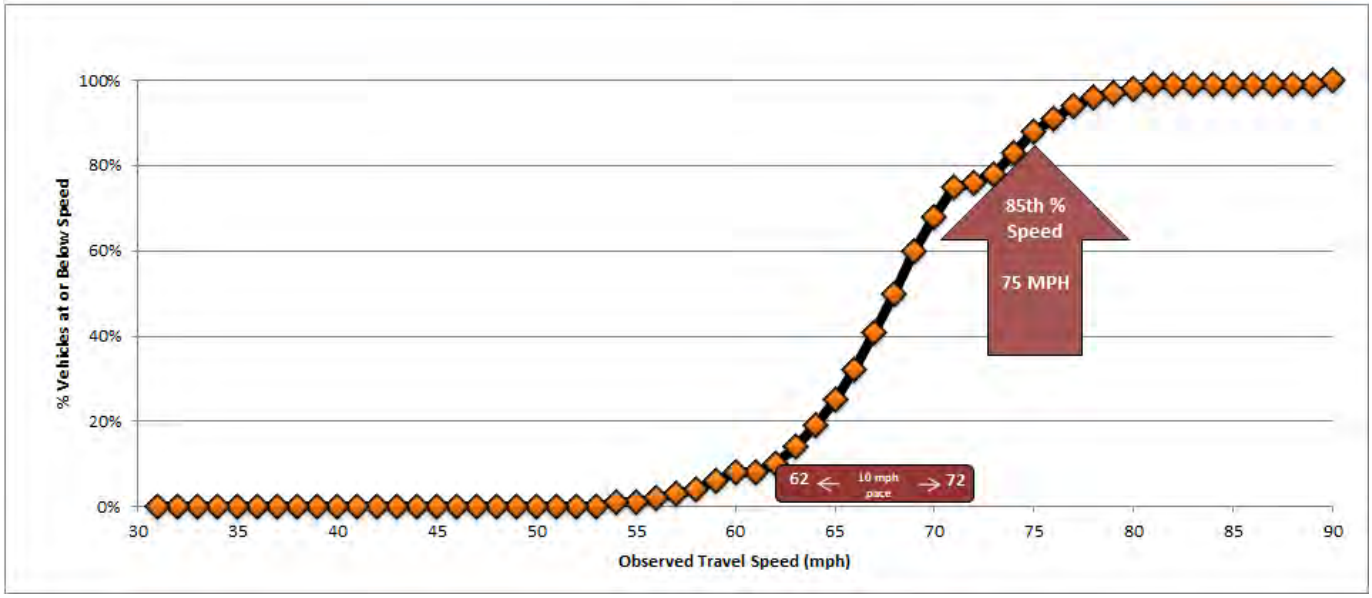




SPEED SAMPLE SUMMARY (PASSENGER VEHICLES)

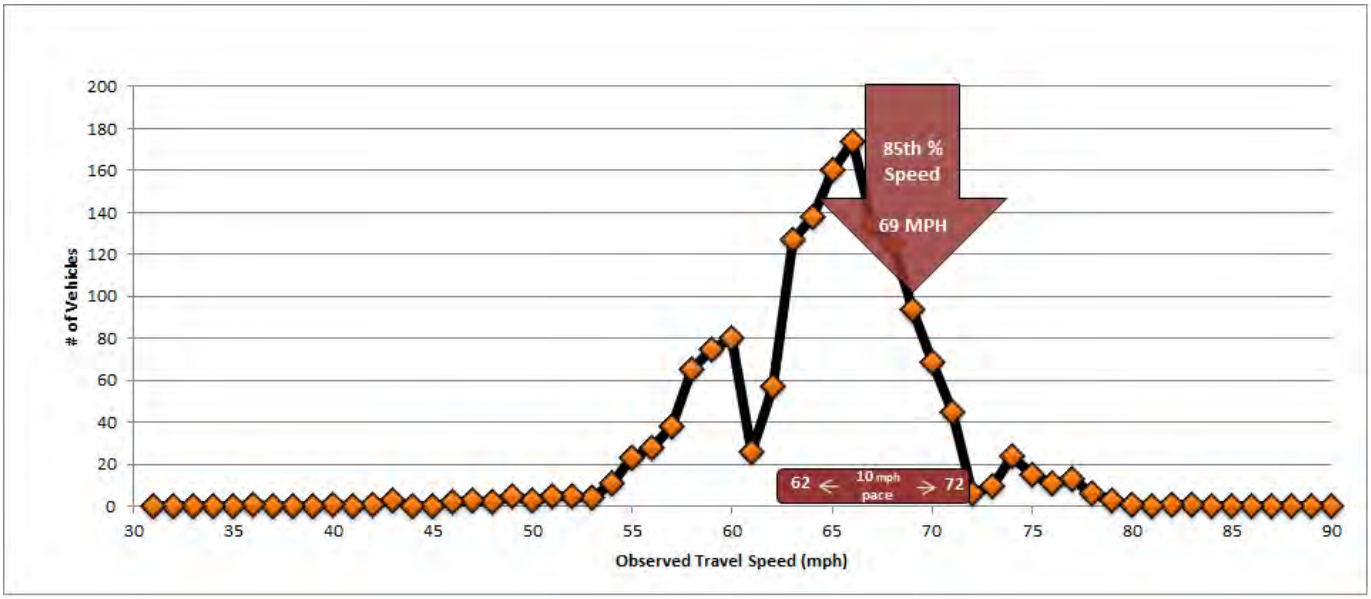
ID:	A1-Seg-03	Speed Limit	65 MPH	Day/Date	Friday, September 9, 2022
Roadway:	US 93	Seg. Length:	1.6 MILES	Time:	24-hours
Study Limits:	Lolo to Missoula	Road Type:	Five-Lane, Two way	Sample Loc	46.779518, -114.091301
City/County:	Missoula	ADT Range:	NB-11600 SB-11600	Weather:	-
RP:	84.0 to 85.6	Truck ADT:	NB-650 SB-570	Observer(s):	KLJ
85th % Speed:	75	10 mph pace	62-72	Machine:	Echo Radar
50th % Speed:	68	% in pace	67%		

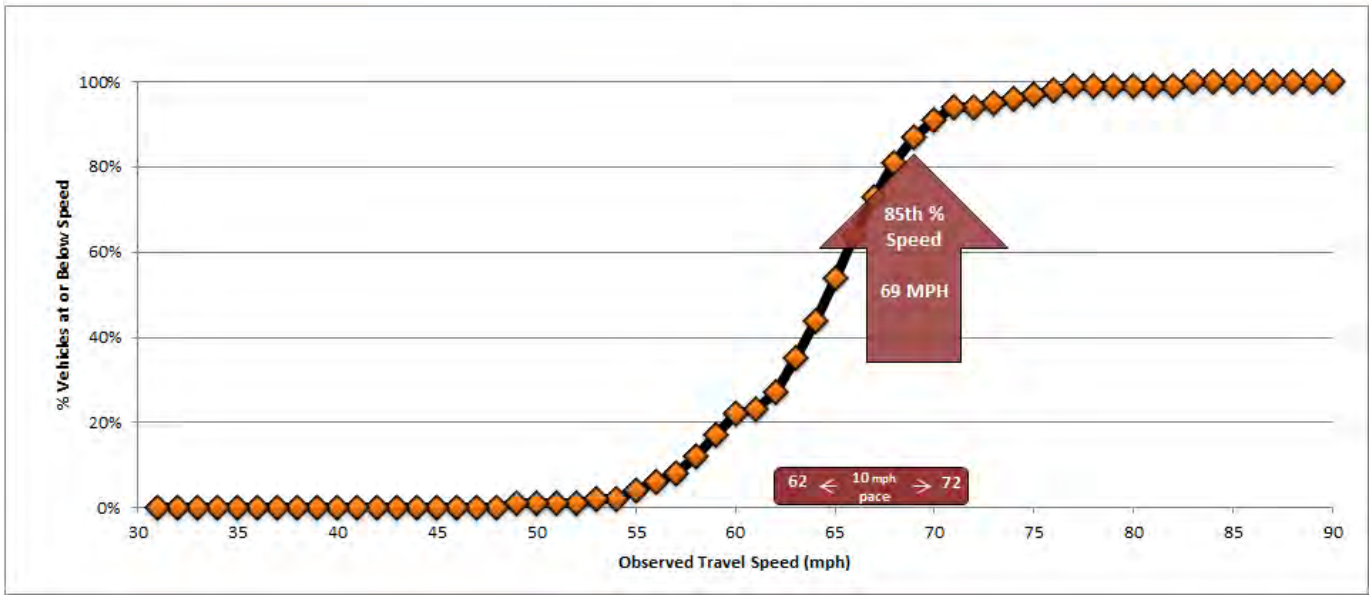




SPEED SAMPLE SUMMARY (TRUCKS)

ID:	A1-Seg-03	Speed Limit	65 MPH	Day/Date	Friday, September 9, 2022
Roadway:	US 93	Seg. Length:	1.6 MILES	Time:	24-hours
Study Limits:	Lolo to Missoula	Road Type:	Five-Lane, Two way	Sample Loc	46.779518, -114.091301
City/County:	Missoula	ADT Range:	NB-11600 SB-11600	Weather:	-
RP:	84.0 to 85.6	Truck ADT:	NB-650 SB-570	Observer(s):	KLJ
85th % Speed:	69	10 mph pace	62-72	Machine:	Echo Radar
50th % Speed:	65	% in pace	70%		





APPENDIX C – NCHRP REPORT

NCHRP 17-76 Speed Limit Setting Tool		
Input Cells	*Description*	*Output Cells*
Site Description Data		
Rural	Roadway context	
Principal arterial	Roadway type	
Yes	Are crash data available?	
Ben F	Analyst	
12/16/2022	Date	
US 93	Roadway name	
A1-Seg-03	Description	
65	Current speed limit (mph)	
	Notes	
Analysis Results		
	Speed limit setting group	Undeveloped
	Suggested speed limit (mph)	**65**
Speed Data		
65	Maximum speed limit (mph)	
75	85th-percentile speed (mph)	
68	50th-percentile speed (mph)	
Site Characteristics		
1.6	Segment length (mi)	
24,762	AADT (two-way total) (veh/d)	
5	Number of lanes (two-way total)	
Undivided	Median type	
10	Number of access points (total of both directions)	
12	Lane width (ft)	
12	Shoulder width (ft)	
No	Adverse alignment present?	
Crash Data		
5	Number of years of crash data	
24,762	Average AADT for crash data period (veh/d)	
22	All (KABCO) crashes for crash data period	
6	Fatal & injury (KABC) crashes for crash data period	
	Average KABCO crash rate (crashes / 100 MVMT)	
	Average KABC crash rate (crashes / 100 MVMT)	
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	161.9
	1.3 x average KABC crash rate (crashes / 100 MVMT)	53.5
	Critical KABCO crash rate (crashes / 100 MVMT)	146.8
	Critical KABC crash rate (crashes / 100 MVMT)	54.2

APPENDIX II – STRAIGHT-LINE DIAGRAMS

Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY

HAMILTON

Location TO MISSOULA

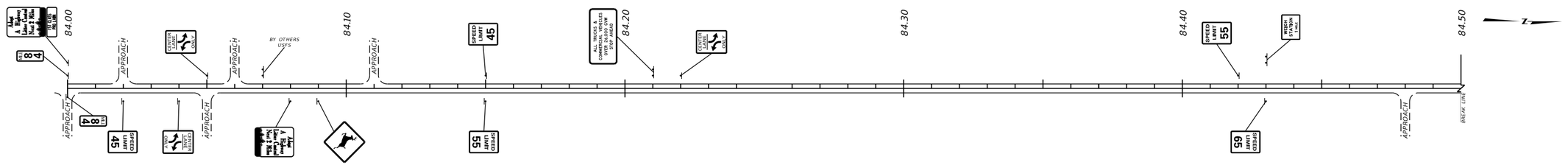
County RAVALLI/MISSOULA

Roadway C000007 (US 93)

RP from 84.00 to 90.00

Scale 1 UNIT = 0.10 MILES

Date MARCH 2023



	TRANSITION-03		TRANSITION-02	
Roadway Width	88-FEET		88-FEET	
Number of Striped Lanes	5		5	
Type of Divider	TWLTL		TWLTL	
Average Daily Traffic	15,900		23,300	
Direction	NB	SB	NB	SB
Number of Vehicles	9,500 VEH	6,400 VEH	11,900 VEH	11,400 VEH
85th Percentile	50 MPH	43 MPH	65 MPH	66 MPH
50th Percentile	44 MPH	34 MPH	59 MPH	62 MPH
10 MPH Pace (% in Pace)	40-50 MPH (59%)	32-42 MPH (44%)	55-65 MPH (64%)	57-67 MPH (68%)
Existing Speed Zone	55 MPH	45 MPH	65 MPH	55 MPH

SPEED PROFILE

LEGEND

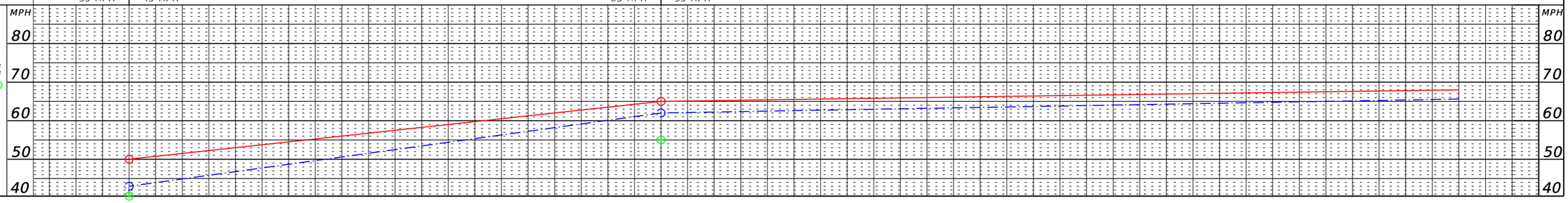
Road Signs

85th Percentile NB SB

Lower Limit of Pace

Remarks:

Sheet 1 of 5



Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY

HAMILTON

Location TO MISSOULA

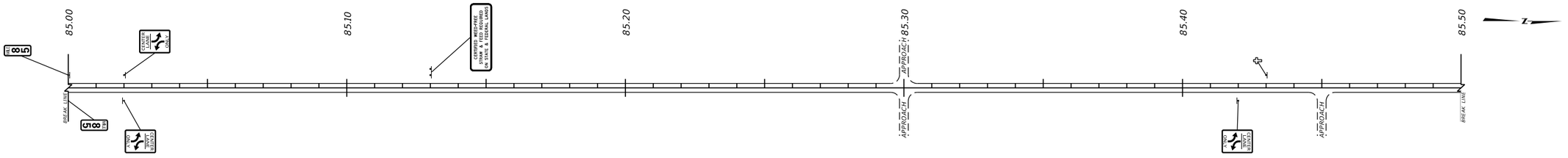
County RAVALLI/MISSOULA

Roadway C000007 (US 93)

RP from 84.00 to 90.00

Scale 1 UNIT = 0.10 MILES

Date MARCH 2023



	SEGMENT-03	
Roadway Width	88-FEET	
Number of Striped Lanes	5	
Type of Divider	TWLTL	
Average Daily Traffic	23,200	
Direction	NB	SB
Number of Vehicles	11,600 VEH	11,600 VEH
85th Percentile	75 MPH	74 MPH
50th Percentile	68 MPH	68 MPH
10 MPH Pace (% in Pace)	62-72 MPH (70%)	62-72 MPH (68%)
Existing Speed Zone	65 MPH	65 MPH

SPEED PROFILE

LEGEND

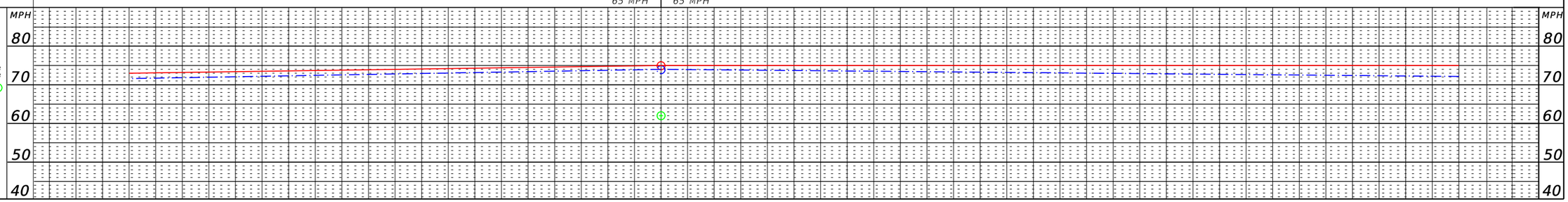
Road Signs

85th Percentile NB SB

Lower Limit of Pace

Remarks:

Sheet 2 of 5



Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY

HAMILTON

Location TO MISSOULA

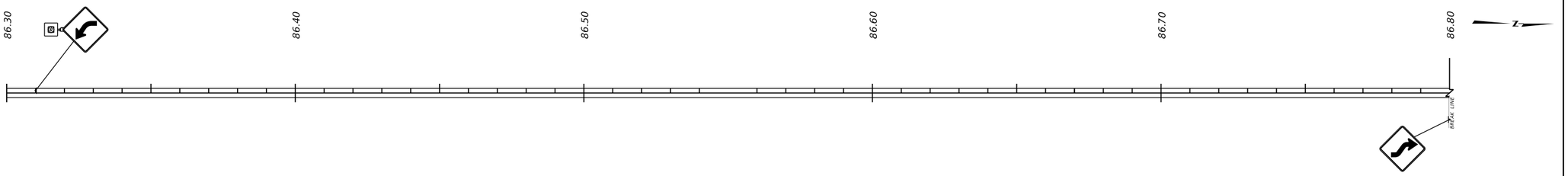
County RAVALLI/MISSOULA

Roadway C000007 (US 93)

RP from 84.00 to 90.00

Scale 1 UNIT = 0.10 MILES

Date MARCH 2023



SEGMENT-02

Roadway Width	66-FEET	
Number of Striped Lanes	4	
Type of Divider	DIVIDED	
Average Daily Traffic	23,400	
Direction	NB	SB
Number of Vehicles	11,750 VEH	11,650 VEH
85th Percentile	75 MPH	66 MPH
50th Percentile	68 MPH	61 MPH
10 MPH Pace (% in Pace)	62-72 MPH (69%)	56-67 MPH (70%)
Existing Speed Zone	65 MPH	65 MPH

SPEED PROFILE

LEGEND

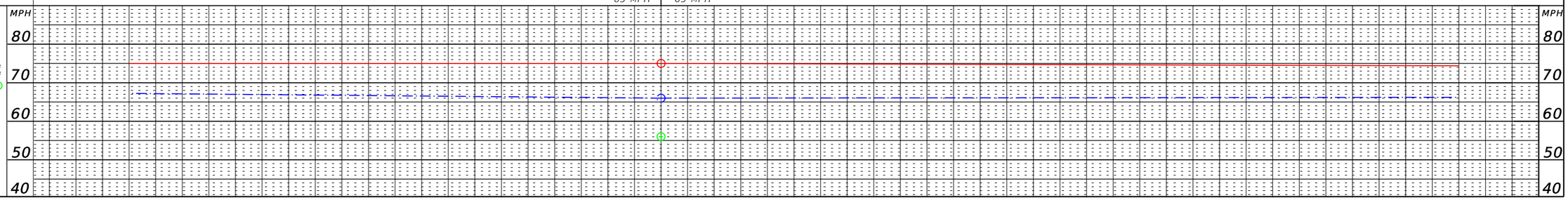
Road Signs

85th Percentile NB SB

Lower Limit of Pace

Remarks:

Sheet 3 of 5



Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY

HAMILTON

Location TO MISSOULA

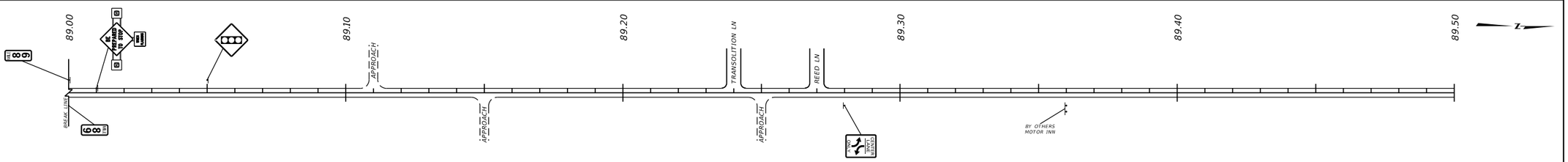
County RAVALLI/MISSOULA

Roadway C000007 (US 93)

RP from 84.00 to 90.00

Scale 1 UNIT = 0.10 MILES

Date MARCH 2023



SEGMENT-01

Roadway Width	88-FEET	
Number of Striped Lanes	5	
Type of Divider	TWLTL	
Average Daily Traffic	23,600	
Direction	NB	SB
Number of Vehicles	11,900 VEH	11,700 VEH
85th Percentile	69 MPH	68 MPH
50th Percentile	65 MPH	64 MPH
10 MPH Pace (% in Pace)	62-72 MPH (62%)	59-69 MPH (59%)
Existing Speed Zone	65 MPH	65 MPH

SPEED PROFILE

LEGEND

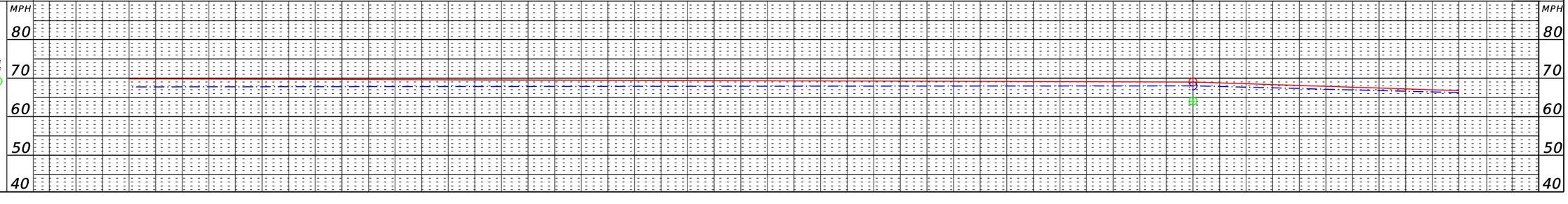
Road Signs

85th Percentile NB SB

Lower Limit of Pace

Remarks:

Sheet 4 of 5



Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY

HAMILTON

Location TO MISSOULA

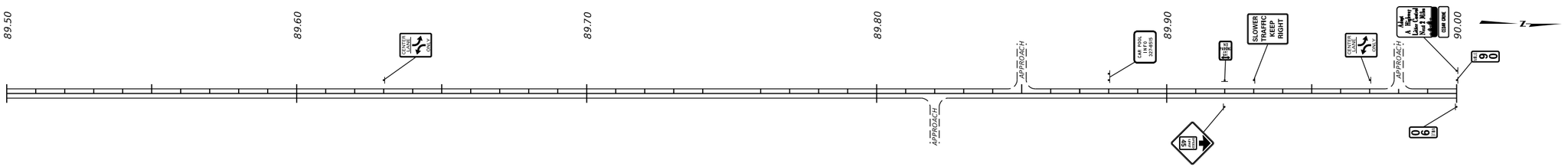
County RAVALLI/MISSOULA

Roadway C000007 (US 93)

RP from 84.00 to 90.00

Scale 1 UNIT = 0.10 MILES

Date MARCH 2023



TRANSITION-01

Roadway Width	88-FEET	
Number of Striped Lanes	5	
Type of Divider	TWLTL	
Average Daily Traffic	29,300	
Direction	NB	SB
Number of Vehicles	14,200 VEH	15,100 VEH
85th Percentile	60 MPH	61 MPH
50th Percentile	53 MPH	56 MPH
10 MPH Pace (% in Pace)	49-59 MPH (58%)	51-61 MPH (67%)
Existing Speed Zone	45 MPH	65 MPH

SPEED PROFILE

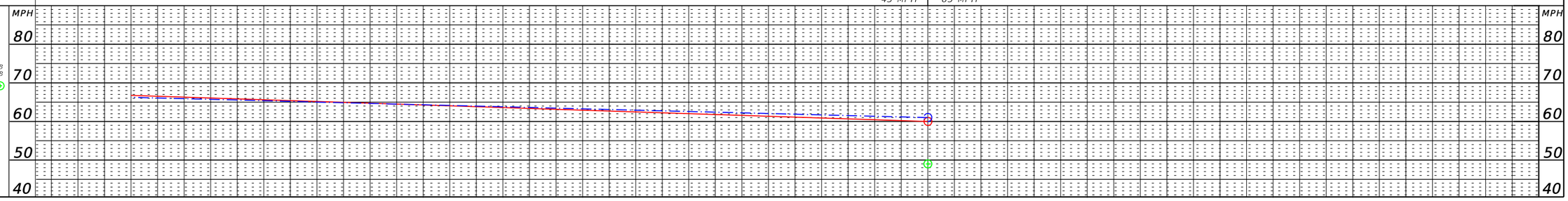
LEGEND

Road Signs

85th Percentile NB SB

Lower Limit of Pace

Remarks:



KLJ

ENGINEERING, REIMAGINED

SPEED STUDY

US Hwy 93 – Florence to Lolo

Ravalli/Missoula County, MT

February 2023

Speed Study

Florence to Lolo, Montana
Ravalli/Missoula County, MT

February 2023

Prepared for:

Montana Department of Transportation

Prepared by:

KLJ Engineering

Table of Contents

1. Introduction 1
2. Methodology 3
3. Roadway Characteristics 3
4. Vehicular Classification 4
5. Safety Characteristics 5
6. Speed Characteristics 7
7. Straight-Line Diagram 10
8. Conclusion 10
9. Recommendations 10

List of Figures

Figure 1 - Study Area 2
Figure 2 - Representative Section of US Hwy 93 from RP 75.4 to 82.7 3
Figure 3 - Five-Year Crash Summary (2016-2020) 5
Figure 4 - Citation Summary by Year 6
Figure 5 - Citation Types Issued (2016 - 2020) 7
Figure 6 - Speed Profile for All Vehicle Types in Both Direction of Travel 8

List of Tables

Table 1 - Speed Transition Zones in the Study Area 1
Table 2 - Vehicular Classification 5
Table 3 - Crash Collision Type 6
Table 4 - Speed Study Profile 8
Table 5 - Speed Study Summary at Speed Transition Zones 9
Table 6 - Speed Differentials at Speed Transition Zones 11

List of Appendices

Appendix I – Pictures I
Appendix II – Speed Study Profiles II
Appendix III - NCHRP Report III
Appendix IV – Straight-Line Diagrams IV

1. Introduction

Speed limits are set to inform motorists of appropriate driving and safe operating speeds under favorable conditions. Speed limits are posted at the statutory speed limit unless a traffic engineering investigation study has been conducted and (where applicable) approved by the Transportation Commission. The *Montana Department of Transportation* (MDT) has requested KLJ Engineering to review the posted speed limit along US Hwy 93 from Florence to Lolo.

Study Area

The study area is US Hwy 93 between Florence and Lolo in both Ravalli and Missoula County, MT. The study area consists of one segment and four transition zones beginning at reference point (RP) 75.4 (intersection with Long Avenue) to RP 82.7 (just south of the intersection with Mormon Creek) (**Figure 1)**. The majority of the 7.3-mile segment is a four-lane undivided roadway, except the northern one-mile of the segment that is four-lanes with a two-way-left-turn-lane (TWLTL) in the center. The statutory speed limit of this segment is 70-mph for regular vehicles and 65-mph for trucks. A weighted average based on MDT's map creates an annual average daily traffic (AADT) of 16,856 that travel along this segment as per 2021 counts reported in MDT's Transportation Data Management System (TDMS).

Speed analysis was conducted for the one segment and the four transition zones. Speed transition zones are sections of roadway where posted speed limit changes from higher to lower limits or vice-versa. Due to the sudden changes in posted speed limits and road environment, drivers usually do not adapt to the posted speed limits and underestimate their traveling speed. There are four locations within the study area where there are speed transitions (**Table 1**).

Table 1 - Speed Transition Zones in the Study Area

	Direction	Transition			
		1	2	3	4
Reference Point	-	82.0	81.9	75.3	75.2
Speed Change (mph)	NB	45	55	70[1]	55
	SB	55	70[1]	55	45

1 – 65-mph for Trucks

Purpose

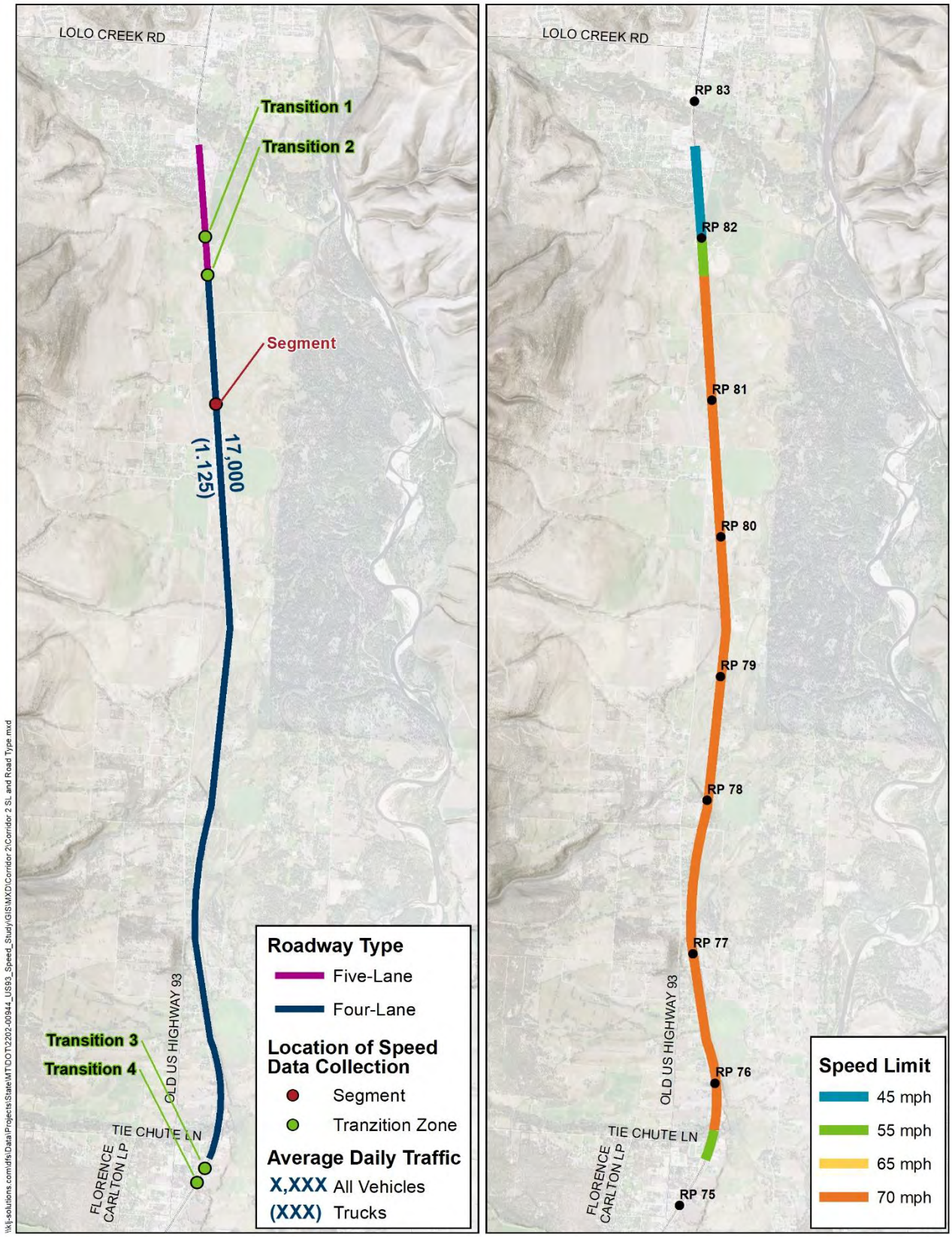
The purpose of this study is to evaluate the appropriate speed of the roadway. The primary tasks for the study included data collection, data analysis, and recommendations for speed limits along the study area. As part of this study, an evaluation and cataloging of existing roadway conditions, collection of historical *Annual Average Daily Traffic* (AADT), and crash data were completed.

Procedures

The steps for setting speed limits include planning, coordination, data collection and analysis, review, and presentation to the stakeholders, and finally, determination or implementation of the speed limits. Quality data and good documentation provides support for the judgments that are made.

Five years of the most recent crash and citation data was also requested and received from the MDT for the analysis.

Figure 1 - Study Area



Source: MDT, ESRI, KLJ, NAIP Aerial from 2019

February 2023

2. Methodology

For determining the appropriate speed limit, the following parameters were reviewed:

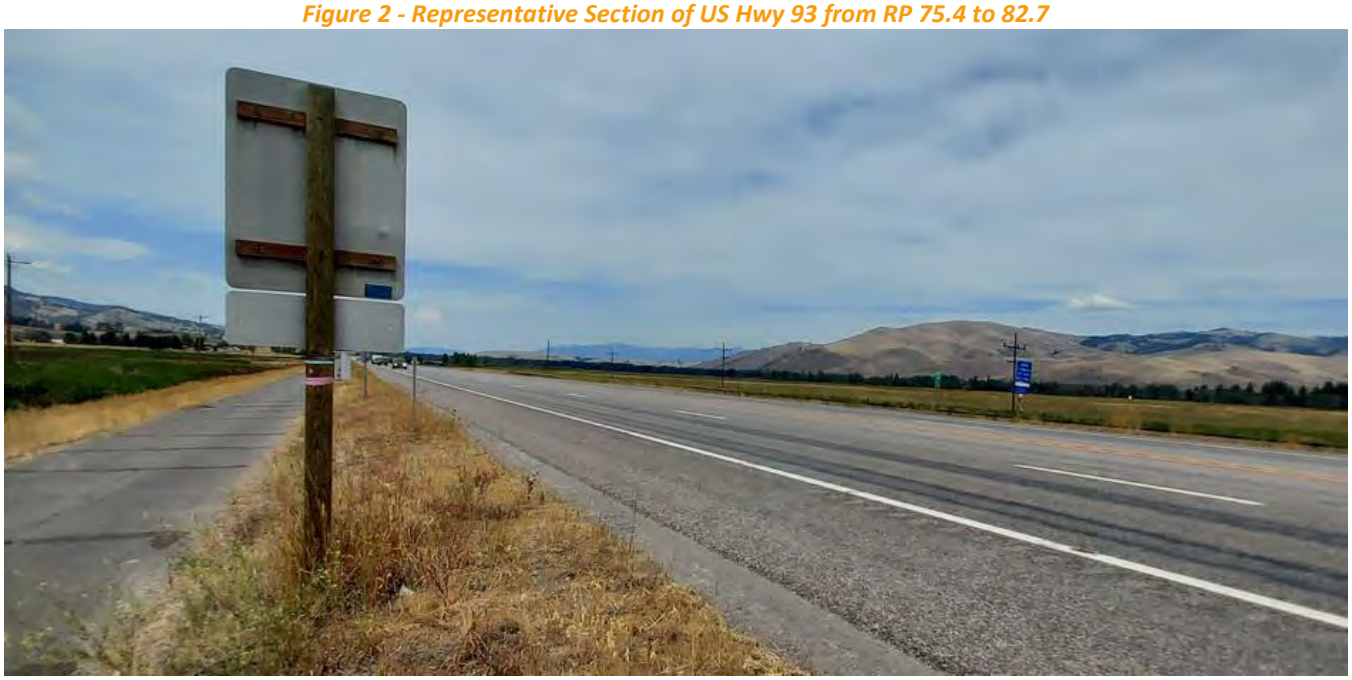
- Roadway Condition/Characteristics
- Crash and Citation History
- Speed Characteristics, and
- Vehicular classes

When considering whether to establish a new posted speed limit or not, surveying and analysis of existing travel speeds is crucial to determining a reasonable posted speed limit. Motorists usually drive at speeds which they perceive as safe, based on the observable roadway conditions. A flat and straight roadway may result in a different travel speed than the posted speed limit due to the driver's observation of the roadway condition.

3. Roadway Characteristics

While speed samples (actual speed measurements of vehicles) are a large part of the necessary data, roadway characteristics should also be considered. Roadway characteristics such as pavement type/conditions, access points, vertical grades, and clear zone assessments data were collected during the field visit in August 2022. **Figure 2** shows the most representative section along the US 93 study segment. Additional pictures of the study segment are available in **Appendix I**.

Figure 2 - Representative Section of US Hwy 93 from RP 75.4 to 82.7



Lanes and Shoulders

The representative typical cross section for this study segment consists mainly of four 11-ft bituminous travelling lanes, and two eight-foot bituminous shoulders. The pavement is generally in good condition. The shoulders are wide enough for safe parking of disabled vehicles. The northern half-mile of the segment has four-lanes with a center TWLTL.

Rumble Strips

There are shoulder rumble strips present throughout the segment. Centerline rumble strips are only present on the four-lane sections of the segment.

Access Points per Mile

An access point refers to public roads, a business driveway, a private driveway, or a farm field access. Fewer access points per mile means drivers are responding to a reduced number and variety of events. The study section has a combined 37 accesses (eight public, 20 private, and nine field access) within the nearly 7.3-mile segment that corresponds to 5.1 access points per mile. The recommended primary full-movement and secondary intersection spacing for a rural principal arterial is one-mile and half-mile, respectively. The recommended and maximum density for driveways per mile for a 70-mph principal arterial roadway is no more than 18.8 based on Stopping Sight Distance chart documented in AASHTO Green Book, 5th Edition.

Vertical Grades

Grade is the rate of change of the vertical alignment. Grade affects vehicle speed and vehicle control, particularly for large trucks. The study segment can be described as generally flat.

Roadside Hazard Assessment

The study area is generally a fill section with a clear zone that is partially obstructed by fixed objects. There is a trail that runs parallel on the west side of the roadway.

In-slope

The in-slope measured at the representative section is generally flat. The in-slope was measured at 6:1 which is considered a recoverable slope. There are driveways along the study segment that have steep slopes because of culverts crossing them. These steep slopes appear to be non-traversable.

Adjacent Development

The study area is mostly rural residential. There is a short section of rural commercial land use in the southern part of the study area.

Statutory and Advisory Speeds

The statutory speed limit is 65-mph for trucks and 70-mph for all other vehicles throughout the segment. There are no advisory speeds along the segment.

Traffic Control

There are no stops on the mainline of the segment of US 93 from Florence to Lolo.

4. Vehicular Classification

Vehicular class data for 24-hour period were collected from September 7th to the 8th, 2022. Vehicle types were categorized to two classifications:

- **Mid-size Vehicles** consisting of motorcycles, passenger vehicles, pickups, vans, buses, conventional vans, and city delivery trucks.
- **Large Vehicles** consisting of single unit four or more axle trucks.

There are 15,840 and 1,120 daily small to mid-size and large vehicles, respectively that travel in the segment. The daily distribution is 51% along northbound and 49% along southbound. The vehicular classifications in the study segment are summarized in **Table 2**.

Table 2 - Vehicular Classification

Classification	Northbound	Southbound	Total	Percent
Small to Mid-Size vehicles	8,130	7,710	15,840	93%
Large vehicles	500	620	1,120	7%
Total (Percent)	**8,630 (51%)**	**8,330 (49%)**	**16,960**	**100%**

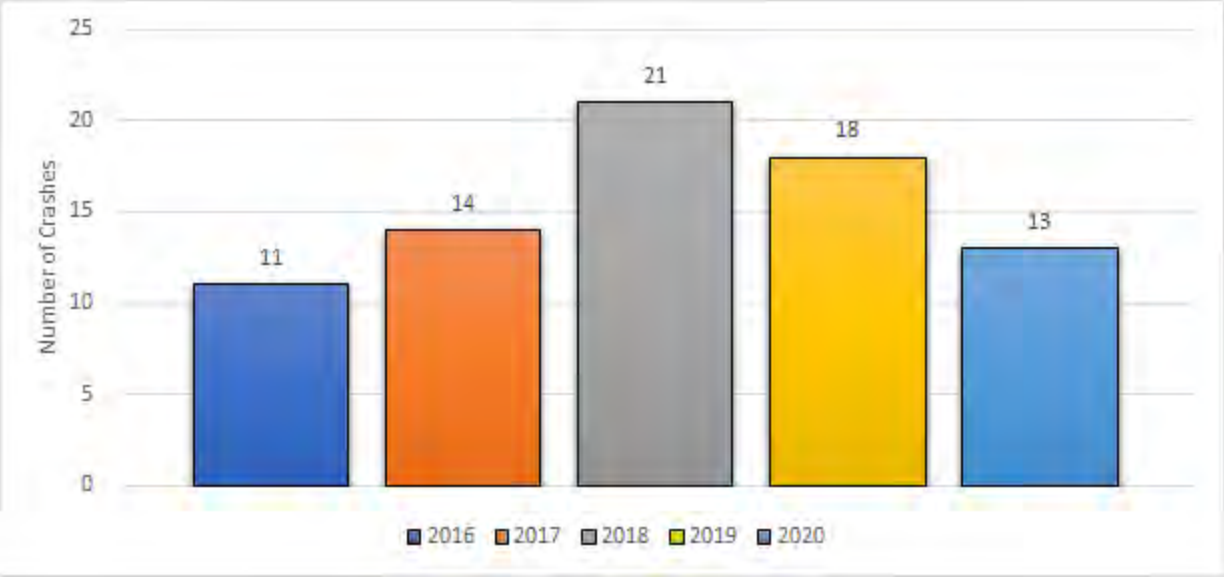
5. Safety Characteristics

Reviewing historic crash and citation information can help identify driver behavior issues that can provide additional information for setting speed the appropriate and safer speed limit.

Crash History

Five years of crash records between January 1, 2016, through December 31, 2020, were requested from the MDT. MDT shared crash records in a spreadsheet format. The five-year crash summary by year is shown in **Figure 3**. There were 77 crashes (no fatal, no serious injury, five minor injury, eight possible injury, 63 property damage only, and one unknown type crashes) reported during the analysis period. This corresponds to 15.4 crashes per year or 2.1 crashes per year per mile.

Figure 3 - Five-Year Crash Summary (2016-2020)



Seventy-five crashes or 97% of all the crashes were non-junction related. Crash summary by crash type is shown in **Table 3**.

Table 3 - Crash Collision Type

Type	# Crashes	% Crashes
Fixed Object	6	8%
Left Turn, Same Direction	1	1%
Lost Control	1	1%
Not Fixed Object Or Debris	2	3%
Other	1	1%
Rear-End	1	1%
Right Angle	1	1%
Roll Over	7	9%
Sideswipe, Opposite Direction	2	3%
Wild Animal	55	71%
Total	**77**	**100%**

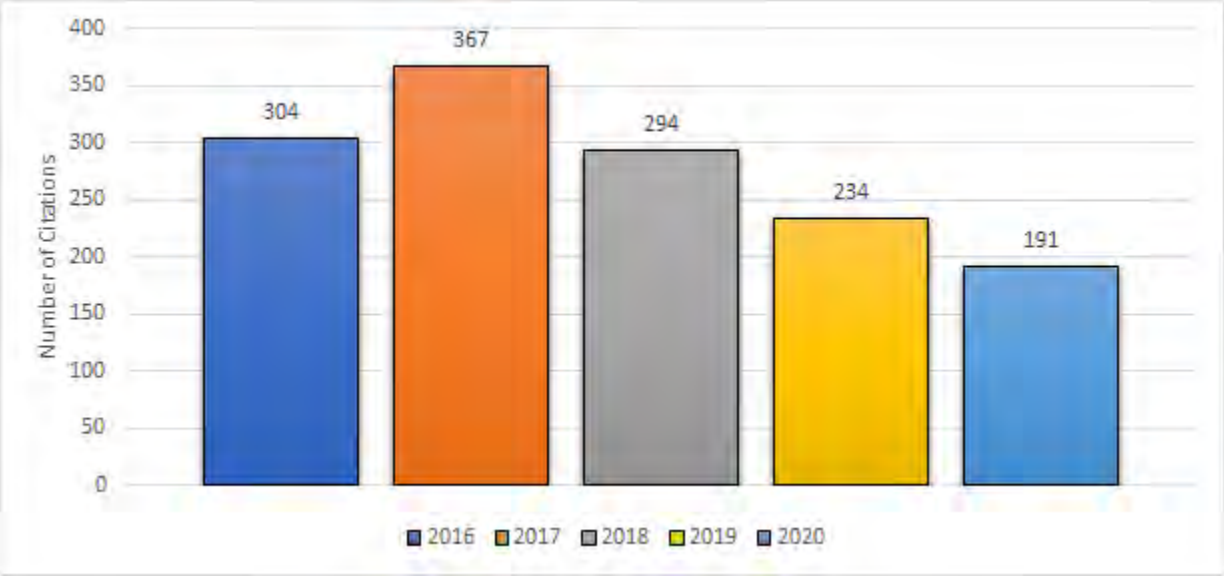
Crashes with wild animals (71%) were the most prominent crash type in the study segment. The crash data had no supplement officer narratives to identify if speeding was the contributing factor for any of these crashes.

Citation History

The speeding law in Montana 1 § 61-8-303 (3) states: "Subject to the maximum speed limits set forth in subsection (above), a person shall operate a vehicle in a careful and prudent manner and at a reduced rate of speed no greater than is reasonable and prudent under the conditions existing at the point of operation, taking into account the amount and character of traffic, visibility, weather, and roadway conditions." It is critical to note that the law enforcement can issue a ticket for driving a vehicle at unsafe speeds, even if a driver is within the posted speed limit. For example, driving at the posted speed limit on the freeway when there is a blizzard or thick fog. Since these driving conditions are unsafe for you and other drivers, law enforcement is within their rights to issue a speeding ticket as per the speeding laws in Montana.

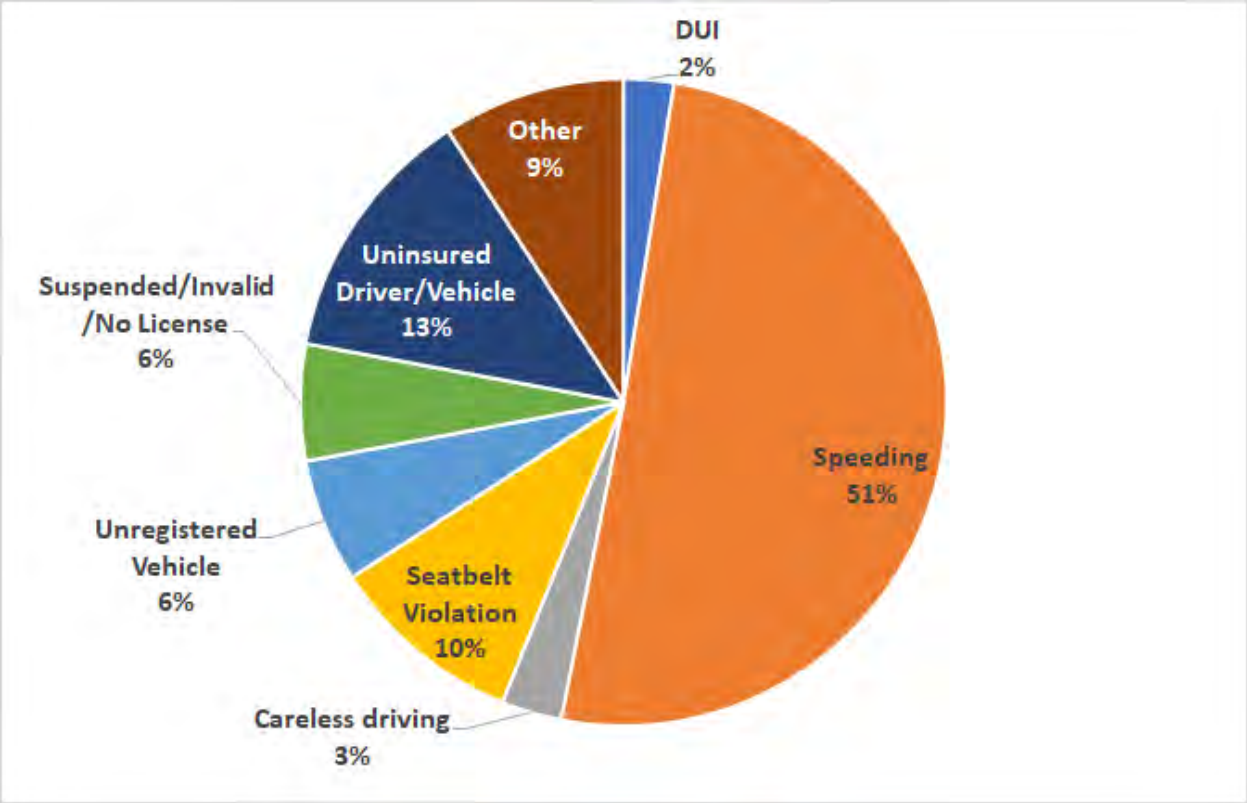
Five years of citation records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. The MDT Traffic & Safety Bureau shared citation records in a spreadsheet format. The five-year citation summary for the segment is shown in **Figure 4**. There were 1,390 citations issued in the study segment during the analysis period of which 703 citations (51%) were speeding violations.

Figure 4 - Citation Summary by Year



The most citations were given in May (12%) and September (12.5%). The types of citation issued in this segment is shown in **Figure 5**. Speeding (51%), and Uninsured driver/vehicle (13%) were the most prominent types of traffic violations in the study area.

Figure 5 - Citation Types Issued (2016 - 2020)



6. Speed Characteristics

Engineering Approach

The engineering approach is a two-step process based on operating conditions such as the 85th percentile speed. The 85th percentile is the speed at which 85% of free-flowing traffic is traveling at or below. Once the speed limit is established based on the 85th percentile speed, it can be adjusted (usually downward) based on other factors such as amount of non-motorized traffic, roadway characteristics, and crash history. MDT's procedures for setting speed limits are based on the engineering approach.

MDT uses 85th percentile, 50th percentile, and pace speeds to evaluate speed data. The pace speed is a 10-mph increment in speeds that encompasses the highest portion of observed speeds.

Spot Speed Data

Spot speed studies typically consist of sample sizes totaling at least 100 vehicles with Free Flow Speed (FFS). FFS is the speed of motorists traveling as desired given prevailing conditions such that no preceding vehicle influences the motorists' speed. Unattended radar devices were placed along the segment and transition zones of the study area to collect vehicular speed samples for a 24-hour period on August 23rd and 24th, 2022**.** The road and shoulder surface were clear of surface water or snow during the period when data were recorded. The 24-hour data consisted of all vehicles that traveled along the study area with various speed profiles including vehicles that

influenced a motorist's choice of speed such as vehicular deceleration to make turns, queuing during peak hour, or a platoon.

Speed Study Results

SEGMENT

The result of the speed profile in the study segment is shown in **Figure 6** and **Table 4**. For details please see **Appendix II**. The 85th percentile speed was found to be 72-mph and the 50th percentile speed was found to be 68-mph. The 10-mph pace was found to be between 64-mph and 74-mph comprising of 70% of daily vehicles within that 10-mph pace. The 85th percentile was greater than the posted speed limit and 50th percentile speeds were below the posted speed limit. The 85th percentile and 50th percentile speeds were within the the 10-mph pace range.

Figure 6 - Speed Profile for All Vehicle Types in Both Direction of Travel

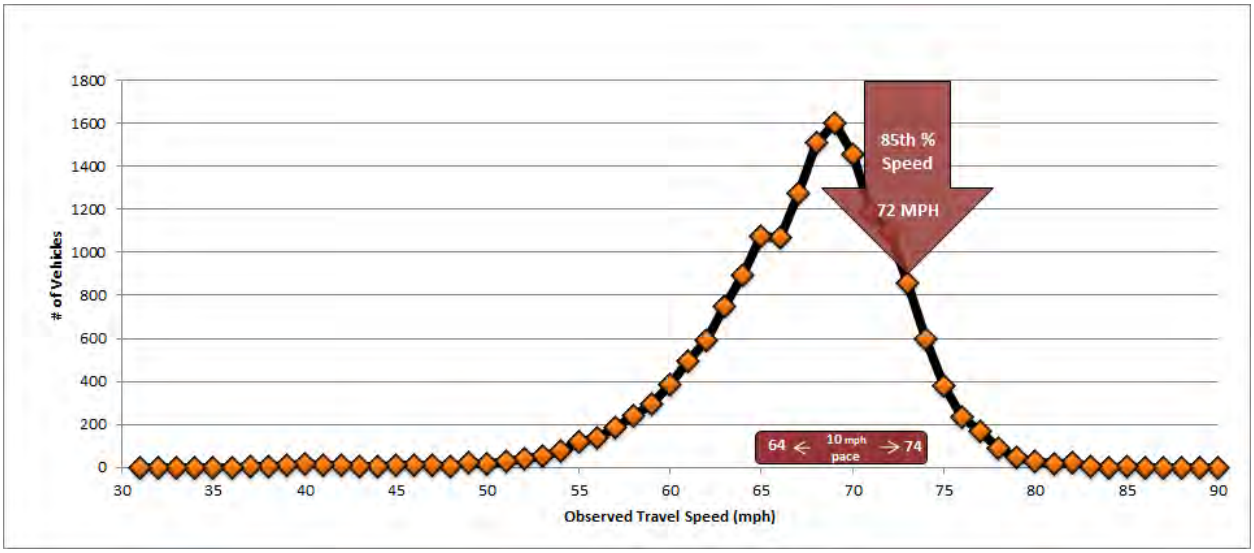


Table 4 - Speed Study Profile

Vehicle Type	Direction	10-mph Pace	% In Pace	85th Percentile Speed	50th Percentile Speed
Small to Mid-size	NB	64-74 mph	72%	72-mph	68-mph
	SB	64-74 mph	70%	73-mph	68-mph
	Both	64-74 mph	71%	73-mph	68-mph
Large	NB	60-70 mph	71%	69-mph	64-mph
	SB	61-71 mph	67%	70-mph	65-mph
	Both	61-71 mph	69%	69-mph	64-mph
All	NB	63-73 mph	71%	72-mph	68-mph
	SB	64-74 mph	70%	73-mph	68-mph
	Both	64-74 mph	70%	72-mph	68-mph

SPEED TRANSITION ZONES

Speed data were collected and analyzed at all four transition locations in the study area. The summary of speed data for the speed transition zones are shown in **Table 5**.

Table 5 - Speed Study Summary at Speed Transition Zones

		Direction	Transition			
			1	2	3	4
Existing	Reference Point	-	82	81.9	75.3	75.2
	Speed Change (mph)	NB	45	55	70[1]	55
		SB	55	70[1]	55	45
Calculated	85th Percentile Speed (mph)	NB	55-mph	73-mph	69-mph	67-mph
		SB	59-mph	74-mph	68-mph	65-mph
		Both	58-mph	74-mph	69-mph	66-mph
	50th Percentile Speed (mph)	NB	49-mph	66-mph	64-mph	61-mph
		SB	54-mph	67-mph	62-mph	58-mph
		Both	51-mph	67-mph	63-mph	60-mph
	10-mph Pace Speed (mph)	NB	43-53 mph	62-72 mph	59-69 mph	56-66 mph
		SB	49-59 mph	62-72 mph	57-67 mph	53-63 mph
		Both	48-58 mph	62-72 mph	59-69 mph	56-66 mph
	% in 10-mph Pace Speed (mph)	NB	72%	63%	66%	62%
		SB	67%	65%	60%	56%
		Both	60%	64%	62%	58%

NB – Northbound; SB – Southbound
1 – 65 mph for Trucks

NCHRP

A recent research report from the *National Cooperative Highway Research Program* (NCHRP) has been completed. NCHRP report 17-76: *Development of a Posted Speed Limit Setting Procedure and Tool* collected insights into how the roadway environment influences operating speed and safety (crashes) through a review of literature and the collection and analysis of data from two states. Using those insights along with an understanding of different methods being used and currently being considered for the setting of posted speed limits, the research team developed a speed limit setting procedure along with a tool. The procedure uses fact-based decision rules that consider both driver speed choice and safety associated with the roadway.

There has been a nationwide push over the last several years for the consideration of 50th percentile speed, especially for developed areas. When the roadway conditions are optimal, the suggested speed limit should reflect the 85th percentile speed. When roadway conditions are not favorable to all users or when crashes are a significant concern, then the suggested speed limit should reflect the rounded down 85th percentile or the 50th percentile speed. Drivers frequently select speeds a certain increment above the posted speed limit, anticipating that they will not receive a ticket if they are below the assumed enforcement speed tolerance. Because of these reasons, 50th percentile speed data were also used in the analysis along with the 85th percentile speed data.

The NCHRP 17-76 Speed Limit Setting Tool was used to calculate the recommended speed limit for the study segment based on key factors such as: 85th percentile and 50th percentile speed, roadway characteristics, and crash history. The recommended speed for the study segment based on NCHRP 17-76 was found to be 70-mph along in this segment. Details of the NCHRP 17-76 report is available in **Appendix III**.

7. Straight-Line Diagram

Straight-line diagrams are linear graphical representations of features and characteristics along roadways on and some off the State Highway System and nearby surrounding area. These diagrams are prepared to support efforts in preparing for field surveys, planning construction projects, verifying Roadway Characteristics Inventory (RCI) data, and other related applications. The straight-line diagrams for the study area with the speed characteristics at the locations where data has been collected and analyzed are included in **Appendix IV**.

8. Conclusion

Vehicular Classification

There are 15,840 and 1,120 daily small to mid-size and large vehicles, respectively that travel in the segment. The daily distribution is 51% along northbound and 49% along southbound.

Safety Characteristics

There were 77 crashes (no fatal, no serious injury, five minor injury, eight possible injury, 63 property damage only, and one unknown type crashes) reported during the analysis period. Crashes with wild animals (71%) were the most prominent crash type in the study segment

There were 1,390 citations issued in the study segment during the analysis period of which 703 citations (51%) were speeding violations.

Roadway Characteristics

The segment, RP 75.4 to RP 82.7, being reviewed has a statutory 65-mph speed limit for trucks and 70-mph for regular vehicles. The majority of the 7.3-mile segment is a paved four-lane undivided roadway, except the northern one-mile of the segment that is four-lanes with a center TWLTL. The segment consists of fill sections with some fixed objects within the clear zone. There are shoulder rumble strips present throughout the segment. Centerline rumble strips are only present on the four-lane section of the segment. The shoulders are wide on both sides of the roadway for safe parking of disabled vehicles. The vertical grades and in-slopes are generally flat in the segment. The road conditions are generally in good condition. The study area is mostly rural residential. There is a short section of rural commercial land use in the southern part of the study area. The driveway density in the study segment is less than the maximum number of driveway thresholds for similar type of facility.

Speed Characteristics

The 85th percentile speed was found to be 72-mph and the 50th percentile speed was found to be 68-mph. The 10-mph pace was found to be between 64-mph and 74-mph comprising of 70% of daily vehicles within that 10-mph pace.

9. Recommendations

Segment

The recommended speed for the study segment based on NCHRP 17-76 was found to be 70-mph along in this segment. The 85th percentile speed, higher percentage of speeding violations, and NCHRP recommended speed is indicative that the existing posted speed limit of 70-mph in this segment is appropriate for this segment.

Speed Transition Zones

The speed differentials between the posted speed limit and 85th percentile speed limit is summarized in **Table 6**. The minimum recommended spacing for a speed transition over 45-mph posted speed is 0.5-mile. The spacing between the speed transitions in this segment of US 93 between Florence and Lolo were all less than the minimum recommended spacings. It is recommended that the speed transition spacings be adjusted to the current MDT practice procedures.

Table 6 - Speed Differentials at Speed Transition Zones

	Direction	Transition			
		1	2	3	4
Reference Point	-	82.0	81.9	75.3	75.2
85th %-ile Speed (mph)	NB	55	73	69	67
	SB	59	74	68	65
Speed Limit Change (mph)	NB	45	55	70	55
	SB	55	70	55	45
Δ in Speed (mph)	NB	+10	+18	-1	+12
	SB	+4	+4	+13	+20

TRANSITION 1

- Northbound - The 85th percentile speed is 10-mph greater than the posted speed limit of 45-mph. Vehicles travelling northbound are entering the town of Lolo from another speed transition of 70-mph to 55-mph. The existing speed limit while entering Lolo may be appropriate. No change in speed limit is recommended for traffic travelling in the northbound direction in this transition zone. However, a traffic calming device may be helpful to lower the travelling speed for traffic travelling northbound in this transition zone.
- Southbound - The speed differentials between the posted speed limit and 85th percentile speed is four-mph greater than the posted speed limit of 55-mph. The vehicles are entering rural high-speed roadway after leaving Lolo. The posted speed limit is appropriate. No change in speed limit is recommended for traffic traveling in the southbound direction in this transition zone.

TRANSITION 2

- Northbound - The 85th percentile speed is 18-mph greater than the posted speed limit of 55-mph. Vehicles travelling northbound are close to entering Lolo. The existing posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the northbound direction in this transition zone.
- Southbound - The 85th percentile speed is four-mph greater than the posted speed limit of 70-mph. Vehicles travelling southbound are transitioning from 55-mph to 70-mph. The posted speed limit is appropriate. No change in speed limit is recommended for traffic traveling in the southbound direction in this transition zone.

TRANSITION 3

- Northbound - The 85th percentile speed is one-mph less than the posted speed limit of 70-mph. Vehicles travelling northbound are entering rural high-speed roadway after leaving Florence. The existing posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the northbound direction in this transition zone.
- Southbound - The 85th percentile speed is 13-mph greater than the posted speed limit of 55-mph. Vehicles travelling southbound are transitioning from 70-mph to 55-mph. The posted speed limit is appropriate. No change in speed limit is recommended for traffic traveling in the southbound direction in this transition zone.

TRANSITION 4

- Northbound - The 85th percentile speed is 12-mph greater than the posted speed limit of 55-mph which is indicative that the vehicles are entering rural high-speed roadway after leaving Florence. The posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the northbound direction in this transition zone.
- Southbound - The 85th percentile speed is 20-mph greater than the posted speed limit of 45-mph. Vehicles travelling southbound are entering the town of Florence. The existing speed limit while entering Florence is appropriate. No change in speed limit is recommended for traffic travelling in the southbound direction in this transition zone. However, a traffic calming device may be helpful to lower the travelling speed for traffic travelling southbound in this transition zone.

APPENDIX I – PICTURES


Adopt
A Highway
Litter Control
Next 2 Miles

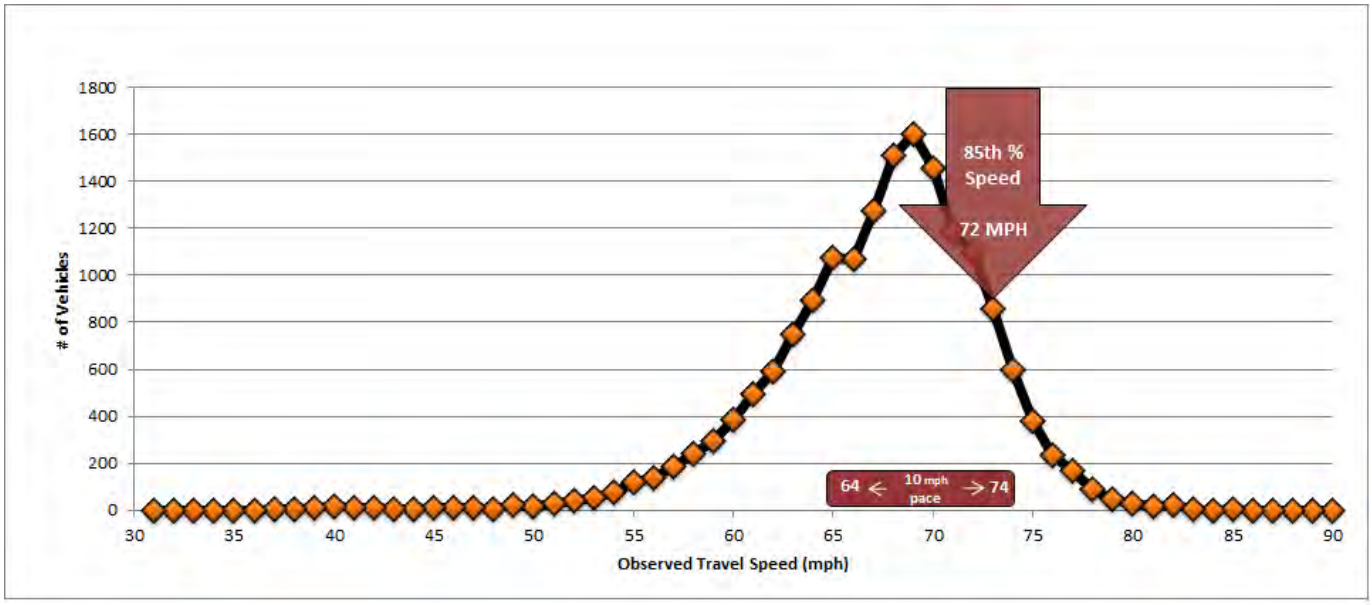

Adopt
A Highway
Litter Control
Next 2 Miles

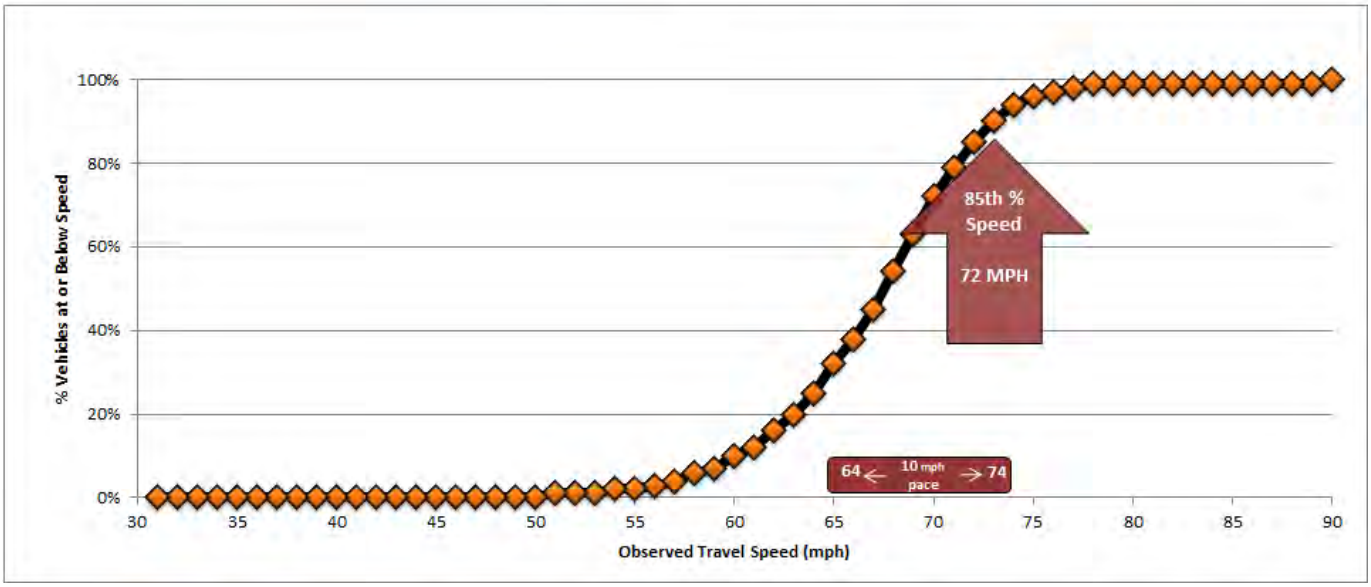

Adopt
A Highway
Litter Control
Next 2 Miles

APPENDIX II – SPEED STUDY PROFILES

SPEED SAMPLE SUMMARY (ALL VEHICLES)

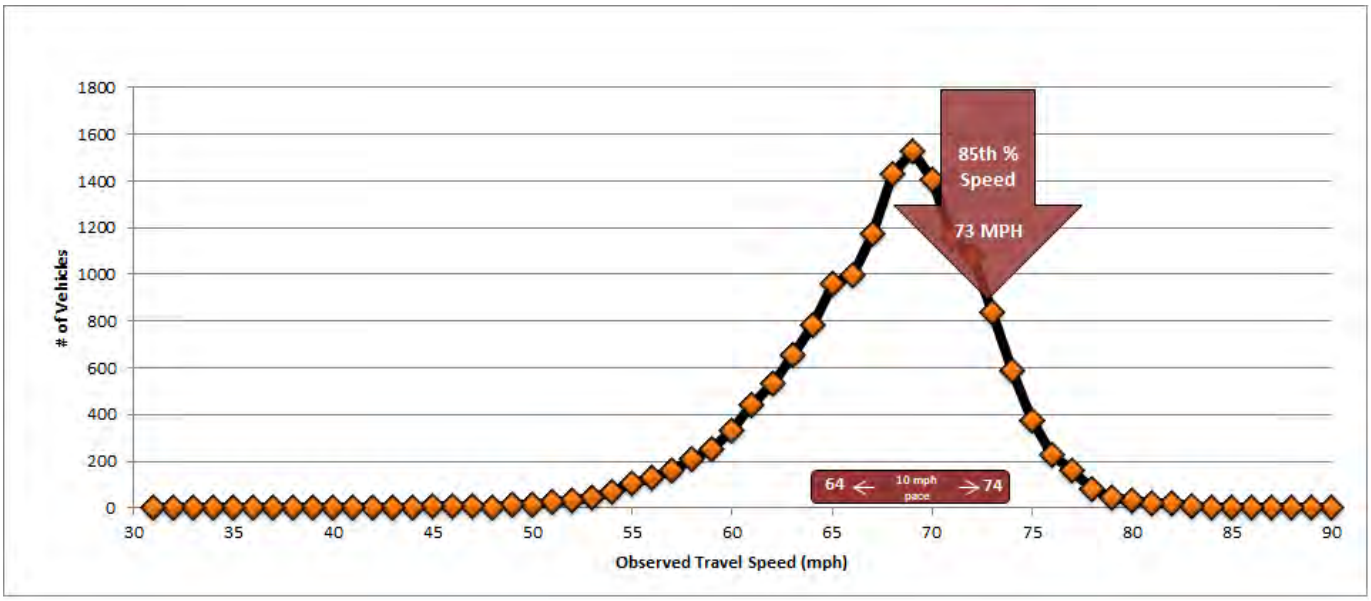
ID:	A2-Seg-01	Speed Limit	70 MPH	Day/Date	Tuesday, August 23, 2022
Roadway:	US 93	Seg. Length:	7.3 MILES	Time:	24-hours
Study Limits:	Florence to Lolo	Road Type:	Four-Lane, Two way	Sample Loc	46.719591, -114.077498
City/County:	Missoula	ADT Range:	NB-6300 SB-7300	Weather:	-
RP:	75.4 to 82.7	Truck ADT:	NB-520 SB-430	Observer(s):	KLJ
85th % Speed:	72	10 mph pace	64-74	Machine:	Houston Radar
50th % Speed:	68	% in pace	70%		

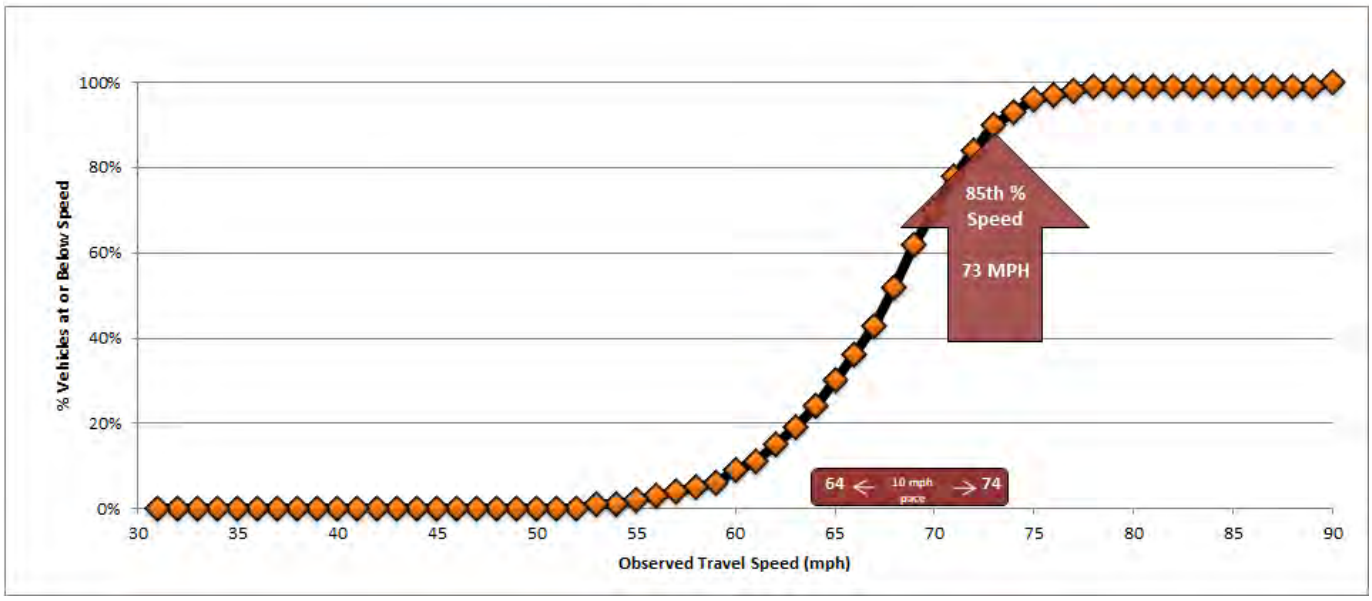




SPEED SAMPLE SUMMARY (PASSENGER VEHICLES)

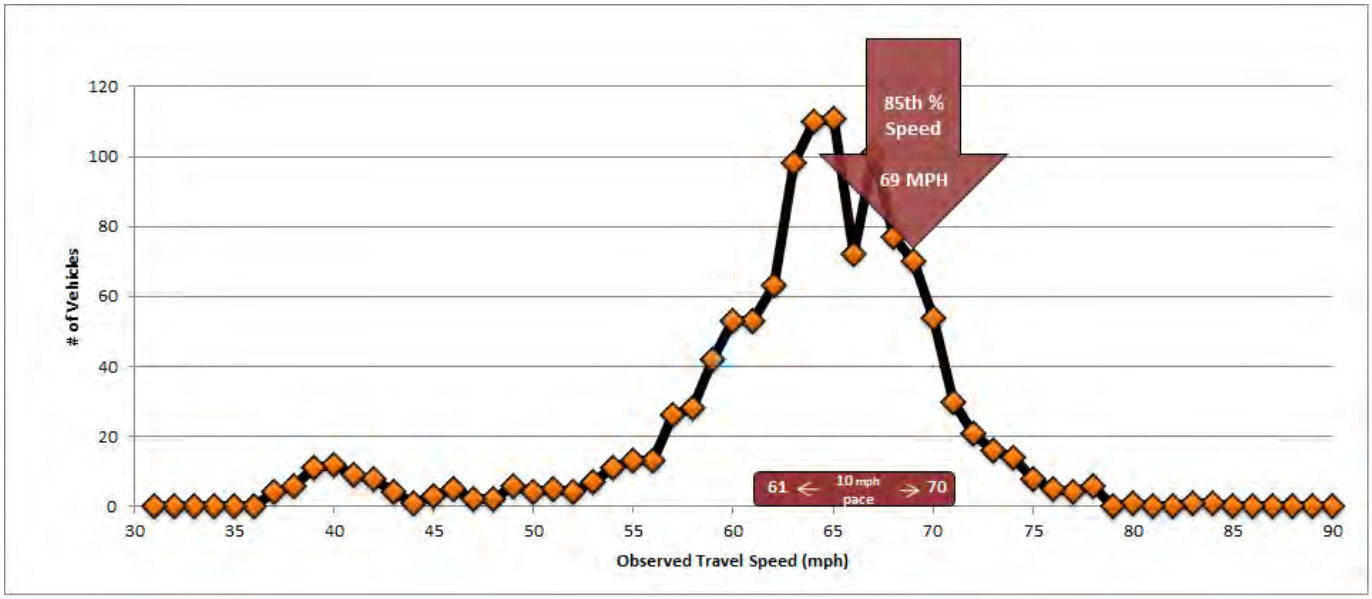
ID:	A2-Seg-01	Speed Limit	70 MPH	Day/Date	Tuesday, August 23, 2022
Roadway:	US 93	Seg. Length:	7.3 MILES	Time:	24-hours
Study Limits:	Florence to Lolo	Road Type:	Four-Lane, Two way	Sample Loc	46.719591, -114.077498
City/County:	Missoula	ADT Range:	NB-6300 SB-7300	Weather:	-
RP:	75.4 to 82.7	Truck ADT:	NB-520 SB-430	Observer(s):	KLJ
85th % Speed:	73	10 mph pace	64-74	Machine:	Houston Radar
50th % Speed:	68	% in pace	71%		

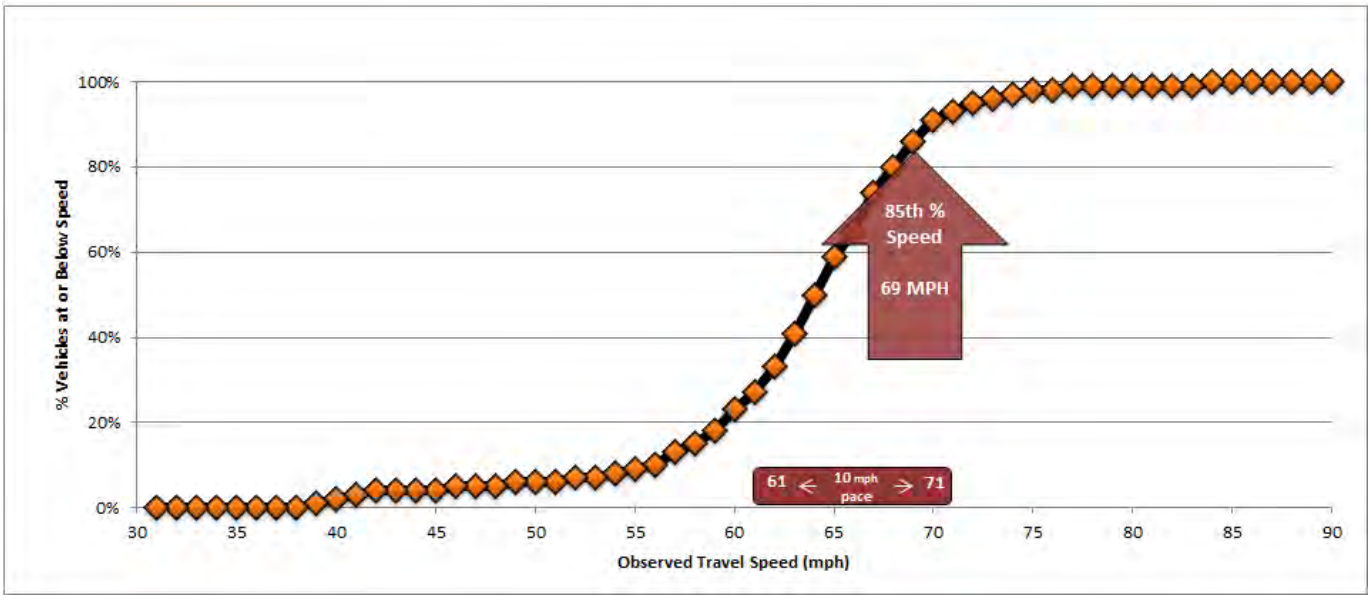




SPEED SAMPLE SUMMARY (TRUCKS)

ID:	A2-Seg-01	Speed Limit	70 MPH	Day/Date	Tuesday, August 23, 2022
Roadway:	US 93	Seg. Length:	7.3 MILES	Time:	24-hours
Study Limits:	Florence to Lolo	Road Type:	Four-Lane, Two way	Sample Loc	46.719591, -114.077498
City/County:	Missoula	ADT Range:	NB-6300 SB-7300	Weather:	-
RP:	75.4 to 82.7	Truck ADT:	NB-520 SB-430	Observer(s):	KLJ
85th % Speed:	69	10 mph pace	61-71	Machine:	Houston Radar
50th % Speed:	64	% in pace	69%		





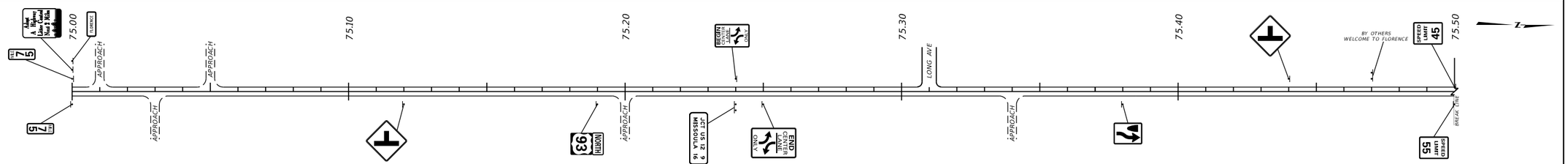
APPENDIX III - NCHRP REPORT

NCHRP 17-76 Speed Limit Setting Tool		
Input Cells	*Description*	*Output Cells*
Site Description Data		
Rural	Roadway context	
Principal arterial	Roadway type	
Yes	Are crash data available?	
Ben F	Analyst	
12/5/2022	Date	
US 93	Roadway name	
A2-Seg-01	Description	
70	Current speed limit (mph)	
	Notes	
Analysis Results		
	Speed limit setting group	Undeveloped
	Suggested speed limit (mph)	**70**
Speed Data		
70	Maximum speed limit (mph)	
72	85th-percentile speed (mph)	
68	50th-percentile speed (mph)	
Site Characteristics		
7.3	Segment length (mi)	
16,900	AADT (two-way total) (veh/d)	
4	Number of lanes (two-way total)	
Undivided	Median type	
37	Number of access points (total of both directions)	
11	Lane width (ft)	
8	Shoulder width (ft)	
	Adverse alignment present?	
Crash Data		
5	Number of years of crash data	
16,900	Average AADT for crash data period (veh/d)	
77	All (KABCO) crashes for crash data period	
13	Fatal & injury (KABC) crashes for crash data period	
	Average KABCO crash rate (crashes / 100 MVMT)	
	Average KABC crash rate (crashes / 100 MVMT)	
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	161.9
	1.3 x average KABC crash rate (crashes / 100 MVMT)	53.5
	Critical KABCO crash rate (crashes / 100 MVMT)	137.0
	Critical KABC crash rate (crashes / 100 MVMT)	48.4

APPENDIX IV – STRAIGHT-LINE DIAGRAMS

Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY
HAMILTON
Location TO MISSOULA
County RAVALLI/MISSOULA
Roadway C000007 (US 93)
RP from 75.20 to 82.70
Scale 1 UNIT = 0.10 MILES
Date FEBRUARY 2023



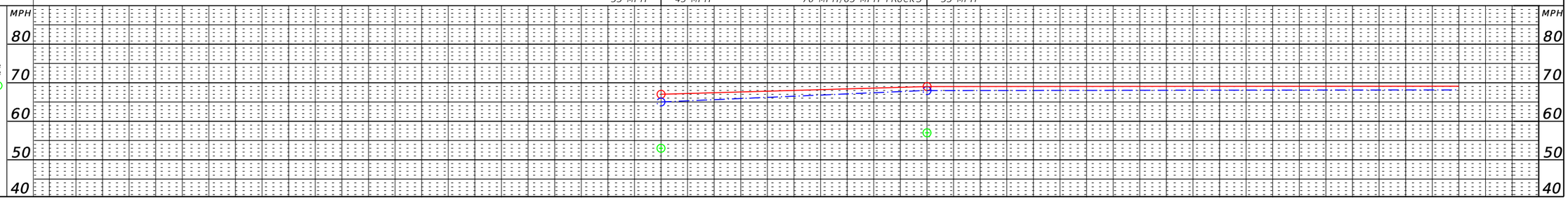
	TRANSITION-04		TRANSITION-03	
Roadway Width	82-FEET		82-FEET	
Number of Striped Lanes	5		5	
Type of Divider	TWLTL		TWLTL	
Average Daily Traffic	17,700		15,600	
Direction	NB	SB	NB	SB
Number of Vehicles	9,500 VEH	8,200 VEH	7,900 VEH	7,700 VEH
85th Percentile	67 MPH	65 MPH	69 MPH	68 MPH
50th Percentile	61 MPH	58 MPH	64 MPH	62 MPH
10 MPH Pace (% in Pace)	56-66 MPH (62%)	53-63 MPH (56%)	59-69 MPH (66%)	57-67 MPH (60%)
Existing Speed Zone	55 MPH	45 MPH	70 MPH/65 MPH TRUCKS	55 MPH

SPEED PROFILE

LEGEND
Road Signs
85th Percentile NB SB
Lower Limit of Pace

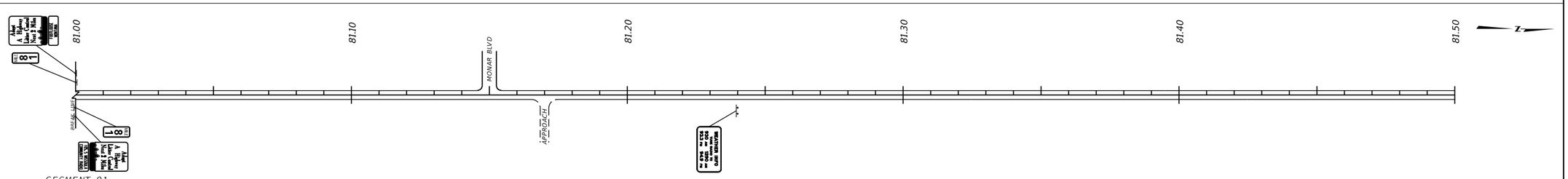
Remarks:

Sheet 1 of 3



Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY
HAMILTON
Location TO MISSOULA
County RAVALLI/MISSOULA
Roadway C000007 (US 93)
RP from 75.20 to 82.70
Scale 1 UNIT = 0.10 MILES
Date FEBRUARY 2023



SEGMENT-01

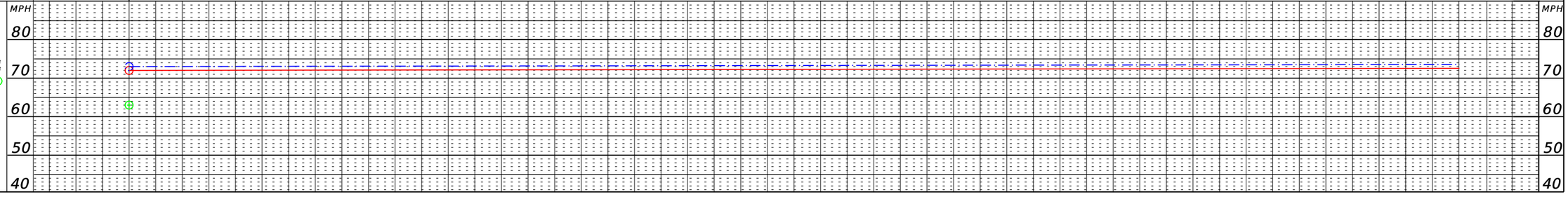
Roadway Width	69-FEET
Number of Striped Lanes	4
Type of Divider	UNDIVEDED
Average Daily Traffic	16,960
Direction	NB / SB
Number of Vehicles	8,630 VEH / 8,330 VEH
85th Percentile	72 MPH / 73 MPH
50th Percentile	68 MPH / 68 MPH
10 MPH Pace (% in Pace)	63-73 MPH (71%) / 64-74 MPH (70%)
Existing Speed Zone	70 MPH/65 MPH TRUCKS / 70 MPH/65 MPH TRUCKS

SPEED PROFILE

LEGEND
Road Signs
85th Percentile NB SB
Lower Limit of Pace

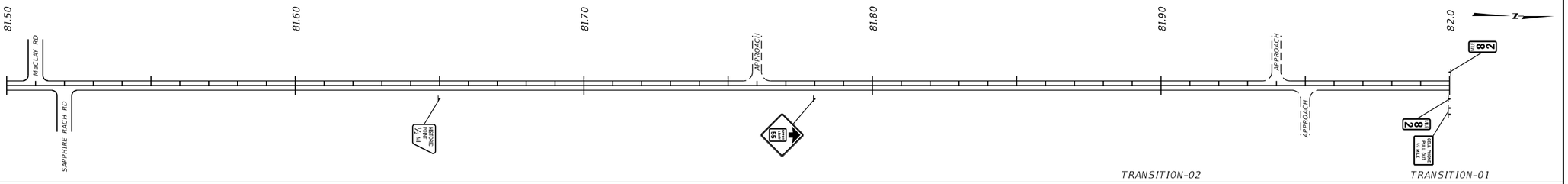
Remarks:

Sheet 2 of 3



Construction Project Number	N/A			
Curves/Grades				

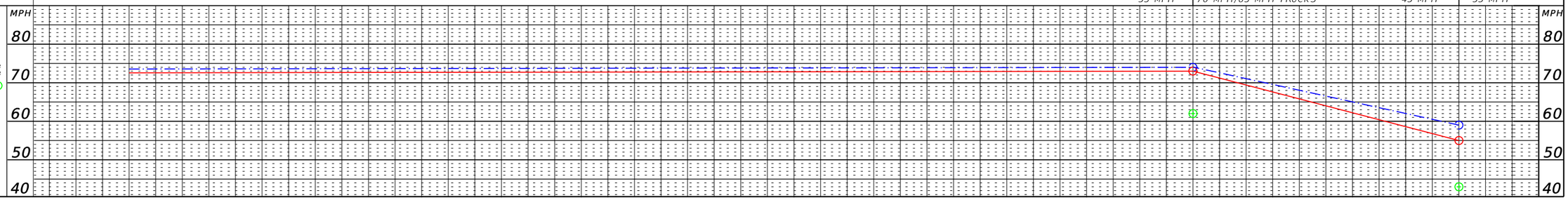
SPEED ZONE SURVEY
HAMILTON
Location TO MISSOULA
County RAVALLI/MISSOULA
Roadway C000007 (US 93)
RP from 75.20 to 82.70
Scale 1 UNIT = 0.10 MILES
Date FEBRUARY 2023



	TRANSITION-02		TRANSITION-01	
Roadway Width	65-FEET		65-FEET	
Number of Striped Lanes	4		4	
Type of Divider	UNDIVIDED		UNDIVIDED	
Average Daily Traffic	17,500		17,000	
Direction	NB	SB	NB	SB
Number of Vehicles	8,500 VEH	9,000 VEH	8,600 VEH	8,400 VEH
85th Percentile	73 MPH	74 MPH	55 MPH	59 MPH
50th Percentile	66 MPH	67 MPH	49 MPH	54 MPH
10 MPH Pace (% in Pace)	62-72 MPH (63%)	62-72 MPH (65%)	43-53 MPH (72%)	49-59 MPH (67%)
Existing Speed Zone	55 MPH	70 MPH/65 MPH TRUCKS	45 MPH	55 MPH

SPEED PROFILE

LEGEND
Road Signs
85th Percentile NB SB
Lower Limit of Pace



Remarks:

ENGINEERING, REIMAGINED

SPEED STUDY

US Hwy 93 – Stevensville to Florence

Ravalli County, MT

February 2023

Speed Study

Stevensville to Florence, Montana

Ravalli County, MT

February 2023

Prepared for:

Montana Department of Transportation

Prepared by:

KLJ Engineering

Table of Contents

1. Introduction 1
2. Methodology 3
3. Roadway Characteristics 3
4. Vehicular Classification 4
5. Safety Characteristics 5
6. Speed Characteristics 8
7. Straight-Line Diagram 10
8. Conclusion 10
9. Recommendations 11

List of Figures

Figure 1 - Study Area 2
Figure 2 - Representative Section of US Hwy 93 from RP 67.8 to 74.0 3
Figure 3 - Five-Year Crash Summary (2016-2020) 5
Figure 4 - Citation Summary by Year 7
Figure 5 - Citation Types Issued (2016 - 2020) 7
Figure 6 - Speed Profile for All Vehicle Types in Both Direction of Travel 8

List of Tables

Table 1 - Speed Transition Zones in the Study Area 1
Table 2 - Vehicular Classification 5
Table 3 - Crash Collision Type 6
Table 4 - Speed Study Profile 9
Table 5 - Speed Study Summary at Speed Transition Zones 9
Table 6 - Speed Differentials at Speed Transition Zones 11

List of Appendices

Appendix I - Pictures I
Appendix II – Speed Study Profiles II
Appendix III - NCHRP Report III
Appendix IV – Straight-Line Diagrams IV

1. Introduction

Speed limits are set to inform motorists of appropriate driving and safe operating speeds under favorable conditions. Speed limits are posted at the statutory speed limit unless a traffic engineering investigation study has been conducted and (where applicable) approved by the Transportation Commission. The *Montana Department of Transportation* (MDT) has requested KLJ Engineering to review the posted speed limit along US Hwy 93 from Stevensville to Florence.

Study Area

The study area is US Hwy 93 between Stevensville and Florence in Ravalli County, MT that consists of one segment and three transition zones that begins from reference point (RP) 67.8 to RP 74.0 between the intersections of N. Kootenai Creek Road and White Cloud Drive (**Figure 1)**. The majority of the 6.2-mile segment is a four-lane undivided roadway, except the northern one-half mile of the segment that is four-lanes with a two-way-left-turn-lane (TWLTL) in the center. The statutory speed limit of this segment is 70-mph for regular vehicles and 65-mph for trucks. The AADT in the study area is 12,156 to the south and 11,875 to the north of Larry Creek Loop based on the 2021 counts reported by the MDT.

Speed analysis was conducted for the one segment and the three transition zones. Speed transition zones are sections of roadway where posted speed limit changes from higher to lower limits or vice-versa. Due to the sudden changes in posted speed limits and road environment, drivers usually do not adapt to the posted speed limits and underestimate their traveling speed. There are three locations within the study area where there are speed transitions (**Table 1**).

Table 1 - Speed Transition Zones in the Study Area

	Direction	Transitions		
		1	2	3
Reference Point	-	74.0	73.6	67.8
Speed Change (mph)	NB	45	55	70[1]
	SB	55	70[1]	55

1 – 65-mph for Trucks

Purpose

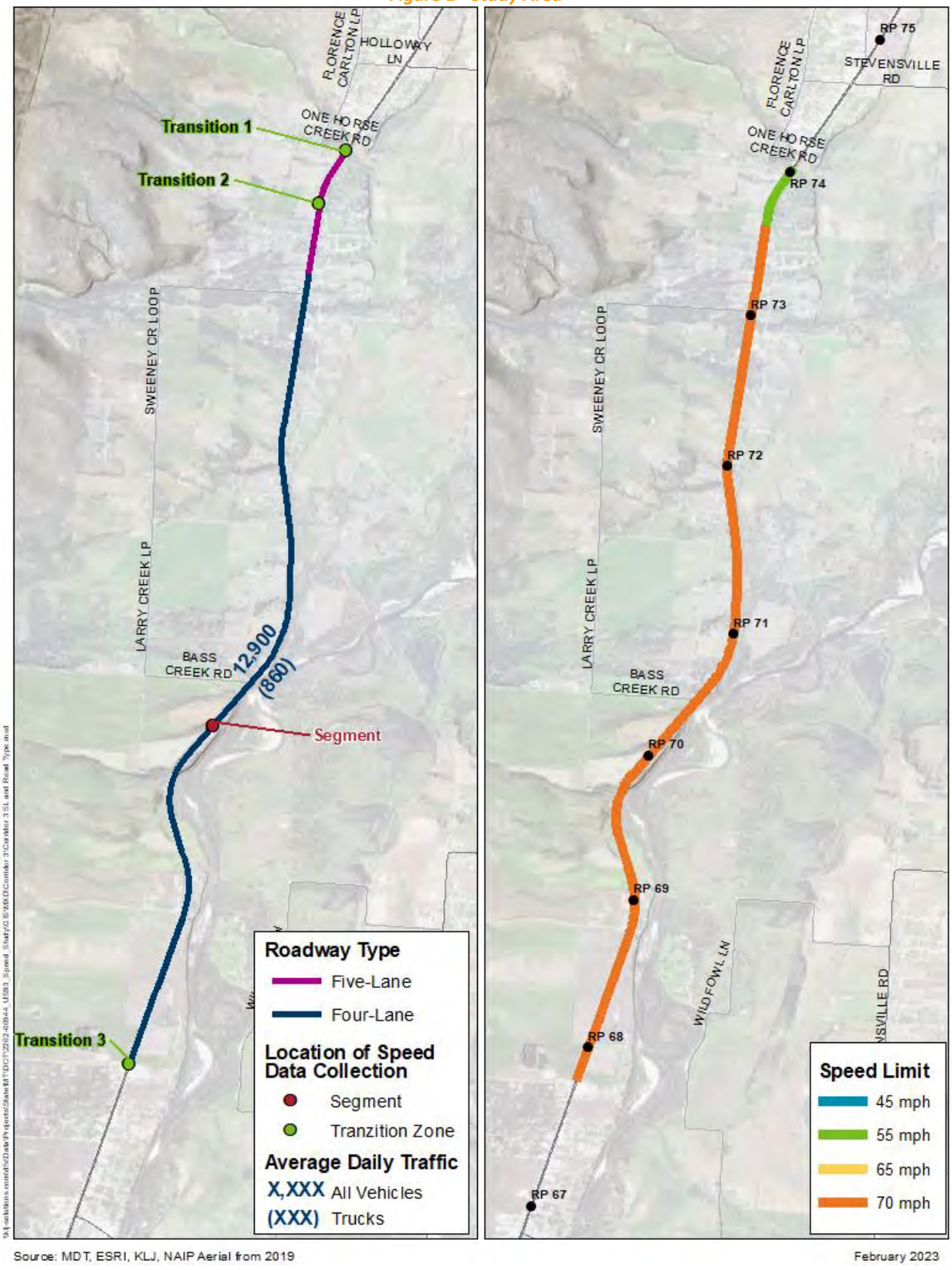
The purpose of this study is to evaluate the appropriate speed of the roadway. The primary tasks for the study included data collection, data analysis, and recommendations for speed limits along the study area. As part of this study, an evaluation and cataloging of existing roadway conditions, collection of historical *Annual Average Daily Traffic* (AADT), and crash data were completed.

Procedures

The steps for setting speed limits include planning, coordination, data collection and analysis, review, and presentation to the stakeholders, and finally, determination or implementation of the speed limits. Quality data and good documentation provides support for the judgments that are made.

Five years of the most recent crash and citation data was also requested and received from the MDT for the analysis.

Figure 1 - Study Area



2. Methodology

For determining the appropriate speed limit, the following parameters were reviewed:

- Roadway Condition/Characteristics
- Crash and Citation History
- Speed Characteristics, and
- Vehicular classes

When considering whether to establish a new posted speed limit or not, surveying and analysis of existing travel speeds is crucial to determining a reasonable posted speed limit. Motorists usually drive at speeds which they perceive as safe, based on the observable roadway conditions. A flat and straight roadway may result in a different travel speed than the posted speed limit due to the driver's observation of the roadway condition.

3. Roadway Characteristics

While speed samples (actual speed measurements of vehicles) are a large part of the necessary data, roadway characteristics should also be considered. Roadway characteristics such as pavement type/conditions, access points, vertical grades, and clear zone assessments data were collected during the field visit in August 2022. **Figure 2** shows the most representative section along the US 93 study segment. Additional pictures of the study segment are available in **Appendix I**.

Figure 2 - Representative Section of US Hwy 93 from RP 67.8 to 74.0

Lanes and Shoulders

The representative typical cross section for this study segment consists mainly of four 11-ft bituminous travelling lanes, and two 10-ft bituminous shoulders. The pavement is generally in good condition. The shoulders are wide enough for safe parking of disabled vehicles. The northern one-half mile of the segment has four-lanes with a center TWLTL.

Rumble Strips

There are shoulder rumble strips present throughout the segment. Centerline rumble strips are only present on the four-lane sections of the segment.

Access Points per Mile

An access point refers to public roads, a business driveway, a private driveway, or a farm field access. Fewer access points per mile means drivers are responding to a reduced number and variety of events. The study section has a combined 43 accesses (14 public, 16 private, and 13 field access) within the nearly 6.2-mile segment that corresponds to 4.6 access points per mile. The recommended primary full-movement and secondary intersection spacing for a rural principal arterial is one-mile and half-mile, respectively. The recommended and maximum density for driveways per mile for a 70-mph principal arterial roadway is no more than 18.8 based on Stopping Sight Distance chart documented in AASHTO Green Book, 5th Edition.

Vertical Grades

Grade is the rate of change of the vertical alignment. Grade affects vehicle speed and vehicle control, particularly for large trucks. The study segment can be described as generally flat.

Roadside Hazard Assessment

The study area is generally a fill section with a clear zone that is partially obstructed by fixed objects. There is a trail that runs parallel on the west side of the roadway. There are sections of roadway on the west side where there is agricultural fence within the clear zone. There are guardrails on most of the horizontal curves.

In-slope

The in-slope measured at the representative section is generally flat. The in-slope was measured at 6:1 which is considered a recoverable slope. There are driveways along the study segment that have steep slopes because of culverts crossing them. These steep slopes appear to be non-traversable.

Adjacent Development

The study area is mostly rural residential. There is a short section of rural industrial land use in the northern part of the study area.

Statutory and Advisory Speeds

The statutory speed limit is 65-mph for trucks and 70-mph for all other vehicles throughout the segment. There are no advisory speeds along the segment.

Traffic Control

There are no stops on the mainline of the segment of US 93 from Stevensville to Florence.

4. Vehicular Classification

Vehicular class data for 24-hour period were collected from September 7th to the 8th, 2022. Vehicle types were categorized to two classifications:

- **Mid-size Vehicles** consisting of motorcycles, passenger vehicles, pickups, vans, buses, conventional vans, and city delivery trucks.
- **Large Vehicles** consisting of single unit four or more axle trucks.

There are 12,040 and 860 daily small to mid-size and large vehicles, respectively that travel in the segment. The daily distribution is 50% along northbound and 50% along southbound. The vehicular classifications in the study segment are summarized in **Table 2**.

Table 2 - Vehicular Classification

Classification	Northbound	Southbound	Total	Percent
Small to Mid-Size vehicles	6,080	5,960	12,040	93%
Large vehicles	420	440	860	7%
Total (Percent)	**6,500 (50.4%)**	**6,400 (49.6%)**	**12,900**	**100%**

5. Safety Characteristics

Reviewing historic crash and citation information can help identify driver behavior issues that can provide additional information for setting speed the appropriate and safer speed limit.

Crash History

Five years of crash records between January 1, 2016, through December 31, 2020, were requested from the MDT. MDT shared crash records in a spreadsheet format. The five-year crash summary by year is shown in **Figure 3**. There were 83 crashes (no fatal, two serious injury, three minor injury, seven possible injury, 69 property damage only, and two unknown type crashes) reported during the analysis period. This corresponds to 16.6 crashes per year or 2.7 crashes per year per mile.

Figure 3 - Five-Year Crash Summary (2016-2020)

Seventy-four crashes or 89% of all the crashes were non-junction related. Crash summary by crash type is shown in **Table 3**.

Table 3 - Crash Collision Type

Type	# Crashes	% Crashes
Domestic Animal	2	2%
Fixed Object	16	19%
Head On	1	1%
Not Fixed Object or Debris	1	1%
Other	2	2%
Rear To Front	1	1%
Rear-End	7	8%
Right Angle	4	5%
Roll Over	5	6%
Sideswipe, Opposite Direction	1	1%
Sideswipe, Same Direction	1	1%
Wild Animal	42	51%
Total	**83**	**100%**

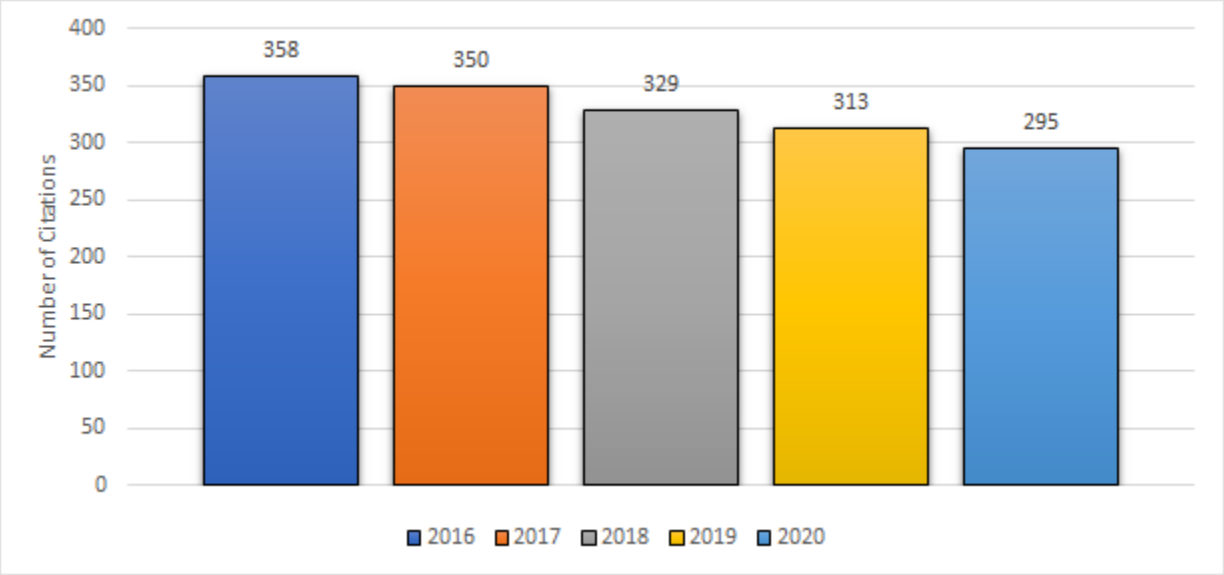
Crashes with wild animals (51%) were the most prominent crash type followed by collision with fixed object crashes (19%) in the study segment. The crash data had no supplement officer narratives to identify if speeding was the contributing factor for any of these crashes.

Citation History

The speeding law in Montana 1 § 61-8-303 (3) states: "Subject to the maximum speed limits set forth in subsection (above), a person shall operate a vehicle in a careful and prudent manner and at a reduced rate of speed no greater than is reasonable and prudent under the conditions existing at the point of operation, taking into account the amount and character of traffic, visibility, weather, and roadway conditions." It is critical to note that the law enforcement can issue a ticket for driving a vehicle at unsafe speeds, even if a driver is within the posted speed limit. For example, driving at the posted speed limit on the freeway when there is a blizzard or thick fog. Since these driving conditions are unsafe for you and other drivers, law enforcement is within their rights to issue a speeding ticket as per the speeding laws in Montana.

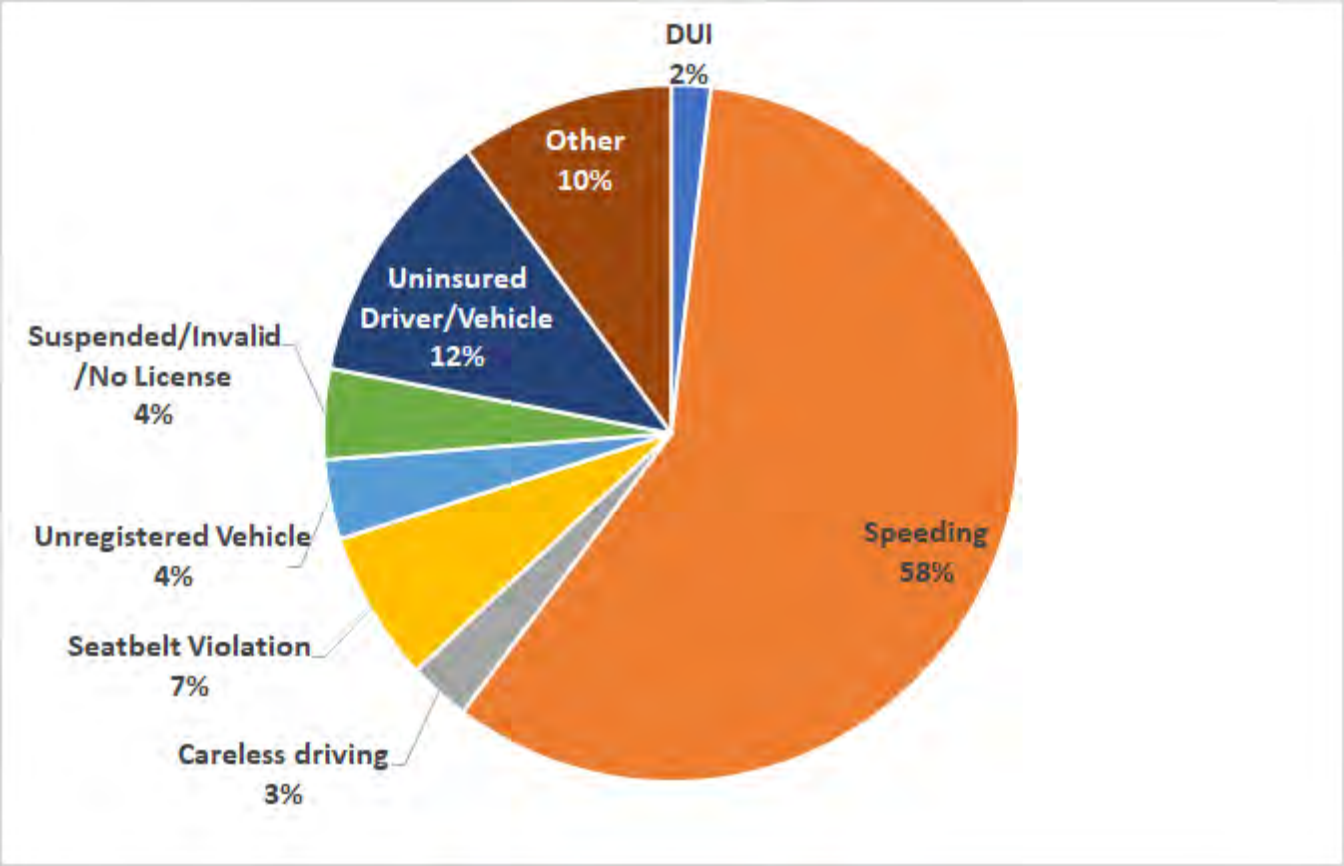
Five years of citation records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. The MDT Traffic & Safety Bureau shared citation records in a spreadsheet format. The five-year citation summary for the segment is shown in **Figure 4**. There were 1,645 citations issued in the study segment during the analysis period of which 961 citations (58%) were speeding violations.

Figure 4 - Citation Summary by Year



The most citations were given between May and July (30%). The types of citation issued in this segment is shown in **Figure 5**. Speeding (58%), and Uninsured driver/vehicle (12%) were the most prominent types of traffic violations in the study area.

Figure 5 - Citation Types Issued (2016 - 2020)



6. Speed Characteristics

Engineering Approach

The engineering approach is a two-step process based on operating conditions such as the 85th percentile speed. The 85th percentile is the speed at which 85% of free-flowing traffic is traveling at or below. Once the speed limit is established based on the 85th percentile speed, it can be adjusted (usually downward) based on other factors such as amount of non-motorized traffic, roadway characteristics, and crash history. MDT's procedures for setting speed limits are based on the engineering approach.

MDT uses 85th percentile, 50th percentile, and pace speeds to evaluate speed data. The pace speed is a 10-mph increment in speeds that encompasses the highest portion of observed speeds.

Spot Speed Data

Spot speed studies typically consist of sample sizes totaling at least 100 vehicles with Free Flow Speed (FFS). FFS is the speed of motorists traveling as desired given prevailing conditions such that no preceding vehicle influences the motorists' speed. Unattended radar devices were placed along the segment and transition zones of the study area to collect vehicular speed samples for a 24-hour period on September 7th and 8th, 2022**.** The road and shoulder surface were clear of surface water or snow during the period when data were recorded. The 24-hour data consisted of all vehicles that traveled along the study area with various speed profiles including vehicles that influenced a motorist's choice of speed such as vehicular deceleration to make turns, queuing during peak hour, or a platoon.

Speed Study Results

SEGMENT

The result of the speed profile in the study segment is shown in **Figure 6** and **Table 4**. For details please see **Appendix II**. The 85th percentile speed was found to be 77-mph and the 50th percentile speed was found to be 70-mph. The 10-mph pace was found to be between 68-mph and 78-mph comprising of 61% of daily vehicles within that 10-mph pace. The 85th percentile was greater than the posted speed limit and 50th percentile speeds were at the posted speed limit. The 85th percentile and 50th percentile speed were within the the 10-mph pace range.

Figure 6 - Speed Profile for All Vehicle Types in Both Direction of Travel

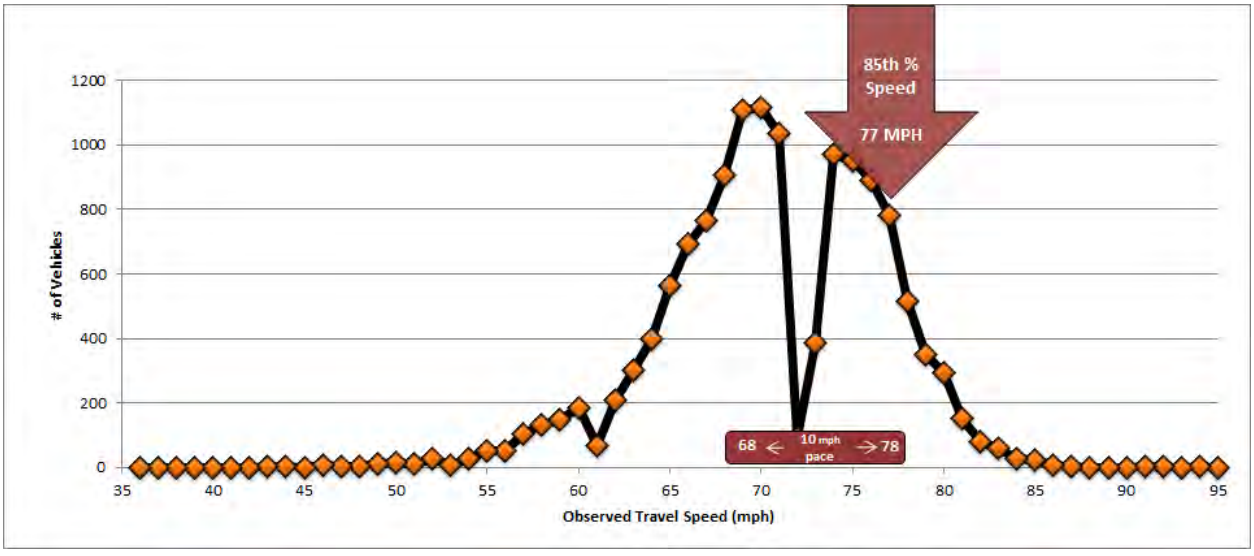


Table 4 - Speed Study Profile

Vehicle Type	Direction	10-mph Pace	% In Pace	85th Percentile Speed	50th Percentile Speed
Small to Mid-size	NB	68-78 mph	65%	78-mph	71-mph
	SB	67-77 mph	61%	76-mph	70-mph
	Both	68-78 mph	62%	77-mph	71-mph
Large	NB	62-72 mph	70%	74-mph	67-mph
	SB	62-72 mph	66%	71-mph	65-mph
	Both	62-72 mph	68%	72-mph	66-mph
All	NB	68-78 mph	64%	77-mph	71-mph
	SB	67-77 mph	59%	76-mph	70-mph
	Both	68-78 mph	61%	77-mph	70-mph

SPEED TRANSITION ZONES

Speed data were collected and analyzed at all three transition locations in the study area. The summary of speed data for the speed transition zones are shown in **Table 5**.

Table 5 - Speed Study Summary at Speed Transition Zones

		Direction	Transition		
			1	2	3
Existing	Reference Point	-	74	73.6	67.8
	Speed Change (mph)	NB	45	55	70[1]
		SB	55	70[1]	55
Calculated	85th %-ile Speed (mph)	NB	71-mph	68-mph	70-mph
		SB	71-mph	72-mph	67-mph
		Both	71-mph	70-mph	68-mph
	50th %-ile Speed (mph)	NB	60-mph	62-mph	64-mph
		SB	60-mph	66-mph	60-mph
		Both	60-mph	64-mph	63-mph
	10-mph Pace Speed (mph)	NB	52-62 mph	56-66 mph	60-70 mph
		SB	51-61 mph	63-73 mph	56-66 mph
		Both	51-61 mph	60-70 mph	57-68 mph
	% in 10-mph Pace Speed (mph)	NB	42%	61%	60%
		SB	41%	61%	59%
		Both	41%	56%	56%

NB – Northbound; SB – Southbound
1 – 65 mph for Trucks

NCHRP

A recent research report from the *National Cooperative Highway Research Program* (NCHRP) has been completed. NCHRP report 17-76: *Development of a Posted Speed Limit Setting Procedure and Tool* collected insights into how the roadway environment influences operating speed and safety (crashes) through a review of literature and the collection and analysis of data from two states. Using those insights along with an understanding of different methods being used and currently being considered for the setting of posted speed limits, the research team developed a speed limit setting procedure along with a tool. The procedure uses fact-based decision rules that consider both driver speed choice and safety associated with the roadway.

There has been a nationwide push over the last several years for the consideration of 50th percentile speed, especially for developed areas. When the roadway conditions are optimal, the suggested speed limit should reflect the 85th percentile speed. When roadway conditions are not favorable to all users or when crashes are a significant concern, then the suggested speed limit should reflect the rounded down 85th percentile or the 50th percentile speed. Drivers frequently select speeds a certain increment above the posted speed limit, anticipating that they will not receive a ticket if they are below the assumed enforcement speed tolerance. Because of these reasons, 50th percentile speed data were also used in the analysis along with the 85th percentile speed data.

The NCHRP 17-76 Speed Limit Setting Tool was used to calculate the recommended speed limit for the study segment based on key factors such as: 85th percentile and 50th percentile speed, roadway characteristics, and crash history. The recommended speed for the study segment based on NCHRP 17-76 was found to be 70-mph along in this segment. Details of the NCHRP 17-76 report is available in **Appendix III**.

7. Straight-Line Diagram

Straight-line diagrams are linear graphical representations of features and characteristics along roadways on and some off the State Highway System and nearby surrounding area. These diagrams are prepared to support efforts in preparing for field surveys, planning construction projects, verifying Roadway Characteristics Inventory (RCI) data, and other related applications. The straight-line diagrams for the study area with the speed characteristics at the locations where data has been collected and analyzed are included in **Appendix IV**.

8. Conclusion

Vehicular Classification

There are 12,040 and 860 daily small to mid-size and large vehicles, respectively that travel in the segment. The daily distribution is 50% along northbound and 50% along southbound.

Safety Characteristics

There were 83 crashes (no fatal, two serious injury, three minor injury, seven possible injury, 69 property damage only, and two unknown type crashes) reported during the analysis period. Crashes with wild animals (51%) were the most prominent crash type followed by collision with fixed object crashes (19%) in the study segment

There were 1,645 citations issued in the study segment during the analysis period of which 961 citations (58%) were speeding violations.

Roadway Characteristics

The segment, RP 67.8 to RP 74.0, being reviewed has a statutory 65-mph speed limit for trucks and 70-mph for regular vehicles. The majority of the 6.2-mile segment is a paved four-lane undivided roadway, except the northern one-half mile of the segment that is four-lanes with a center TWLTL. The segment consists of fill sections with some fixed objects within the clear zone. There are shoulder rumble strips present throughout the segment. Centerline rumble strips are only present on the four-lane section of the segment. The shoulders are wide on both sides of the roadway for safe parking of disabled vehicles. The vertical grades and in-slopes are generally flat in the segment. The road conditions are generally in good condition. The study area is mostly rural residential. There is a short section of rural industrial land use in the northern part of the study area. The driveway density in the study segment is less than the maximum number of driveway thresholds for similar type of facility.

Speed Characteristics

The 85th percentile speed was found to be 77-mph and the 50th percentile speed was found to be 70-mph. The 10-mph pace was found to be between 68-mph and 78-mph comprising of 61% of daily vehicles within that 10-mph pace.

9. Recommendations

Segment

The recommended speed for the study segment based on NCHRP 17-76 was found to be 70-mph along in this segment. The 85th percentile speed, higher percentage of speeding violations, and NCHRP recommended speed is indicative that the existing posted speed limit of 70-mph in this segment is appropriate for this segment.

Speed Transition Zones

The speed differentials between the posted speed limit and 85th percentile speed limit is summarized in **Table 6**. The minimum recommended spacing for a speed transition over 45-mph posted speed is 0.5-mile. The spacing between the speed transitions in this segment of US 93 between Stevensville and Florence were all less than the minimum recommended spacings. It is recommended that the speed transition spacings be adjusted to the current MDT practice procedures.

Table 6 - Speed Differentials at Speed Transition Zones

	Direction	Transition		
		1	2	3
Reference Point	-	74.0	73.6	67.8
85th %-ile Speed (mph)	NB	71	68	70
	SB	71	72	67
Speed Limit Change (mph)	NB	45	55	70
	SB	55	70	55
Δ in Speed (mph)	NB	+26	+13	0
	SB	+16	+2	+12

TRANSITION 1

- Northbound - The 85th percentile speed is 26-mph greater than the posted speed limit of 45-mph. Vehicles travelling northbound are entering the town of Florence from another speed transition of 70 mph to 55 mph. The existing speed limit while entering Florence may be appropriate. No change in speed limit is recommended for traffic travelling in the northbound direction in this transition zone. However, a traffic calming device may be helpful to lower the travelling speed for traffic travelling northbound in this transition zone.
- Southbound - The speed differentials between the posted speed limit and 85th percentile speed is 16-mph less than the posted speed limit of 55-mph which is indicative that the vehicles are entering rural high-speed roadway after leaving Florence. The posted speed limit is appropriate. No change in speed limit is recommended for traffic traveling in the southbound direction in this transition zone.

TRANSITION 2

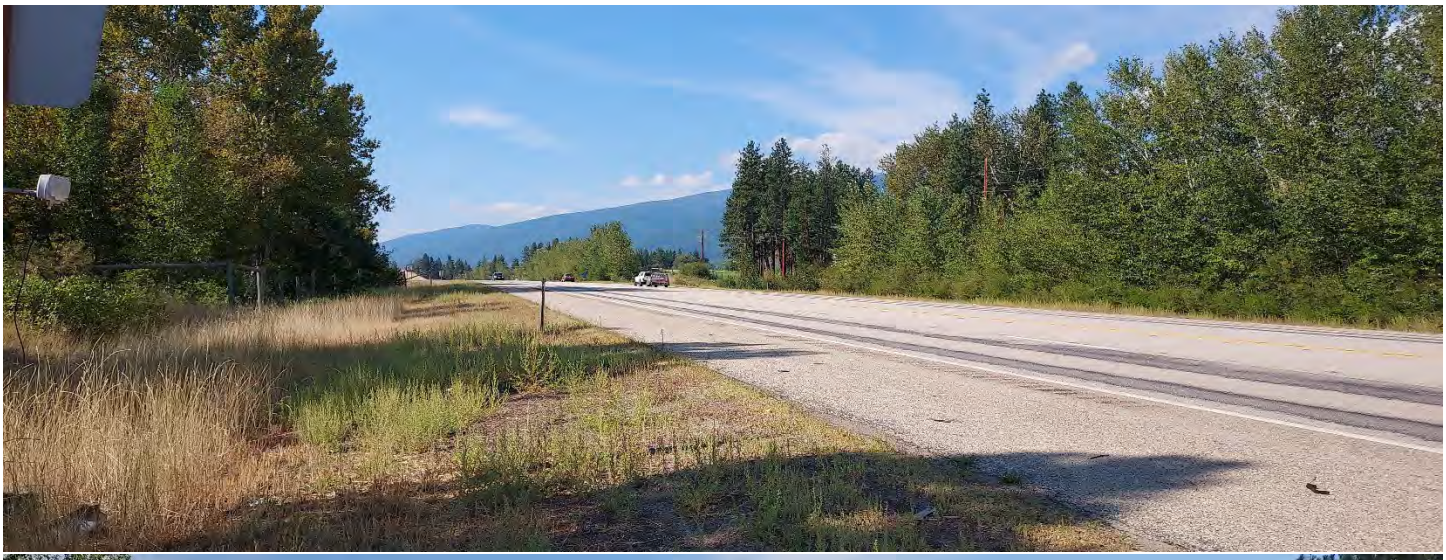
- Northbound - The 85th percentile speed is 13-mph greater than the posted speed limit of 55-mph. Vehicles travelling northbound are close to entering Florence. The existing posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the northbound direction in this transition zone.

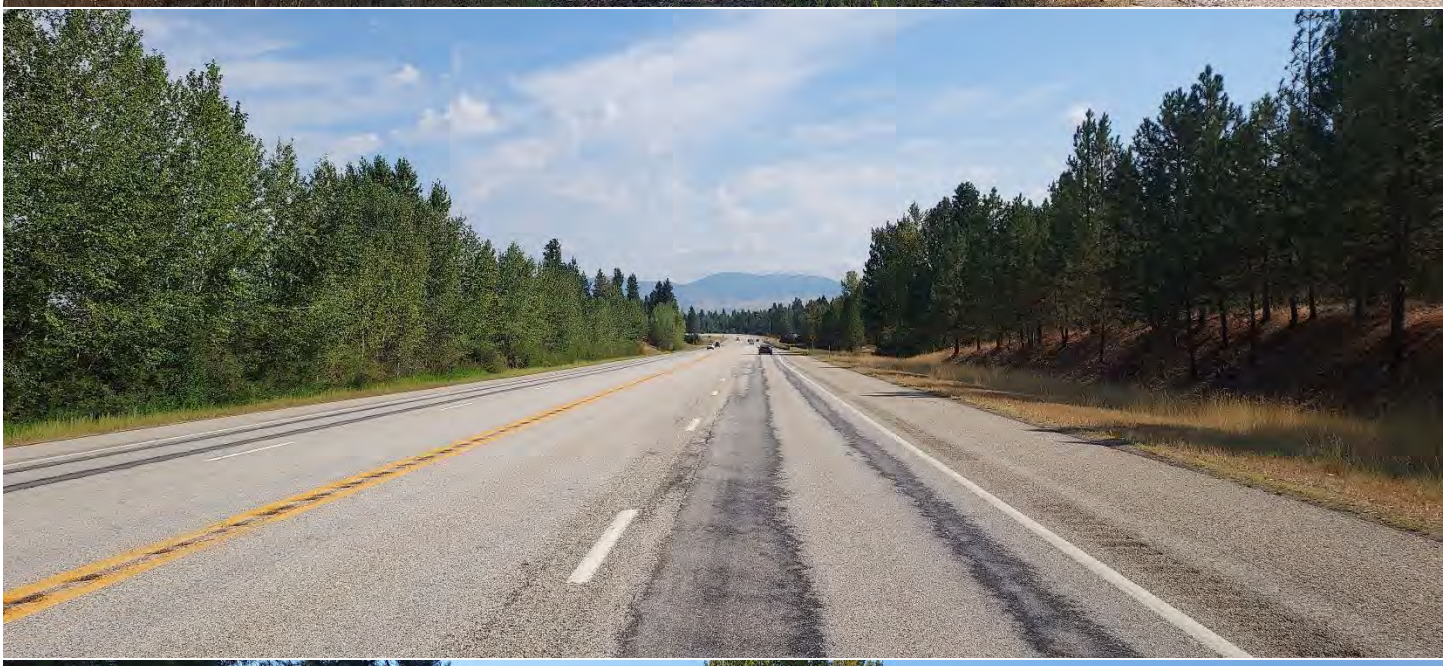
- Southbound - The 85th percentile speed is 2-mph greater than the posted speed limit of 70-mph. Vehicles travelling southbound are transitioning from 55-mph to 70-mph. The posted speed limit is appropriate. No change in speed limit is recommended for traffic traveling in the southbound direction in this transition zone.

TRANSITION 3

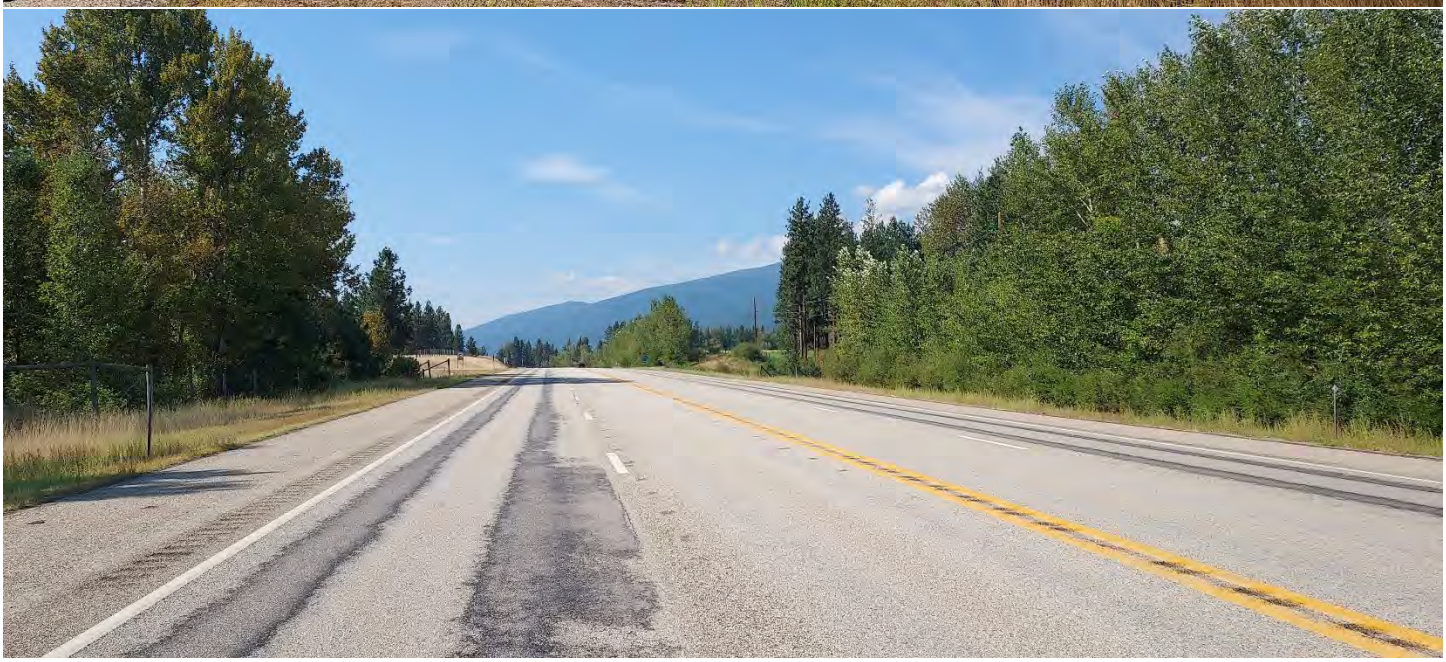
- Northbound - The 85th percentile speed is at the posted speed limit of 70-mph. which is indicative that the vehicles are entering rural high-speed roadway after leaving Stevensville. The posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the northbound direction in this transition zone.
- Southbound - The 85th percentile speed is 12-mph greater than the posted speed limit of 55-mph. Vehicles travelling southbound are entering the town of Stevensville. The existing speed limit while entering Stevensville is appropriate. No change in speed limit is recommended for traffic travelling in the southbound direction in this transition zone. However, a traffic calming device may be helpful to lower the travelling speed for traffic travelling southbound in this transition zone.

APPENDIX I - PICTURES





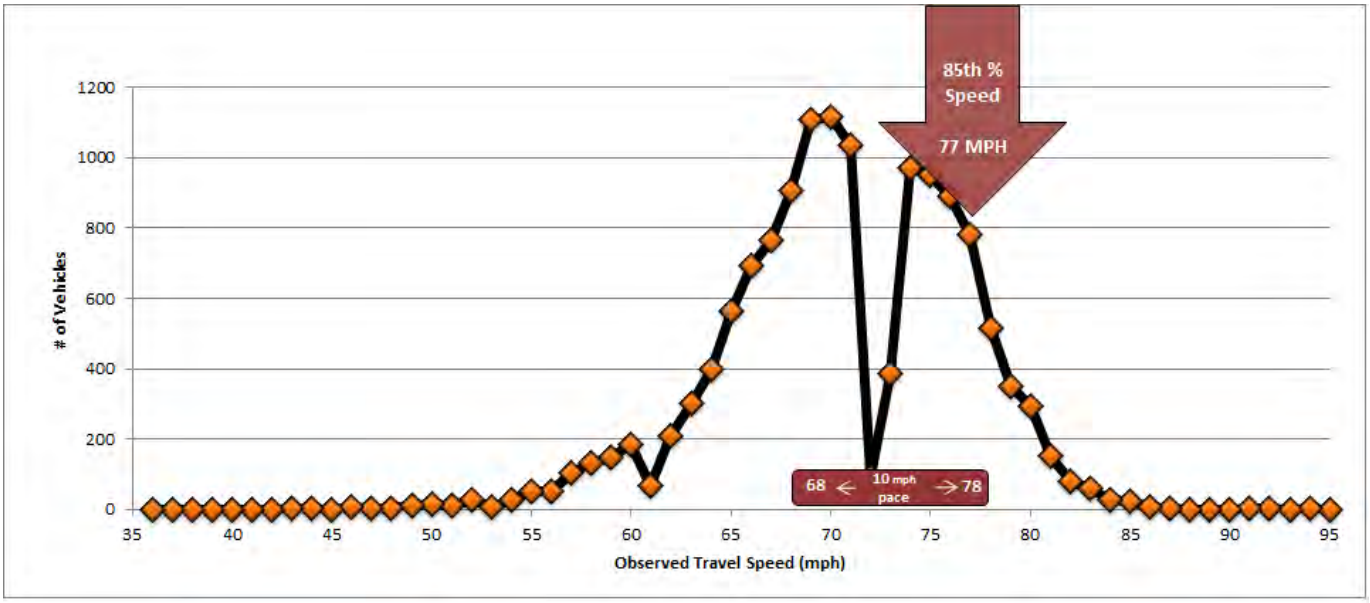

National Forest
RECREATION
AREA
1/4 MI
AHEAD

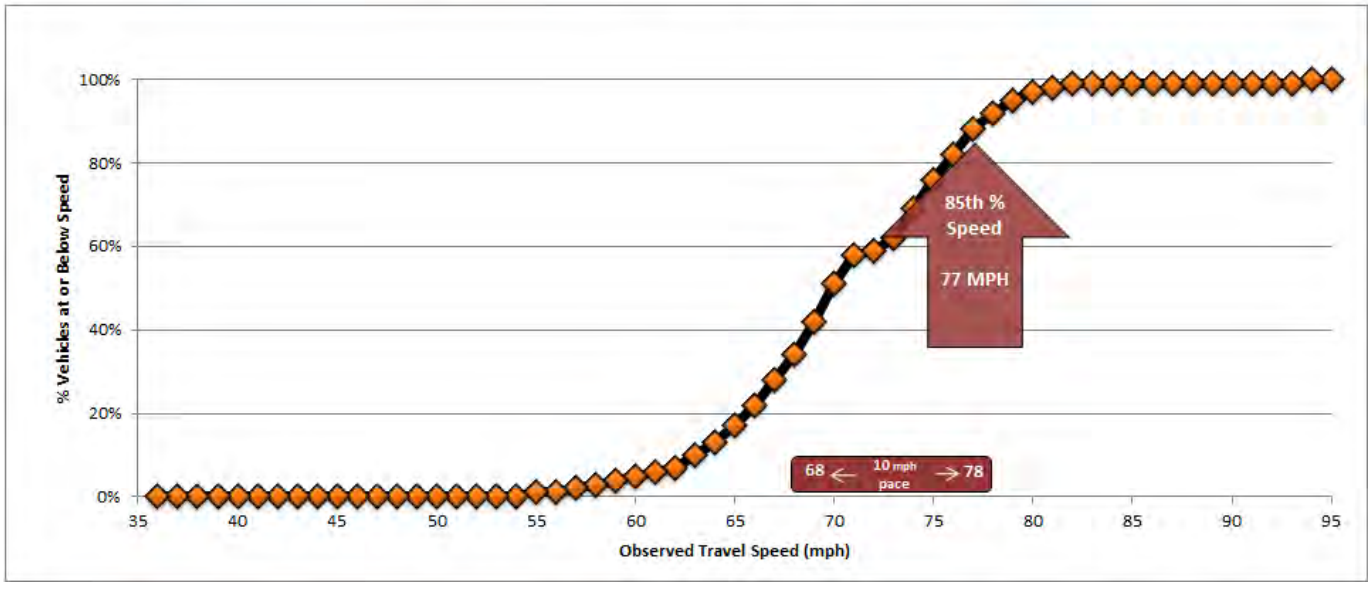


APPENDIX II – SPEED STUDY PROFILES

SPEED SAMPLE SUMMARY (ALL VEHICLES)

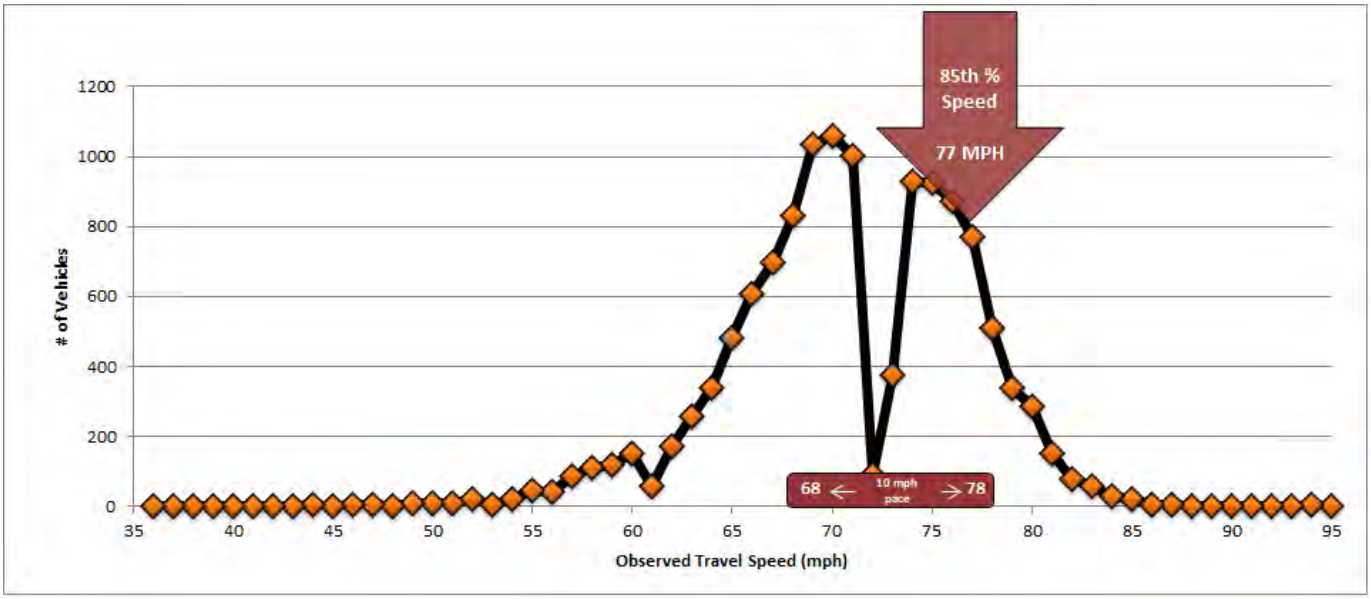
ID:	A3-Seg-01	Speed Limit	70 MPH	Day/Date	Wednesday, 9/7/2022
Roadway:	US 93	Seg. Length:	6.2 MILES	Time:	24-hours
Study Limits:	Stevensville to Florence	Road Type:	Four-Lane, Two way	Sample Loc	46.569521,-114.099432
City/County:	Ravalli	ADT Range:	NB-6500 SB-6400	Weather:	-
RP:	67.8 to 74.0	Truck ADT:	NB-420 SB-440	Observer(s):	KLJ
85th % Speed:	77	10 mph pace	68-78	Machine:	Echo Radar
50th % Speed:	70	% in pace	61%		

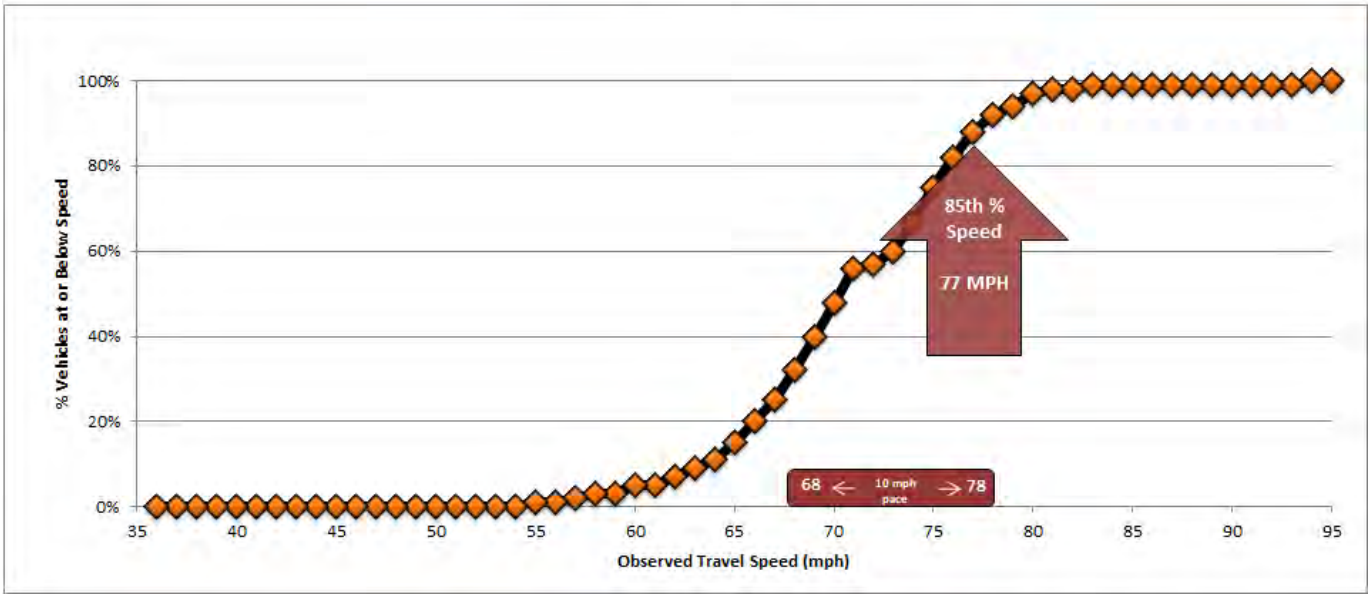




SPEED SAMPLE SUMMARY (PASSENGER VEHICLES)

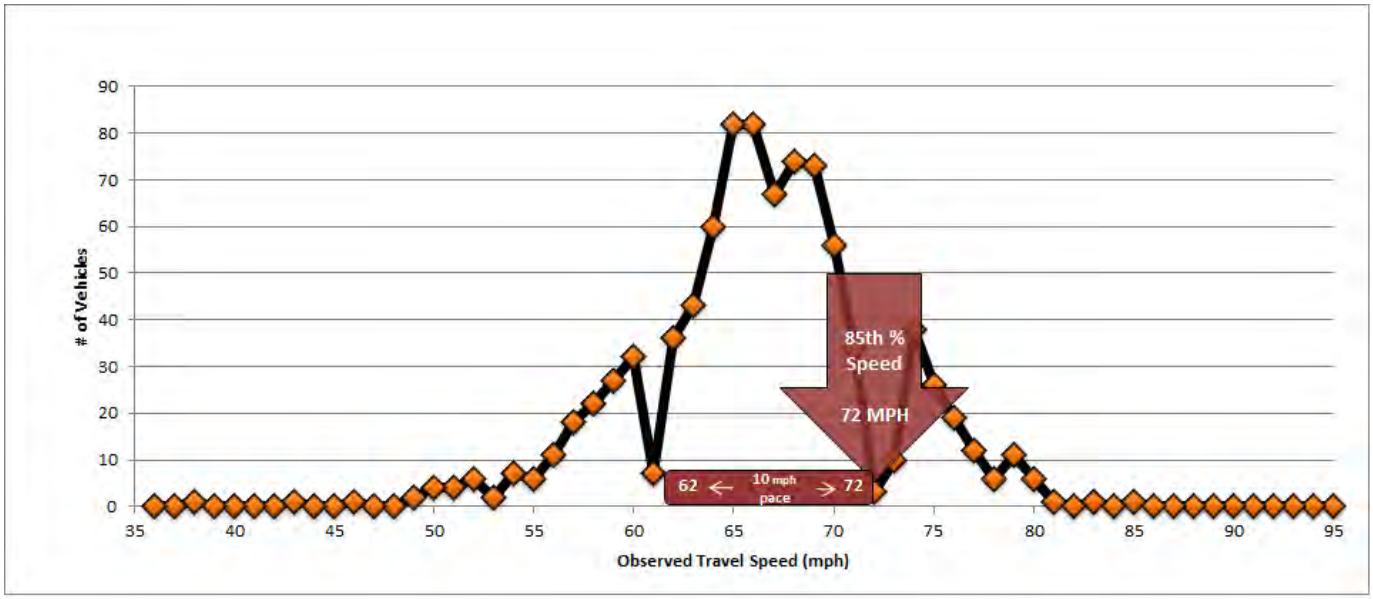
ID:	A3-Seg-01	Speed Limit	70 MPH	Day/Date	Wednesday, 9/7/2022
Roadway:	US 93	Seg. Length:	6.2 MILES	Time:	24-hours
Study Limits:	Stevensville to Florence	Road Type:	Four-Lane, Two way	Sample Loc	46.569521,-114.099432
City/County:	Ravalli	ADT Range:	NB-6500 SB-6400	Weather:	-
RP:	67.8 to 74.0	Truck ADT:	NB-420 SB-440	Observer(s):	KLJ
85th % Speed:	77	10 mph pace	68-78	Machine:	Echo Radar
50th % Speed:	71	% in pace	62%		

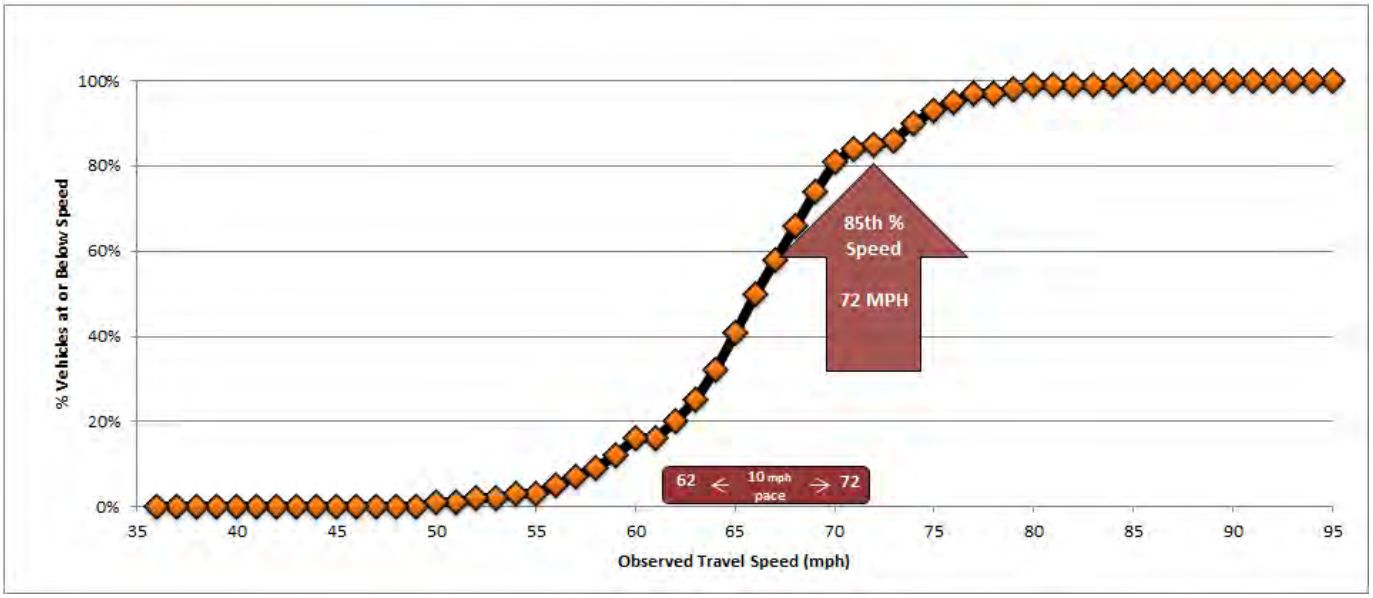




SPEED SAMPLE SUMMARY (TRUCKS)

ID:	A3-Seg-01	Speed Limit	70 MPH	Day/Date	Wednesday, 9/7/2022
Roadway:	US 93	Seg. Length:	6.2 MILES	Time:	24-hours
Study Limits:	Stevensville to Florence	Road Type:	Four-Lane, Two way	Sample Loc	46.569521,-114.099432
City/County:	Ravalli	ADT Range:	NB-6500 SB-6400	Weather:	-
RP:	67.8 to 74.0	Truck ADT:	NB-420 SB-440	Observer(s):	KLJ
85th % Speed:	72	10 mph pace	62-72	Machine:	Echo Radar
50th % Speed:	66	% in pace	68%		





APPENDIX III - NCHRP REPORT

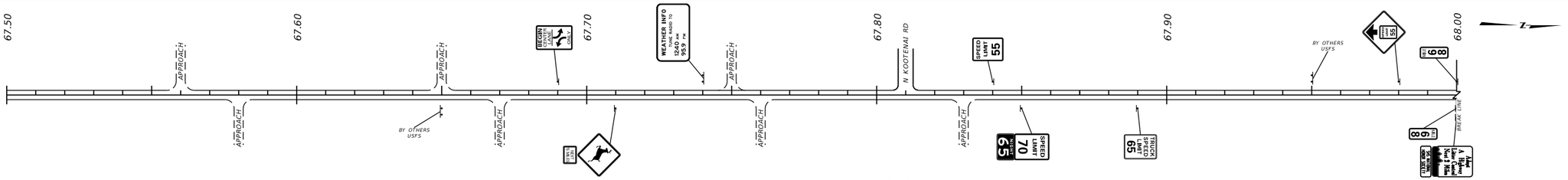
NCHRP 17-76 Speed Limit Setting Tool

Input Cells	Description	Output Cells
Site Description Data		
Rural	Roadway context	
Principal arterial	Roadway type	
Yes	Are crash data available?	
Ben F	Analyst	
12/5/2022	Date	
US 93	Roadway name	
A3-Seg-01	Description	
70	Current speed limit (mph)	
	Notes	
Analysis Results		
	Speed limit setting group	Undeveloped
	Suggested speed limit (mph)	**70**
Speed Data		
70	Maximum speed limit (mph)	
77	85th-percentile speed (mph)	
70	50th-percentile speed (mph)	
Site Characteristics		
6.2	Segment length (mi)	
12,050	AADT (two-way total) (veh/d)	
4	Number of lanes (two-way total)	
Undivided	Median type	
43	Number of access points (total of both directions)	
11	Lane width (ft)	
10	Shoulder width (ft)	
No	Adverse alignment present?	
Crash Data		
5	Number of years of crash data	
12,050	Average AADT for crash data period (veh/d)	
83	All (KABCO) crashes for crash data period	
12	Fatal & injury (KABC) crashes for crash data period	
	Average KABCO crash rate (crashes / 100 MVMT)	
	Average KABC crash rate (crashes / 100 MVMT)	
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	161.9
	1.3 x average KABC crash rate (crashes / 100 MVMT)	53.5
	Critical KABCO crash rate (crashes / 100 MVMT)	140.6
	Critical KABC crash rate (crashes / 100 MVMT)	50.5

APPENDIX IV – STRAIGHT-LINE DIAGRAMS

Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY
HAMILTON
Location TO MISSOULA
County RAVALLI/MISSOULA
Roadway C000007 (US 93)
RP from 67.50 to 74.00
Scale 1 UNIT = 0.10 MILES
Date FEBRUARY 2023



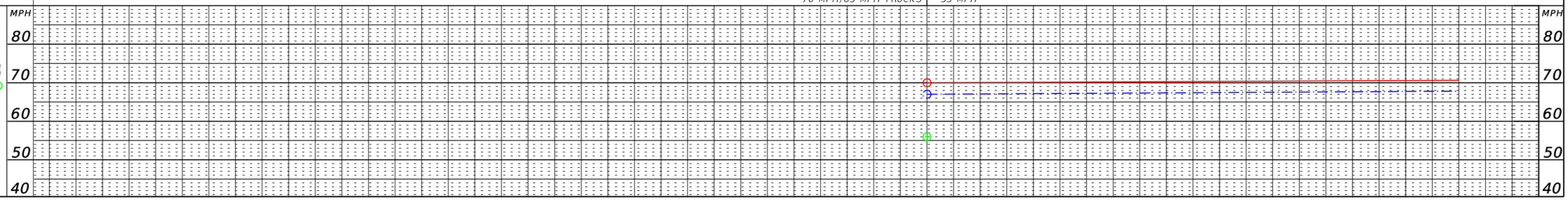
Roadway Width	90-FEET	
Number of Striped Lanes	4	
Type of Divider	DIVIDED	
Average Daily Traffic	10,700	
Direction	NB	SB
Number of Vehicles	5,300 VEH	5,400 VEH
85th Percentile	70 MPH	67 MPH
50th Percentile	64 MPH	60 MPH
10 MPH Pace (% in Pace)	60-70 MPH (60%)	56-66 MPH (59%)
Existing Speed Zone	70 MPH/65 MPH TRUCKS	55 MPH

SPEED PROFILE

LEGEND
Road Signs
85th Percentile NB SB
Lower Limit of Pace

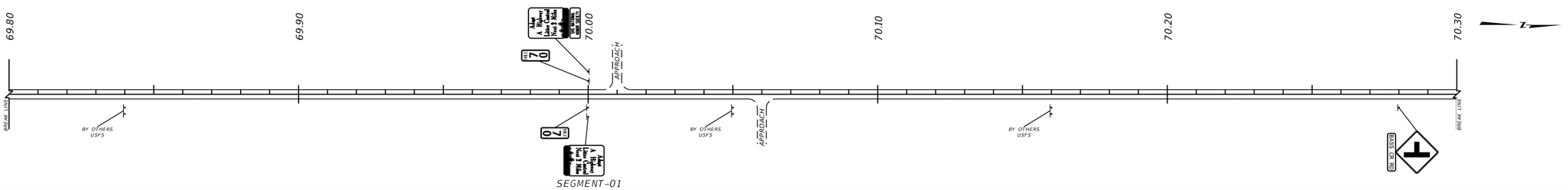
Remarks:

Sheet 1 of 3



Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY
HAMILTON
Location TO MISSOULA
County RAVALLI/MISSOULA
Roadway C000007 (US 93)
RP from 67.50 to 74.00
Scale 1 UNIT = 0.10 MILES
Date FEBRUARY 2023



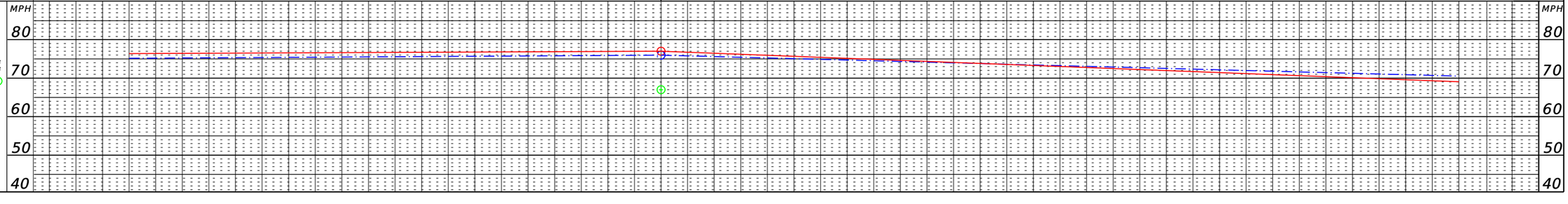
Roadway Width	68-FEET	
Number of Striped Lanes	4	
Type of Divider	UNDIVEDED	
Average Daily Traffic	12,900	
Direction	NB	SB
Number of Vehicles	6,500 VEH	6,400 VEH
85th Percentile	77 MPH	76 MPH
50th Percentile	71 MPH	70 MPH
10 MPH Pace (% in Pace)	68-78 MPH (64%)	67-77 MPH (59%)
Existing Speed Zone	70 MPH/65 MPH TRUCKS	70 MPH/65 MPH TRUCKS

SPEED PROFILE

LEGEND
Road Signs
85th Percentile NB SB
Lower Limit of Pace

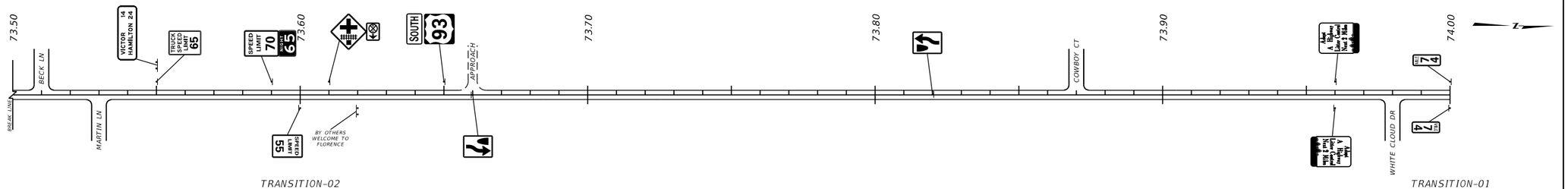
Remarks:

Sheet 2 of 3



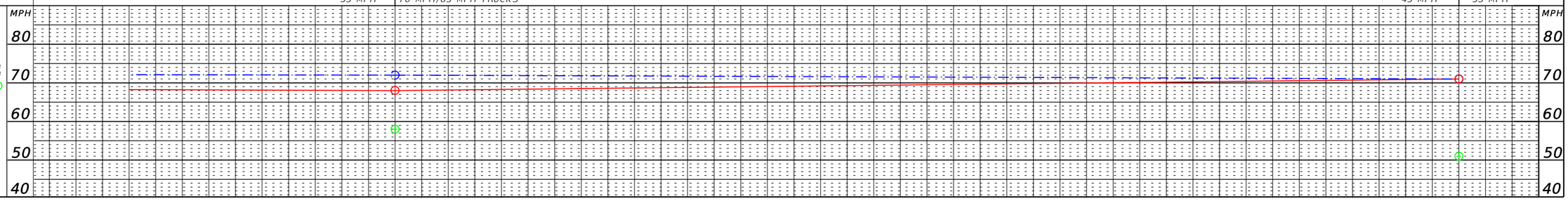
Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY
HAMILTON
Location TO MISSOULA
County RAVALLI/MISSOULA
Roadway C000007 (US 93)
RP from 67.50 to 74.00
Scale 1 UNIT = 0.10 MILES
Date FEBRUARY 2023



Roadway Width	82-FEET		82-FEET	
Number of Striped Lanes	5		5	
Type of Divider	TWLTL		TWLTL	
Average Daily Traffic	10,000		9,300	
Direction	NB	SB	NB	SB
Number of Vehicles	5,000 VEH	5,000 VEH	5,000 VEH	4,300 VEH
85th Percentile	68 MPH	72 MPH	71 MPH	71 MPH
50th Percentile	62 MPH	66 MPH	60 MPH	60 MPH
10 MPH Pace (% in Pace)	56-66 MPH (61%)	63-73 MPH (61%)	52-62 MPH (42%)	51-71 MPH (41%)
Existing Speed Zone	55 MPH	70 MPH/65 MPH TRUCKS	45 MPH	55 MPH

SPEED PROFILE



LEGEND
Road Signs
85th Percentile NB SB
Lower Limit of Pace

Remarks:

ENGINEERING, REIMAGINED

SPEED STUDY

US Hwy 93 – Victor to Stevensville

Ravalli County, MT

January 2023

Speed Study

Victor to Stevensville, Montana

Ravalli County, MT

January 2023

Prepared for:

Montana Department of Transportation

Prepared by:

KLJ Engineering

Table of Contents

1. Introduction 1
2. Study Location 1
3. Vehicular Classification 3
4. Safety Characteristics 4
5. Speed Characteristics 7
6. Straight-Line Diagram 9
7. Recommendations 10

List of Figures

Figure 1 - Study Area 2
Figure 2 - Five-Year Crash Summary (2016-2020) 4
Figure 3 - Citation Summary by Year 6
Figure 4 - Citation Types Issued in the study area (2016 - 2020) 6
Figure 5 - Citation Types Issued at the Intersection of US Hwy 93 with Bell Crossing (2016 - 2020) 7

List of Tables

Table 1 - Speed Transition Zones in the Study Area 3
Table 2 - Vehicular Classification 3
Table 3 - Crash Collision Type 5
Table 4 – Segment Wide Speed Study Summary 8
Table 5 - Speed Study Summary at Speed Transition Zones 9
Table 6 - Speed Differentials at Speed Transition Zones 10

List of Appendices

Appendix I - Segment Speed Studies I
Appendix II – Straight-Line Diagrams II

1. Introduction

Speed limits are set to inform motorists of appropriate driving and safe operating speeds under favorable conditions. Speed limits are posted at the statutory speed limit unless a traffic engineering investigation study has been conducted and (where applicable) approved by the Transportation Commission. The *Montana Department of Transportation* (MDT) has requested KLJ Engineering to review the posted speed limit along US Hwy 93 from Victor to Stevensville.

Purpose

The purpose of this study is to evaluate the appropriate speed of the roadway. The primary tasks for the study included data collection, data analysis, and recommendations for speed limits along the study area. As part of this study, an evaluation and cataloging of existing roadway conditions, collection of historical *Annual Average Daily Traffic* (AADT), and crash data were completed.

2. Study Area

The study area is US Hwy 93 between Victor and Stevensville in Ravalli County, MT. The nearly 6.1-miles roadway study area have varied roadway type and speed limits as shown in **Figure 1**. The AADT in the study area ranges from 9,354 in the north to 7,215 in the south based on the 2021 counts reported by the MDT.

Segments

The study area was divided into two segments based on the roadway type. Speed analysis was conducted individually for both the segments. The speed limit of US Hwy 93 in this study area is 70-mph for regular vehicles and 65-mph for trucks throughout. The following are the study segments along the study area:

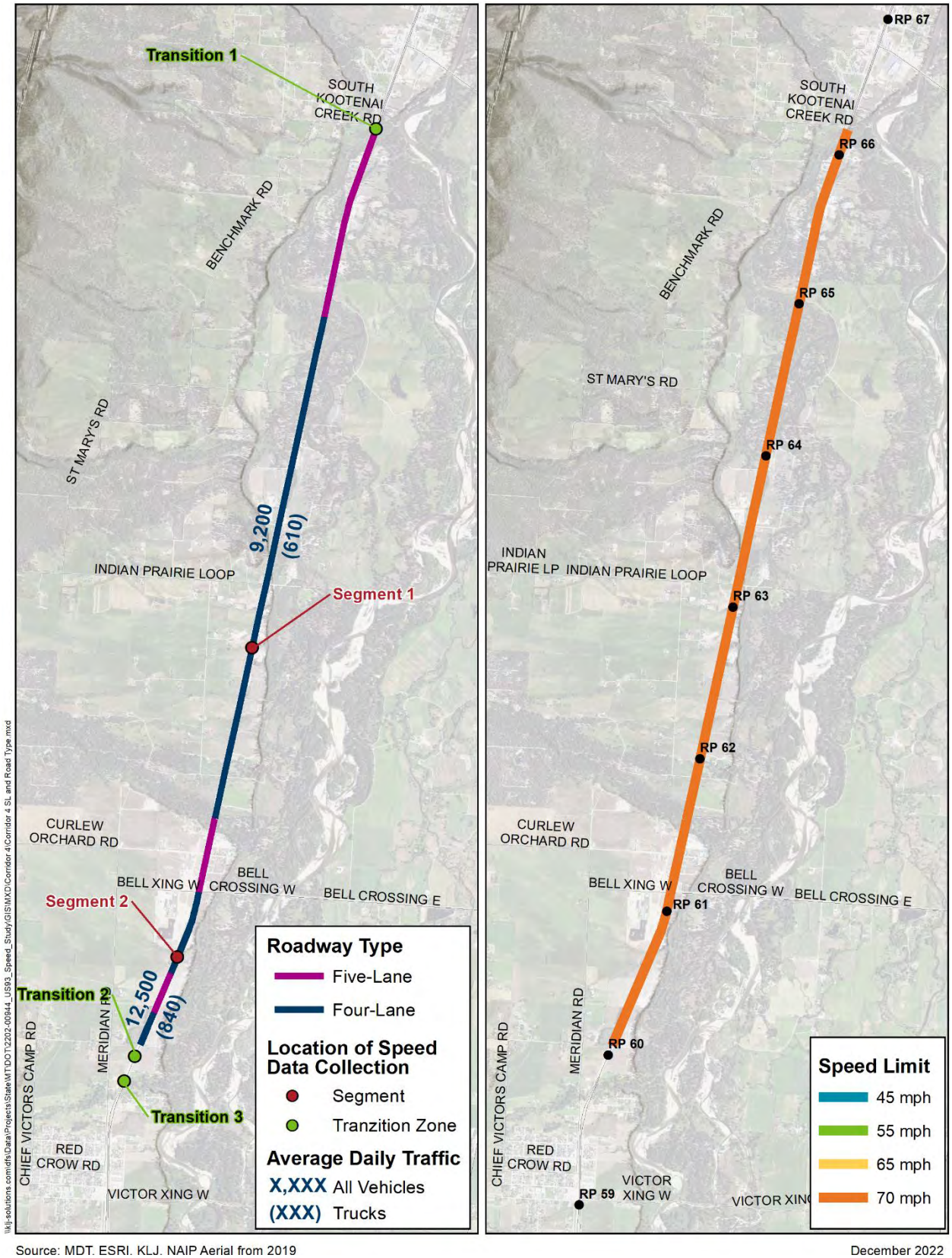
SEGMENT 1

This 5.1-mile segment represents the study area from US Hwy 93 reference point (RP): 61.1 to RP 66.2 located between the intersections of Bell Crossing Rd and South Kootena Creek Rd. The majority of the 5.1-mile segment is a paved four-lane undivided roadway, except the northern quarter and southern 1/5th of the segment that is a four-lane roadway with a two-way-left-turn-lane (TWLTL) in the center. The statutory speed limit of this segment is 70-mph for regular vehicles and 65-mph for trucks.

SEGMENT 2

This one-mile segment represents the study area from US Hwy 93 at RP 60.1 to RP 61.1 located between the intersection with Bell Crossing Rd to one mile south of the intersection. The northern and southern part of the segment is a paved four-lane undivided roadway. One-third of the segment in the middle is a paved four-lane roadway with a center TWLTL. The statutory speed limit of this segment is 70-mph for regular vehicles and 65-mph for trucks.

Figure 1 - Study Area



Source: MDT. ESRI. KLJ. NAIP Aerial from 2019

December 2022

Speed Transition Zones

Speed transition zones are sections of roadway where posted speed limit changes from higher to lower limits or vice-versa. Due to the sudden changes in posted speed limits and road environment, drivers usually do not adapt to the posted speed limits and underestimate their traveling speed. There are three locations within the study area where there are speed transitions (**Figure 1**). Speed data were collected and analyzed at all eight locations in the study area. The speed transition zones where data was collected are summarized in **Table 1**.

Table 1 - Speed Transition Zones in the Study Area

	Direction	Transitions		
		1	2	3
Reference Point	-	66.2	60	59.8
Speed Change (mph)	NB	55	70[1]	55
	SB	70[1]	55	45

1 – 65-mph for Trucks

Bell Crossing Rd/US Hwy 93 Intersection

Special consideration was given to the intersection of US Hwy 93 with Bell Crossing Rd located near RP 61.1. The intersection is a roadway with four through travelling lanes and dedicated left turn lanes. The northbound approach has a dedicated right-turn lane. There is no right-turn lane along southbound approach. The intersection is controlled by side street stops at the Bell Crossing approaches. The speed limit along US Hwy 93 at the intersection is 70-mph for regular vehicles and 65-mph for trucks.

3. Vehicular Classification

Vehicular class data for 24-hour period were collected on August 23, 2022. Vehicle types were categorized to two classifications:

- **Mid-size Vehicles** consisting of motorcycles, passenger vehicles, pickups, vans, buses, conventional vans, and city delivery trucks.
- **Large Vehicles** consisting of single unit four or more axle trucks.

The vehicular classifications in the study segment are summarized in **Table 2**.

Table 2 - Vehicular Classification

Segment	Classification	Northbound	Southbound	Total	Percent
Segment 01	Small to Mid-Size vehicles	4,590	4,000	8,590	93%
	Large vehicles	310	300	610	7%
	Total (Percent)	**4,900 (53%)**	**4,300 (47%)**	**9,200**	**100%**
Segment 02	Small to Mid-Size vehicles	5,900	5,760	11,660	93%
	Large vehicles	400	440	840	7%
	Total (Percent)	**6,300 (50%)**	**6,200 (50%)**	**12,500**	**100%**

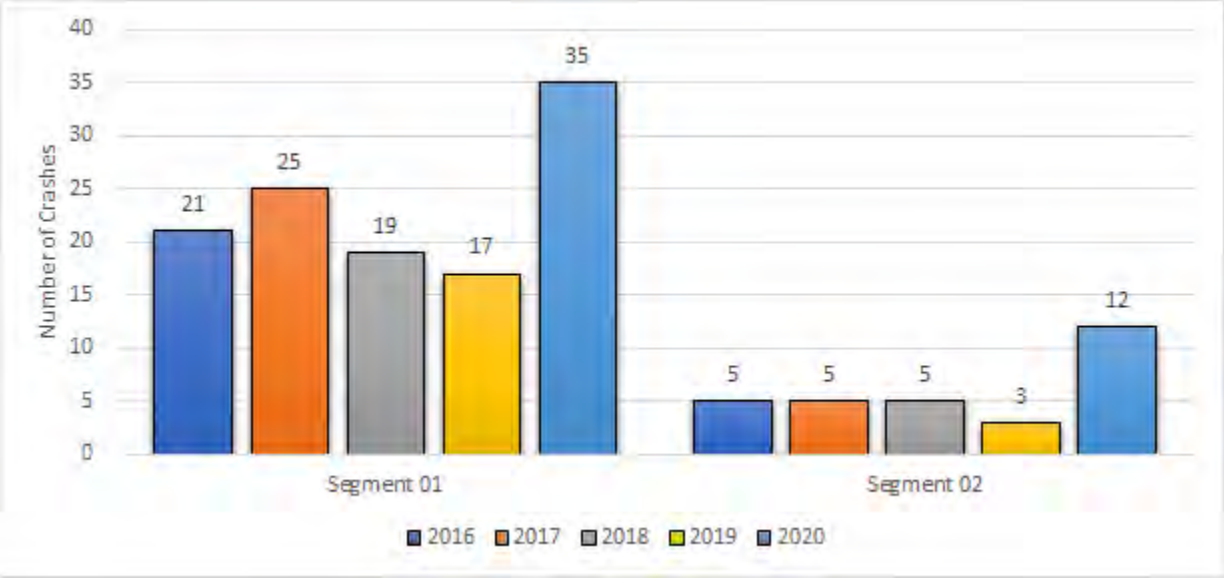
4. Safety Characteristics

Reviewing historic crash and citation information can help identify driver behavior issues that can provide additional information for setting the appropriate and safer speed limit.

Crash History

Five years of crash records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. MDT shared crash records in a spreadsheet format. The five-year crash summary by segment and year is shown in **Figure 2**. There were 147 crashes (four fatal, five serious injury, 16 minor injury, nine possible injury, 111 property damage only, and two unknown type crashes) reported during the analysis period. This corresponds to 29.4 crashes per year or 4.8 crashes per year per mile. Crash history by the individual roadway segments of the study area is included in **Appendix I**.

Figure 2 - Five-Year Crash Summary (2016-2020)



124 crashes or 84% of all the crashes were non-junction related. Crash summary by crash types is shown in **Table 3**.

Table 3 - Crash Collision Type

Type	# Crashes	% Crashes
Domestic Animal	1	1%
Fixed Object	9	6%
Head On	1	1%
Immersion	1	1%
Jackknife	1	1%
Left Turn, Opposite Direction	**2**	1%
Left Turn, Same Direction	5	3%
Not Fixed Object or Debris	2	1%
Other	4	3%
Parked Vehicle	1	1%
Rear To Front	2	1%
Rear To Rear	1	1%
Rear To Side	1	1%
Rear-End	28	19%
Right Angle	6	4%
Right Turn, Same Direction	3	2%
Roll Over	4	3%
Sideswipe, Opposite Direction	3	2%
Sideswipe, Same Direction	2	1%
U Turn	1	1%
Wild Animal	69	47%
Total	**147**	**100%**

Crashes with wild animals (47%) were the most prominent crash types followed by rear-end (19%) and collision with fixed objects (6%) in the study segment. Crash types by the individual roadway segments of the study area is included in **Appendix I.**

BELL CROSSING RD/ US HWY 93 INTERSECTION

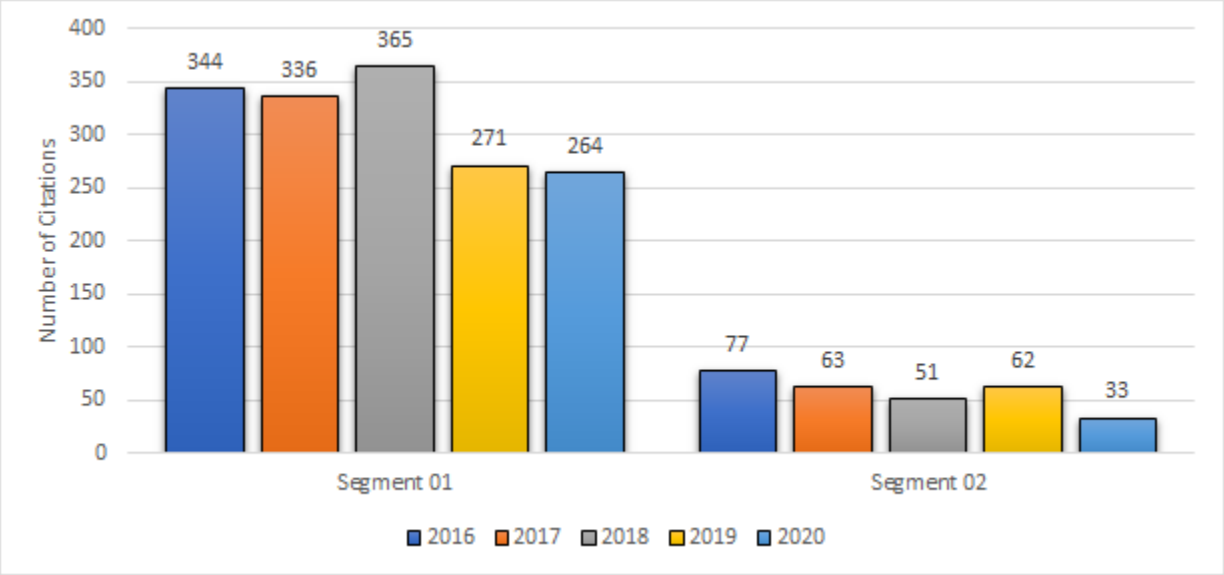
There were no crashes reported during the analysis period at the intersection.

Citation History

The speeding law in Montana 1 § 61-8-303 (3) states: "Subject to the maximum speed limits set forth in subsection (above), a person shall operate a vehicle in a careful and prudent manner and at a reduced rate of speed no greater than is reasonable and prudent under the conditions existing at the point of operation, taking into account the amount and character of traffic, visibility, weather, and roadway conditions." It is critical to note that the law enforcement can issue a ticket for driving a vehicle at unsafe speeds, even if a driver is within the posted speed limit. For example, driving at the posted speed limit on the freeway when there is a blizzard or thick fog. Since these driving conditions are unsafe for you and other drivers, law enforcement is within their rights to issue a speeding ticket as per the speeding laws in Montana.

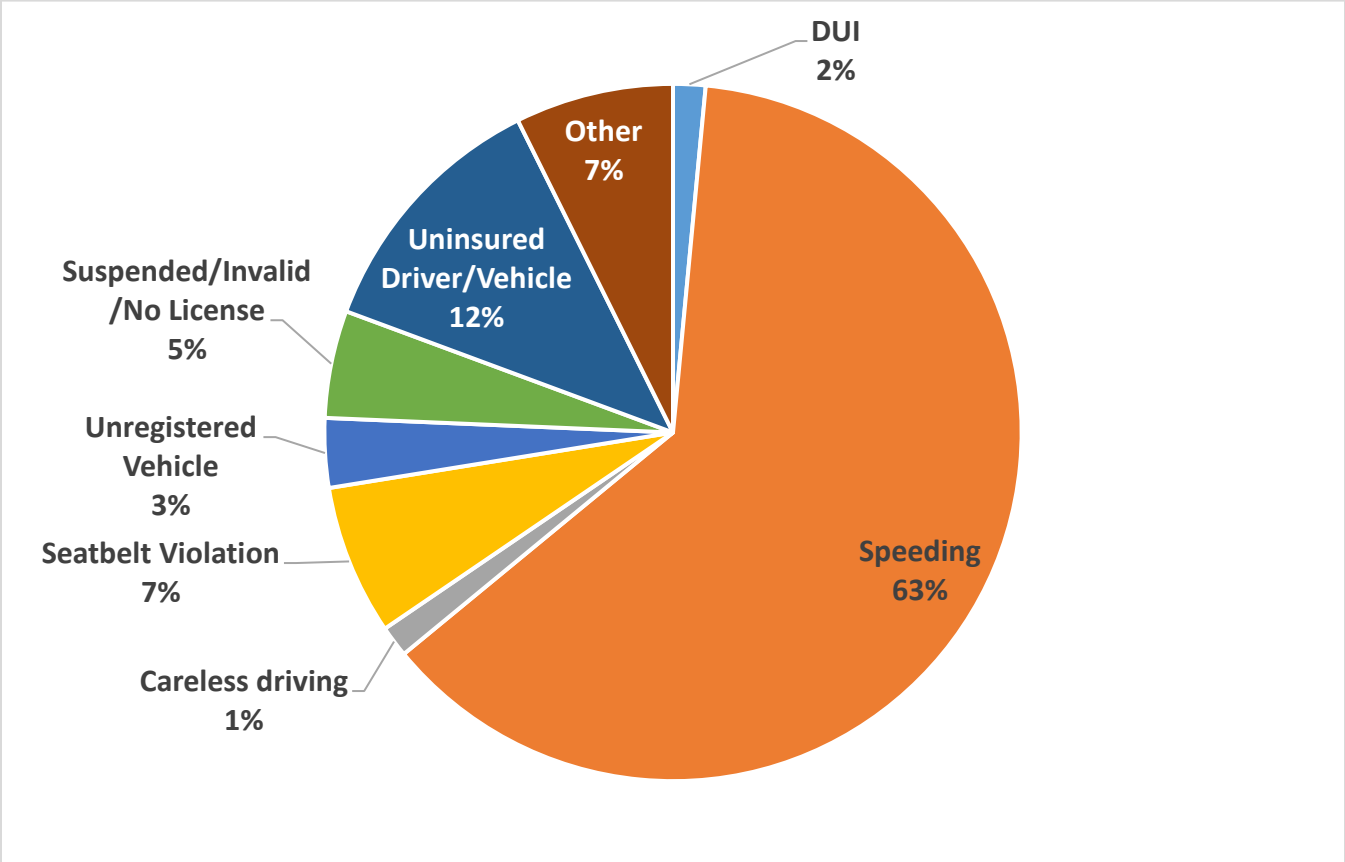
Five years of citation records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. The citation records are extracted in a spreadsheet format. The five-year citation summary for the segments is shown in **Figure 3**. There were 1,866 citations issued in the study area during the analysis period of which 1,167 citations (63%) were speeding violations.

Figure 3 - Citation Summary by Year



The types of citations issued in the study area are shown in **Figure 4**. Speeding (63%), and Uninsured driver/vehicle (12%) were the most prominent types of traffic violations in the study area.

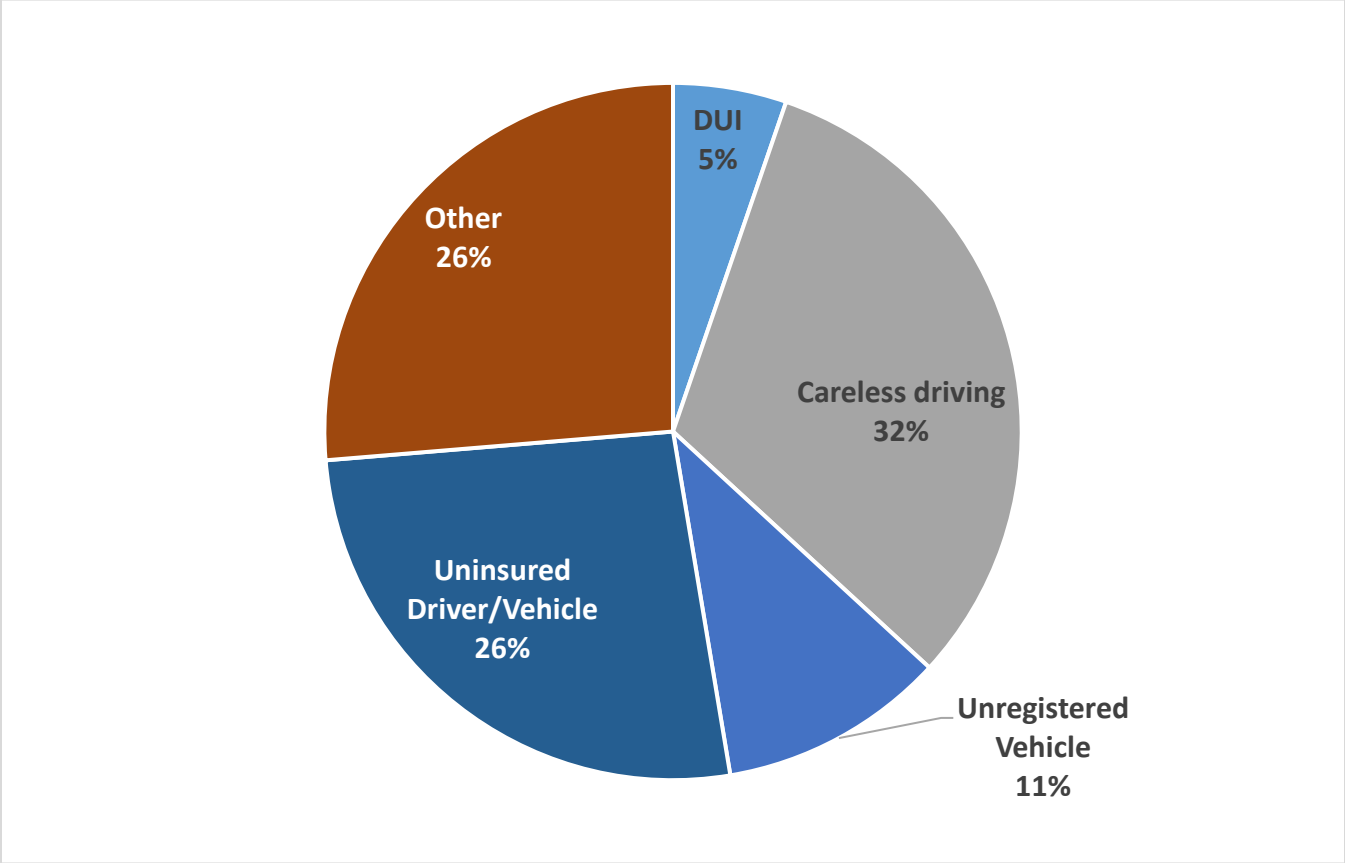
Figure 4 - Citation Types Issued in the study area (2016 - 2020)



BELL CROSSING RD / US HWY 93 INTERSECTION

There were 19 citations at the intersection during the analysis period. The types of citations issued at this intersection are shown in **Figure 4**. Careless Driving (32%) is the most prominent type of traffic violation at this intersection.

Figure 5 - Citation Types Issued at the Intersection of US Hwy 93 with Bell Crossing (2016 - 2020)



5. Speed Characteristics

Engineering Approach

The engineering approach is a two-step process based on operating conditions such as the 85th percentile speed. The 85th percentile is the speed at which 85% of free-flowing traffic is traveling at or below. Once the speed limit is established based on the 85th percentile speed, it can be adjusted (usually downward) based on other factors such as amount of non-motorized traffic, roadway characteristics, and crash history. MDT's procedures for setting speed limits are based on the engineering approach.

MDT uses 85th percentile, 50th percentile, and pace speeds to evaluate speed data. The pace speed is a 10-mph increment in speeds that encompasses the highest portion of observed speeds.

Spot Speed Data

Spot speed studies typically consist of sample sizes totaling at least 100 vehicles with Free Flow Speed (FFS). FFS is the speed of motorists traveling as desired given prevailing conditions such that no preceding vehicle influences

the motorists' speed. Unattended radar devices were placed along the two segments of the study area to collect vehicular speed samples for a 24-hour period between late August and early September 2022**.** The 24-hour data consisted of all vehicles that traveled along the study area with various speed profiles including vehicles that influenced a motorist's choice of speed such as vehicular deceleration to make turns, queuing during peak hour, or a platoon.

Speed data were collected at the two segments, three speed transition zones, and at the intersection of US Hwy 93 with Bell Crossing Rd.

NCHRP

A recent research report from the *National Cooperative Highway Research Program* (NCHRP) has been completed. NCHRP report 17-76: *Development of a Posted Speed Limit Setting Procedure and Tool* collected insights into how the roadway environment influences operating speed and safety (crashes) through a review of literature and the collection and analysis of data from two states. Using those insights along with an understanding of different methods being used and currently being considered for the setting of posted speed limits, the research team developed a speed limit setting procedure along with a tool. The procedure uses fact-based decision rules that consider both driver speed choice and safety associated with the roadway.

There has been a nationwide push over the last several years for the consideration of 50th percentile speed, especially for developed areas. When roadway conditions are not favorable to all users or when crashes are a significant concern, then the suggested speed limit should reflect the rounded down 85th percentile or the 50th percentile speed. Drivers frequently select speeds a certain increment above the posted speed limit, anticipating that they will not receive a ticket if they are below the assumed enforcement speed tolerance. Because of these reasons, 50th percentile speed data were also used in the analysis along with the 85th percentile speed data.

The NCHRP 17-76 Speed Limit Setting Tool was used to calculate the recommended speed limit for the study segment based on key factors such as: 85th percentile and 50th percentile speed, roadway characteristics, and crash history.

Speed Study Results

SEGMENTS

The summary of speed data for the segments for all vehicle types are shown in **Table 4**. For detailed information including the speed by type of vehicle and direction is discussed in individual segment reports included in the **Appendix I**.

Table 4 – Segment Wide Speed Study Summary

Segment	Existing Speed Limit	Calculated Speed %ile		10-mph Pace	% in Pace	NCHRP Recommendation
		85th	50th			
Segment 1	70-mph	68-mph	57-mph	51-61	54%	65-mph
Segment 2	70-mph	69-mph	63-mph	59-69	63%	65-mph

SPEED TRANSITION ZONES

The summary of speed data for the speed transition zones are shown in **Table 5**.

Table 5 - Speed Study Summary at Speed Transition Zones

		Direction	Transition		
			1	2	3
Existing	Reference Point	-	66.2	60	59.8
	Speed Change (mph)	NB	55	70	55
		SB	70	55	45
Calculated	85th %-ile Speed (mph)	NB	70-mph	72-mph	65-mph
		SB	59-mph	72-mph	64-mph
		Both	67-mph	72-mph	65-mph
	50th %-ile Speed (mph)	NB	65-mph	66-mph	59-mph
		SB	53-mph	66-mph	57-mph
		Both	58-mph	66-mph	58-mph
	10-mph Pace Speed (mph)	NB	62-72 mph	63-73 mph	55-65 mph
		SB	49-59 mph	63-73 mph	51-61 mph
		Both	50-60 mph	63-73 mph	54-64 mph
	% in 10-mph Pace Speed (mph)	NB	61%	61%	63%
		SB	66%	61%	63%
		Both	43%	61%	60%

NB – Northbound; SB – Southbound
1 – 65 mph for Trucks

BELL CROSSSING RD INTERSECTION

Spot speed data was collected at the intersection of US Hwy 93 at Bell Crossing Rd on Tuesday, August 30, 2022, from 9:15AM to 11:00AM. Pocket radar device were used to collect speed data. Speed data of 662 sample size were collected and analyzed for speed. The 85th percentile speed and 50th percentile speed was calculated to be 70-mph and 64-mph, respectively. The 10-mph pace was found to be between 61-mph and 71-mph, with 61% of the vehicles travelling within the 10-mph pace. The 85th percentile speed is found to be the posted speed limit. The 50th percentile speed is under the posted speed limit and is within the 10-mph pace.

6. Straight-Line Diagram

Straight-line diagrams are linear graphical representations of features and characteristics along roadways on and some off the State Highway System and nearby surrounding area. These diagrams are prepared to support efforts in preparing for field surveys, planning construction projects, verifying Roadway Characteristics Inventory (RCI) data, and other related applications. The straight-line diagrams for the study area with the speed characteristics at the locations where data has been collected and analyzed are included in **Appendix II**.

7. Recommendations

Segment

Based on the review of the roadway and environment conditions, crash history, speed characteristics, and NCHRP 17-76 Speed Limit Setting Tool, the existing speed limits at the study segments may need to be modified to 65-mph for all vehicle types. However, this could create inconsistent speed limit expectations along the study area for the unfamiliar users travelling between Hamilton and Missoula.

Speed Transition Zones

The speed differentials between the posted speed limit and 85th percentile speed limit are summarized in **Table 6**. The minimum recommended spacing for a speed transition over 45-mph posted speed is 0.5-mile. The spacing between the speed transitions in this segment of US 93 between Victor and Stevensville were all less than the minimum recommended spacings. It is recommended that the speed transition spacings be adjusted to the current MDT practice procedures.

Table 6 - Speed Differentials at Speed Transition Zones

	Direction	Transition		
		1	2	3
85th %-ile Speed (mph)	NB	70	72	65
	SB	59	72	64
Speed Limit Change (mph)	NB	55	70	55
	SB	70	55	45
Δ in Speed (mph)	NB	+15	+2	+10
	SB	-11	+17	+19

TRANSITION 1

- Northbound - The 85th percentile speed is 15-mph greater than the posted speed limit of 55-mph. Vehicles travelling northbound are entering the town of Stevensville from a statutory speed limit of 70 mph cars/65 trucks. This is indicative that the existing speed limit entering Stevensville is appropriate. No change in speed limit is recommended for traffic traveling in the northbound direction in this transition zone.
- Southbound - The speed differentials between the posted speed limit and 85th percentile speed is 11-mph less than the posted speed limit of 70-mph which is indicative that the vehicles are entering rural high-speed roadway after leaving Stevensville. The posted speed limit is appropriate. No change in speed limit is recommended for traffic traveling in the southbound direction in this transition zone.

TRANSITION 2

- Northbound - The 85th percentile speed is two-mph greater than the posted speed limit of 70-mph. Vehicles travelling northbound are close to entering rural high-speed roadway. The existing posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the northbound direction in this transition zone.
- Southbound - The 85th percentile speed is 17-mph greater than the posted speed limit of 55-mph. Vehicles travelling southbound are transitioning from 70-mph to 55-mph. This sudden drop in speed may be the cause of many rear-end crashes in this location. It is recommended that the statutory speed limit of 70-mph in this segment be changed to 65-mph for the traffic traveling in the southbound direction in this transition zone.

TRANSITION 3

- Northbound - The 85th percentile speed is 10-mph greater than the posted speed limit of 55-mph. which is indicative that the vehicles are entering rural high-speed roadway after leaving Victor. The posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the northbound direction in this transition zone.
- Southbound - The 85th percentile speed is 19-mph greater than the posted speed limit of 45-mph. Vehicles travelling southbound are entering the town of Victor from another speed limit transition of 70-mph to 55-mph. The existing speed limit while entering Stevensville may be appropriate. No change in speed limit is recommended for traffic travelling in the southbound direction in this transition zone. However, a traffic calming device may be helpful to lower the travelling speed for traffic travelling southbound in this transition zone.

Bell Crossing Intersection

The 85th percentile speed at this intersection was found to be at the speed limit of 70mph. The existing speed limit is appropriate. No change in speed limit is recommended at the intersection.

APPENDIX I - SEGMENT SPEED STUDIES

ENGINEERING, REIMAGINED

SPEED STUDY

US Hwy 93 – Victor to Stevensville

Reference Point: 61.1 to 66.2

Ravalli County, MT

January 2023

Speed Study

Victor to Stevensville, Montana

RP: 61.1 to 66.2

January 2023

Prepared for:

Montana Department of Transportation

Prepared by:

KLJ Engineering

Table of Contents

1. Introduction 3
2. Methodology 4
3. Roadway Characteristics 4
4. Vehicular Classification 5
5. Safety Characteristics 6
6. Speed Characteristics 9
7. Conclusion 10

List of Figures

Figure 1 - Study Segment 3
Figure 2 - Representative Section of US Hwy 93 from RP 61.1 to 66.2 4
Figure 3 - Five-Year Crash Summary (2016-2020) 6
Figure 4 - Citation Summary by Year 8
Figure 5 - Speed Profile 9

List of Tables

Table 1 - Vehicular Classification 6
Table 2 - Crash Collision Type 7
Table 3 - Speed Study Profile 10

List of Appendices

Appendix A – Pictures .... A
Appendix B – Speed Study Profiles .... B
Appendix C – NCHRP Report C

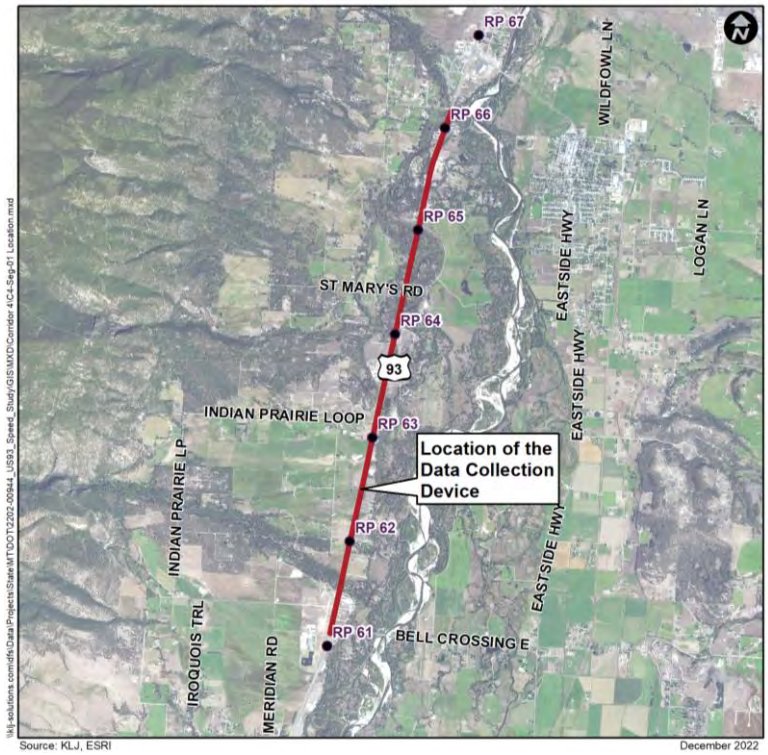
1. Introduction

Speed limits are set to inform motorists of appropriate driving and safe operating speeds under favorable conditions. Speed limits are posted at the statutory speed limit unless a traffic engineering investigation study has been conducted and (where applicable) approved by the Transportation Commission. The *Montana Department of Transportation* (MDT) has requested KLJ Engineering to review the speed limit along US Hwy 93 from Victor to Stevensville.

Study Location

The study segment is US Hwy 93 that begins from Reference Point (RP) 61.1 to RP 66.2 or between the intersection of US Hwy 93 with Bell Crossing Rd to South Kootena Creek Rd. The majority of the 5.1-mile segment paved four-lane undivided roadway, except the northern quarter and southern 1/5th of the segment that is four-lanes with two-way-left-turn-lane (TWLTL) in the center. The statutory speed limit of this segment is 70-mph for regular vehicles and 65-mph for trucks. The annual average daily traffic (AADT) is 9,354 along this segment as per 2021 Counts reported in MDT's Transportation Data Management System (TDMS). The location of the study segment is shown in **Figure 1**.

Figure 1 - Study Segment



Objective

The purpose of this study is to evaluate the appropriate speed of the roadway. The primary tasks for the study included data collection, data analysis, and recommendations for speed limits along the study segment. As part of this study, an evaluation and cataloging of existing roadway conditions, collection of historical AADT, and crash data will be completed.

Procedures

The steps for setting speed limits include planning, coordination, data collection and analysis, review, and presentation to the stakeholders, and finally, determination or implementation of the speed limits. Quality data and good documentation provides support for the judgments that are made.

Five years of the most recent crash and citation data was also requested and received from the MDT for the analysis.

2. Methodology

For determining the appropriate speed limit, the following parameters were reviewed:

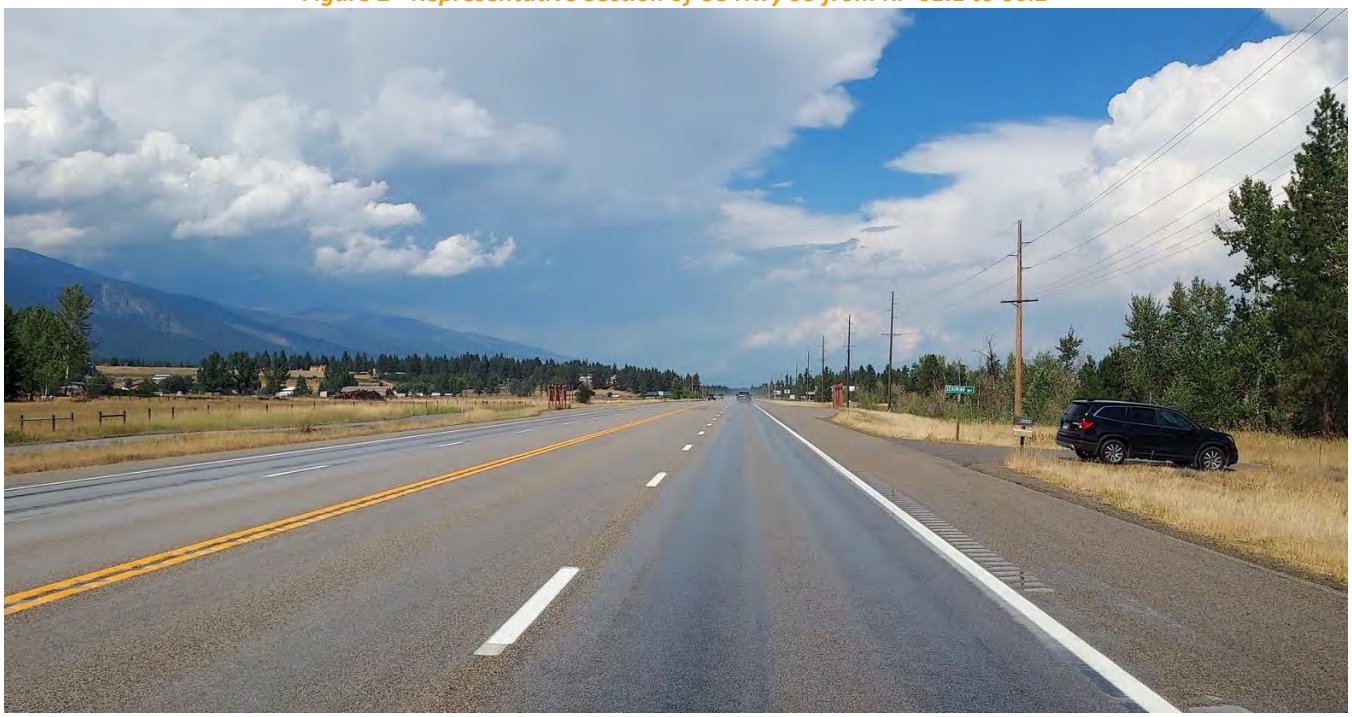
- Roadway Condition/Characteristics
- Crash and Citation History
- Speed Characteristics, and
- Vehicular classes

When considering whether to establish a new posted speed limit or not, surveying and analysis of existing travel speeds is crucial to determining a reasonable posted speed limit. Motorist usually drive at speeds which they perceive as safe, based on the observable roadway conditions. A flat and straight roadway may result in a different travel speed than the posted speed limit due to the driver's observation of the roadway condition.

3. Roadway Characteristics

While speed samples (actual speed measurements of vehicles) are a large part of the necessary data, roadway characteristics should also be considered. Roadway characteristics such as pavement type/conditions, access points, vertical grades, and clear zone assessments data were collected during the field visit in August 2022. **Figure 2** shows the most representative sections of the segments of roadway along the US 93 study segment. Additional pictures of the study segment are available in **Appendix A**.

Figure 2 - Representative Section of US Hwy 93 from RP 61.1 to 66.2



Lanes and Shoulders

The representative typical cross section for this study segment consists mainly of four 11-ft bituminous travelling lanes, and two 10-ft bituminous shoulders. The pavement is generally in good condition. The shoulders are wide enough for safe parking of disabled vehicles. The northern quarter and southern 1/5th of the segment has four-lanes with a center TWLTL.

Rumble Strips

There are shoulder rumble strips present throughout the segment. Centerline rumble strips are only present on the four-lane sections of the segment.

Access Points per Mile

An access point refers to public roads, a business driveway, a private driveway, or a farm field access. Fewer access points per mile means drivers are responding to a reduced number and variety of events. The study section has a combined 48 accesses (11 public, 26 private, and 11 field access) within the nearly 5.1-mile segment that corresponds to 9.4 access points per mile. The recommended primary full-movement and secondary intersection spacing for a rural principal arterial is one-mile and half-mile, respectively. The recommended and maximum density for driveways per mile for a 70-mph principal arterial roadway is no more than 18.8 based on Stopping Sight Distance chart documented in AASHTO Green Book, 5th Edition.

Vertical Grades

Grade is the rate of change of the vertical alignment. Grade affects vehicle speed and vehicle control, particularly for large trucks. The study segment can be described as generally flat.

Roadside Hazard Assessment

The segment generally comprises of both cut and fill section with a clear zone that is partially obstructed. There is a trail that runs parallel on the west side of the roadway. There are sections of roadway on the west side where there is agricultural fence within the clear zone. There are guardrails within clear zone that protect from a creek around RP 65.0, and along the south end of the study segment.

In-slope

The in-slope measured at the representative section is generally flat. The in-slope was measured at 6:1 which is considered a recoverable slope. There are driveways along the study segment that have steep slopes because of culverts crossing them. These steep slopes appear to be non-traversable.

Adjacent Development

The area around the segment is mostly rural residential with a short section of agricultural land use in the middle of the segment.

Statutory and Advisory Speeds

The statutory speed limit is 65-mph for trucks and 70-mph for all other vehicles throughout the segment. There are no advisory speeds along the segment.

Traffic Control

The southern end of the study segment, Bell Crossing Rd, has an dual overhead flashing beacon that is flashing yellow for Hwy 93 and flashing red for Bell Crossing Rd.

4. Vehicular Classification

Vehicular class data for 24-hour period were collected on August 23, 2022. Vehicle types were categorized to two classifications:

- **Mid-size Vehicles** consisting of motorcycles, passenger vehicles, pickups, vans, buses, conventional vans, and city delivery trucks.
- **Large Vehicles** consisting of single unit four or more axle trucks.

There are 8,590 and 610 daily small to mid-size and large vehicles, respectively that travel in the segment. Note that data collected for the northbound direction were lumped for all vehicles and did not differentiate between small to mid-size and large vehicles. Historic records were reviewed to establish the truck percentages for northbound direction. The daily distribution is 53% along northbound and 47% along southbound. The vehicular classifications in the study segment are summarized in **Table 1**.

Table 1 - Vehicular Classification

Classification	Northbound	Southbound	Total	Percent
Small to Mid-Size vehicles	4,590	4,000	8,590	93%
Large vehicles	310[1]	300	610	7%
Total (Percent)	**4,900 (53%)**	**4,300 (47%)**	**9,200**	**100%**

1 - The traffic data collected along northbound lumped all vehicle types into one. Speed for trucks were calculated based on historic truck percentages and engineering judgement.

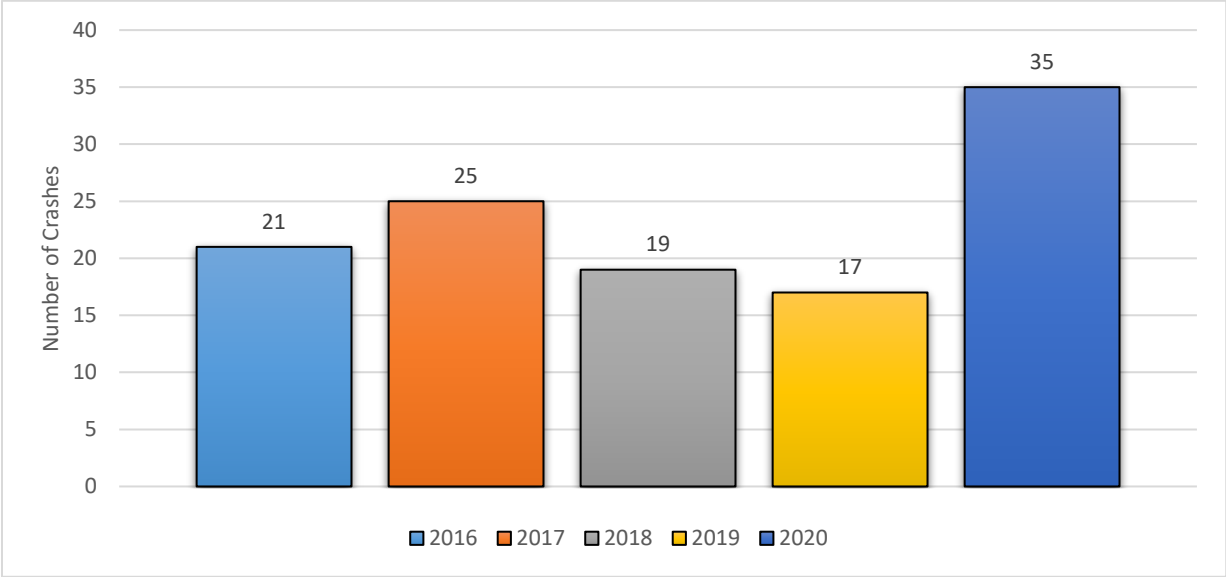
5. Safety Characteristics

Reviewing historic crash and citation information can help identify driver behavior issues that can provide additional information for setting speed the appropriate and safer speed limit.

Crash History

Five years of crash records between January 1, 2016, through December 31, 2020, were requested from the MDT. MDT shared crash records in a spreadsheet format. The five-year crash summary by year is shown in **Figure 3**. There were 117 crashes (one fatal, four serious injury, 12 minor injury, six possible injury, 92 property damage only, and two unknown type crashes) reported during the analysis period. This corresponds to 23.4 crashes per year or 4.6 crashes per year per mile. The number of crashes increased by 70% in 2020 from the average crashes per year between 2016 and 2019.

Figure 3 - Five-Year Crash Summary (2016-2020)



102 crashes or 87% of all the crashes were non-junction related. Crash summary by crash type is shown in **Table 2**.

Table 2 - Crash Collision Type

Type	# Crashes	% Crashes
Domestic Animal	1	1%
Fixed Object	7	6%
Head On	1	1%
Jackknife	1	1%
Left Turn, Opposite Direction	2	2%
Left Turn, Same Direction	3	3%
Not Fixed Object or Debris	2	2%
Other	3	3%
Rear-End	16	14%
Right Angle	5	4%
Roll Over	4	3%
Sideswipe, Opposite Direction	3	3%
Sideswipe, Same Direction	1	1%
Wild Animal	68	58%
Total	**117**	**100%**

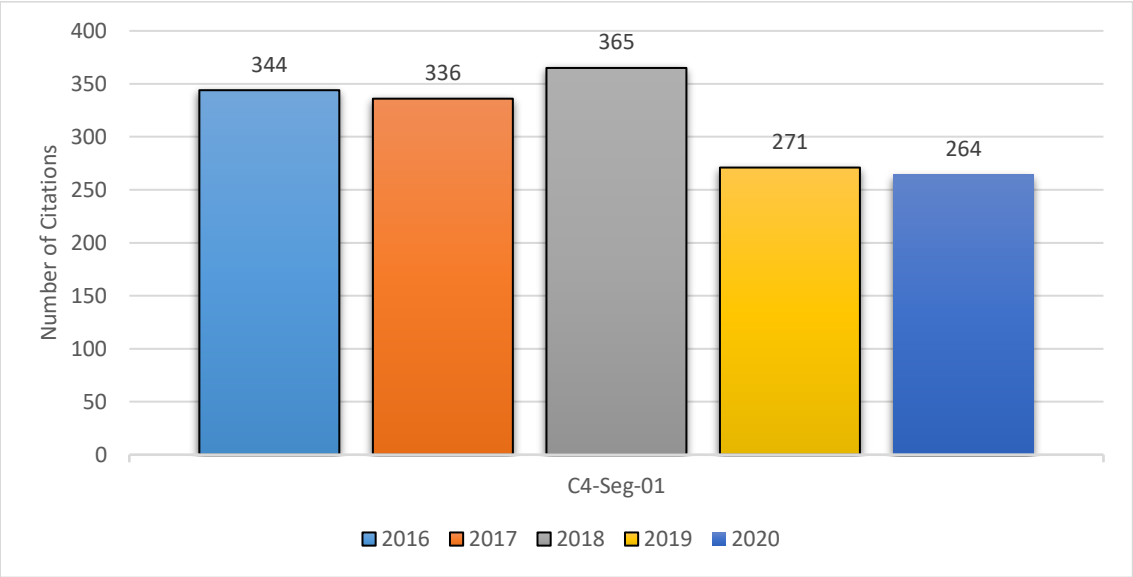
Crashes with wild animals (58%) were the most prominent crash type followed by rear-end crashes (14%) in the study segment. The crash data had no supplement officer narratives to identify if speeding was the contributing factor for any of these crashes.

Citation History

The speeding law in Montana 1 § 61-8-303 (3) states: "Subject to the maximum speed limits set forth in subsection (above), a person shall operate a vehicle in a careful and prudent manner and at a reduced rate of speed no greater than is reasonable and prudent under the conditions existing at the point of operation, taking into account the amount and character of traffic, visibility, weather, and roadway conditions." It is critical to note that the law enforcement can issue a ticket for driving a vehicle at unsafe speeds, even if a driver is within the posted speed limit. For example, driving at the posted speed limit on the freeway when there is a blizzard or thick fog. Since these driving conditions are unsafe for you and other drivers, law enforcement is within their rights to issue a speeding ticket as per the speeding laws in Montana.

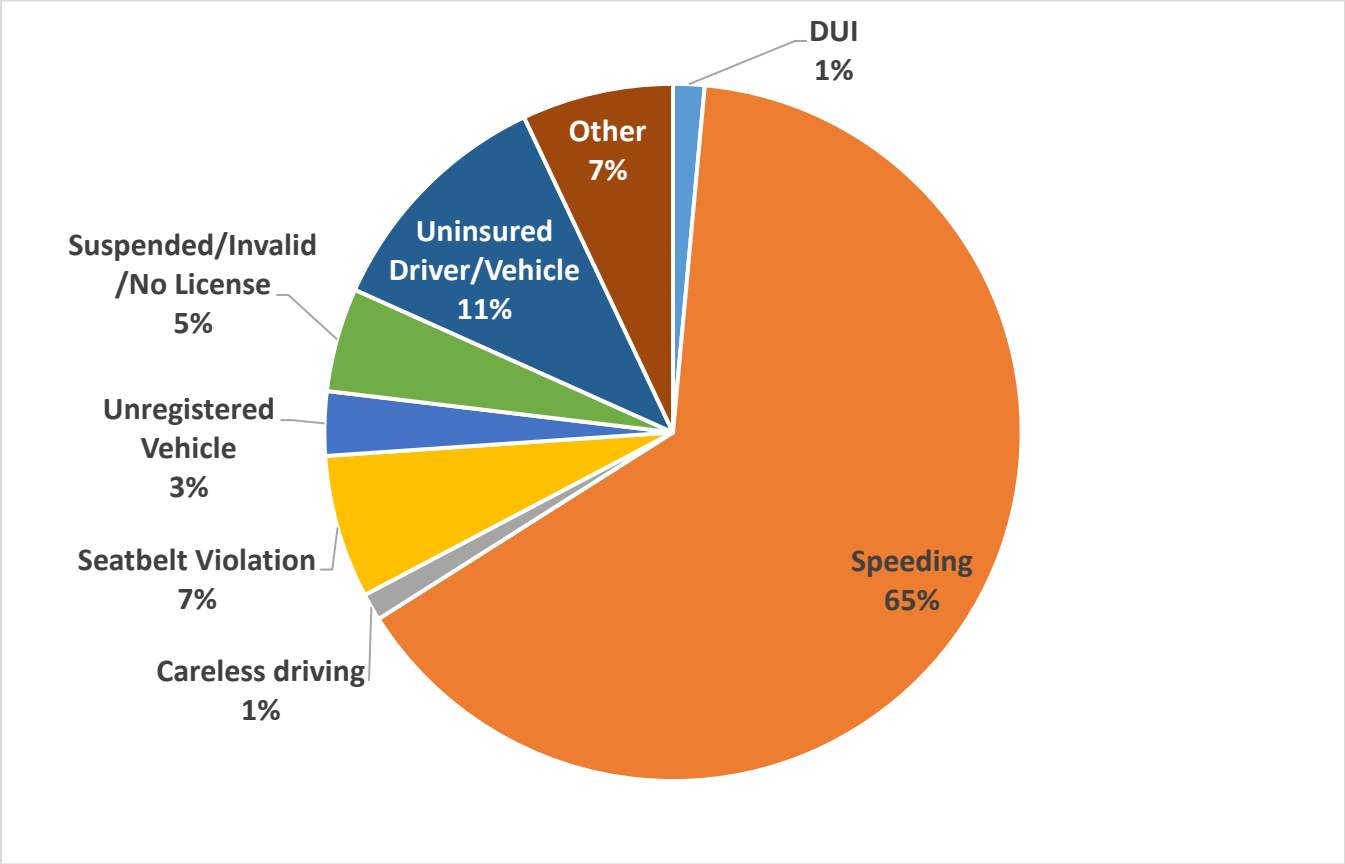
Five years of citation records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. The MDT Traffic & Safety Bureau shared citation records in a spreadsheet format. The five-year citation summary for the segment is shown in **Figure 4**. There were 1,580 citations issued in the study segment during the analysis period of which 1,020 citations (65%) were speeding violations.

Figure 4 - Citation Summary by Year



The most citations were given between April and June (30%). The types of citation issued in this segment is shown in **Figure 5**. Speeding (65%), and Uninsured driver/vehicle (11%) were the most prominent types of traffic violations in the study area.

Figure 5 - Citation Types Issued (2016 - 2020)



6. Speed Characteristics

Engineering Approach

The engineering approach is a two-step process based on operating conditions such as the 85th percentile speed. The 85th percentile is the speed at which 85% of free-flowing traffic is traveling at or below. Once the speed limit is established based on the 85th percentile speed, it can be adjusted (usually downward) based on other factors such as amount of non-motorized traffic, roadway characteristics, and crash history. MDT's procedures for setting speed limits are based on the engineering approach.

MDT uses 85th percentile, 50th percentile, and pace speeds to evaluate speed data. The pace speed is a 10-mph increment in speeds that encompasses the highest portion of observed speeds.

Spot Speed Data

Spot speed studies typically consist of sample sizes totaling at least 100 vehicles with Free Flow Speed (FFS). FFS is the speed of motorists traveling as desired given prevailing conditions such that no preceding vehicle influences the motorists' speed. Unattended radars were placed along the study segment to collect vehicular speed samples for a 24-hour period from August 24 to 25, 2022 near RP 62.5**.** The 24-hour data consisted of all vehicles that traveled along the study segment with various speed profiles including vehicles that influenced a motorist's choice of speed such as vehicular deceleration to make turns, queuing during peak hour, or a platoon.

The road and shoulder surface were clear of surface water or snow during the period when data were recorded. The result of the speed profile in the study segment is shown in **Figure 6** and **Table 3**. For details please see **Appendix B**. The 85th percentile speed was found to be 68-mph and the 50th percentile speed was found to be 57-mph. The 10-mph pace was found to be between 51-mph and 61-mph comprising of 54% of daily vehicles within that 10-mph pace. The 85th percentile and 50th percentile speeds were less than the posted speed limit. The 85th percentile speed was higher than the upper tail-end of the 10-mph pace range, whereas the 50th percentile speed was within the 10-mph pace.

Figure 6 - Speed Profile for All Vehicle Types in Both Direction of Travel

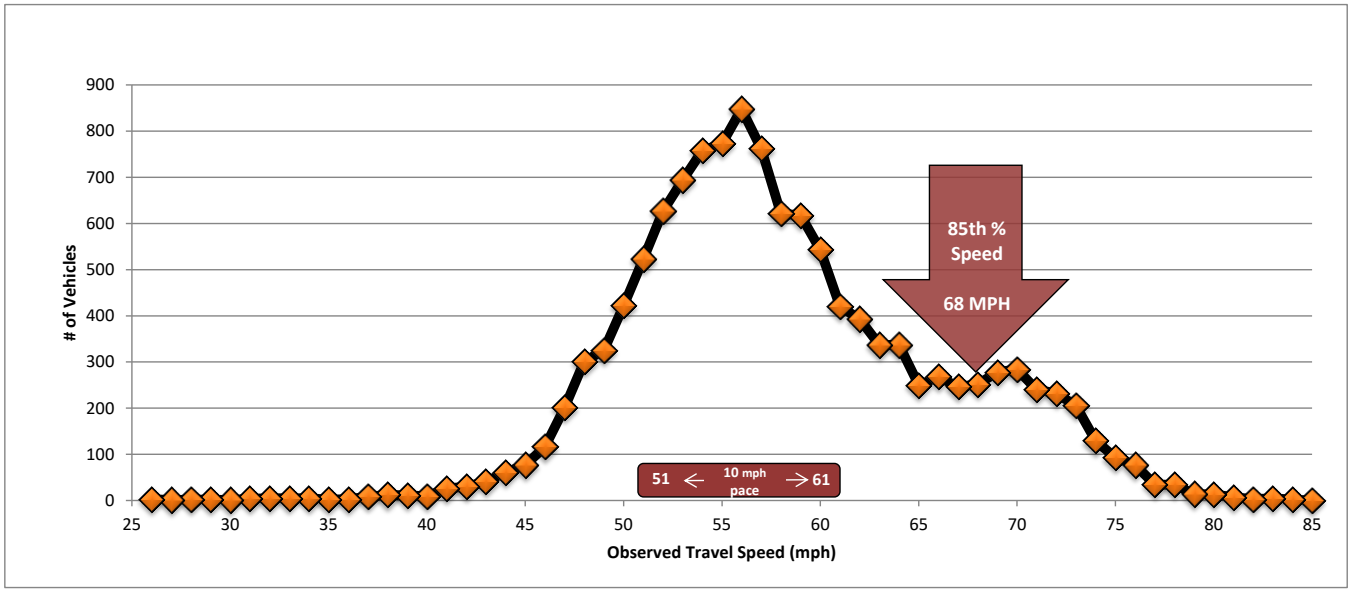


Table 3 - Speed Study Profile

Vehicle Type	Direction	10-mph Pace	% In Pace	85th Percentile Speed	50th Percentile Speed
Small to Mid-size	NB	52-62 mph	65%	63-mph	57-mph
	SB	51-61 mph	41%	71-mph	60-mph
	Both	51-61 mph	54%	68-mph	57-mph
Large	NB[1]	51-61 mph[1]	67%[1]	61-mph[1]	56-mph[1]
	SB	47-57 mph	53%	65-mph	55-mph
	Both	50-60 mph	58%	64-mph	56-mph
All	NB	51-61 mph	65%	62-mph	56-mph
	SB	51-61 mph	41%	71-mph	60-mph
	Both	51-61 mph	54%	68-mph	57-mph

1 – The traffic data collected along northbound lumped all vehicle types into one. Speed for trucks were calculated based on historic truck percentages and engineering judgement.

NCHRP

A recent research report from the *National Cooperative Highway Research Program* (NCHRP) has been completed. NCHRP report 17-76: *Development of a Posted Speed Limit Setting Procedure and Tool* collected insights into how the roadway environment influences operating speed and safety (crashes) through a review of literature and the collection and analysis of data from two states. Using those insights along with an understanding of different methods being used and currently being considered for the setting of posted speed limits, the research team developed a speed limit setting procedure along with a tool. The procedure uses fact-based decision rules that consider both driver speed choice and safety associated with the roadway.

There has been a nationwide push over the last several years for the consideration of 50th percentile speed, especially for developed areas. When the roadway conditions are optimal, the suggested speed limit should reflect the 85th percentile speed. When roadway conditions are not favorable to all users or when crashes are a significant concern, then the suggested speed limit should reflect the rounded down 85th percentile or the 50th percentile speed. Drivers frequently select speeds a certain increment above the posted speed limit, anticipating that they will not receive a ticket if they are below the assumed enforcement speed tolerance. Because of these reasons, 50th percentile speed data were also used in the analysis along with the 85th percentile speed data.

The NCHRP 17-76 Speed Limit Setting Tool was used to calculate the recommended speed limit for the study segment based on key factors such as: 85th percentile and 50th percentile speed, roadway characteristics, and crash history. The recommended speed for the study segment based on NCHRP 17-76 was found to be 65-mph along in this segment. Details of the NCHRP 17-76 report is available in **Appendix C**.

7. Conclusion

Vehicular Classification

There are 8,590 and 610 daily small to mid-size and large vehicles, respectively that travel in the segment. The daily distribution is 53% along northbound and 47% along southbound.

Safety Characteristics

There were 117 crashes (one fatal, four serious injury, 12 minor injury, six possible injury, 92 property damage only, and two unknown type crashes) reported during the analysis period. Crashes with wild

animals (58%) were the most prominent crash types followed by rear-end crashes (14%) in the study segment.

There were 1,580 citations issued in the study segment during the analysis period of which 1,020 citations (65%) were speeding violations.

Roadway Characteristics

The segment, RP 61.1 to RP 66.2, being reviewed has a statutory 65-mph speed limit for trucks and 70-mph for regular vehicles. The majority of the 5.1-mile segment is a paved four-lane undivided roadway, except the northern quarter and southern 1/5th of the segment that is four lanes with a center TWLTL. The segment consists of both cut and fill sections with some fixed objects within the clear zone. There are shoulder rumble strips present throughout the segment. Centerline rumble strips are only present on the four-lane section of the segment. The shoulders are wide on both sides of the roadway for safe parking of disabled vehicles. The vertical grades and in-slopes are generally flat in the segment. The road conditions are generally in good condition. The area around the segment is mostly rural residential with some agricultural in the middle of the segment. The driveway density in the study segment is less than the maximum number of driveway thresholds for similar type of facility.

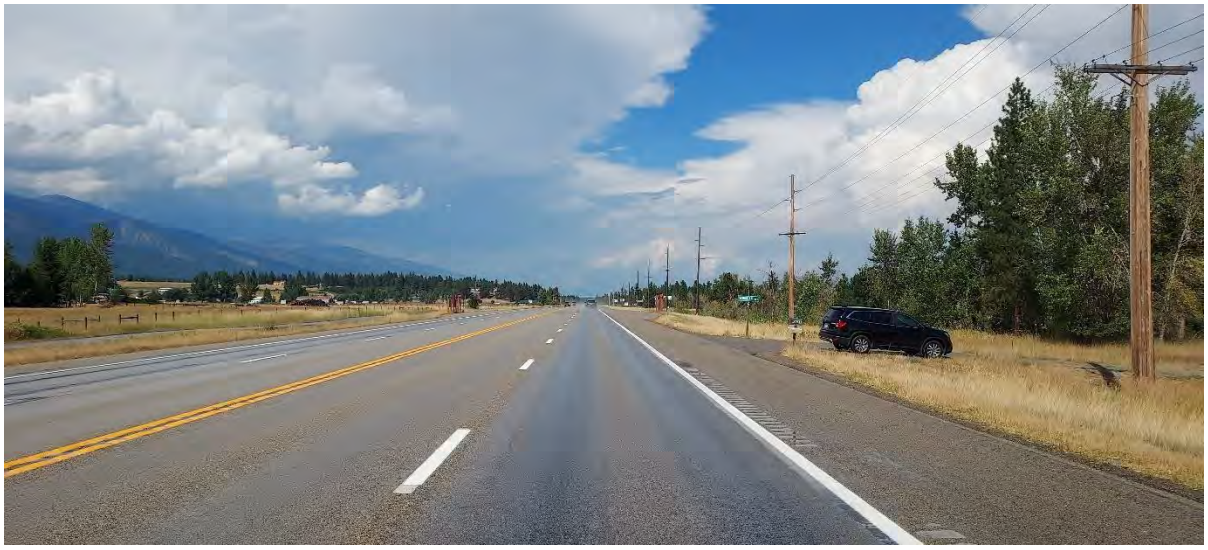
Speed Characteristics

The 85th percentile speed was found to be 68-mph and the 50th percentile speed was found to be 57-mph. The 10-mph pace was found to be between 51-mph and 61-mph comprising of 54% of daily vehicles within that 10-mph pace. The recommended speed for the study segment based on NCHRP 17-76 was found to be 65-mph along in this segment. The 85th percentile speed, percentage of rear-end crashes, and high percentage of speeding violations, and NCHRP recommended speed is indicative that the existing posted speed limit of 70-mph in this segment may need to be reduced to 65-mph.

APPENDIX A – PICTURES


HISTORIC
POINT

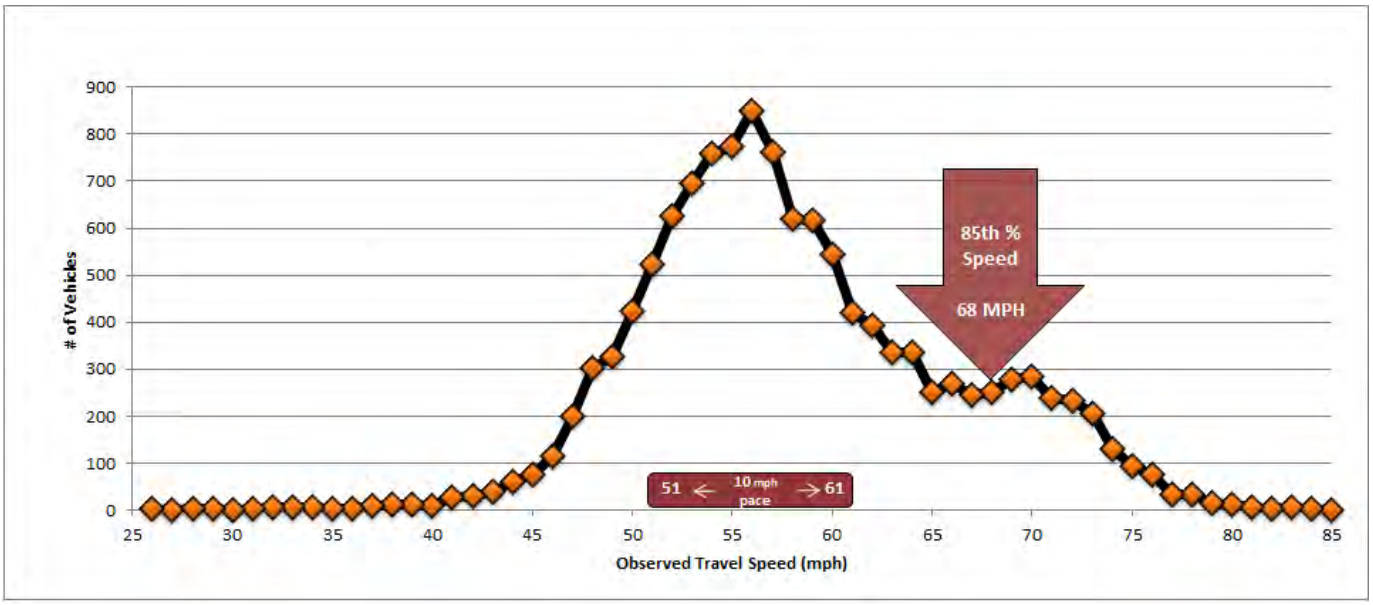

HISTORIC
POINT

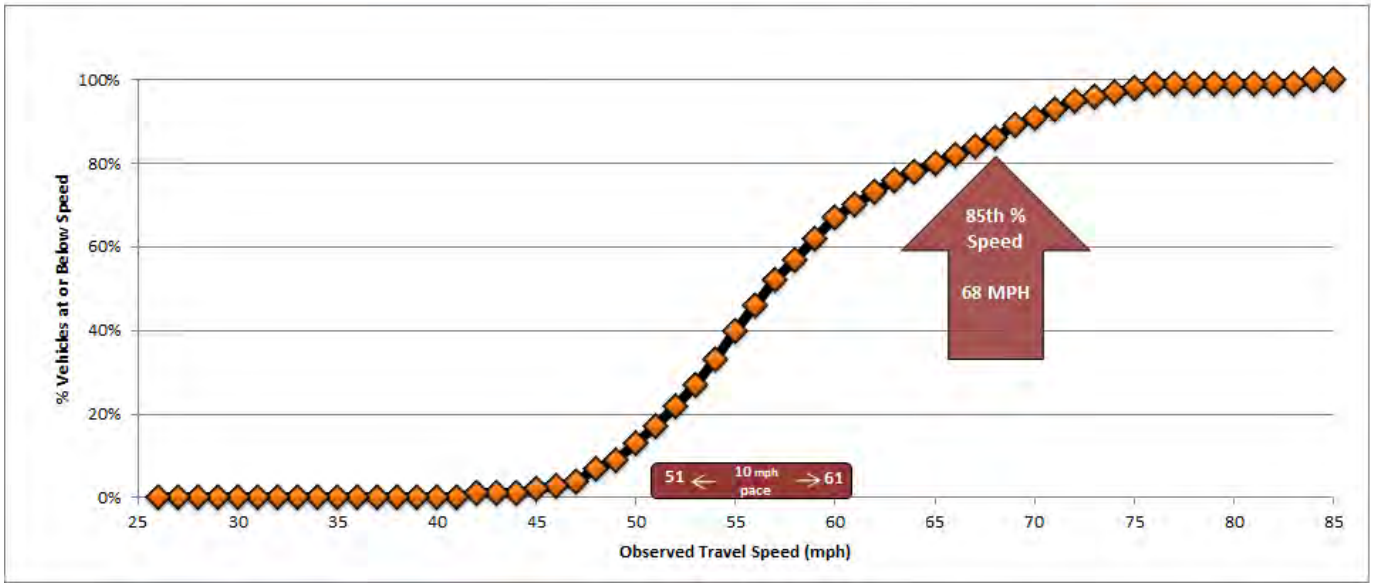


APPENDIX B – SPEED STUDY PROFILES

SPEED SAMPLE SUMMARY (ALL VEHICLES)

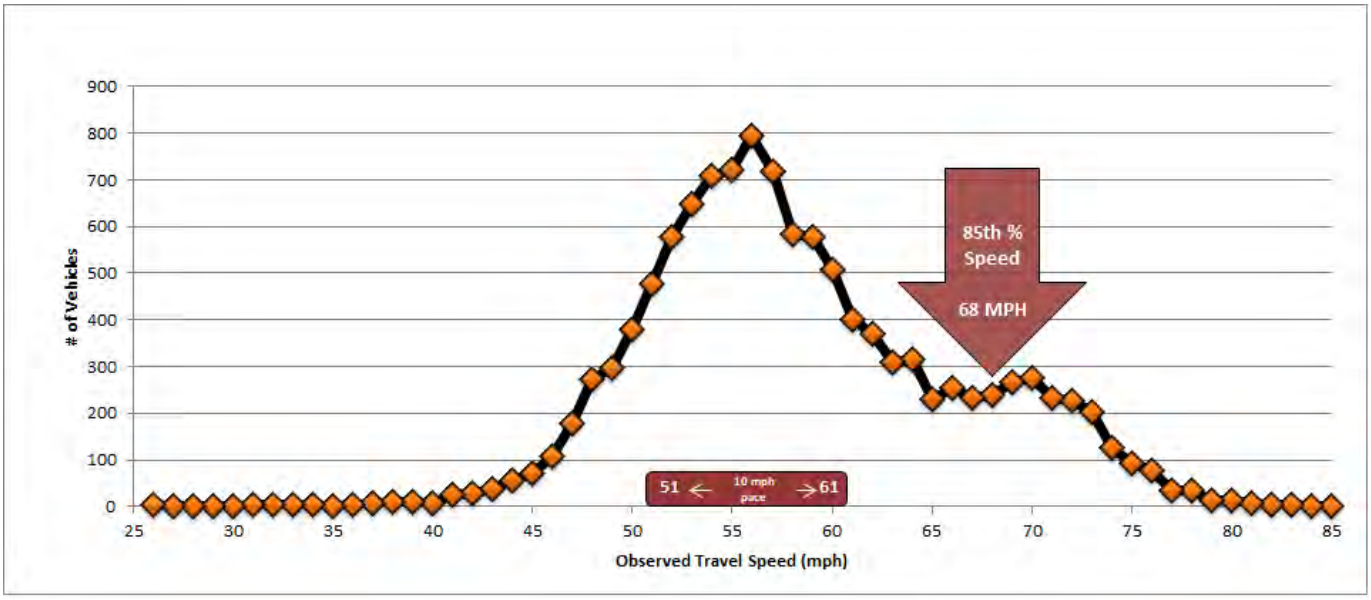
ID:	A4-Seg-01	Speed Limit	70 MPH	Day/Date	Thursday, August 25, 2022
Roadway:	US 93	Seg. Length:	5.1 MILES	Time:	24-hours
Study Limits:	Victor to Stevensville	Road Type:	Four-Lane, Two way	Sample Loc	46.466361,-114.130201
City/County:	Ravalli	ADT Range:	NB-4900 SB-4300	Weather:	-
RP:	61.1 to 66.2	Truck ADT:	NB-0 SB-300	Observer(s):	KLJ
85th % Speed:	68	10 mph pace	51-61	Machine:	Houston Radar
50th % Speed:	57	% in pace	54%		

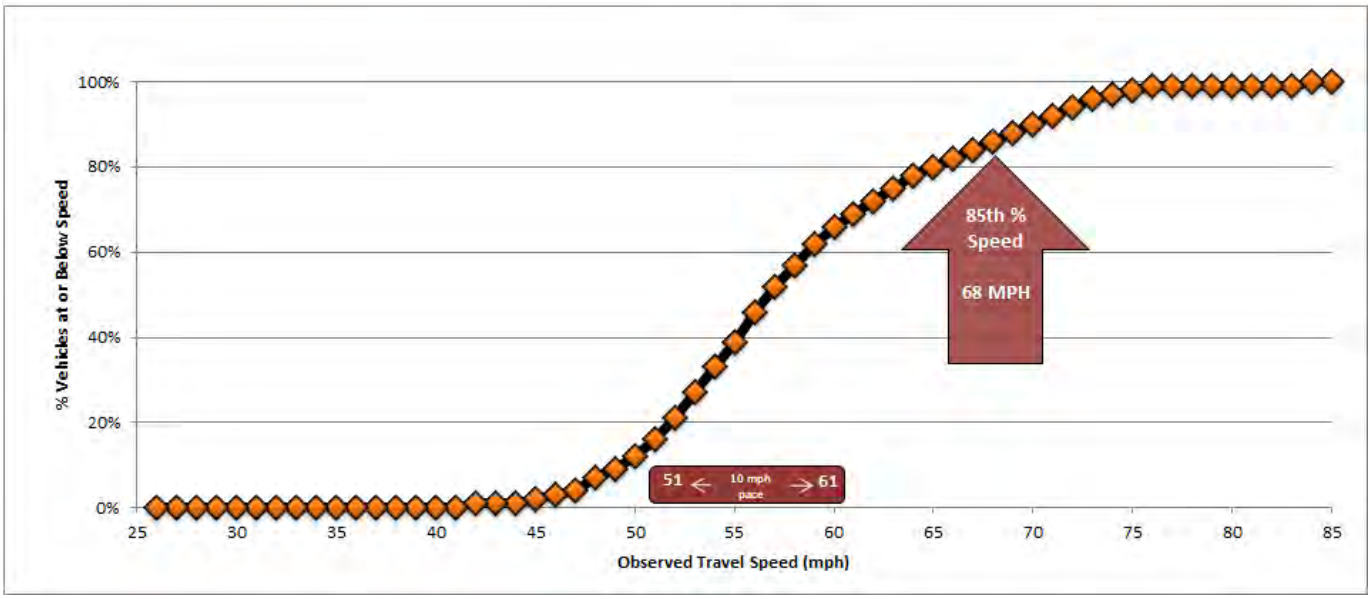




SPEED SAMPLE SUMMARY (PASSENGER VEHICLES)

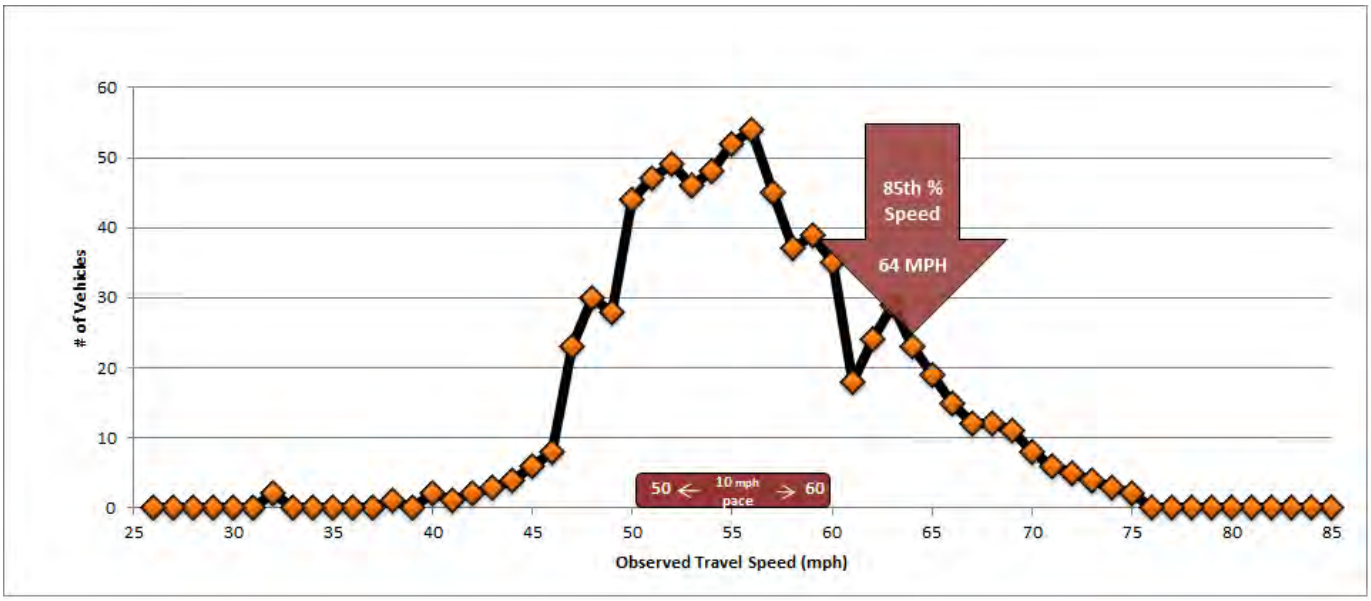
ID:	A4-Seg-01	Speed Limit	70 MPH	Day/Date	Thursday, August 25, 2022
Roadway:	US 93	Seg. Length:	5.1 MILES	Time:	24-hours
Study Limits:	Victor to Stevensville	Road Type:	Four-Lane, Two way	Sample Loc	46.466361,-114.130201
City/County:	Ravalli	ADT Range:	NB-4900 SB-4300	Weather:	-
RP:	61.1 to 66.2	Truck ADT:	NB-0 SB-300	Observer(s):	KLJ
85th % Speed:	68	10 mph pace	51-61	Machine:	Houston Radar
50th % Speed:	57	% in pace	54%		

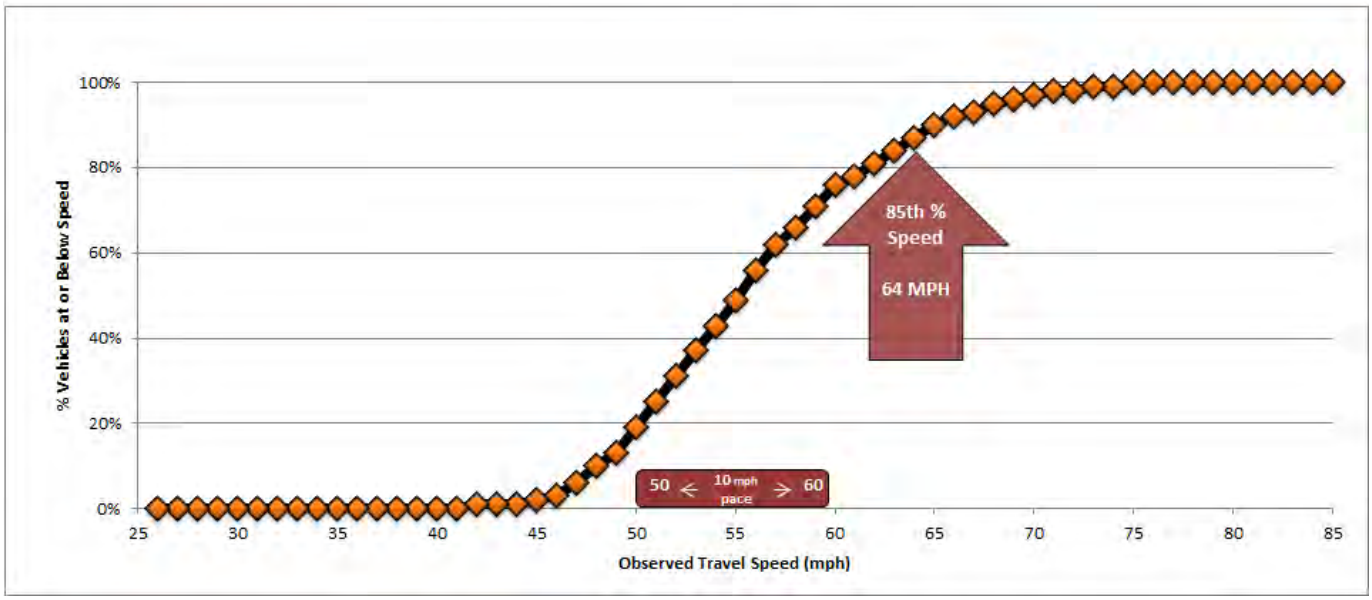




SPEED SAMPLE SUMMARY (TRUCKS)

ID:	A4-Seg-01	Speed Limit	70 MPH	Day/Date	Thursday, August 25, 2022
Roadway:	US 93	Seg. Length:	5.1 MILES	Time:	24-hours
Study Limits:	Victor to Stevensville	Road Type:	Four-Lane, Two way	Sample Loc	46.466361,-114.130201
City/County:	Ravalli	ADT Range:	NB-4900 SB-4300	Weather:	-
RP:	61.1 to 66.2	Truck ADT:	NB-0 SB-300	Observer(s):	KLJ
85th % Speed:	64	10 mph pace	50-60	Machine:	Houston Radar
50th % Speed:	56	% in pace	58%		





APPENDIX C – NCHRP REPORT

NCHRP 17-76 Speed Limit Setting Tool			
Input Cells	*Description*	*Output Cells*	
Site Description Data			**Color-Coding Legend**
Rural	Roadway context		Aqua = basic input cell
Principal arterial	Roadway type		Denim = basic input cell with drop-down menu
Yes	Are crash data available?		Orange = optional input cell (not needed for calculations
Oz Khan, PE	Analyst		Green = optional input cell (use if data for agency & region are available, leave blank otherwis
11/17/2022	Date		Rose = intermediate calculations
US Hwy 93	Roadway name		Purple = final analysis results
b/w RP 61.1 and 66.2	Description		
70	Current speed limit (mph)		
A4-Seg-01	Notes		**Note: The "Test macros" button provides a message to verify proper macro operation**
Analysis Results			**Advisory, Calculated, or Warning Messages**
	Speed limit setting group	Undeveloped	
	Suggested speed limit (mph)	**65**	**This value is determined by speed data & site characteristics.**
Speed Data			**Advisory, Calculated, or Warning Messages**
70	Maximum speed limit (mph)		
68	85th-percentile speed (mph)		
57	50th-percentile speed (mph)		
Site Characteristics			**Advisory, Calculated, or Warning Messages**
5.1	Segment length (mi)		
8,200	AADT (two-way total) (veh/d)		
4	Number of lanes (two-way total		
Undivided	Median type		**Rounded-Down 85th**
48	Number of access points (total of both directions		
11	Lane width (ft)		
10	Shoulder width (ft)		
No	Adverse alignment present?		
Crash Data			**Advisory, Calculated, or Warning Messages**
5	Number of years of crash data		
8,200	Average AADT for crash data period (veh/d		
117	All (KABCO) crashes for crash data period		**Observed KABCO crash rate = 153.3 crashes / 100 MVMT**
23	Fatal & injury (KABC) crashes for crash data period		**Observed KABC crash rate = 30.14 crashes / 100 MVMT**
	Average KABCO crash rate (crashes / 100 MVMT		**HSIS average KABCO crash rate = 145.63 crashes / 100 MVMT**
	Average KABC crash rate (crashes / 100 MVMT		**HSIS average KABC crash rate = 42.08 crashes / 100 MVMT**
	1.3 x average KABCO crash rate (crashes / 100 MVMT	189.3	
	1.3 x average KABC crash rate (crashes / 100 MVMT	54.7	
	Critical KABCO crash rate (crashes / 100 MVMT)	169.0	
	Critical KABC crash rate (crashes / 100 MVMT)	54.9	

ENGINEERING, REIMAGINED

SPEED STUDY

US Hwy 93 – Victor to Stevensville

Reference Point: 60.1 to 61.1

Ravalli County, MT

January 2023

Speed Study

Victor to Stevensville, Montana

RP: 60.1 to 61.1

January 2023

Prepared for:

Montana Department of Transportation

Prepared by:

KLJ Engineering

Table of Contents

1. Introduction 1
2. Methodology 2
3. Roadway Characteristics 2
4. Vehicular Classification 3
5. Safety Characteristics 3
6. Speed Characteristics 6
7. Conclusion 8

List of Figures

Figure 1 - Study Segment 1
Figure 2 - Five-Year Crash Summary (2016-2020) 4
Figure 3 - Citation Summary by Year 5
Figure 4 - Citation Types Issued (2016 - 2020) 6
Figure 5 - Speed Profile for All Vehicles Types in Both Direction of Travel 7

List of Tables

Table 1 - Vehicular Classification 3
Table 2 - Crash Collision Type 4
Table 3 - Speed Study Profile 7

List of Appendices

Appendix A – Speed Study Profiles ..... A
Appendix B – NCHRP Report ..... B

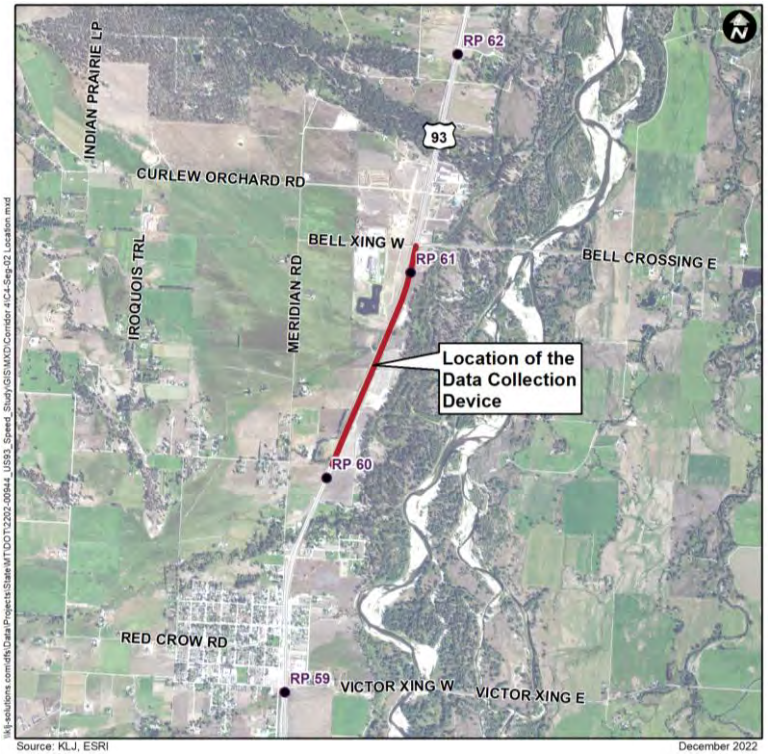
1. Introduction

Speed limits are set to inform motorists of appropriate driving and safe operating speeds under favorable conditions. Speed limits are posted at the statutory speed limit unless a traffic engineering investigation study has been conducted and (where applicable) approved by the Transportation Commission. The *Montana Department of Transportation* (MDT) has requested KLJ Engineering to review the posted speed limit along US Hwy 93 from Victor to Stevensville.

Study Location

The study segment is US Hwy 93 that begins from Reference Point (RP) 60.1 to 61.1 or between the intersection of US Hwy 93 with Bell Crossing Rd to one mile south of the intersection. The northern and southern part of the segment is a paved four-lane undivided roadway. One-third of the segment in the middle is a paved four-lane roadway with a two-way-left-turn-lane (TWLTL) in the center. The statutory speed limit of this segment is 70-mph for regular vehicles and 65-mph for trucks. There is an annual average daily traffic (AADT) of 7,215 that travel along this segment as per data collected in 2021 by MDT. The location of the study segment is shown in **Figure 1**.

Figure 1 - Study Segment



Objective

The purpose of this study is to evaluate the appropriate speed of the roadway. The primary tasks for the study included data collection, data analysis, and recommendations for speed limits along the study segment. As part of this study, an evaluation and cataloging of existing roadway conditions, collection of historical AADT, and crash data will be completed.

Procedures

The steps for setting speed limits include planning, coordination, data collection and analysis, review, and presentation to the stakeholders, and finally, determination or implementation of the speed limits. Quality data and good documentation provides support for the judgments that are made.

Five years of the most recent crash and citation data was also requested and received from the MDT Traffic & Safety Bureau for the analysis.

2. Methodology

For determining the appropriate speed limit, the following parameters were reviewed:

- Roadway Condition/Characteristics
- Crash and Citation History
- Speed Characteristics, and
- Vehicular classes

When considering whether to establish a new posted speed limit or not, surveying and analysis of existing travel speeds is crucial to determining a reasonable posted speed limit. Motorist usually drive at speeds which they perceive as safe, based on the observable roadway conditions. A flat and straight roadway may result in a different travel speed than the posted speed limit due to the driver's observation of the roadway condition.

3. Roadway Characteristics

While speed samples (actual speed measurements of vehicles) are a large part of the necessary data, roadway characteristics should also be considered. Roadway characteristics such as pavement type/conditions, access points, vertical grades, and clear zone assessments data were collected during the field visit in August 2022.

Lanes and Shoulders

The representative typical cross section for this study segment consists mainly of four 11-ft bituminous travelling lanes, and two 10-ft bituminous shoulders. The pavement is generally in good condition. The shoulders are wide enough for safe parking of disabled vehicles. One-third of the segment in the middle is a paved four-lane roadway with a center TWLTL.

Rumble Strips

There are shoulder rumble strips present throughout the segment. There are centerline rumple strips present in the four-lane section of the segment.

Access Points per Mile

An access point refers to public roads, a business driveway, a private driveway, or a farm field access. Fewer access points per mile means drivers are responding to a reduced number and variety of events. The study section has a combined 11 accesses (one public, seven private, and three field access) within the nearly one-mile segment that corresponds to 11 accesses points per mile. The recommended primary full-movement and secondary intersection spacing for a rural principal arterial is one-mile and half-mile, respectively. The recommended and maximum density for driveways per mile for a 70-mph principal arterial roadway is no more than 18.8 based on Stopping Sight Distance chart documented in AASHTO Green Book, 5th Edition.

Vertical Grades

Grade is the rate of change of the vertical alignment. Grade affects vehicle speed and vehicle control, particularly for large trucks. The study segment can be described as generally flat.

Roadside Hazard Assessment

The segment generally comprises of fill section with a clear zone that is partially obstructed. There are some agricultural fences within the clear zone on the west side of the roadway.

In-slope

The in-slope measured at the representative section is generally flat. The in-slope was measured 6:1 which is considered a recoverable slope.

Adjacent Development

The area around the segment is mostly rural residential with a short section of rural commercial.

Statutory and Advisory Speeds

The statutory speed limit is 65-mph for trucks and 70-mph for regular vehicles throughout the segment. There are no advisory speeds along the segment.

Traffic Control

There are no traffic controls on mainline of US Hwy 93.

4. Vehicular Classification

Vehicular class data for 24-hour period were collected on August 23, 2022. Vehicle types were categorized to two classifications:

- **Mid-size Vehicles** consisting of motorcycles, passenger vehicles, pickups, vans, buses, conventional vans, and city delivery trucks.
- **Large Vehicles** consisting of single unit four or more axle trucks.

There are 8,590 and 610 daily small to mid-size and large vehicles, respectively that travel in the segment. Note that data collected for this segment were lumped for all vehicles and did not differentiate between small to mid-size and large vehicles. Historic records were reviewed to establish the truck percentages for this segment. The daily distribution is 50% along northbound and 50% along southbound. The vehicular classifications in the study segment are summarized in **Table 1**.

Table 1 - Vehicular Classification

Classification	Northbound	Southbound	Total	Percent
Small to Mid-Size vehicles	5900	5760	11660	93%
Large vehicles[1]	400[1]	440[1]	840[1]	7%
Total (Percent)	**6,300 (50%)**	**6,200 (50%)**	**12,500**	**100%**

1 - The traffic data collected in this segment lumped all vehicle types into one. Speed for trucks were calculated based on historic truck percentages and engineering judgement.

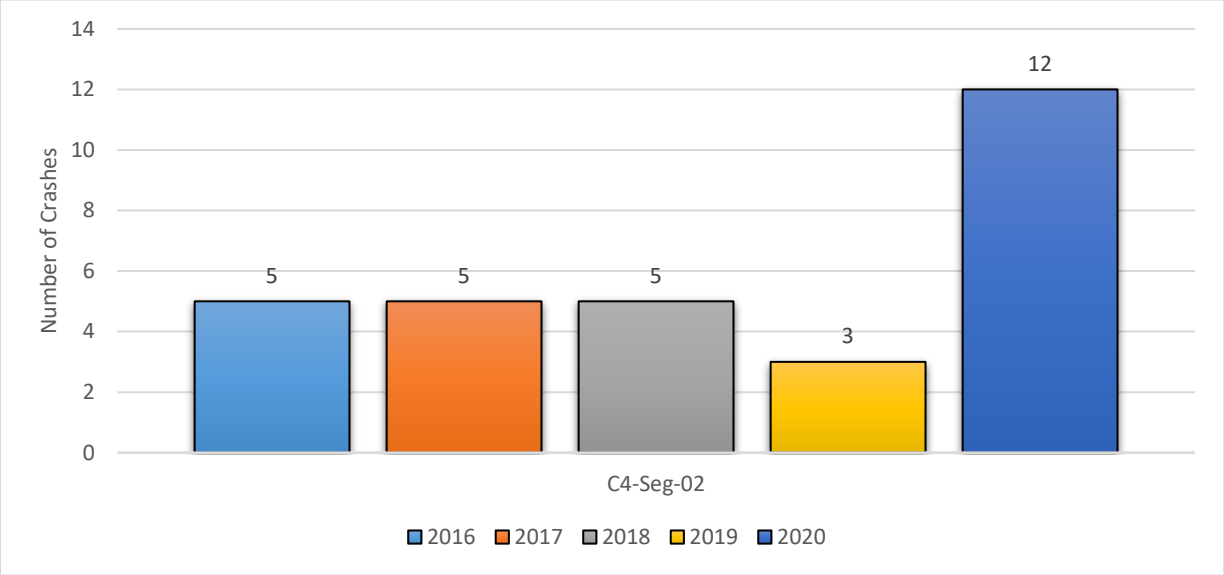
5. Safety Characteristics

Reviewing historic crash and citation information can help identify driver behavior issues that can provide additional information for setting speed the appropriate and safer speed limit.

Crash History

Five years of crash records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. The crash records were shared in a spreadsheet format. The five-year crash summary by year is shown in **Figure 2**. There were 30 crashes (one serious injury, four minor injury, three possible injury, and 22 property damage only type of crashes) reported during the analysis period. This corresponds to six crashes per year and six-crashes per year per mile. The number of crashes in 2020 increased by 2.6 times from the average crashes per year between 2016 and 2019.

Figure 2 - Five-Year Crash Summary (2016-2020)



22 crashes or 73% of all the crashes were non-junction related. Crash summary by crash type is shown in **Table 2**.

Table 2 - Crash Collision Type

Type	# Crashes	% Crashes
Fixed Object	2	7%
Immersion	1	3%
Left Turn, Same Direction	2	7%
Other	1	3%
Parked Vehicle	1	3%
Rear To Front	**2**	7%
Rear To Rear	1	3%
Rear To Side	1	3%
Rear-End	12	40%
Right Angle	1	3%
Right Turn, Same Direction	3	10%
Sideswipe, Same Direction	1	3%
U Turn	1	3%
Wild Animal	1	3%
Total	**30**	**100%**

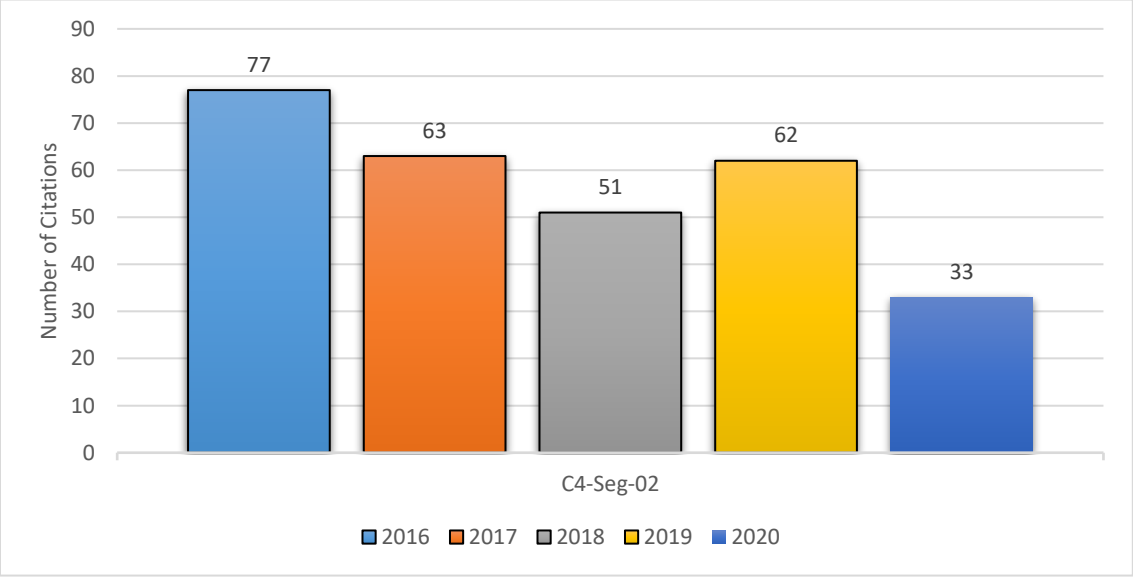
Rear-end crashes (40%) were the most prominent crash types followed by right turn crashes (10%) in the study segment, and specifically at the Bell Crossing Rd intersection. The crash data had no supplement officer narratives to identify if speeding was the contributing factor for any of these crashes.

Citation History

The speeding law in Montana 1 § 61-8-303 (3) states: "Subject to the maximum speed limits set forth in subsection (above), a person shall operate a vehicle in a careful and prudent manner and at a reduced rate of speed no greater than is reasonable and prudent under the conditions existing at the point of operation, taking into account the amount and character of traffic, visibility, weather, and roadway conditions." It is critical to note that the law enforcement can issue a ticket for driving a vehicle at unsafe speeds, even if a driver is within the posted speed limit. For example, driving at the posted speed limit on the freeway when there is a blizzard or thick fog. Since these driving conditions are unsafe for you and other drivers, law enforcement is within their rights to issue a speeding ticket as per the speeding laws in Montana.

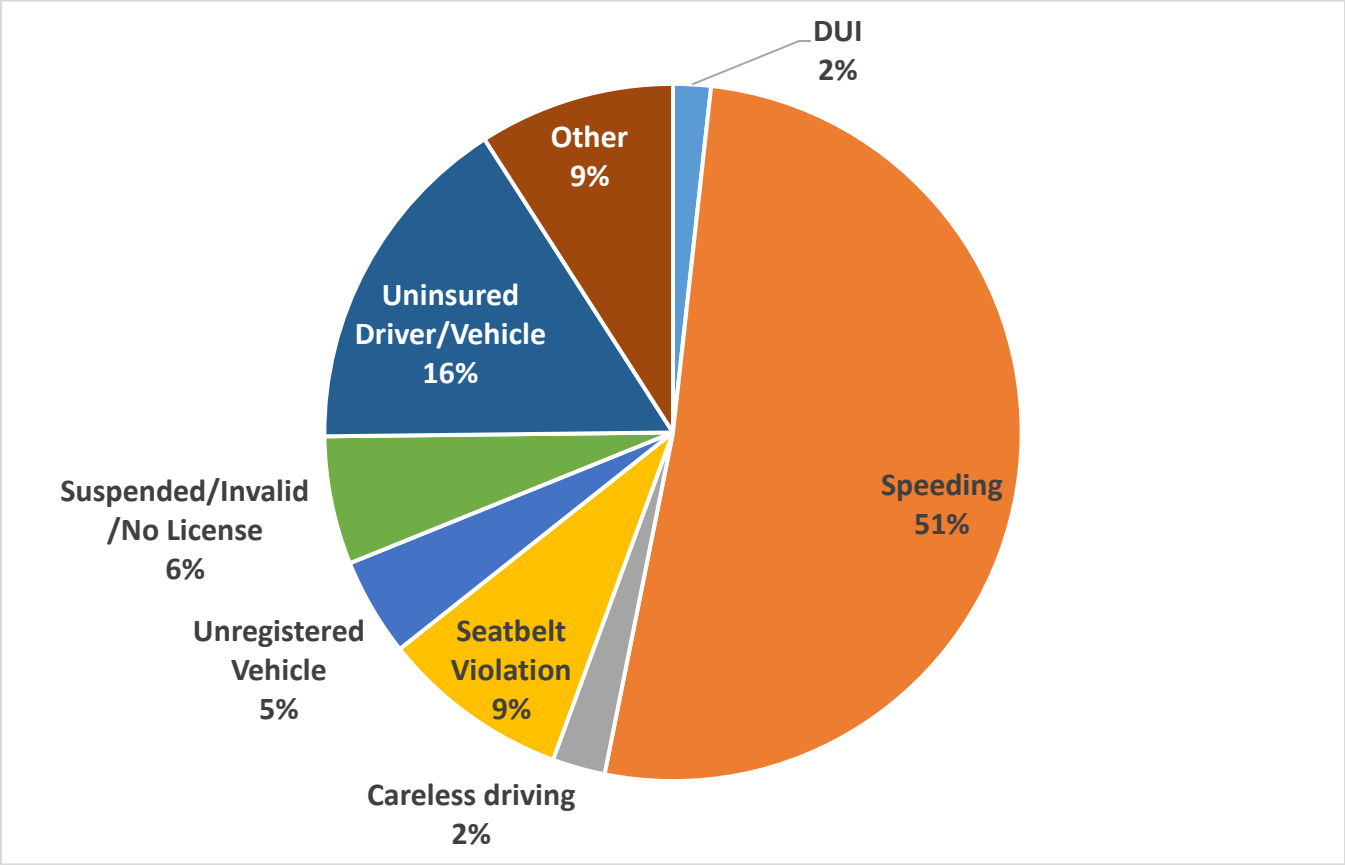
Five years of citation records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. The MDT Traffic & Safety Bureau shared citation records in a spreadsheet format. The five-year citation summary in the segment is shown in **Figure 3**. There were 286 citations issued in the study segment during the analysis period of which 147 citations (51%) were speeding violations.

Figure 3 - Citation Summary by Year



The most citations were given in the month of November (16%). The types of citation issued in this segment is shown in **Figure 4**. Speeding (51%), and Uninsured driver/vehicle (16%) were the most prominent types of traffic violations in the study area.

Figure 4 - Citation Types Issued (2016 - 2020)



6. Speed Characteristics

Engineering Approach

The engineering approach is a two-step process based on operating conditions such as the 85th percentile speed. The 85th percentile is the speed at which 85% of free-flowing traffic is traveling at or below. Once the speed limit is established based on the 85th percentile speed, it can be adjusted (usually downward) based on other factors such as amount of non-motorized traffic, roadway characteristics, and crash history. MDT's procedures for setting speed limits are based on the engineering approach.

MDT uses 85th percentile, 50th percentile, and pace speeds to evaluate speed data. The pace speed is a 10-mph increment in speeds that encompasses the highest portion of observed speeds.

Spot Speed Data

Spot speed studies typically consist of sample sizes totaling at least 100 vehicles with Free Flow Speed (FFS). FFS is the speed of motorists traveling as desired given prevailing conditions such that no preceding vehicle influences the motorists' speed. Unattended radars were placed along the study segment to collect vehicular speed samples for a 24-hour period from August 31 to September 1, 2022, near RP 60.5**.** The 24-hour data consisted of all vehicles that traveled along the study segment with various speed profiles including vehicles that influenced a motorist's choice of speed such as vehicular deceleration to make turns, queuing during peak hour, or a platoon.

The road and shoulder surface were clear of surface water or snow during the period when data were recorded. The result of the speed profile in the study segment is shown in Figure 5 and Table 3. For details please see **Appendix A**. The 85th percentile speed was found to be 69-mph and the 50th percentile speed was found to be 63-mph. The 10-mph pace was found to be between 59-mph and 69-mph comprising of 63% of daily vehicles within that 10-mph pace. The 85th percentile and 50th percentile speeds were less than the posted speed limit. The 85th percentile speed were higher than the upper tail-end of the 10-mph pace range, whereas the 50th percentile speeds were within the 10-mph pace.

Figure 5 - Speed Profile for All Vehicle Types in Both Direction of Travel

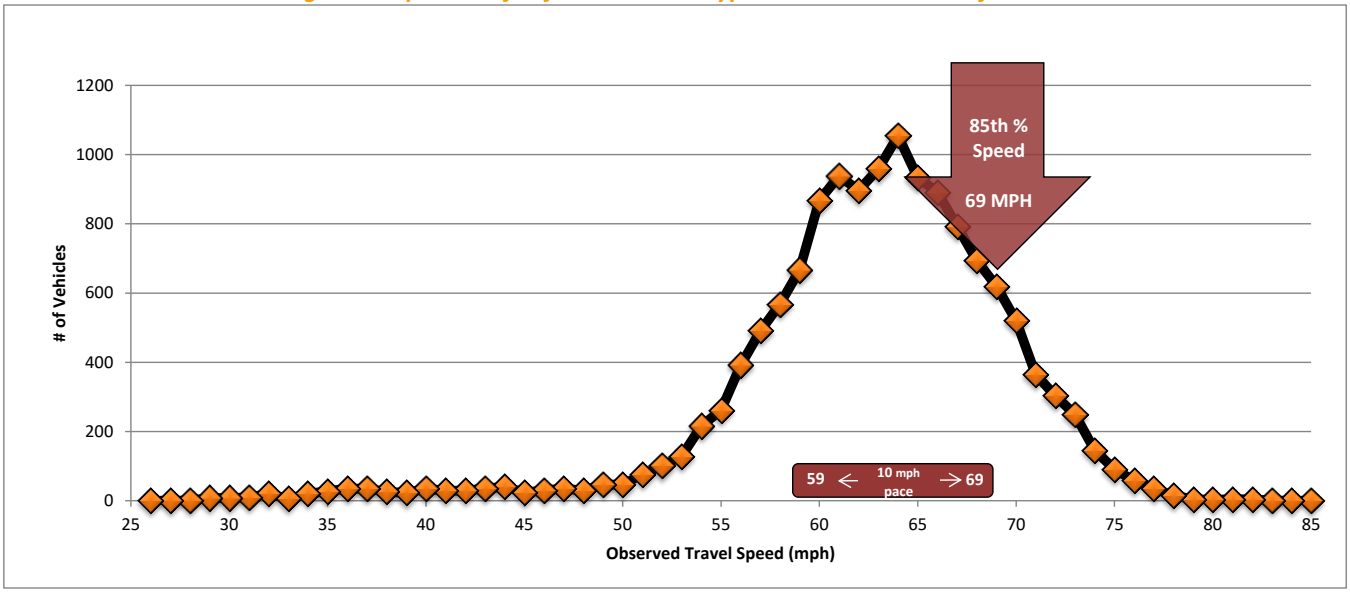


Table 3 - Speed Study Profile

Vehicle Type	Direction	10-mph Pace	% In Pace	85th Percentile Speed	50th Percentile Speed
Small to Mid-size	NB	58-68 mph	65%	68-mph	63-mph
	SB	60-70 mph	60%	70-mph	64-mph
	Both	59-69 mph	63%	69-mph	63-mph
Large[1]	NB[1]	58-68 mph	68%	68-mph	63-mph
	SB	60-70 mph	63%	70-mph	64-mph
	Both	59-69 mph	65%	69-mph	63-mph
All	NB	58-68 mph	66%	68-mph	63-mph
	SB	60-70 mph	60%	70-mph	64-mph
	Both	59-69 mph	63%	69-mph	63-mph

1 – The traffic data collected in this segment lumped all vehicle types into one type. Speed for trucks were calculated based on historic truck percentages and engineering judgement.

NCHRP

A recent research report from the *National Cooperative Highway Research Program* (NCHRP) has been completed. NCHRP report 17-76: *Development of a Posted Speed Limit Setting Procedure and Tool* collected insights into how the roadway environment influences operating speed and safety (crashes) through a review of literature and the collection and analysis of data from two states. Using those insights along with an understanding of different methods being used and currently being considered for the setting of posted speed limits, the research team developed a speed limit setting procedure along with a tool. The procedure uses fact-based decision rules that consider both driver speed choice and safety associated with the roadway.

There has been a nationwide push over the last several years for the consideration of 50th percentile speed, especially for developed areas. When the roadway conditions are optimal, the suggested speed limit should reflect the 85th percentile speed. When roadway conditions are not favorable to all users or when crashes are a significant concern, then the suggested speed limit should reflect the rounded down 85th percentile or the 50th percentile speed. Drivers frequently select speeds a certain increment above the posted speed limit, anticipating that they will not receive a ticket if they are below the assumed enforcement speed tolerance. Because of these reasons, 50th percentile speed data were also used in the analysis along with the 85th percentile speed data.

The NCHRP 17-76 Speed Limit Setting Tool was used to calculate the recommended speed limit for the study segment based on key factors such as: 85th percentile and 50th percentile speed, roadway characteristics, and crash history. The recommended speed for the study segment based on NCHRP 17-76 was found to be 65-mph along in this segment. Details of the NCHRP 17-76 report is available in **Appendix B**.

7. Conclusion

Vehicular Classification

There are 8,590 and 610 daily small to mid-size and large vehicles, respectively that travel in the segment. The daily distribution is 50% along northbound and 50% along southbound.

Safety Characteristics

There were 30 crashes (one serious injury, four minor injury, three possible injury, and 22 property damage only type of crashes) reported during the analysis period. Rear-end crashes (40%) were the most prominent crash types followed by right turn crashes (10%) in the study segment, and specifically at the Bell Crossing Rd intersection.

There were 286 citations issued in the study segment during the analysis period of which 147 citations (51%) were speeding violations.

Roadway Characteristics

The segment, RP 60.1 to RP 61.1, being reviewed has a statutory 65-mph speed limit for trucks and 70-mph for regular vehicles. The northern and southern part of the segment is a paved four-lane undivided roadway. One-third of the segment in the middle is a paved four-lane roadway with a center TWLTL. The segment generally comprises of fill sections with some fixed objects within the clear zone. There are shoulder rumble strips present throughout the segment. Centerline rumble strips are present only in the four-lane section of the segment. The shoulders are wide on both sides of the roadway for safe parking of disabled vehicles. The vertical grades and in-slopes are generally flat in the segment. The road conditions are generally in good condition. The area around the segment is mostly rural residential with short section of rural commercial. The driveway density in the study segment is less than the maximum number of driveway thresholds for similar type of facility.

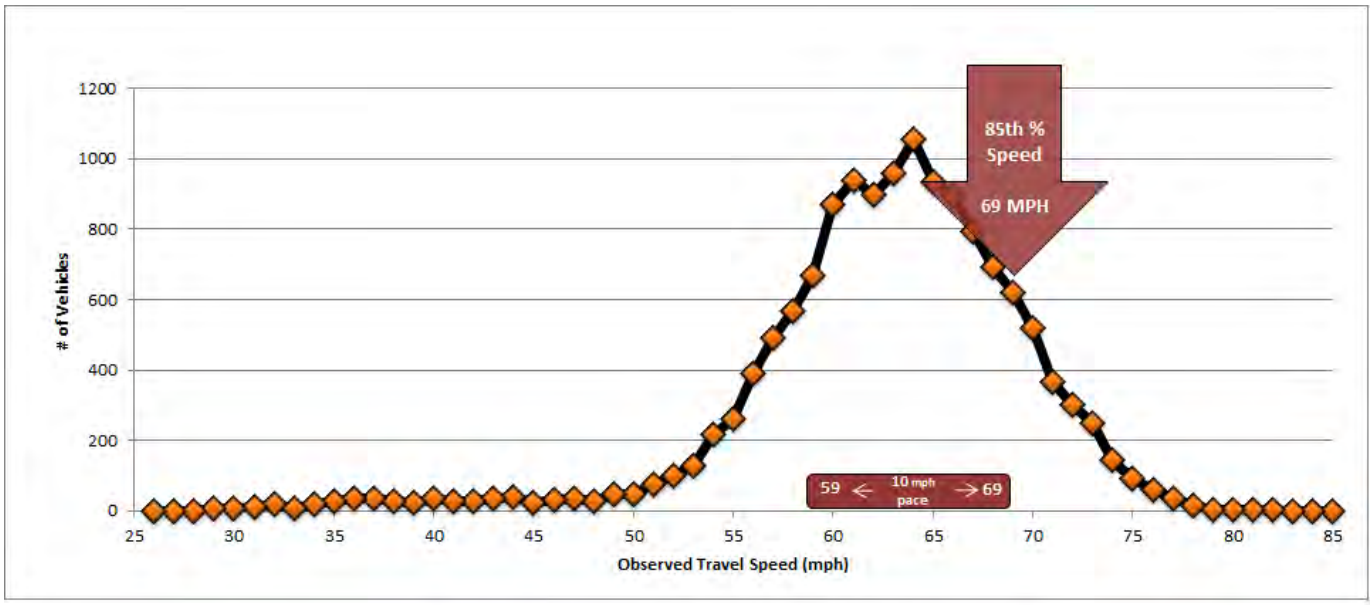
Speed Characteristics

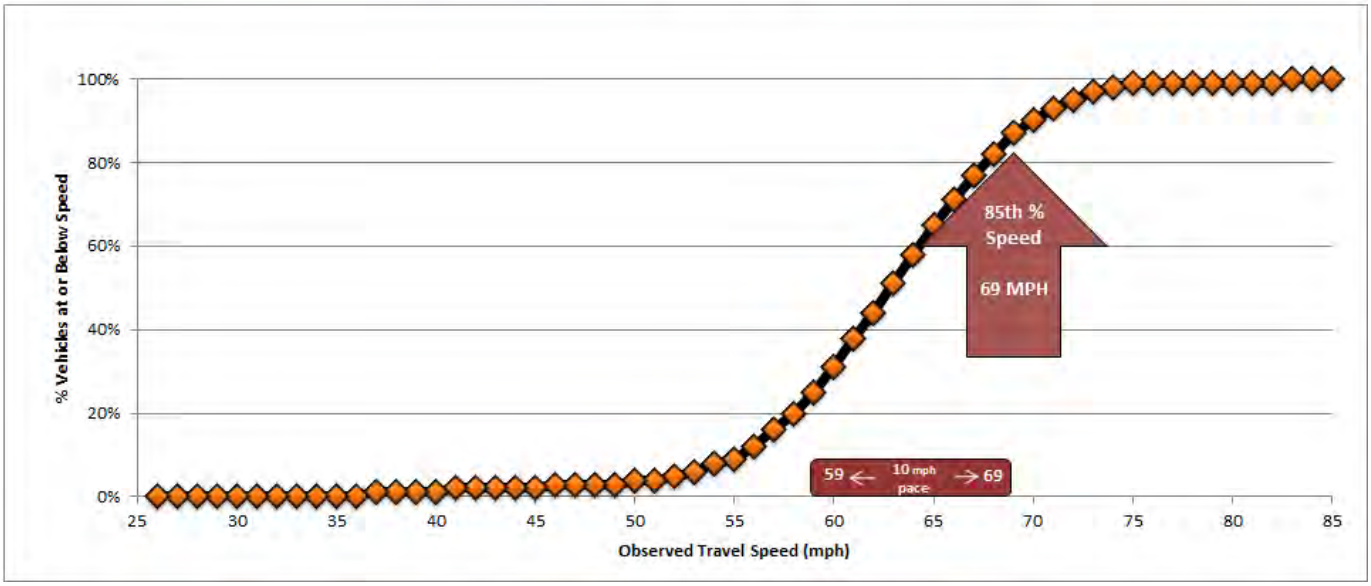
The 85th percentile speed was found to be 69-mph and the 50th percentile speed was found to be 63-mph. The 10-mph pace was found to be between 59-mph and 69-mph comprising of 63% of daily vehicles within that 10-mph pace. The recommended speed for the study segment based on NCHRP 17-76 was found to be 65-mph along in this segment. The 85th percentile speed, percentage of rear-end crashes, and NCHRP recommended speed is indicative that the existing posted speed limit of 70-mph in this segment may need to be reduced to 65-mph.

APPENDIX A – SPEED STUDY PROFILES

SPEED SAMPLE SUMMARY (ALL VEHICLES)

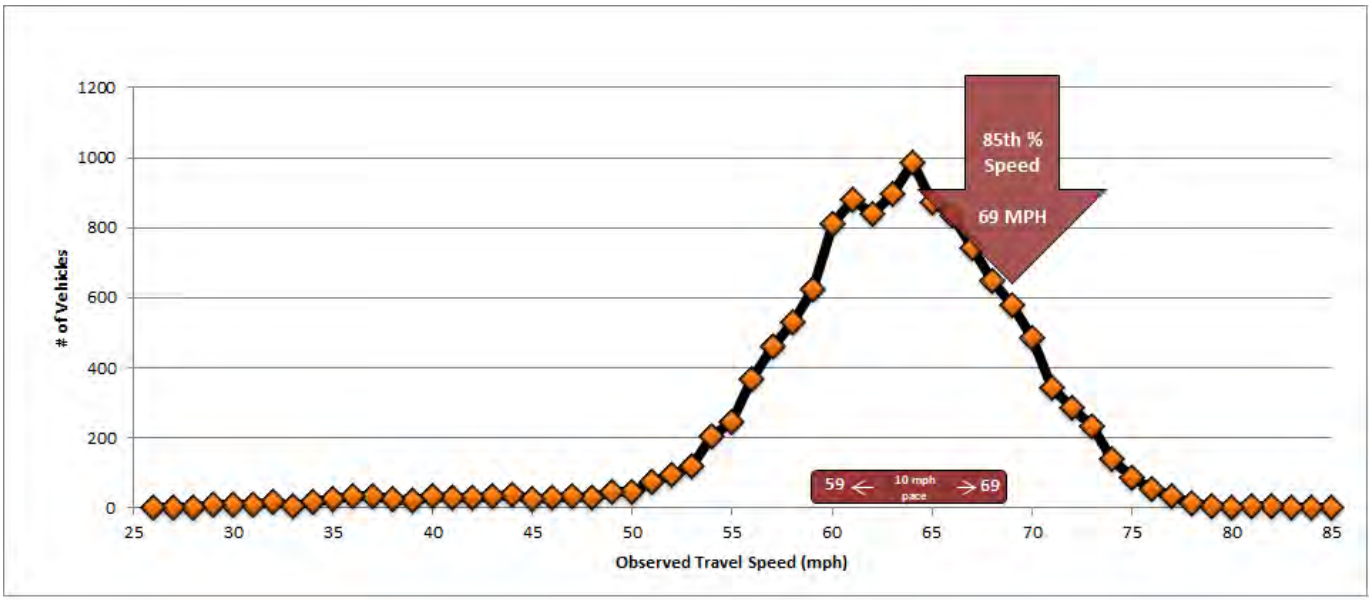
ID:	A4-Seg-02	Speed Limit	70 MPH	Day/Date	Thursday, September 1, 2022
Roadway:	US 93	Seg. Length:	1 MILES	Time:	24-hours
Study Limits:	Victor to Stevensville	Road Type:	Four-Lane, Two way	Sample Loc	46.437182,-114.137772
City/County:	Ravalli	ADT Range:	NB-6300 SB-6200	Weather:	-
RP:	60.1 to 61.1	Truck ADT:	NB-400 SB-440	Observer(s):	KLJ
85th % Speed:	69	10 mph pace	59-69	Machine:	Houston Radar
50th % Speed:	63	% in pace	63%		

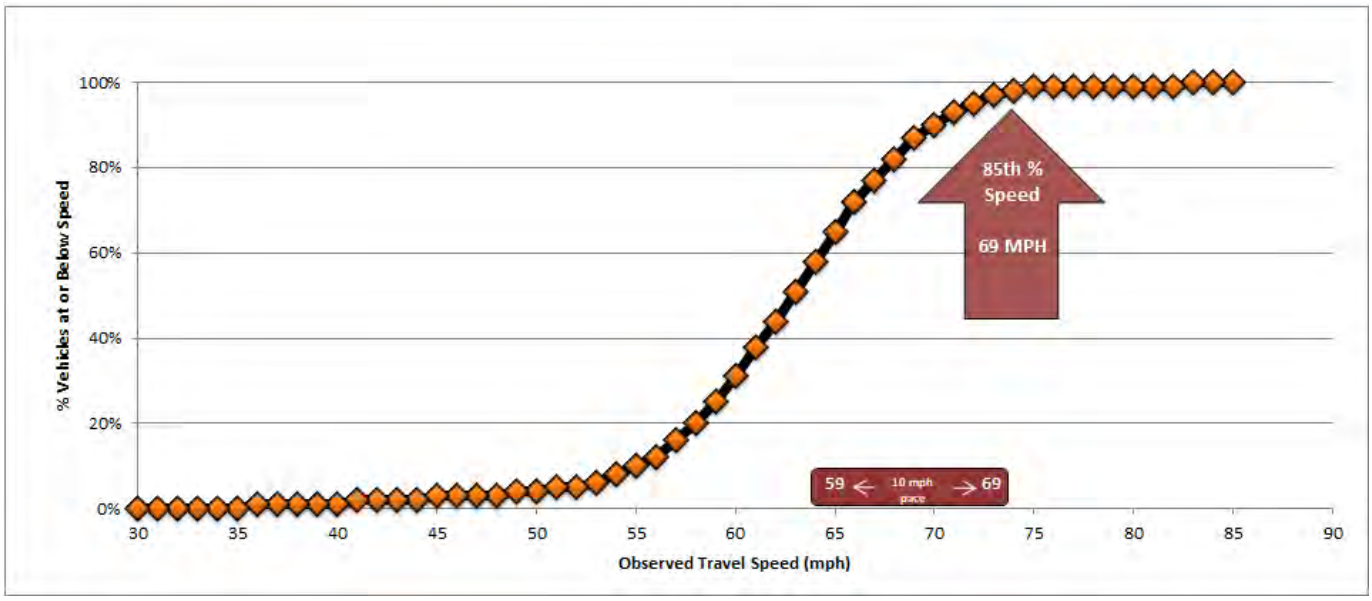




SPEED SAMPLE SUMMARY (PASSENGER VEHICLES)

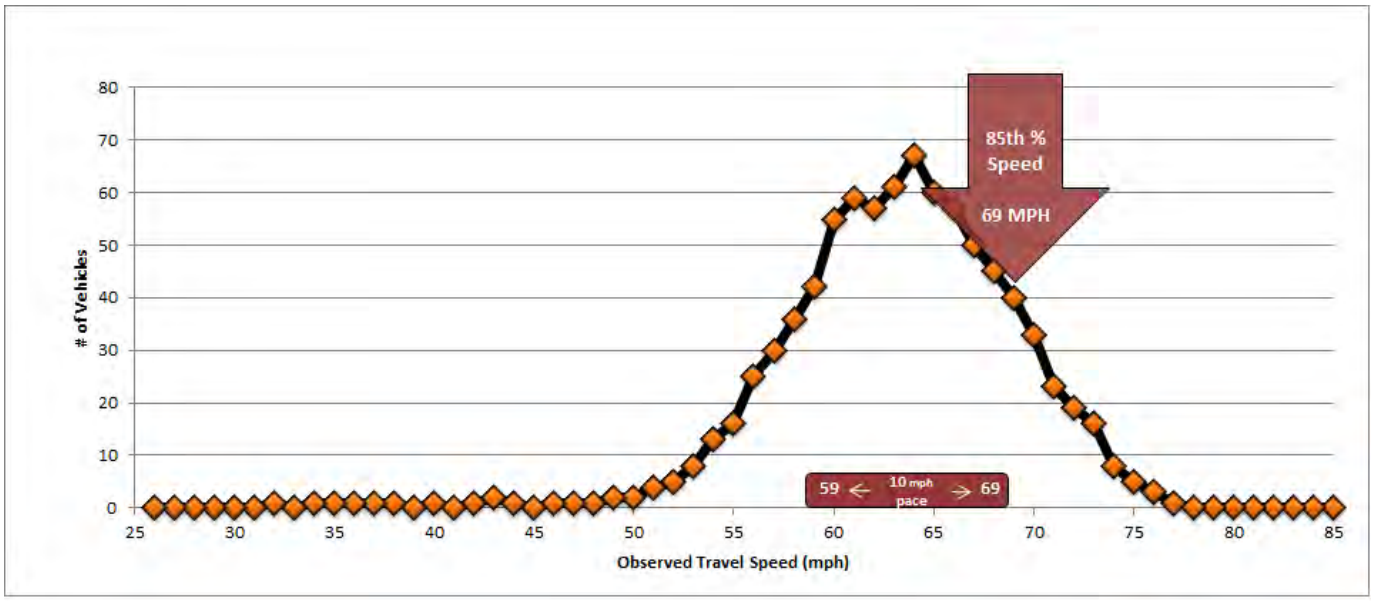
ID:	A4-Seg-02	Speed Limit	70 MPH	Day/Date	Thursday, September 1, 2022
Roadway:	US 93	Seg. Length:	1 MILES	Time:	24-hours
Study Limits:	Victor to Stevensville	Road Type:	Four-Lane, Two way	Sample Loc	46.437182,-114.137772
City/County:	Ravalli	ADT Range:	NB-6300 SB-6200	Weather:	-
RP:	60.1 to 61.1	Truck ADT:	NB-400 SB-440	Observer(s):	KLJ
85th % Speed:	69	10 mph pace	59-69	Machine:	Houston Radar
50th % Speed:	63	% in pace	63%		

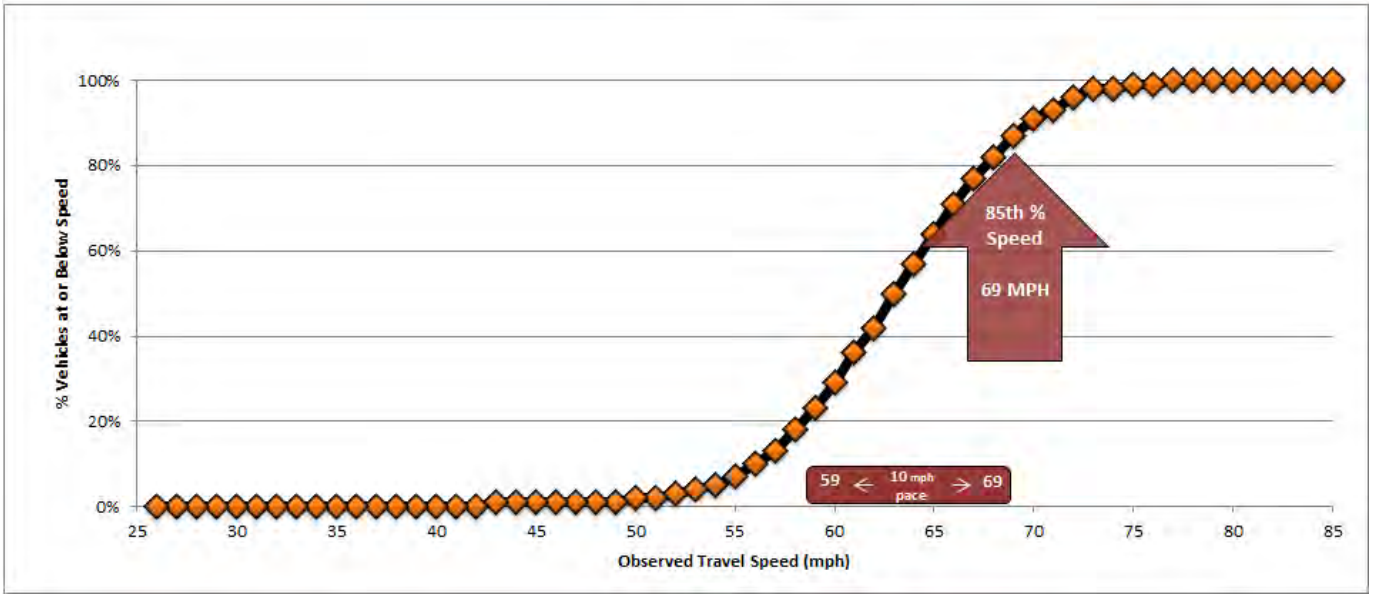




SPEED SAMPLE SUMMARY (TRUCKS)

ID:	A4-Seg-02	Speed Limit	70 MPH	Day/Date	Thursday, September 1, 2022
Roadway:	US 93	Seg. Length:	1 MILES	Time:	24-hours
Study Limits:	Victor to Stevensville	Road Type:	Four-Lane, Two way	Sample Loc	46.437182,-114.137772
City/County:	Ravalli	ADT Range:	NB-6300 SB-6200	Weather:	-
RP:	60.1 to 61.1	Truck ADT:	NB-400 SB-440	Observer(s):	KLJ
85th % Speed:	69	10 mph pace	59-69	Machine:	Houston Radar
50th % Speed:	63	% in pace	65%		





APPENDIX B – NCHRP REPORT

NCHRP 17-76 Speed Limit Setting Tool

Input Cells	Description	Output Cells
Site Description Data		
Rural	Roadway context	
Principal arterial	Roadway type	
Yes	Are crash data available?	
Oz Khan, PE	Analyst	
11/17/2022	Date	
US Hwy 93	Roadway name	
b/w RP 60.1 and 61.1	Description	
70	Current speed limit (mph)	
C4-Seg-02	Notes	
Analysis Results		
	Speed limit setting group	Undeveloped
	Suggested speed limit (mph)	**65**
Speed Data		
70	Maximum speed limit (mph)	
69	85th-percentile speed (mph)	
63	50th-percentile speed (mph)	
Site Characteristics		
1	Segment length (mi)	
12,500	AADT (two-way total) (veh/d)	
4	Number of lanes (two-way total	
Undivided	Median type	
11	Number of access points (total of both directions	
11	Lane width (ft)	
10	Shoulder width (ft)	
No	Adverse alignment present?	
Crash Data		
5	Number of years of crash data	
12,500	Average AADT for crash data period (veh/d	
30	All (KABCO) crashes for crash data period	
8	Fatal & injury (KABC) crashes for crash data period	
	Average KABCO crash rate (crashes / 100 MVMT	
	Average KABC crash rate (crashes / 100 MVMT	
	1.3 x average KABCO crash rate (crashes / 100 MVMT	161.9
	1.3 x average KABC crash rate (crashes / 100 MVMT	53.5
	Critical KABCO crash rate (crashes / 100 MVMT)	165.2
	Critical KABC crash rate (crashes / 100 MVMT)	65.4

Color-Coding Legend

Aqua = basic input cell
Denim = basic input cell with drop-down menu
Orange = optional input cell (not needed for calculations
Green = optional input cell (use if data for agency & region are available, leave blank otherwis
Rose = intermediate calculations
Purple = final analysis results

Note: The "Test macros" button provides a message to verify proper macro operation

Advisory, Calculated, or Warning Messages

This value is determined by speed data & site characteristics.

Advisory, Calculated, or Warning Messages

Advisory, Calculated, or Warning Messages

For a suggested speed limit of 65 mph, minimum segment length = 3 mi.

Rounded-Down 85th

Advisory, Calculated, or Warning Messages

Observed KABCO crash rate = 131.51 crashes / 100 MVMT
Observed KABC crash rate = 35.07 crashes / 100 MVMT
HSIS average KABCO crash rate = 124.54 crashes / 100 MVMT
HSIS average KABC crash rate = 41.14 crashes / 100 MVMT

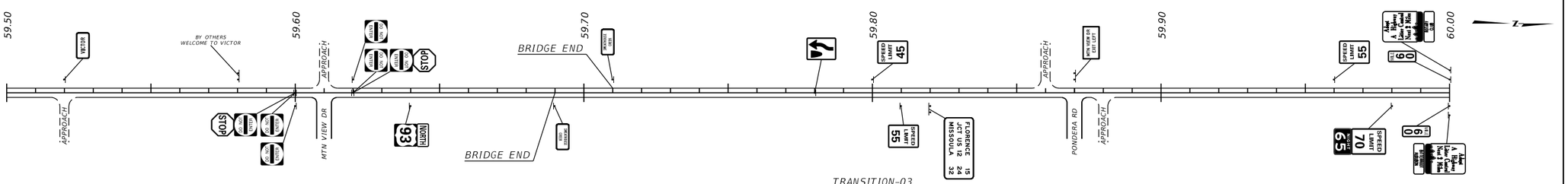
APPENDIX II – STRAIGHT-LINE DIAGRAMS

Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY

HAMILTON

Location TO MISSOULA
County RAVALLI/MISSOULA
Roadway C000007 (US 93)
RP from 59.50 to 66.50
Scale 1 UNIT = 0.10 MILES
Date JANUARY 2023

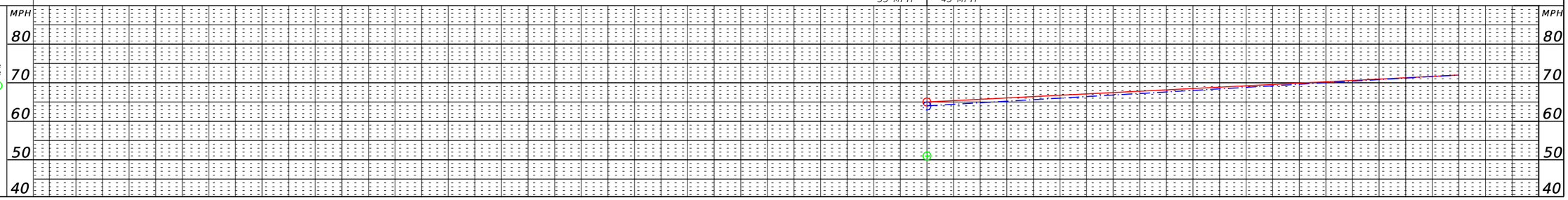


Roadway Width	72-FEET	
Number of Striped Lanes	5	
Type of Divider	TWLTL	
Average Daily Traffic	9,700	
Direction	NB	SB
Number of Vehicles	5,000 VEH	4,700 VEH
85th Percentile	65 MPH	64 MPH
50th Percentile	59 MPH	57 MPH
10 MPH Pace (% in Pace)	55-65 MPH (63%)	51-61 MPH (63%)
Existing Speed Zone	55 MPH	45 MPH

SPEED PROFILE

LEGEND
Road Signs
85th Percentile — NB — SB
Lower Limit of Pace

Remarks:



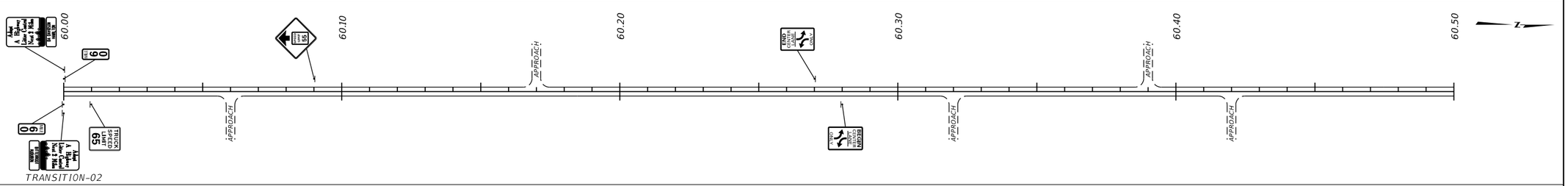
Sheet 1 of 5

Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY

HAMILTON

Location TO MISSOULA
County RAVALLI/MISSOULA
Roadway C000007 (US 93)
RP from 59.50 to 66.50
Scale 1 UNIT = 0.10 MILES
Date JANUARY 2023

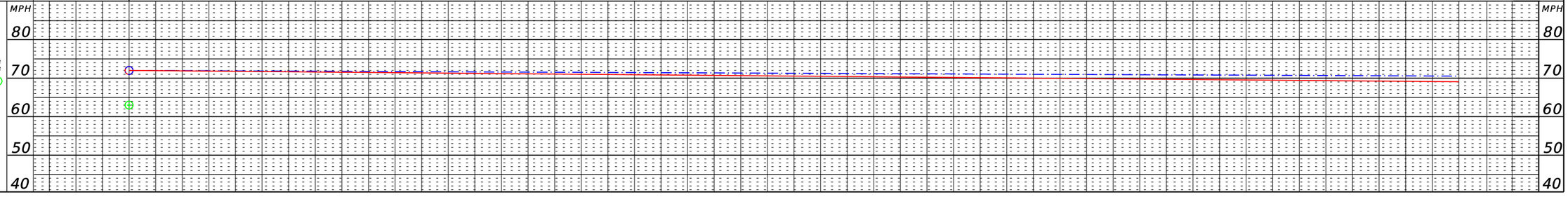


Roadway Width	67-FEET	
Number of Striped Lanes	4	
Type of Divider	UNDIVEDED	
Average Daily Traffic	10,200	
Direction	NB	SB
Number of Vehicles	5,000 VEH	5,200 VEH
85th Percentile	72 MPH	72 MPH
50th Percentile	66 MPH	66 MPH
10 MPH Pace (% in Pace)	63-73 MPH (61%)	63-73 MPH (61%)
Existing Speed Zone	70MPH/60MPH TRUCKS	55 MPH

SPEED PROFILE

LEGEND
Road Signs
85th Percentile — NB — SB
Lower Limit of Pace

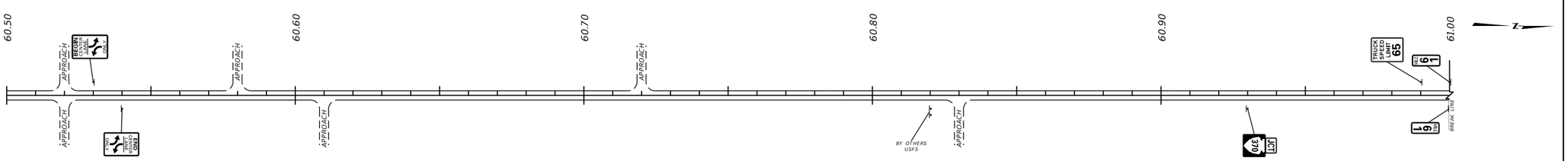
Remarks:



Sheet 2 of 5

Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY
HAMILTON
Location TO MISSOULA
County RAVALLI/MISSOULA
Roadway C000007 (US 93)
RP from 59.50 to 66.50
Scale 1 UNIT = 0.10 MILES
Date JANUARY 2023



SEGMENT-02

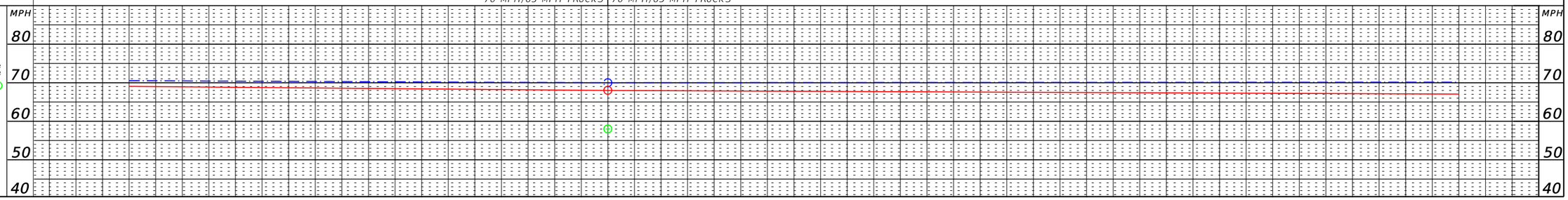
	NB	SB
Roadway Width	71-FEET	
Number of Striped Lanes	4	
Type of Divider	UNDIVEDED	
Average Daily Traffic	12,500	
Direction	NB	SB
Number of Vehicles	6,300 VEH	6,200 VEH
85th Percentile	68 MPH	70 MPH
50th Percentile	63 MPH	64 MPH
10 MPH Pace (% in Pace)	58-68 MPH (66%)	60-70 MPH (60%)
Existing Speed Zone	70 MPH/65 MPH TRUCKS	70 MPH/65 MPH TRUCKS

SPEED PROFILE

LEGEND
Road Signs
85th Percentile NB SB
Lower Limit of Pace

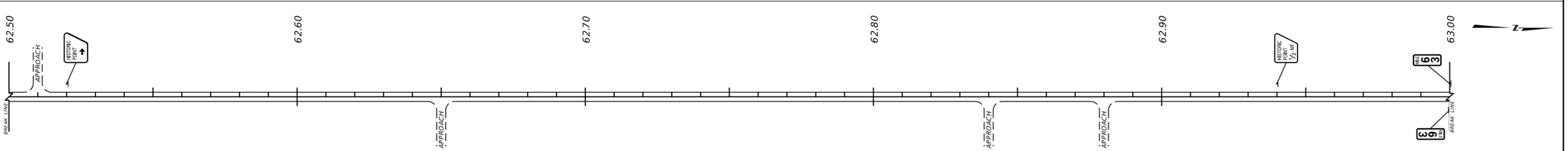
Remarks:

Sheet 3 of 5



Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY
HAMILTON
Location TO MISSOULA
County RAVALLI/MISSOULA
Roadway C000007 (US 93)
RP from 59.50 to 66.50
Scale 1 UNIT = 0.10 MILES
Date JANUARY 2023



SEGMENT-01

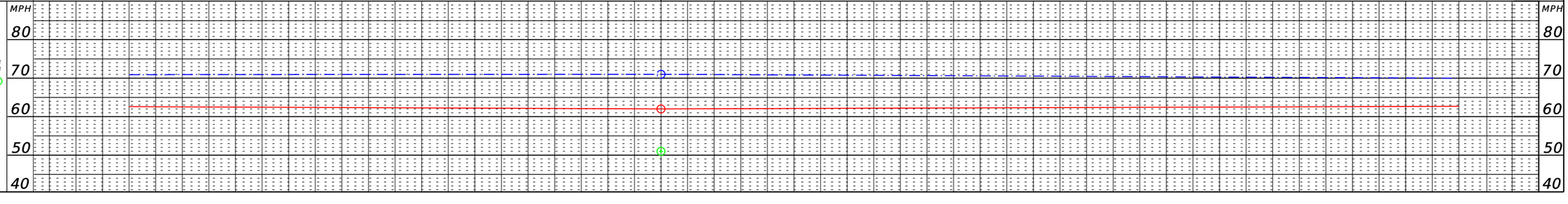
	NB	SB
Roadway Width	71-FEET	
Number of Striped Lanes	4	
Type of Divider	UNDIVEDED	
Average Daily Traffic	9,200	
Direction	NB	SB
Number of Vehicles	4,900 VEH	4,300 VEH
85th Percentile	62 MPH	71 MPH
50th Percentile	56 MPH	60 MPH
10 MPH Pace (% in Pace)	51-61 MPH (65%)	51-61 MPH (41%)
Existing Speed Zone	70 MPH/65 MPH TRUCKS	70 MPH/65 MPH TRUCKS

SPEED PROFILE

LEGEND
Road Signs
85th Percentile NB SB
Lower Limit of Pace

Remarks:

Sheet 4 of 5



Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY

HAMILTON

Location TO MISSOULA

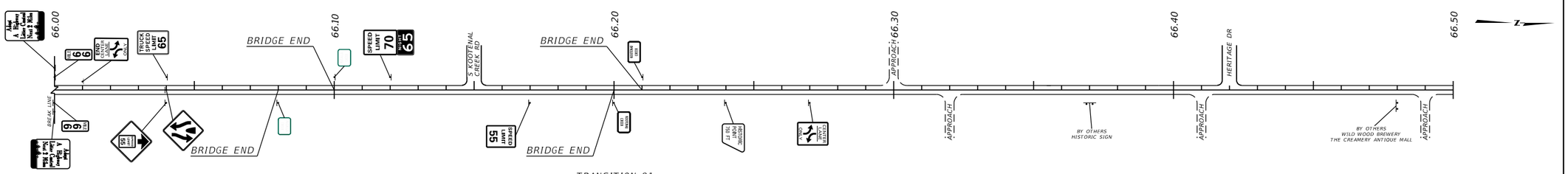
County RAVALLI/MISSOULA

Roadway C000007 (US 93)

RP from 59.50 to 66.50

Scale 1 UNIT = 0.10 MILES

Date JANUARY 2023



Roadway Width	75-FEET	
Number of Striped Lanes	4	
Type of Divider	DIVEDED	
Average Daily Traffic	10,200	
Direction	NB	SB
Number of Vehicles	5,000 VEH	5,200 VEH
85th Percentile	70 MPH	59 MPH
50th Percentile	65 MPH	53 MPH
10 MPH Pace (% in Pace)	62-72 MPH (61%)	49-59 MPH (66%)
Existing Speed Zone	55 MPH	70 MPH/65 MPH TRUCKS

SPEED PROFILE

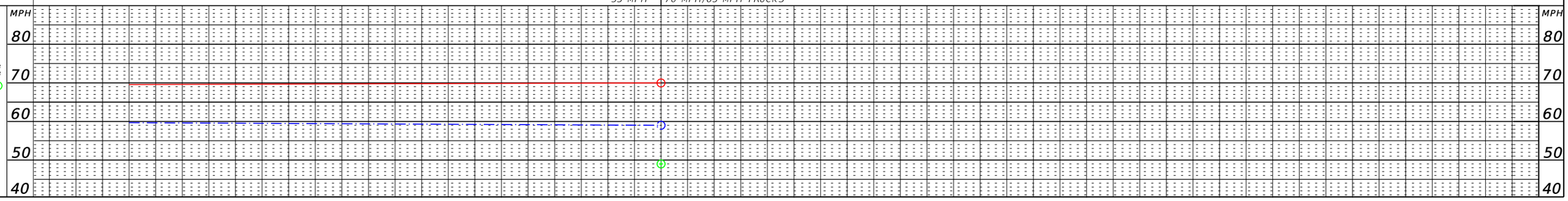
LEGEND

Road Signs

85th Percentile NB SB

Lower Limit of Pace

Remarks:



ENGINEERING, REIMAGINED

SPEED STUDY

US Hwy 93 – Hamilton to Victor

Ravalli County, MT

January 2023

Speed Study

Hamilton to Victor, Montana

Ravalli County, MT

January 2023

Prepared for:

Montana Department of Transportation

Prepared by:

KLJ Engineering

Table of Contents

1. Introduction 3
2. Study Area 3
3. Vehicular Classification 6
4. Safety Characteristics 6
5. Speed Characteristics 10
6. Straight-Line Diagram 12
7. Recommendations 12

List of Figures

Figure 1 - Study Area 5
Figure 2 - Five-Year Crash Summary (2016-2020) 7
Figure 3 - Citation Summary by Year 8
Figure 4 - Citation Types Issued in the study area (2016 - 2020) 9
Figure 5 - Citation Types Issued at the Intersection of US Hwy 93 with Woodside Cutoff Rd(2016 - 2020) 10

List of Tables

Table 1 - Speed Transition Zones in the Study area 4
Table 2 - Vehicular Classification 6
Table 3 - Crash Collision Type 7
Table 4 – Segment Wide Speed Study Summary 11
Table 5 - Speed Study Summary at Speed Transition Zones 12
Table 6 - Speed Differentials at Speed Transition Zones 13

List of Appendices

Appendix I - Segment Speed Studies I
Appendix II – Straight-Line Diagrams II

1. Introduction

Speed limits are set to inform motorists of appropriate driving and safe operating speeds under favorable conditions. Speed limits are set to the statutory speed limit unless a traffic engineering investigation study has been conducted and (where applicable) approved by the Transportation Commission. The *Montana Department of Transportation* (MDT) has requested KLJ Engineering to review the posted speed limit along US Hwy 93 from Hamilton to Victor.

Purpose

The purpose of this study is to evaluate the appropriate speed of the roadway. The primary tasks for the study included data collection, data analysis, and recommendations for speed limits along the study area. As part of this study, an evaluation and cataloging of existing roadway conditions, collection of historical *Annual Average Daily Traffic* (AADT), and crash data were completed.

2. Study Area

The study area is US Hwy 93 between Hamilton and Victor in Ravalli County, MT. The nearly 8.6-miles roadway study area have varied roadway type and speed limits as shown in **Figure 1**. The AADT in the study area ranges between 14,417 in the south and 7,215 in the north.

Segments

The study area was divided into four segments based on the roadway type and speed limit. Speed analysis was conducted individually for all four segments. In 2007, the speed limit of US Hwy 93 from Hamilton to Victor was investigated and was commission approved to retain the 65mph posted speed limit. In 2015, this study area was reviewed again and presented to the transportation commission. The segment from Hamilton to Woodside Cutoff Rd was retained at the 65-mph speed limit for all vehicles based on local officials' recommendation. The segment from Woodside Cutoff Rd north to Victor was recommend discontinuing the reduced 65 mph speed zones and re-instating the statutory 70-mph speed limit for cars/65-mph for trucks. In addition, the 2015 study proposed to extend-align the previously approved 55 mph speed zone on the northside of Woodside to encompass the curb & gutter segment having consecutive access points. The transportation commission approved these changes. The following are the study segments along the study area:

SEGMENT 1

This 2.6-mile segment represents the study area from US Hwy 93 at reference point (RP): 56.0 to 58.6 located between Bear Creek Rd and south of Victor Crossing W. The segment is a four-lane roadway with a center TWLTL and occasional dedicated right turn lanes. The statutory speed limit of this segment is 70-mph for regular vehicles and 65-mph for trucks.

SEGMENT 2

This 1.5-mile segment represents the study area from US Hwy 93 from RP 54.5 to RP 56.0 located between north of Sheafman Creek Rd and Bear Creek Rd. The segment is a four-lane undivided roadway with occasional dedicated left turn lanes. The statutory speed limit of this segment is 70-mph for regular vehicles and 65-mph for trucks.

SEGMENT 3

This 2.5-mile segment represents the study area from US Hwy 93 from RP 52.0 to RP 54.5 located between Woodside Cutoff Rd and north of Sheafman Creek Rd. The segment is a four-lane roadway with a center TWLTL and occasional dedicated right turn lanes. The statutory speed limit of this segment is 70-mph for regular vehicles

and 65-mph for trucks for the northern three-quarters of the segment. The rest of the segment has a several transition zones as you travel south to Woodside Cutoff Rd.

SEGMENT 4

This two-mile segment represents the study area from US Hwy 93 from RP 50.0 to RP 52.0 located between north of Main Street and Woodside Cutoff Rd. The segment is a four-lane roadway with a center TWLTL and occasional dedicated right turn lanes. The posted speed limit of this segment is 45-mph for northern quarter of the segment. The rest of the segment is 65-mph, except for a short transition zone of 55-mph between the 45-mph to 65-mph zones. This 65-mph speed limit in this segment was commission approved on August 30, 2007.

Speed Transition Zones

Speed transition zones are sections of roadway where posted speed limit changes from higher to lower limits or vice-versa. Due to the sudden changes in posted speed limits and road environment, drivers usually do not adapt to the posted speed limits and underestimate their traveling speed. There are eight locations within the study area where there are speed transitions (**Figure 1**). Speed data were collected and analyzed at all eight locations in the study area. The speed transition zones where data was collected are summarized in **Table 1**.

Table 1 - Speed Transition Zones in the Study area

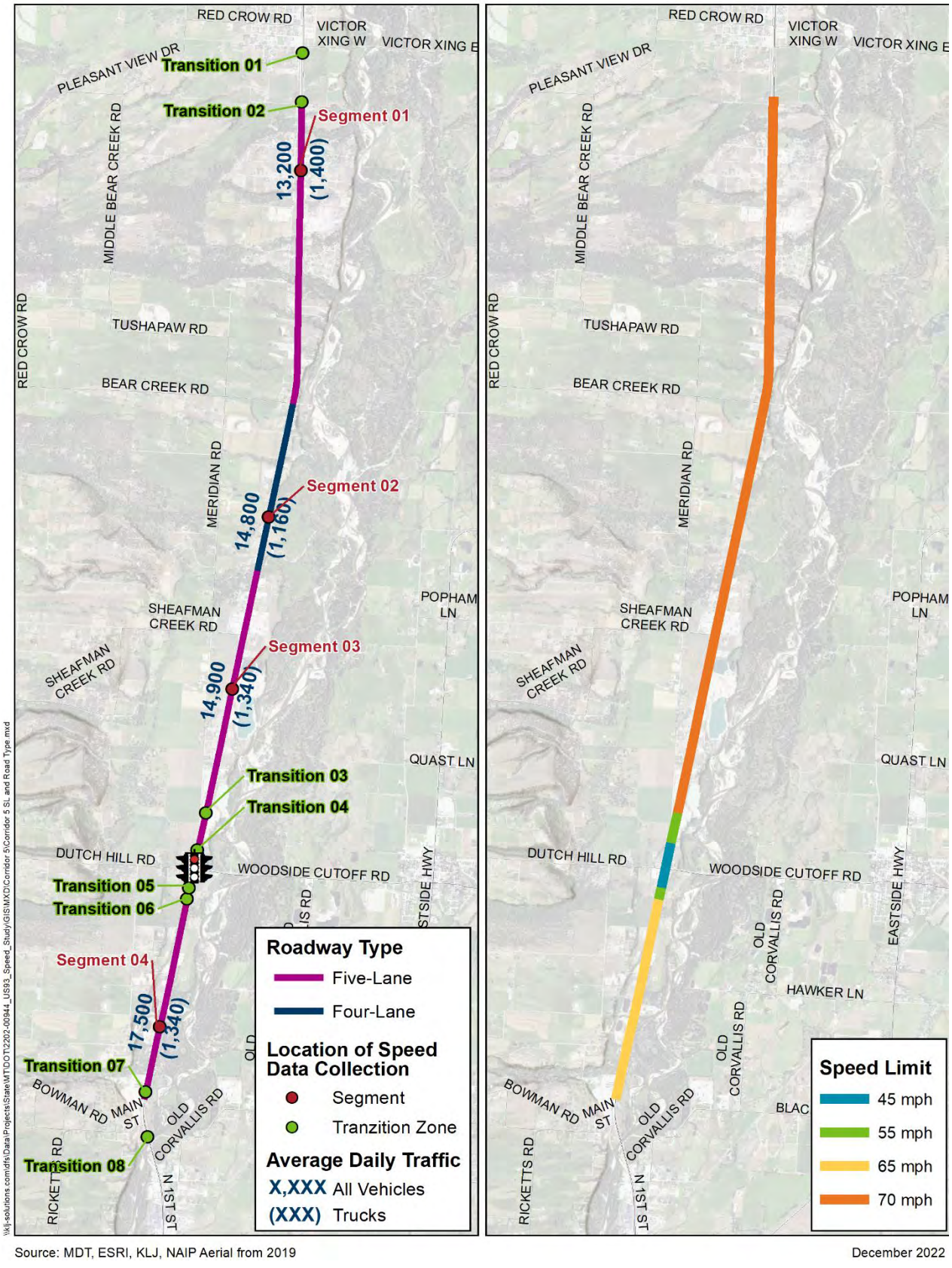
	Direction	Transition							
		1	2	3	4	5	6	7	8
Reference Point	-	59.1	58.7	52.5	52.1	51.8	51.5	50.1	49.7
Speed Change (mph)	NB	45	55	70[1]	55	45	55	65	55
	SB	55	70[1]	55	45	55	65	55	45

1 – 65 mph for Trucks

Woodside Cutoff Rd /US Hwy 93 Intersection

Special consideration was given to the intersection of US Hwy 93 with Woodside Cutoff Rd located near RP 52.0. The intersection is a divided roadway with four through travelling lanes and dedicated left and right turn lanes. The intersection is controlled by a traffic signal. The speed limit along US Hwy 93 at the intersection is 45-mph. Speed transition zones between a roadway segment and the intersection influence area allow drivers the opportunity to react to changing conditions and adjust their speed accordingly. There are two speed transition zones along US Hwy 93 at the intersection (between Transition 5 at RP 51.8 and Transition 4 at RP 52.1).

Figure 1 - Study Area



Source: MDT, ESRI, KLJ, NAIP Aerial from 2019

December 2022

3. Vehicular Classification

Vehicular class data for 24-hour period were collected on August 23, 2022, at four locations along the study area. Vehicle types were categorized to two classifications:

- **Mid-size Vehicles** consisting of motorcycles, passenger vehicles, pickups, vans, buses, conventional vans, and city delivery trucks.
- **Large Vehicles** consisting of single unit four or more axle trucks.

The vehicular classifications in the study segment are summarized in **Table 2**.

Table 2 - Vehicular Classification

Segment	Classification	Northbound	Southbound	Total	Percent
Segment 1	Small to Mid-Size vehicles	5,400	6,400	11,800	89%
	Large vehicles	700	700	1,400	11%
	Total (Percent)	**6,100 (46%)**	**7,100 (54%)**	**13,200**	**100%**
Segment 2	Small to Mid-Size vehicles	6,700	6,940	13,640	92%
	Large vehicles	600	560	1,160	8%
	Total (Percent)	**7,300 (50%)**	**7,500 (50%)**	**13,200**	**100%**
Segment 3	Small to Mid-Size vehicles	6,850	6,710	13,560	91%
	Large vehicles	650	690	1,340	9%
	Total (Percent)	**7,500 (50%)**	**7,400 (50%)**	**14,900**	**100%**
Segment 4	Small to Mid-Size vehicles	7,990	8,170	16,160	92%
	Large vehicles	710	630	1,340	8%
	Total (Percent)	**8,700 (50%)**	**8,800 (50%)**	**17,500**	**100%**

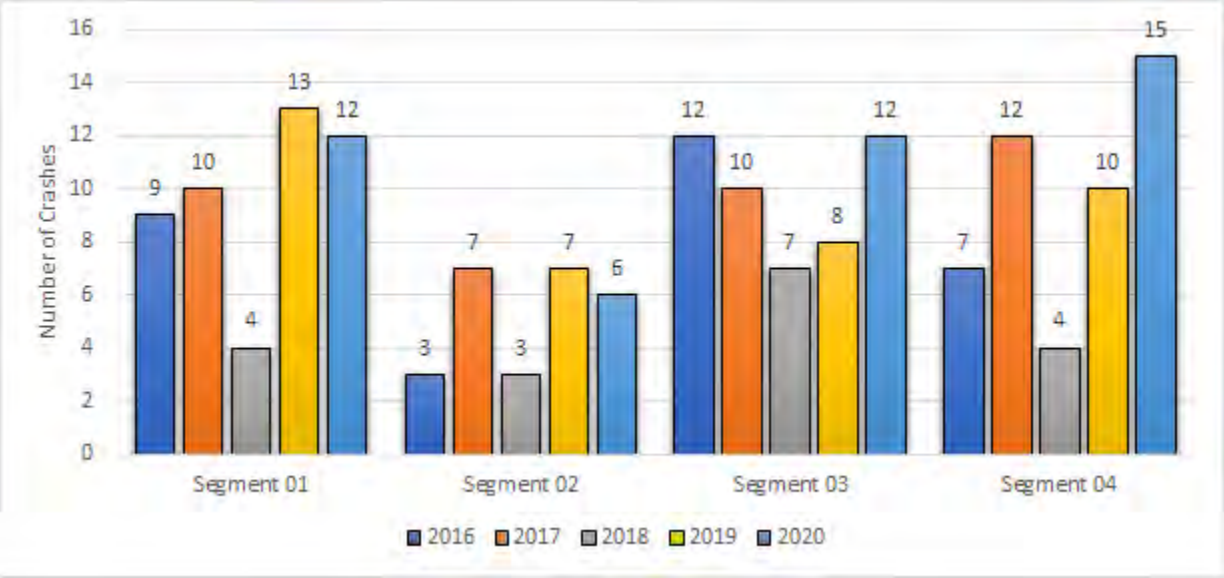
4. Safety Characteristics

Reviewing historic crash and citation information can help identify driver behavior issues that can provide additional information for setting the appropriate and safer speed limit.

Crash History

Five years of crash records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. MDT shared crash records in a spreadsheet format. The five-year crash summary by segment and year is shown in **Figure 2**. There were 171 crashes (four fatal, eight serious injury, 23 minor injury, 19 possible injury, 115 property damage only, and two unknown type crashes) reported during the analysis period. This corresponds to 34.2 crashes per year or four crashes per year per mile. Crash history by the individual roadway segments of the study area is included in **Appendix I**.

Figure 2 - Five-Year Crash Summary (2016-2020)



138 crashes or 81% of all the crashes were non-junction related. Crash summary by crash type is shown in **Table 3**.

Table 3 - Crash Collision Type

Type	# Crashes	% Crashes
Fell/ Jumped from Motor Vehicle	1	1%
Fire/ Explosion	3	2%
Fixed Object	27	16%
Head On	1	1%
Jackknife	2	1%
Left Turn, Opposite Direction	3	2%
Not Fixed Object or Debris	4	2%
Other	1	1%
Parked Vehicle	2	1%
Pedestrian	3	2%
Rear-End	18	11%
Right Angle	17	10%
Roll Over	16	9%
Sideswipe, Same Direction	5	3%
Wild Animal	68	40%
TOTAL	**171**	**100%**

Crashes with wild animals (40%) were the most prominent crash types followed by collision with fixed objects (16%), rear-end (11%), and right angle (10%) in the study segment. Crash types by the individual roadway segments of the study area is included in **Appendix I.**

WOODSIDE CUTOFF / US HWY 93 INTERSECTION

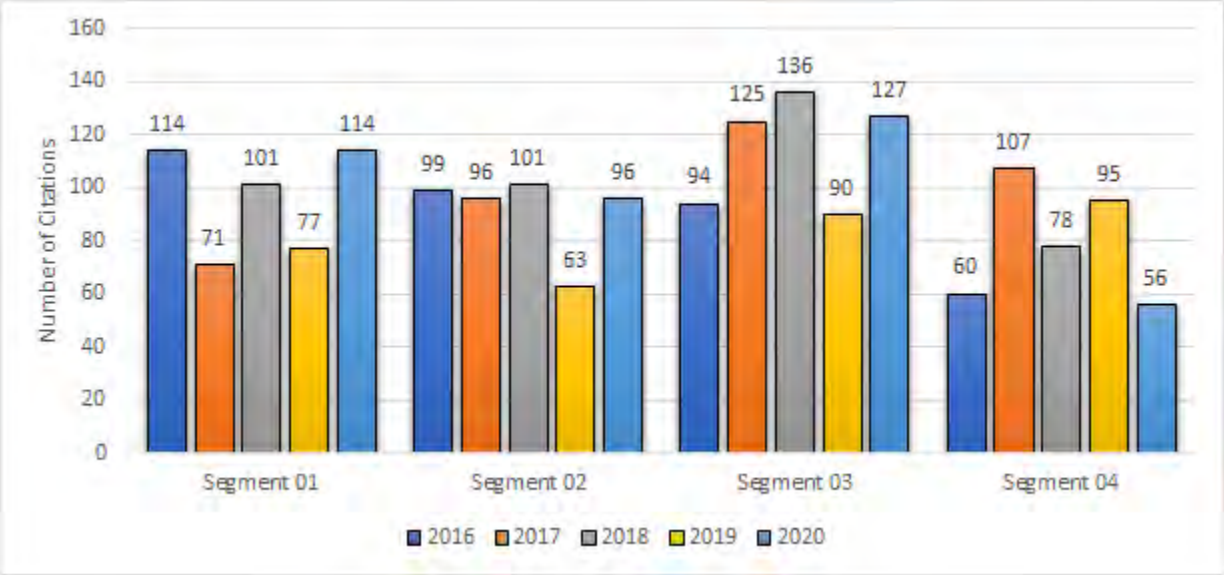
There were five crashes (One fatal, two possible injury, and two property damage only crashes) reported during the analysis period. The fatal and injury crashes were angle-related while the property damage only crashes were rear-end related. Limited to no data was available to identify if speeding was the primary contributor of these crashes at the intersection.

Citation History

The speeding law in Montana 1 § 61-8-303 (3) states: "Subject to the maximum speed limits set forth in subsection (above), a person shall operate a vehicle in a careful and prudent manner and at a reduced rate of speed no greater than is reasonable and prudent under the conditions existing at the point of operation, taking into account the amount and character of traffic, visibility, weather, and roadway conditions." It is critical to note that the law enforcement can issue a ticket for driving a vehicle at unsafe speeds, even if a driver is within the posted speed limit. For example, driving at the posted speed limit on the freeway when there is a blizzard or thick fog. Since these driving conditions are unsafe for you and other drivers, law enforcement is within their rights to issue a speeding ticket as per the speeding laws in Montana.

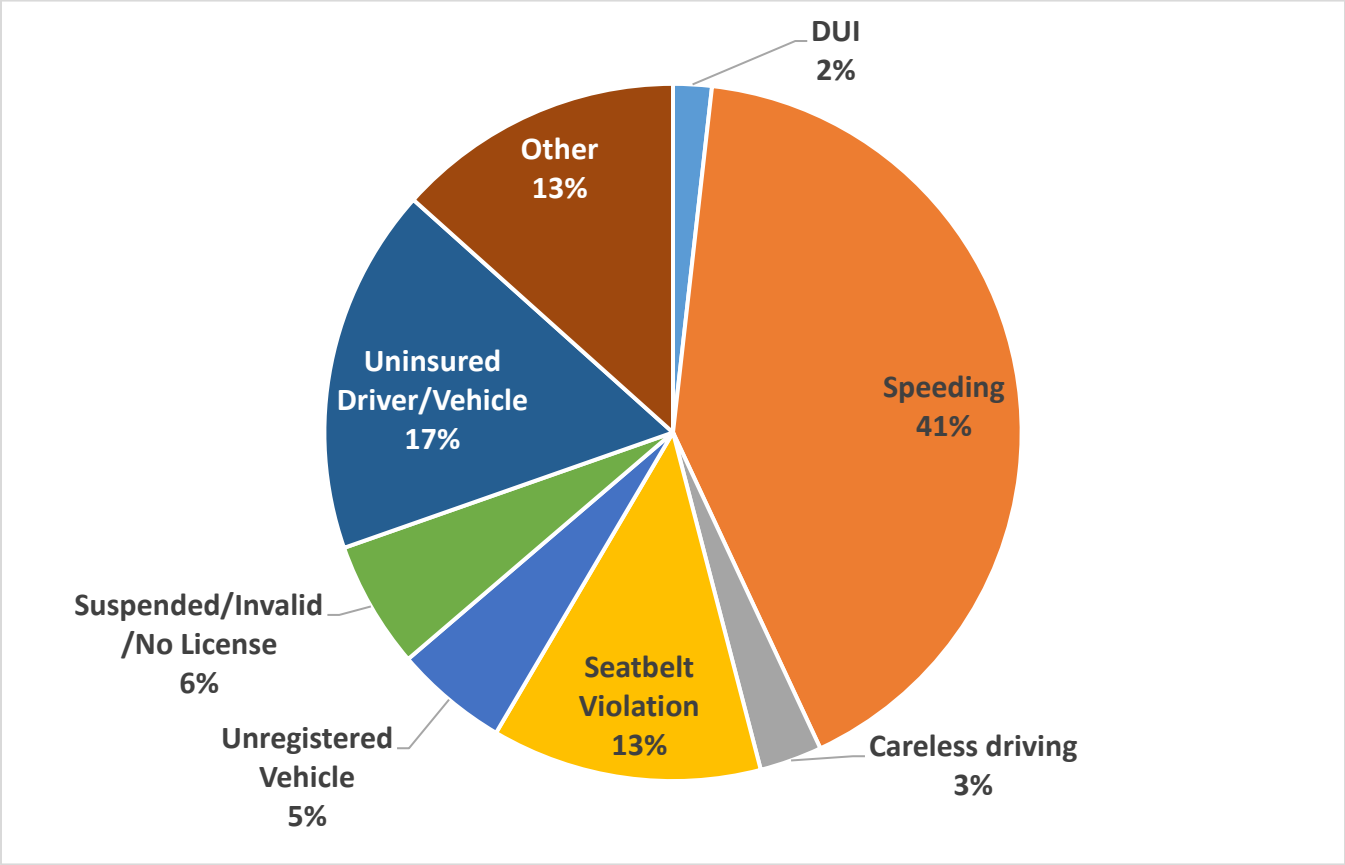
Five years of citation records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. The citation records are extracted in a spreadsheet format. The five-year citation summary in the segments is shown in **Figure 3**. There were 1,900 citations issued in the study area during the analysis period of which 784 citations (41%) were speeding violations.

Figure 3 - Citation Summary by Year



The types of citations issued in this study area are shown in **Figure 4**. Speeding (41%), Uninsured driver/vehicle (17%), and failure to wear seatbelt (13%) were the most prominent types of traffic violations in the study area.

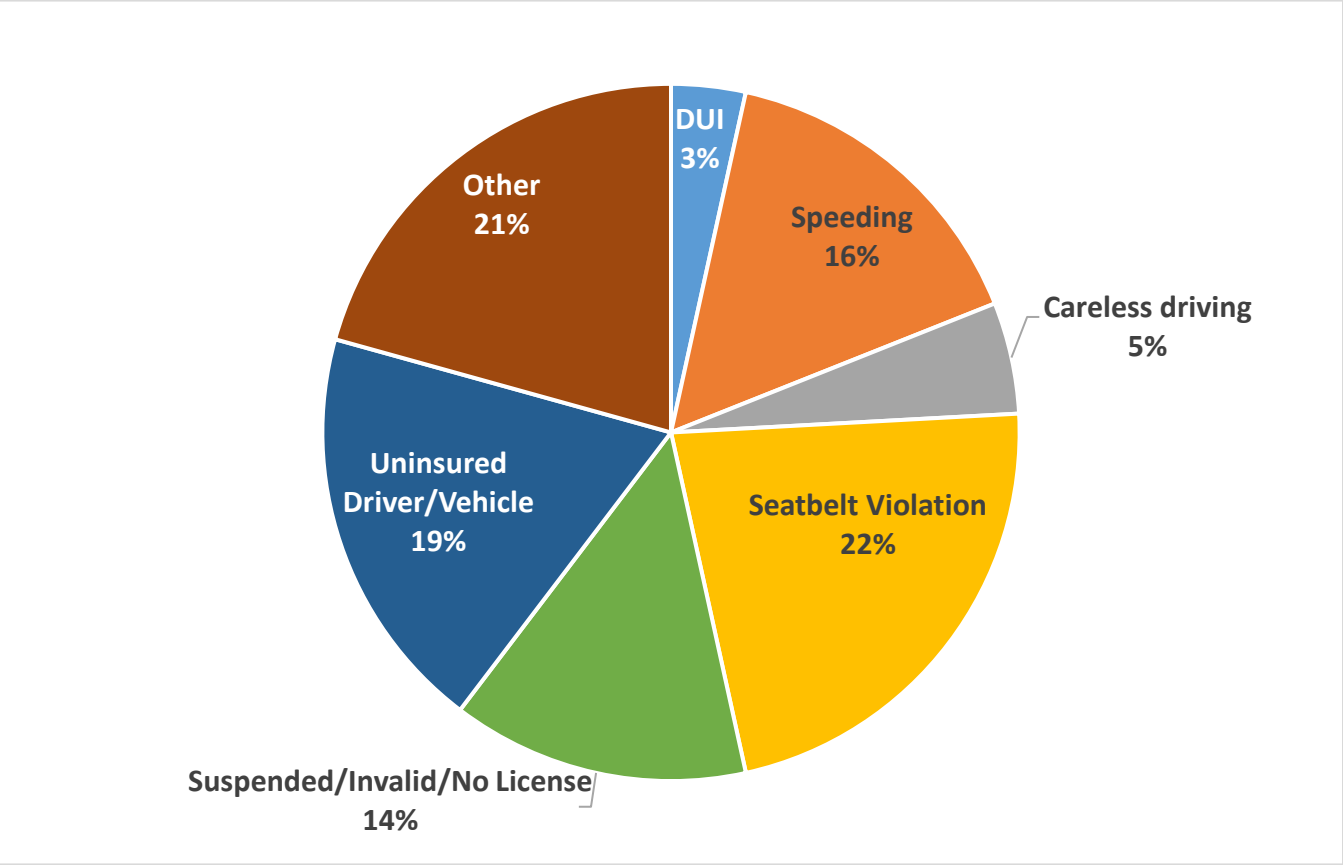
Figure 4 - Citation Types Issued in the study area (2016 - 2020)



WOODSIDE CUTOFF / US HWY 93 INTERSECTION

There were 58 citations at the intersection during the analysis period. The types of citations issued at this intersection are shown in **Figure 5**. Seatbelt violations (21%) is the most prominent type of traffic violation at this intersection.

Figure 5 - Citation Types Issued at the Intersection of US Hwy 93 with Woodside Cutoff Rd (2016 - 2020)



5. Speed Characteristics

Engineering Approach

The engineering approach is a two-step process based on operating conditions such as the 85th percentile speed. The 85th percentile is the speed at which 85% of free-flowing traffic is traveling at or below. Once the speed limit is established based on the 85th percentile speed, it can be adjusted (usually downward) based on other factors such as amount of non-motorized traffic, roadway characteristics, and crash history. MDT's procedures for setting speed limits are based on the engineering approach.

MDT uses 85th percentile, 50th percentile, and pace speed to evaluate speed data. The pace speed is a 10-mph increment in speeds that encompasses the highest portion of observed speeds.

Spot Speed Data

Spot speed studies typically consist of sample sizes totaling at least 100 vehicles with Free Flow Speed (FFS). FFS is the speed of motorists traveling as desired given prevailing conditions such that no preceding vehicle influences the motorists' speed. Unattended pneumatic tubes were placed along the four segments of the study area to collect vehicular speed samples for a 24-hour period from August 23 to 24, 2022**.** The 24-hour data consisted of all vehicles that traveled along the study area with various speed profiles including vehicles that influenced a motorist's choice of speed such as vehicular deceleration to make turns, queuing during peak hour, or a platoon.

Speed data were collected at the four segments, eight speed transition zones, and at the intersection of US Hwy 93 with Woodside Cutoff Rd.

NCHRP

A recent research report from the *National Cooperative Highway Research Program* (NCHRP) has been completed. NCHRP report 17-76: *Development of a Posted Speed Limit Setting Procedure and Tool* collected insights into how the roadway environment influences operating speed and safety (crashes) through a review of literature and the collection and analysis of data from two states. Using those insights along with an understanding of different methods being used and currently being considered for the setting of posted speed limits, the research team developed a speed limit setting procedure along with a tool. The procedure uses fact-based decision rules that consider both driver speed choice and safety associated with the roadway.

There has been a nationwide push over the last several years for the consideration of 50th percentile speed, especially for developed areas. When the roadway conditions are optimal, the suggested speed limit should reflect the 85th percentile speed. When roadway conditions are not favorable to all users or when crashes are a significant concern, then the suggested speed limit should reflect the rounded down 85th or 50th percentile speed. Drivers frequently select speeds a certain increment above the posted speed limit, anticipating that they will not receive a ticket if they are below the assumed enforcement speed tolerance. Because of these reasons, 50th percentile speed data were also used in the analysis along with the 85th percentile speed data.

The NCHRP 17-76 Speed Limit Setting Tool was used to calculate the recommended speed limit for the study segment based on key factors such as: 85th percentile and 50th percentile speed, roadway characteristics, and crash history.

Speed Study Results

SEGMENTS

The summary of speed data for the segments for all vehicle types are shown in **Table 4**. For detailed information including the speed by type of vehicle and direction is discussed in individual segment reports included in the **Appendix I**.

Table 4 – Segment Wide Speed Study Summary

Segment	Existing Speed Limit	Calculated Speed %ile		10-mph Pace	% in Pace	NCHRP Recommendation
		85th	50th			
Segment 1	70-mph	77-mph	70-mph	65-75	50%	70-mph
Segment 2	70-mph	72-mph	63-mph	58-68	55%	70-mph
Segment 3	70-mph	76-mph	69-mph	66-76	57%	70-mph
Segment 4	65-mph	72-mph	66-mph	62-72	61%	65-mph

SPEED TRANSITION ZONES

The summary of speed data for the speed transition zones are shown in **Table 5**.

Table 5 - Speed Study Summary at Speed Transition Zones

		Direction	Transition							
			1	2	3	4	5	6	7	8
Existing	Reference Point	-	59.1	58.7	58.3	52.1	51.8	51.5	50.0	49.7
	Speed Change (mph)	NB	45	55	70[1]	55	45	55	65	55
		SB	55	70[1]	55	45	55	65	55	45
Calculated	85th %-ile Speed (mph)	NB	54	73	64	60	56	62	69	59
		SB	55	63	67	50	57	63	66	60
		Both	55	68	66	57	57	62	68	59
	50th %-ile Speed (mph)	NB	48	64	59	53	50	56	64	50
		SB	50	57	61	45	51	57	60	53
		Both	49	60	60	49	50	56	62	52
	10-mph Pace Speed (mph)	NB	44-54	58-68	54-64	49-59	46-56	52-62	59-69	45-55
		SB	46-56	52-62	56-66	41-51	47-57	52-62	55-65	49-59
		Both	45-55	54-64	55-65	43-53	47-57	52-62	58-68	48-58
	% of vehicles in 10-mph Pace	NB	65%	48%	61%	59%	57%	66%	67%	45%
		SB	68%	62%	59%	69%	58%	60%	65%	60%
		Both	66%	51%	59%	52%	57%	64%	62%	52%

NB – Northbound; SB – Southbound
1 – 65 mph for Trucks

WOODSIDE CUTOFF INTERSECTION

Spot speed data was collected at the intersection of US Hwy 93 with Woodside Cutoff Rd on Tuesday, August 23, 2022, from 10:15AM to 12:30PM. Pocket radar device were used to collect speed data. Speed data of 616 sample size were collected and analyzed for speed. The 85th percentile speed and 50th percentile speed was calculated to be 51-mph and 45-mph, respectively. The 10-mph pace was found to be between 41-mph and 51-mph, with 67% of the vehicles travelling within the 10-mph pace. The 85th percentile speed is found to be greater than the posted speed limit and near to the upper tail of the 10-mph pace. The 50th percentile speed is at the posted speed limit and is within the 10-mph pace.

6. Straight-Line Diagram

Straight-line diagrams are linear graphical representations of features and characteristics along roadways on and some off the State Highway System and nearby surrounding area. These diagrams are prepared to support efforts in preparing for field surveys, planning construction projects, verifying Roadway Characteristics Inventory (RCI) data, and other related applications. The straight-line diagrams for the study area with the speed characteristics at the locations where data has been collected and analyzed are included in **Appendix II**.

7. Recommendations

Segment

Based on the review of the roadway and environment conditions, crash history, speed characteristics, and NCHRP 17-76 Speed Limit Setting Tool, the existing speed limits at the study segments are appropriate and no changes in speed limit is recommended.

Speed Transition Zones

The speed differentials between the posted speed limit and 85th percentile speed limit are summarized in **Table 6**. The minimum recommended spacing for a speed transition over 45-mph posted speed is 0.5-mile. The spacing between the speed transitions in this segment of US 93 between Hamilton and Victor were all less than the minimum recommended spacings. It is recommended that the speed transition spacings be adjusted to the current MDT practice procedures.

Table 6 - Speed Differentials at Speed Transition Zones

	Direction	Transition							
		1	2	3	4	5	6	7	8
85th %-ile Speed (mph)	NB	54	73	64	60	56	62	69	59
	SB	55	63	67	50	57	63	66	60
Speed Limit Change (mph)	NB	45	55	70	55	45	55	65	55
	SB	55	70	55	45	55	65	55	45
Δ in Speed (mph)	NB	+9	+18	-6	+5	+11	+7	+4	+4
	SB	0	-7	+12	+5	+2	-2	+11	+15

TRANSITION 1

- Northbound - The 85th percentile speed is nine-mph greater than the posted speed limit of 45-mph. Vehicles travelling northbound are entering the town of Victor from a statutory speed limit of 70 mph cars/65 trucks. This is indicative that the existing speed limit entering Victor is appropriate. No change in speed limit is recommended for traffic travelling in the northbound direction.
- Southbound - The speed differentials between the posted speed limit and 85th percentile speed is zero which is indicative that the vehicles are entering rural high-speed roadway after leaving Victor. The posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the southbound direction.

TRANSITION 2

- Northbound - The 85th percentile speed is 18-mph greater than the posted speed limit of 55-mph. Vehicles travelling northbound are close to entering the upstream speed limit change from 55-mph to 45-mph before entering Victor. Although the 85th percentile speed is 18-mph higher than the posted speed limit, the existing posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the northbound direction.
- Southbound - The 85th percentile speed is seven-mph less than the posted speed limit of 70-mph. Vehicles travelling southbound are transitioning from 55-mph to 70-mph. The existing posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the southbound direction.

TRANSITION 3

- Northbound - The 85th percentile speed is six-mph less than the posted speed limit of 70-mph. Vehicles travelling northbound are transitioning from 55-mph to 70-mph. The existing posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the northbound direction
- Southbound - The 85th percentile speed is 12-mph greater than the posted speed limit of 55-mph. Vehicles travelling southbound are transitioning from 70-mph to 55-mph before transitioning to 45-mph while entering the signalized intersection at Woodside Cutoff Rd. The existing posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the southbound direction.

TRANSITION 4

- Northbound - The 85th percentile speed is five-mph greater than the posted speed limit of 55-mph. Vehicles travelling northbound are transitioning from 45-mph to 55-mph after crossing the signalized intersection at Woodside Cutoff Rd. The existing posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the northbound direction
- Southbound - The 85th percentile speed is five-mph greater than the posted speed limit of 45-mph. Vehicles travelling southbound are transitioning from 55-mph to 45-mph before crossing the signalized intersection at Woodside Cutoff Rd. The existing posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the southbound direction.

TRANSITION 5

- Northbound - The 85th percentile speed is 11-mph greater than the posted speed limit of 45-mph. Vehicles travelling northbound are transitioning from 55-mph to 45-mph before crossing the signalized intersection at Woodside Cutoff Rd. The existing posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the northbound direction
- Southbound - The 85th percentile speed is two-mph greater than the posted speed limit of 55-mph. Vehicles travelling southbound are transitioning from 45-mph to 55-mph after crossing the signalized intersection at Woodside Cutoff Rd. The existing posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the southbound direction.

TRANSITION 6

- Northbound - The 85th percentile speed is seven-mph greater than the posted speed limit of 55-mph. Vehicles travelling northbound are transitioning from 65-mph to 55-mph and then transitioning to 45-mph before crossing the signalized intersection at Woodside Cutoff Rd. The existing posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the northbound direction Southbound - The 85th percentile speed is two-mph less than the posted speed limit of 65-mph. Vehicles travelling southbound are transitioning from 55-mph to 45-mph. The existing posted speed limit is appropriate. No change in speed limit is recommended along southbound.

TRANSITION 7

- Northbound - The 85th percentile speed is four-mph greater than the posted speed limit of 65-mph. Vehicles travelling northbound are transitioning from 55-mph to 65-mph. The existing posted speed limit is appropriate. No change in speed limit is recommended along northbound.
- Southbound - The 85th percentile speed is 11-mph greater than the posted speed limit of 55-mph. Vehicles travelling southbound are transitioning from 65-mph to 55-mph. The existing posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the southbound direction.

TRANSITION 8

- Northbound - The 85th percentile speed is four-mph greater than the posted speed limit of 65-mph. which is indicative that the vehicles are entering rural high-speed roadway after leaving Hamilton. The posted speed limit is appropriate. No change in speed limit is recommended for traffic travelling in the northbound direction
- Southbound - The 85th percentile speed is 15-mph greater than the posted speed limit of 45-mph. Vehicles travelling southbound are entering the town of Hamilton from high-speed rural roadway. This is indicative that the existing speed limit while entering Hamilton is appropriate. No change in speed limit is recommended for traffic travelling in the southbound direction. However, a traffic calming device may be helpful to lower the travelling speed along southbound.

Woodside Cutoff Intersection

The intersection is signal control with high volume of traffic. The speed differentials between the 85th percentile speed limit and the posted speed is not significantly high. Increasing the posted speed limit could lead to increase in rear-end crashes since sudden red-light stop could trigger sudden brake from higher speed to come to a complete stop. The existing posted speed limit is appropriate. No change in speed limit is recommended at the intersection.

APPENDIX I - SEGMENT SPEED STUDIES

ENGINEERING, REIMAGINED

SPEED STUDY

US Hwy 93 – Hamilton to Victor

Reference Point: 56.0 to 58.6

Ravalli County, MT

January 2023

Speed Study

Hamilton to Victor, Montana

RP: 56.0 to 58.6

January 2023

Prepared for:

Montana Department of Transportation

Prepared by:

KLJ Engineering

Table of Contents

1. Introduction 1
2. Methodology 2
3. Roadway Characteristics 2
4. Vehicular Classification 3
5. Safety Characteristics 4
6. Speed Characteristics 7
7. Conclusion 8

List of Figures

Figure 1 - Study Segment 1
Figure 2 - Representative Section of US Hwy 93 from RP 56.0 to 58.6 2
Figure 3 - Five-Year Crash Summary (2016-2020) 4
Figure 4 - Citation Summary by Year 6
Figure 5 - Citation Types Issued (2016 - 2020) 6
Figure 6 - Speed Profile for All Vehicles Types in Both Direction of Travel 7

List of Tables

Table 1 - Vehicular Classification 4
Table 2 - Crash Collision Type 5
Table 3 - Speed Study Profile 8

List of Appendices

Appendix A – Pictures ..... A
Appendix B – Speed Study Profiles ..... B
Appendix C – NCHRP Report C

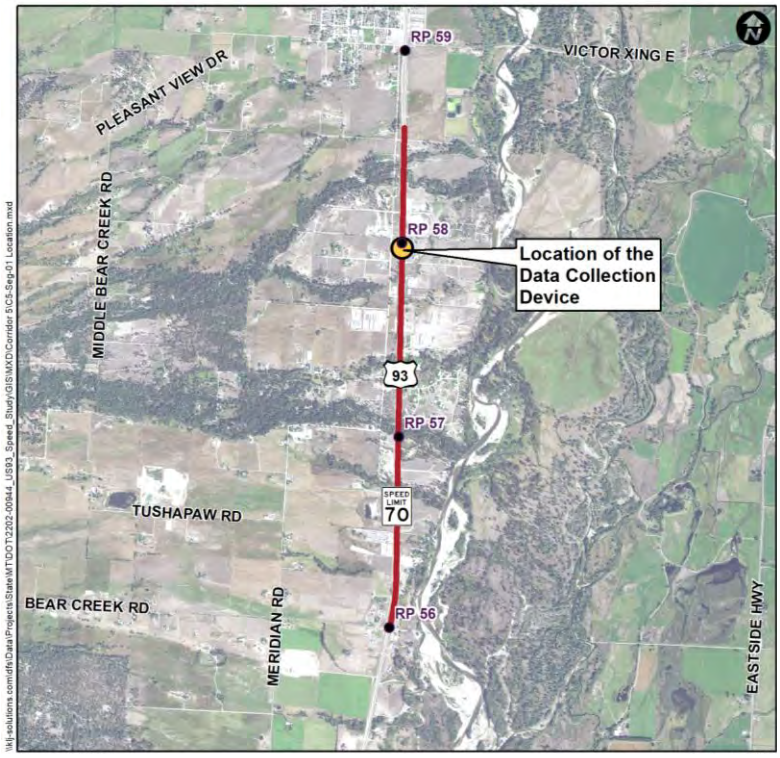
1. Introduction

Speed limits are set to inform motorists of appropriate driving and safe operating speeds under favorable conditions. Speed limits are posted at the statutory speed limit unless a traffic engineering investigation study has been conducted and (where applicable) approved by the Transportation Commission. The *Montana Department of Transportation* (MDT) has requested KLJ Engineering to review the posted speed limit along US Hwy 93 from Hamilton to Victor.

Study Location

The study segment is US Hwy 93 that begins from Reference Point (RP) 56.0 to 58.6 or between Bear Creek Rd and 2,000 ft south of Victor Crossing. The 2.6-mile segment is a paved four-lane roadway with a two-way-left-turn-lane (TWLTL) in the center and has a statutory speed limit of 65-mph for trucks and 70-mph for all other vehicles throughout the segment. There is an annual average daily traffic (AADT) of 7,215 that travel along this segment as per 2021 counts reported in MDT's Transportation Data Management System (TDMS). The location of the study segment is shown in **Figure 1**.

Figure 1 - Study Segment



Objective

The purpose of this study is to evaluate the appropriate speed of the roadway. The primary tasks for the study included data collection, data analysis, and recommendations for speed limits along the study segment. As part of this study, an evaluation and cataloging of existing roadway conditions, collection of historical AADT, and crash data will be completed.

Procedures

The steps for setting speed limits include planning, coordination, data collection and analysis, review, and presentation to the stakeholders, and finally, determination or implementation of the speed limits. Quality data and good documentation provides support for the judgments that are made.

Five years of the most recent crash and citation data was also requested and received from the MDT Traffic & Safety Bureau for the analysis.

2. Methodology

For determining the appropriate speed limit, the following parameters were reviewed:

- Roadway Condition/Characteristics
- Crash and Citation History
- Speed Characteristics, and
- Vehicular classes

When considering whether to establish a new posted speed limit or not, surveying and analysis of existing travel speeds is crucial to determining a reasonable posted speed limit. Motorist usually drive at speeds which they perceive as safe, based on the observable roadway conditions. A flat and straight roadway may result in a different travel speed than the posted speed limit due to the driver's observation of the roadway condition.

3. Roadway Characteristics

While speed samples (actual speed measurements of vehicles) are a large part of the necessary data, roadway characteristics should also be considered. Roadway characteristics such as pavement type/conditions, access points, vertical grades, and clear zone assessments data were collected during the field visit in August 2022. **Figure 2** shows the most representative sections of the segments of roadway along the US 93 Study segment. Additional pictures of the study segment are available in **Appendix A**.

Figure 2 - Representative Section of US Hwy 93 from RP 56.0 to 58.6

Lanes and Shoulders

The typical cross section for this study section consists mainly of four 11-ft bituminous travelling lanes, 15-ft center two-way-left-turn-lane (TWLTL), and two 10-ft bituminous shoulders. The pavement is generally in good condition. The shoulders are wide enough for safe parking of disabled vehicles.

Rumble Strips

There are shoulder rumble strips present throughout the segment. There are no centerline rumple strips present throughout the segment.

Access Points per Mile

An access point refers to public roads, a business driveway, a private driveway, or a farm field access. Fewer access points per mile means drivers are responding to a reduced number and variety of events. The study section has a combined 36-accesses (8 public, 18 private, and 10 field access) within the nearly 2.6-mile segment that corresponds to 13.9 accesses points per mile. The recommended primary full-movement and secondary intersection spacing for a rural principal arterial is one-mile and half-mile, respectively. The recommended and maximum density for driveways per mile for a 70-mph principal arterial roadway is no more than 18.8 based on Stopping Sight Distance chart documented in AASHTO Green Book, 5th Edition.

Vertical Grades

Grade is the rate of change of the vertical alignment. Grade affects vehicle speed and vehicle control, particularly for large trucks. The study segment can be described as generally flat.

Roadside Hazard Assessment

The segment generally comprises of both cut and fill section with a clear zone that is partially obstructed. There are sections of roadways that have guardrails within the clear zone that protect from steep slopes and creeks. There is a trail that runs parallel to the west side of the roadway.

In-slope

The in-slope measured at the representative section is generally flat. The in-slope was measured at 6:1 which is considered a recoverable slope. There are driveways along the study segment that have steep slopes because of culverts crossing them. These steep slopes appear to be non-traversable.

Adjacent Development

The area is generally rural residential.

Statutory and Advisory Speeds

The statutory speed limit is 65-mph for trucks and 70-mph for all other vehicles throughout the segment. There are no advisory speeds along the segment.

Traffic Control

There are no traffic control devices at the intersections along the segment that requires motorists on mainline to slow, stop and/or yield.

4. Vehicular Classification

Vehicular class data for 24-hour period were collected on August 23, 2022. Vehicle types were categorized to two classifications:

- **Mid-size Vehicles** consisting of motorcycles, passenger vehicles, pickups, vans, buses, conventional vans, and city delivery trucks.
- **Large Vehicles** consisting of single unit four or more axle trucks.

There are 11,900 and 1,300 daily small to mid-size and large vehicles, respectively that travel in the segment. The daily distribution is 46% along northbound and 54% along southbound. The vehicular classifications in the study segment are summarized in **Table 1**.

Table 1 - Vehicular Classification

Classification	Northbound	Southbound	Total	Percent
Small to Mid-Size vehicles	5,420	6,480	11,900	90%
Large vehicles	680	620	1,300	10%
Total (Percent)	**6,100 (46%)**	**7,100 (54%)**	**13,200**	**100%**

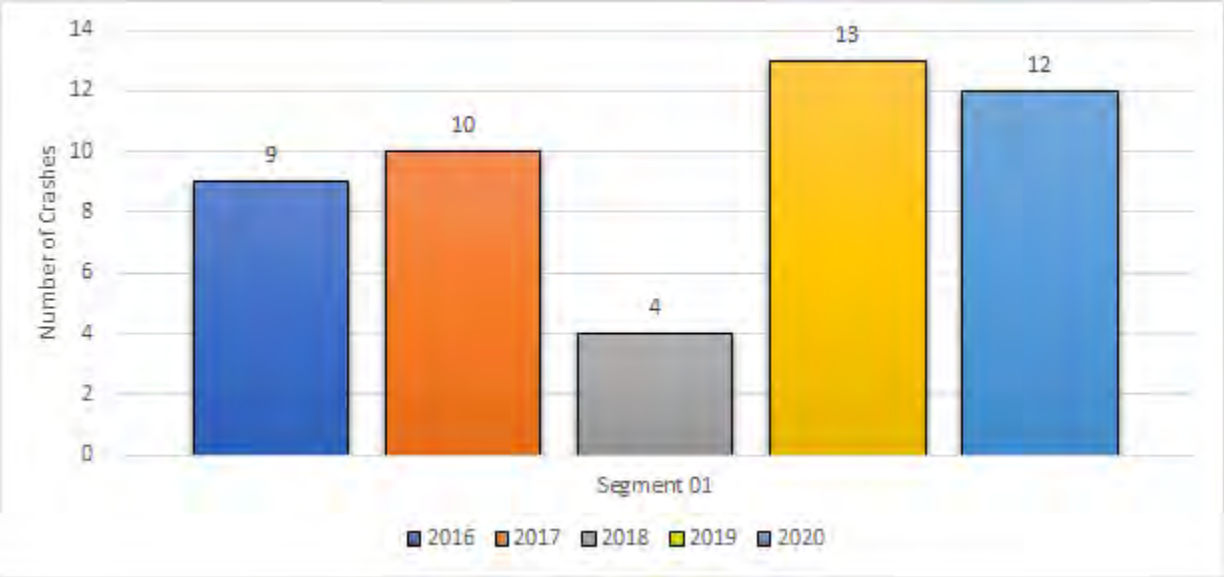
5. Safety Characteristics

Reviewing historic crash and citation information can help identify driver behavior issues that can provide additional information for setting speed the appropriate and safer speed limit.

Crash History

Five years of crash records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. MDT shared crash records in a spreadsheet format. The five-year crash summary by year is shown in **Figure 3**. There were 48 crashes (one fatal, one serious injury, eight minor injury, four possible injury, 33 property damage only, and one unknown type crashes) reported during the analysis period. This corresponds to 9.6 crashes per year or 3.7 crashes per mile per year.

Figure 3 - Five-Year Crash Summary (2016-2020)



41 crashes or 85% of all the crashes were non-junction related. Crash summary by crash type is shown in **Table 2**.

Table 2 - Crash Collision Type

Type	# Crashes
Fixed Object	9
Head On	1
Jackknife	1
Left Turn, Opposite Direction	2
Not Fixed Object Or Debris	2
Pedestrian	1
Rear-End	3
Right Angle	2
Roll Over	5
Wild Animal	22
Total	**48**

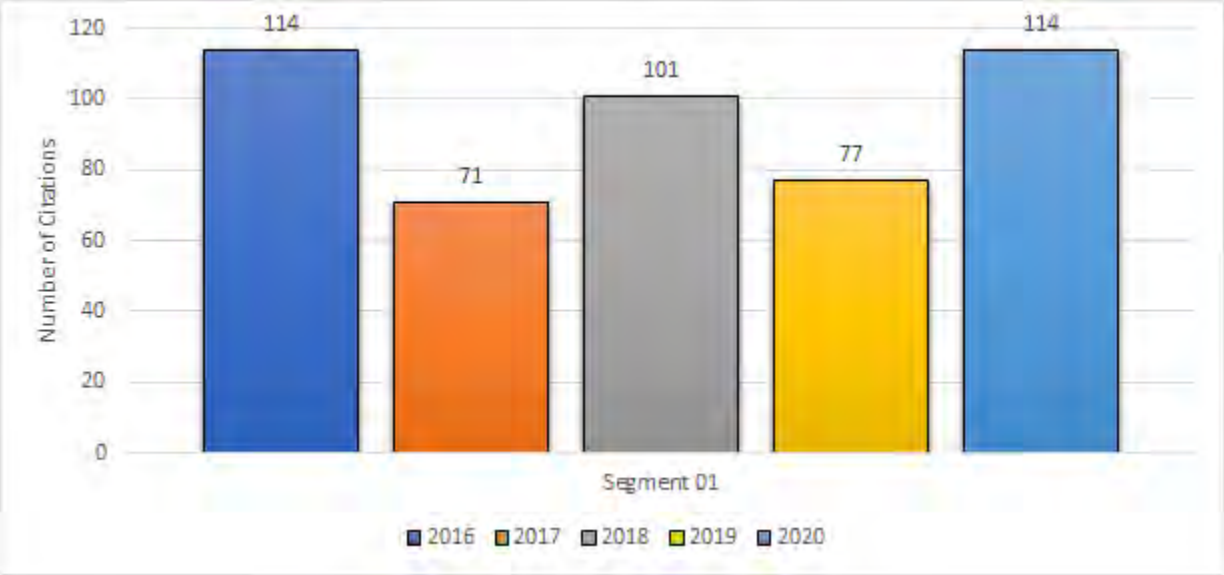
Crashes with wild animals (46%) were the most prominent crash types followed by collision with fixed objects (19%) in the study segment. The crash data had no supplement officer narratives to identify if speeding was the contributing factor for any of these crashes.

Citation History

The speeding law in Montana 1 § 61-8-303 (3) states: "Subject to the maximum speed limits set forth in subsection (above), a person shall operate a vehicle in a careful and prudent manner and at a reduced rate of speed no greater than is reasonable and prudent under the conditions existing at the point of operation, taking into account the amount and character of traffic, visibility, weather, and roadway conditions." It is critical to note that the law enforcement can issue a ticket for driving a vehicle at unsafe speeds, even if a driver is within the posted speed limit. For example, driving at the posted speed limit on the freeway when there is a blizzard or thick fog. Since these driving conditions are unsafe for you and other drivers, law enforcement is within their rights to issue a speeding ticket as per the speeding laws in Montana.

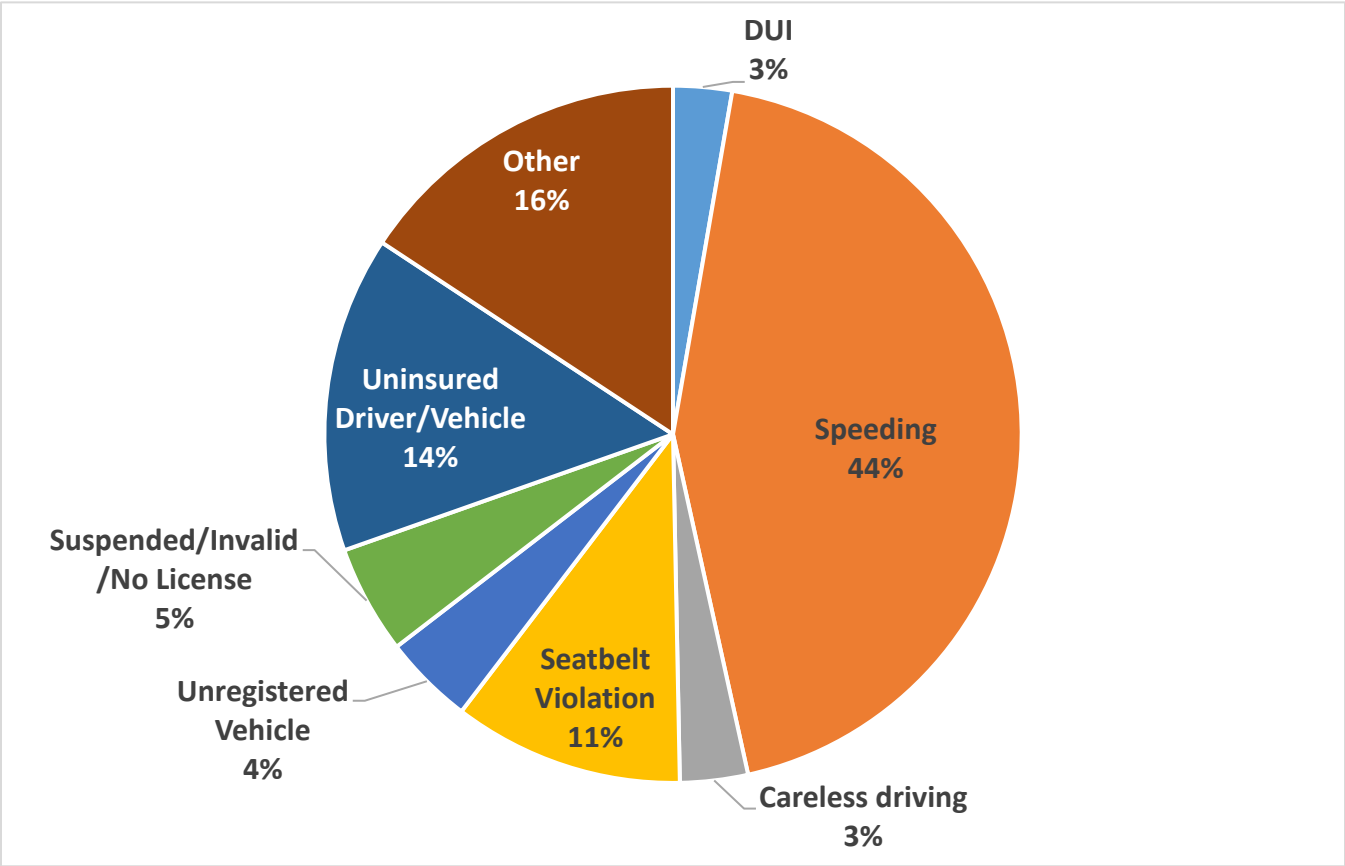
Five years of citation records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. The citation records were shared in a spreadsheet format. The five-year citation summary in the segment is shown in **Figure 4**. There were 477 citations issued in the study segment during the analysis period of which 209 citations (44%) were speeding violations.

Figure 4 - Citation Summary by Year



The greatest number of citations were given in the month of July (15.5%). The types of citations issued in this segment are shown in **Figure 5**. Speeding (44%), Uninsured driver/vehicle (14%), and failure to wear seatbelt (11%) were the most prominent types of traffic violations in the study segment.

Figure 5 - Citation Types Issued (2016 - 2020)



6. Speed Characteristics

Engineering Approach

The engineering approach is a two-step process based on operating conditions such as the 85th percentile speed. The 85th percentile is the speed at which 85% of free-flowing traffic is traveling at or below. Once the speed limit is established based on the 85th percentile speed, it can be adjusted (usually downward) based on other factors such as amount of non-motorized traffic, roadway characteristics, and crash history. MDT's procedures for setting speed limits are based on the engineering approach.

MDT uses 85th percentile, 50th percentile, and pace speed to evaluate speed data. The pace speed is a 10-mph increment in speeds that encompasses the highest portion of observed speeds.

Spot Speed Data

Spot speed studies typically consist of sample sizes totaling at least 100 vehicles with Free Flow Speed (FFS). FFS is the speed of motorists traveling as desired given prevailing conditions such that no preceding vehicle influences the motorists' speed. Unattended pneumatic tubes were placed along the study segment to collect vehicular speed samples for a 24-hour period from August 23 to 24, 2022 near RP 58.0**.** The 24-hour data consisted of all vehicles that traveled along the study segment with various speed profiles including vehicles that influenced a motorist's choice of speed such as vehicular deceleration to make turns, queuing during peak hour, or a platoon.

The road and shoulder surface were clear of surface water or snow during the period when data were recorded. The result of the speed profile in the study segment is shown in **Figure 6** and **Table 3**. For details please see **Appendix B**. The 85th percentile speed was found to be 77-mph and the 50th percentile speed was found to be 70-mph. The 10-mph pace was found to be between 65-mph and 75-mph comprising of 50% of daily vehicles within that 10-mph pace. The 85th percentile speeds were generally higher than the posted speed limit and higher than the upper tail-end of the 10-mph pace range, whereas the 50th percentile speeds were within the posted speed limit and 10-mph pace.

Figure 6 - Speed Profile for All Vehicle Types in Both Direction of Travel

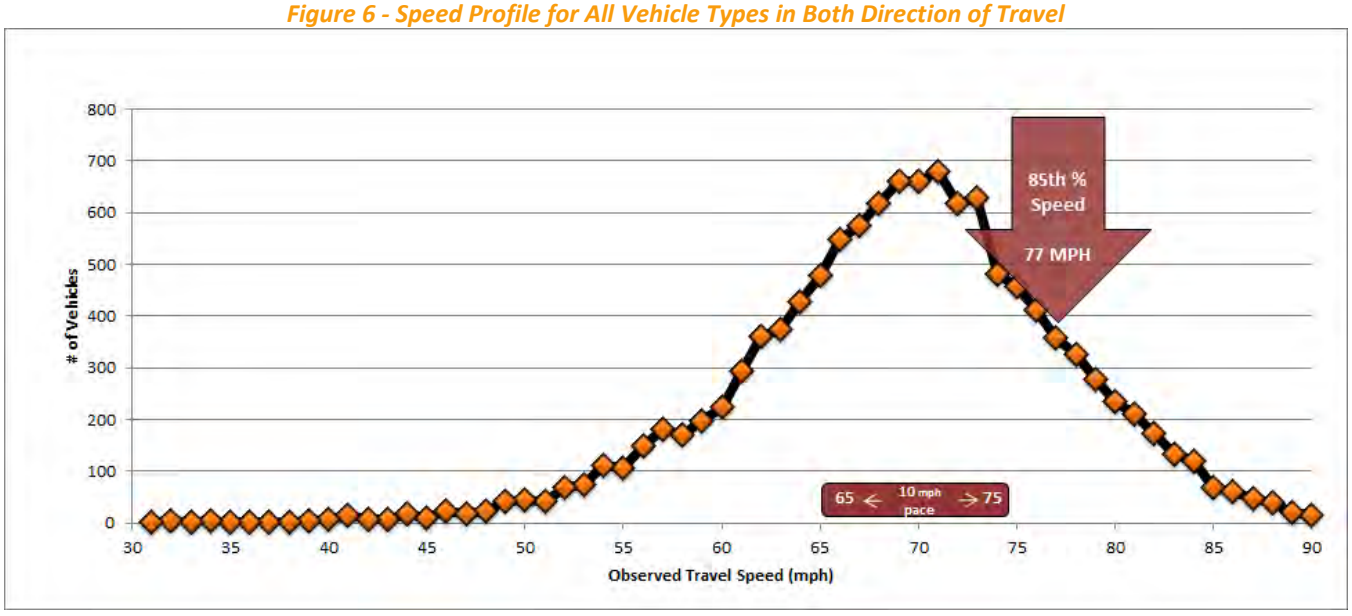


Table 3 - Speed Study Profile

Vehicle Type	Direction	10-mph Pace	% In Pace	85th Percentile Speed	50th Percentile Speed
Small to Mid-size	NB	64-74 mph	44%	79-mph	70-mph
	SB	65-75 mph	56%	76-mph	70-mph
	Both	64-74 mph	51%	77-mph	70-mph
Large	NB	70-80 mph	45%	78-mph	71-mph
	SB	67-77 mph	48%	76-mph	68-mph
	Both	68-78 mph	41%	77-mph	69-mph
All	NB	65-75 mph	44%	79-mph	70-mph
	SB	65-75 mph	55%	76-mph	70-mph
	Both	65-75 mph	50%	77-mph	70-mph

NCHRP

A recent research report from the *National Cooperative Highway Research Program* (NCHRP) has been completed. NCHRP report 17-76: *Development of a Posted Speed Limit Setting Procedure and Tool* collected insights into how the roadway environment influences operating speed and safety (crashes) through a review of literature and the collection and analysis of data from two states. Using those insights along with an understanding of different methods being used and currently being considered for the setting of posted speed limits, the research team developed a speed limit setting procedure along with a tool. The procedure uses fact-based decision rules that consider both driver speed choice and safety associated with the roadway.

There has been a nationwide push over the last several years for the consideration of 50th percentile speed, especially for developed areas. When the roadway conditions are optimal, the suggested speed limit should reflect the 85th percentile speed. When roadway conditions are not favorable to all users or when crashes are a significant concern, then the suggested speed limit should reflect the rounded down 85th percentile or the 50th percentile speed. Drivers frequently select speeds a certain increment above the posted speed limit, anticipating that they will not receive a ticket if they are below the assumed enforcement speed tolerance. Because of these reasons, 50th percentile speed data were also used in the analysis along with the 85th percentile speed data.

The NCHRP 17-76 Speed Limit Setting Tool was used to calculate the recommended speed limit for the study segment based on key factors such as: 85th percentile and 50th percentile speed, roadway characteristics, and crash history. The recommended speed for the study segment based on NCHRP 17-76 was found to be 70-mph along in this segment. Details of the NCHRP 17-76 report is available in **Appendix C**.

7. Conclusion

Vehicular Classification

There are 11,900 and 1,300 daily small to mid-size and large vehicles, respectively, that travel in the segment. The daily distribution is 46% along northbound and 54% along southbound.

Safety Characteristics

There were 48 crashes (one fatal, one serious injury, eight minor injury, four possible injury, 33 property damage only, and one unknown type crashes) reported during the analysis period. Crashes with wild animals (46%) were the most prominent crash types followed by collision with fixed objects (19%) in the study segment.

There were 477 citations issued in the study segment during the analysis period of which 209 citations (44%) were speeding violations.

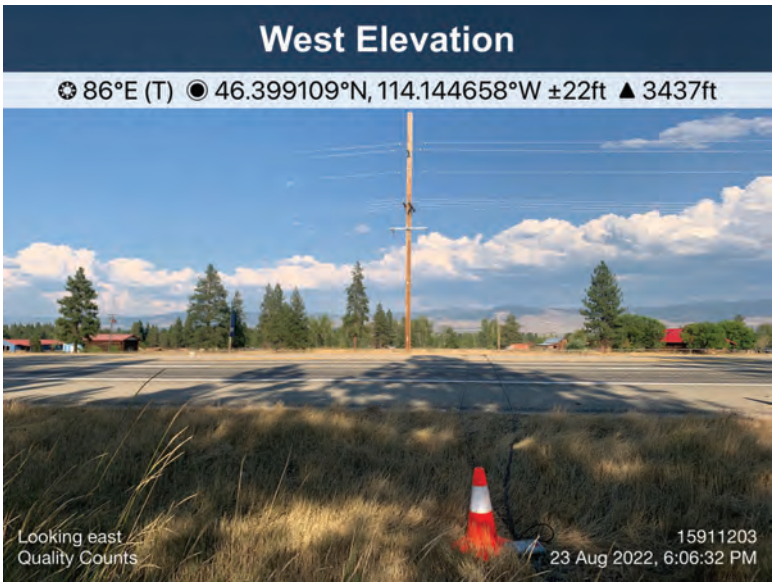
Roadway Characteristics

The segment, RP 56.0 to RP 58.6, being reviewed has a statutory 70-mph speed limit. The 2.6-mile segment is a paved four-lane with a two-way-left-turn-lane (TWLTL) in the center. The segment consists of both cut and fill sections with some fixed objects within the clear zone. There are shoulder rumble strips present but no centerline rumble strips present throughout the segment. The shoulders are wide on both sides of the roadway for safe parking of disabled vehicles. The vertical grades and inslopes are generally flat in the segment. The road conditions are generally in good condition. The area around the segment is mostly rural residential. The driveway density in the study segment is less than the maximum number of driveway thresholds for similar type of facility.

Speed Characteristics

The 85th percentile speed was found to be 77-mph and the 50th percentile speed was found to be 70-mph. The 10-mph pace was found to be between 65-mph and 75-mph comprising of 50% of daily vehicles within that 10-mph pace. The recommended speed for the study segment based on NCHRP 17-76 was found to be 70-mph along in this segment. This indicates that the existing posted speed limit of 70-mph in this segment is reasonable.

APPENDIX A – PICTURES


West Elevation
86°E (T) 46.399109°N, 114.144658°W ±22ft ▲3437ft
Looking east
Quality Counts
15911203
23 Aug 2022, 6:06:32 PM


North West Elevation
157°SE (T) 46.399272°N, 114.144598°W ±26ft ▲3441ft
Looking south
Quality Counts
15911203
23 Aug 2022, 6:07:09 PM

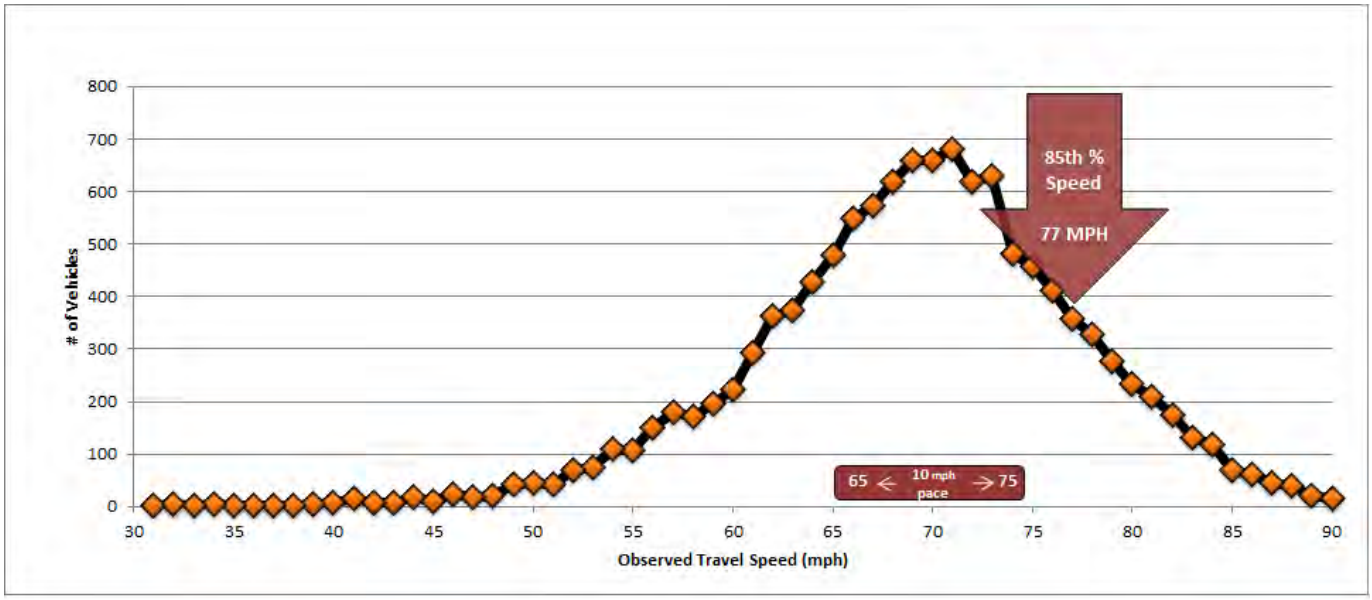

South West Elevation
22°NE (T) 46.398982°N, 114.144567°W ±19ft ▲3442ft
Looking north
Quality Counts
15911203
23 Aug 2022, 6:07:39 PM

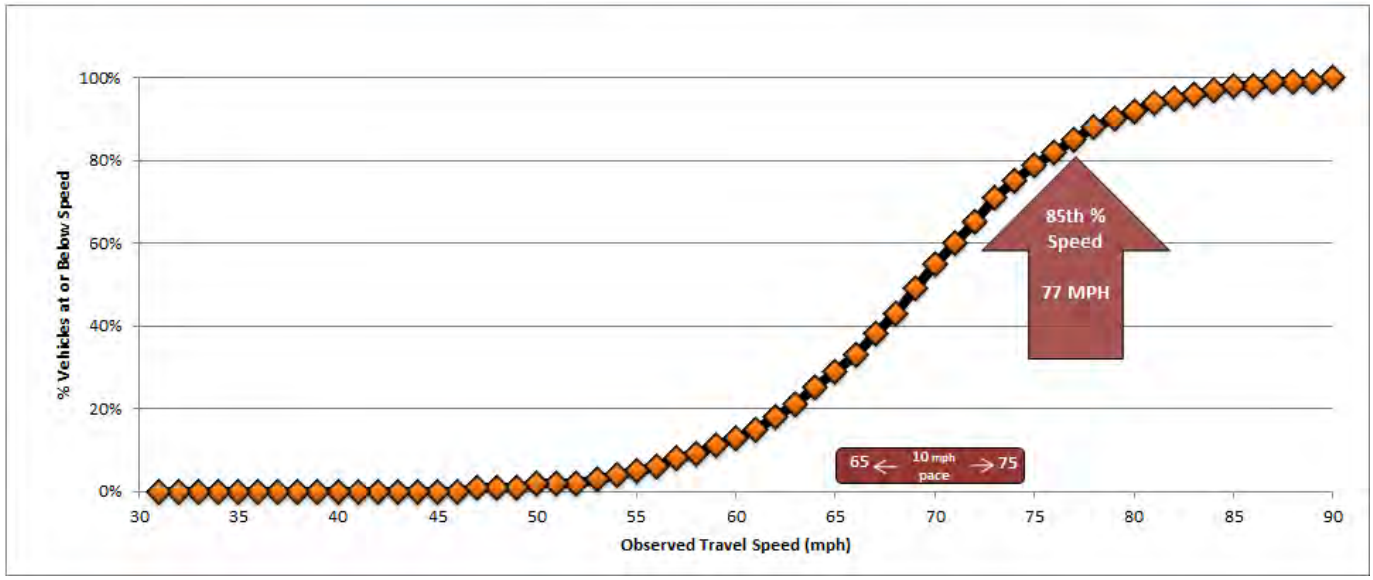

North East Elevation
248°SW (T) 46.399187°N, 114.144168°W ±16ft ▲3439ft
Looking west
Quality Counts
15911203
23 Aug 2022, 6:09:09 PM

APPENDIX B – SPEED STUDY PROFILES

SPEED SAMPLE SUMMARY (ALL VEHICLES)

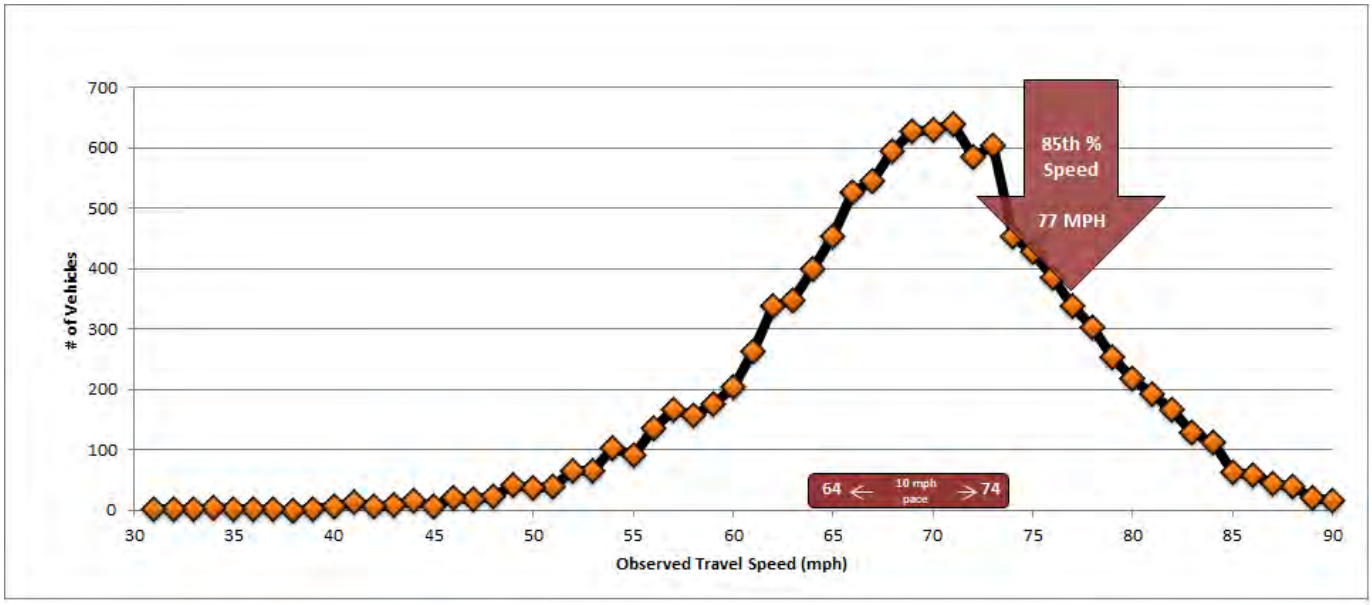
ID:	Segment 1	Speed Limit	70 MPH	Day/Date	Tuesday, August 23, 2022
Roadway:	US 93	Seg. Length:	2.6 MILES	Time:	24-hours
Study Limits:	Hamilton to Victor	Road Type:	Five-Lane, Two way	Sample Loc	46.399051, -114.144331
City/County:	Ravalli	ADT Range:	NB-6100 SB-7100	Weather:	Clear
RP:	56.0 to 58.6	Truck ADT:	NB-680 SB-620	Observer(s):	Quality Counts
85th % Speed:	77	10 mph pace	65-75	Machine:	Tubes
50th % Speed:	70	% in pace	50%		

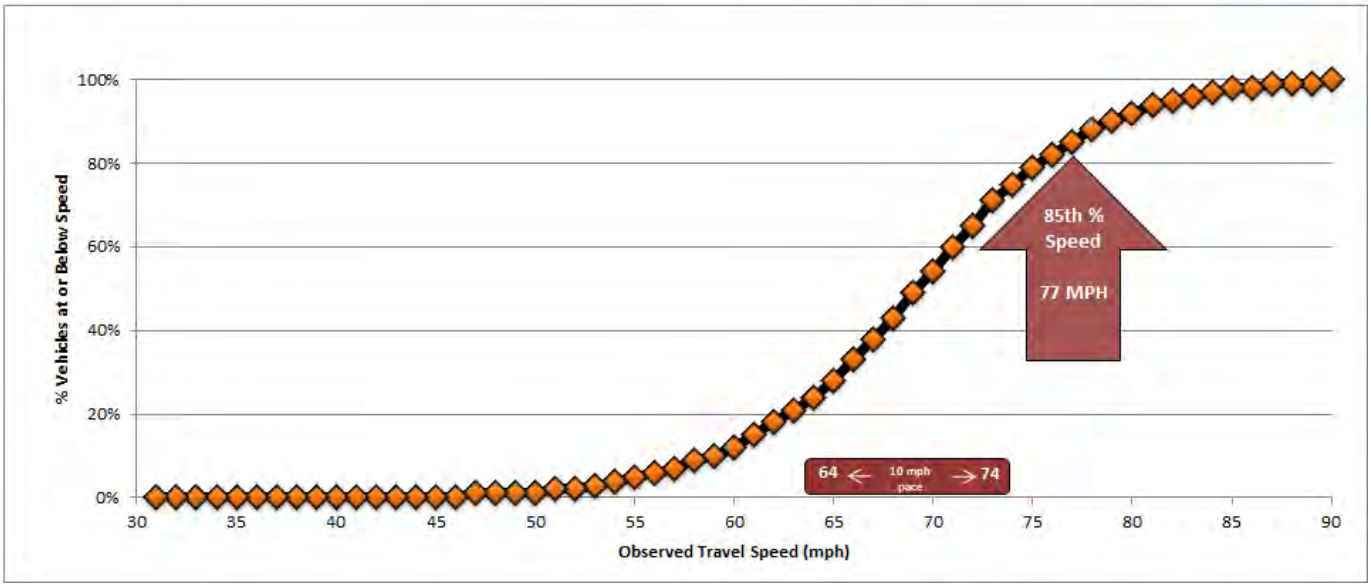




SPEED SAMPLE SUMMARY (PASSENGER VEHICLES)

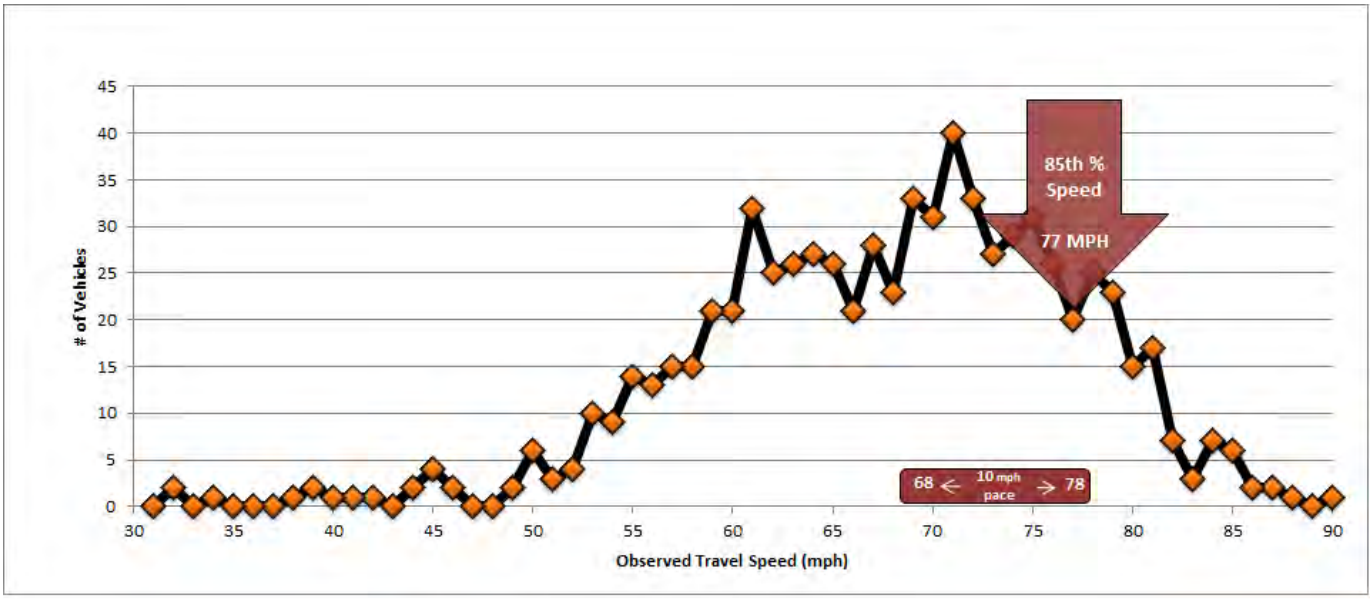
ID:	Segment 1	Speed Limit	70 MPH	Day/Date	Tuesday, August 23, 2022
Roadway:	US 93	Seg. Length:	2.6 MILES	Time:	24-hours
Study Limits:	Hamilton to Victor	Road Type:	Five-Lane, Two way	Sample Loc	46.399051, -114.144331
City/County:	Ravalli	ADT Range:	NB-6100 SB-7100	Weather:	Clear
RP:	56.0 to 58.6	Truck ADT:	NB-680 SB-620	Observer(s):	Quality Counts
85th % Speed:	77	10 mph pace	64-74	Machine:	Tubes
50th % Speed:	70	% in pace	51%		

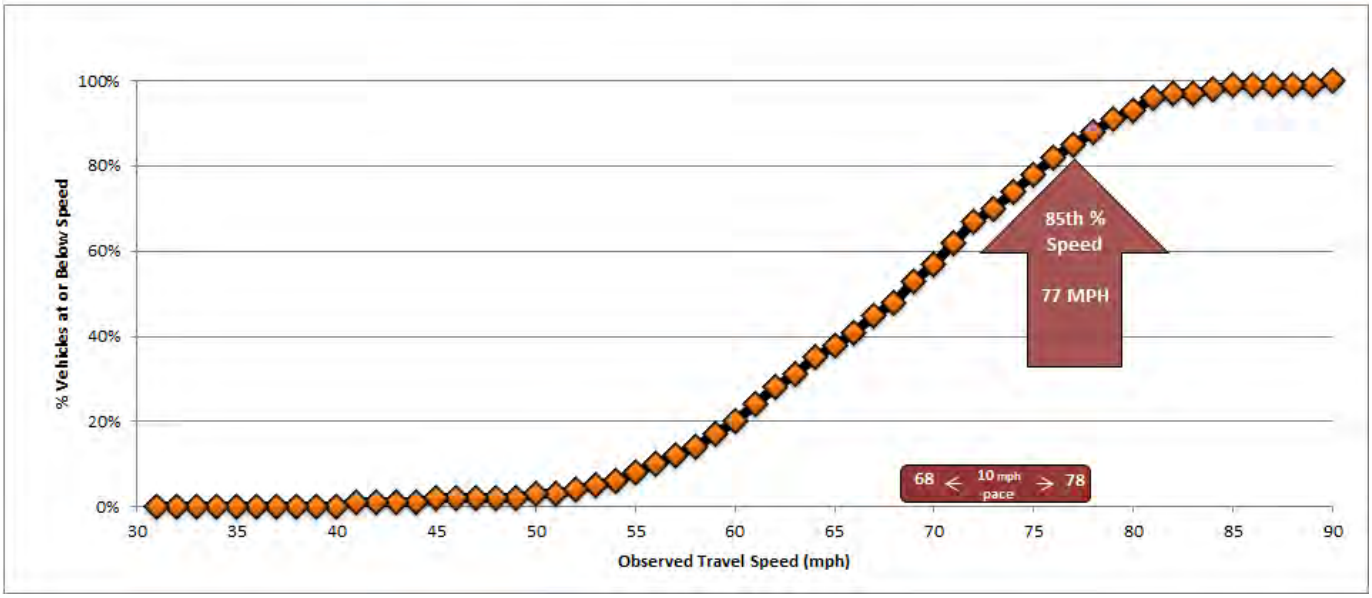




SPEED SAMPLE SUMMARY (TRUCKS)

ID:	Segment 1	Speed Limit	70 MPH	Day/Date	Tuesday, August 23, 2022
Roadway:	US 93	Seg. Length:	2.6 MILES	Time:	24-hours
Study Limits:	Hamilton to Victor	Road Type:	Five-Lane, Two way	Sample Loc	46.399051, -114.144331
City/County:	Ravalli	ADT Range:	NB-6100 SB-7100	Weather:	Clear
RP:	56.0 to 58.6	Truck ADT:	NB-680 SB-620	Observer(s):	Quality Counts
85th % Speed:	77	10 mph pace	68-78	Machine:	Tubes
50th % Speed:	69	% in pace	41%		





APPENDIX C – NCHRP REPORT

NCHRP 17-76 Speed Limit Setting Tool

Input Cells	*Description*	*Output Cells*
Site Description Data		
Rural	Roadway context	
Principal arterial	Roadway type	
Yes	Are crash data available?	
Oz Khan, PE	Analyst	
10/11/2022	Date	
US Hwy 93	Roadway name	
5-lane Roadway	Description	
70	Current speed limit (mph)	
A5-Seg-01	Notes	

Color-Coding Legend

Aqua = basic input cell
Denim = basic input cell with drop-down menu
Orange = optional input cell (not needed for calculations
Green = optional input cell (use if data for agency & region are available, leave blank otherwis
Rose = intermediate calculations
Purple = final analysis results

Note: The "Test macros" button provides a message to verify proper macro operation

Analysis Results

Speed limit setting group	Undeveloped
Suggested speed limit (mph)	**70**

Advisory, Calculated, or Warning Messages

The calculated value exceeds the upper value for this speed limit setting group; therefore, the suggested speed limit reflects the assumed upper value.

Speed Data		**Advisory, Calculated, or Warning Messages**
70	Maximum speed limit (mph)	
77	85th-percentile speed (mph)	
70	50th-percentile speed (mph)	

Site Characteristics		**Advisory, Calculated, or Warning Messages**
2.6	Segment length (mi)	**For a suggested speed limit of 70 mph, minimum segment length = 6.2 mi.**
8,600	AADT (two-way total) (veh/d)	
5	Number of lanes (two-way total	
Undivided	Median type	**Rounded-Down 85th**
36	Number of access points (total of both directions	
11	Lane width (ft)	
10	Shoulder width (ft)	
No	Adverse alignment present?	

Crash Data		**Advisory, Calculated, or Warning Messages**
5	Number of years of crash data	
8,600	Average AADT for crash data period (veh/d	
48	All (KABCO) crashes for crash data period	**Observed KABCO crash rate = 117.63 crashes / 100 MVMT**
15	Fatal & injury (KABC) crashes for crash data period	**Observed KABC crash rate = 36.76 crashes / 100 MVMT**
	Average KABCO crash rate (crashes / 100 MVMT	**HSIS average KABCO crash rate = 145.63 crashes / 100 MVMT**
	Average KABC crash rate (crashes / 100 MVMT	**HSIS average KABC crash rate = 42.08 crashes / 100 MVMT**
1.3 x average KABCO crash rate (crashes / 100 MVMT	189.3	
1.3 x average KABC crash rate (crashes / 100 MVMT	54.7	
Critical KABCO crash rate (crashes / 100 MVMT	177.9	
Critical KABC crash rate (crashes / 100 MVMT	60.0	

ENGINEERING, REIMAGINED

SPEED STUDY

US Hwy 93 – Hamilton to Victor

Reference Point: 54.5 to 56.0

Ravalli County, MT

January 2023

Speed Study

Hamilton to Victor, Montana

RP: 54.5 to 56.0

January 2023

Prepared for:

Montana Department of Transportation

Prepared by:

KLJ Engineering

Table of Contents

1. Introduction 1
2. Methodology 2
3. Roadway Characteristics 2
4. Vehicular Classification 3
5. Safety Characteristics 4
6. Speed Characteristics 7
7. Conclusion 8

List of Figures

Figure 1 - Study Segment 1
Figure 2 - Representative Section of US Hwy 93 from RP 54.5 to 56.0 2
Figure 3 - Five-Year Crash Summary (2016-2020) 4
Figure 4 - Citation Summary by Year 6
Figure 5 - Speed Profile 7

List of Tables

Table 1 - Vehicular Classification 4
Table 2 - Crash Collision Type 5
Table 3 - Speed Study Profile 8

List of Appendices

Appendix A – Pictures ..... A
Appendix B – Speed Study Profiles ..... B
Appendix C – NCHRP Report C

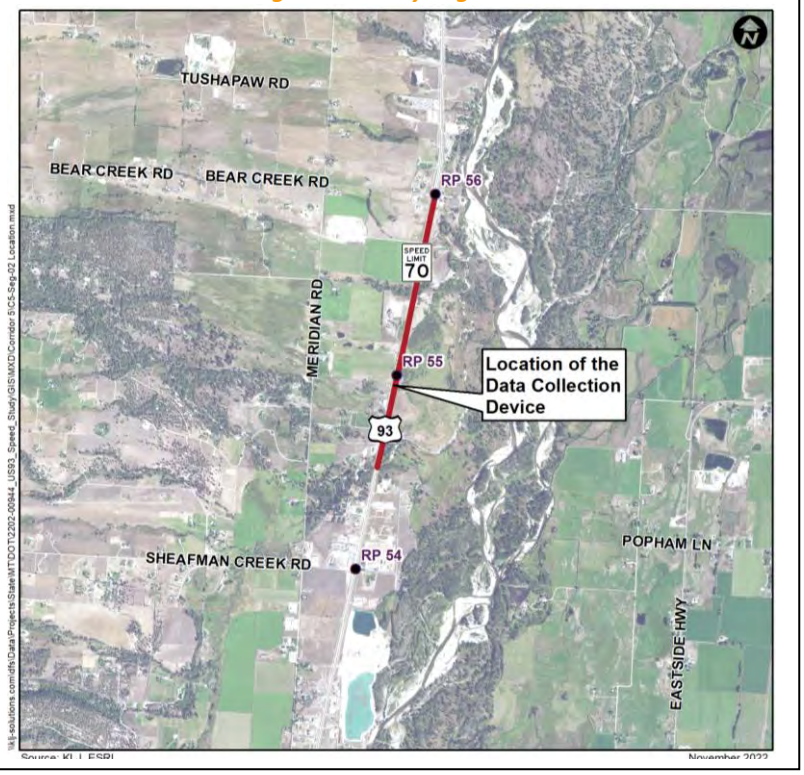
1. Introduction

Speed limits are set to inform motorists of appropriate driving and safe operating speeds under favorable conditions. Speed limits are set at the statutory speed limit unless a traffic engineering investigation study has been conducted and (where applicable) approved by the Transportation Commission. The *Montana Department of Transportation* (MDT) has requested KLJ Engineering to review the posted speed limit along US Hwy 93 from Hamilton to Victor.

Study Location

The study segment is US Hwy 93 that begins from Reference Point (RP) 54.5 to 56.0 or between Bear Creek Rd and half-mile north of Sheafman Creek Rd. The 1.5-mile segment is a paved four-lane roadway and has a statutory speed limit of 65-mph for trucks and 70-mph for all other vehicles throughout the segment. A weighted average based on MDT's map creates an annual average daily traffic (AADT) of 13,417 that travel along this segment as per 2021 counts reported in MDT's Transportation Data Management System (TDMS). The location of the study segment is shown in **Figure 1**.

Figure 1 - Study Segment



Objective

The purpose of this study is to evaluate the appropriate speed of the roadway. The primary tasks for the study included data collection, data analysis, and recommendations for speed limits along the study segment. As part of this study, an evaluation and cataloging of existing roadway conditions, collection of historical AADT, and crash data will be completed.

Procedures

The steps for setting speed limits include planning, coordination, data collection and analysis, review, and presentation to the stakeholders, and finally, determination or implementation of the speed limits. Quality data and good documentation provides support for the judgments that are made.

Five years of the most recent crash and citation data was also requested and received from the MDT Traffic & Safety Bureau for the analysis.

2. Methodology

For determining the appropriate speed limit, the following parameters were reviewed:

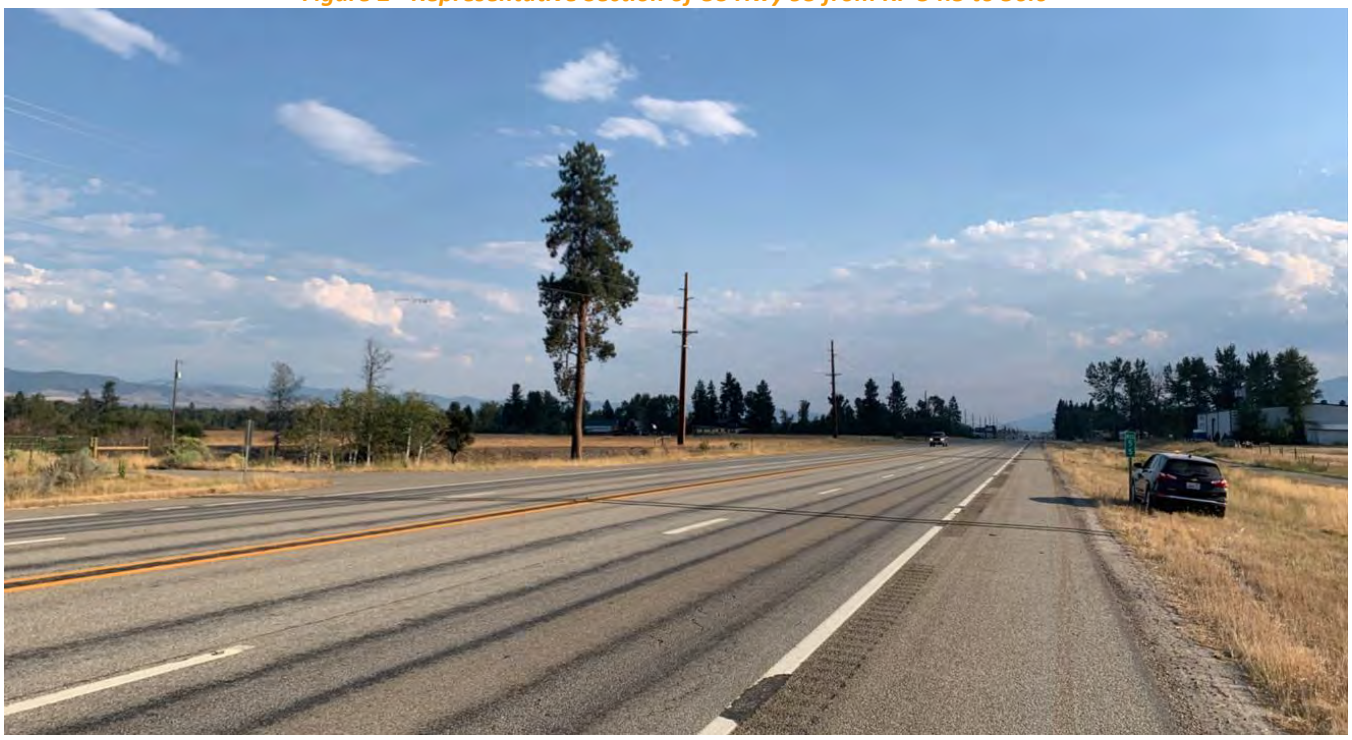
- Roadway Condition/Characteristics
- Crash and Citation History
- Speed Characteristics, and
- Vehicular classes

When considering whether to establish a new posted speed limit or not, surveying and analysis of existing travel speeds is crucial to determining a reasonable posted speed limit. Motorist usually drive at speeds which they perceive as safe, based on the observable roadway conditions. A flat and straight roadway may result in a different travel speed than the posted speed limit due to the driver's observation of the roadway condition.

3. Roadway Characteristics

While speed samples (actual speed measurements of vehicles) are a large part of the necessary data, roadway characteristics should also be considered. Roadway characteristics such as pavement type/conditions, access points, vertical grades, and clear zone assessments data were collected during the field visit on August 23, 2022. **Figure 2** shows the most representative sections of the segments of roadway along the US 93 Study segment. Additional pictures of the study segment are available in **Appendix A**.

Figure 2 - Representative Section of US Hwy 93 from RP 54.5 to 56.0



Lanes and Shoulders

The typical cross section for this study section consists mainly of four 12-ft bituminous travelling lanes, and two 11.5-ft bituminous shoulders. The pavement is generally in good condition. The shoulders are wide enough for safe parking of disabled vehicles.

Rumble Strips

There are shoulder rumble strips present throughout the segment. Centerline rumble strips are present where there is no TWLTL throughout the segment.

Access Points per Mile

An access point refers to public roads, a business driveway, a private driveway, or a farm field access. Fewer access points per mile means drivers are responding to a reduced number and variety of events. The study section has a combined 14 accesses (two public, eight private, and four field access) within the nearly 1.5-mile segment that corresponds to 9.3 accesses points per mile. The recommended primary full-movement and secondary intersection spacing for a rural principal arterial is one-mile and half-mile, respectively. The recommended and maximum density for driveways per mile for a 70-mph principal arterial roadway is no more than 18.8 based on Stopping Sight Distance chart documented in AASHTO Green Book, 5th Edition.

Vertical Grades

Grade is the rate of change of the vertical alignment. Grade affects vehicle speed and vehicle control, particularly for large trucks. The study segment can be described as generally flat.

Roadside Hazard Assessment

The segment generally comprises of fill section with a clear zone that is partially obstructed. There are sections of guardrails within the clear zone that protects from steep slopes and creeks. There is a trail that runs parallel to the roadway along the southbound side of the roadway that has agricultural fence beyond it.

In-slope

The in-slope measured at the representative section is generally flat. The in-slope was measured at 6:1 which is considered a recoverable slope. There are driveways along the study segment that have steep slopes because of culverts crossing them. These steep slopes appear to be non-traversable.

Adjacent Development

The northern section of the study segment is mostly rural residential, while the rest of the study segment is rural agricultural.

Statutory and Advisory Speeds

The statutory speed limit is 65-mph for trucks and 70-mph for all other vehicles throughout the segment. There are no advisory speeds along the segment.

Traffic Control

There are no traffic control devices at the intersections along the segment that requires motorists on mainline to slow, stop and/or yield.

4. Vehicular Classification

Vehicular class data for 24-hour period were collected on August 23, 2022. Vehicle types were categorized to two classifications:

- **Small to Mid-size Vehicles** consisting of motorcycles, passenger vehicles, pickups, vans, buses, conventional vans, and city delivery trucks.
- **Large Vehicles** consisting of single unit four or more axle trucks.

There are 13,640 and 1,160 daily small to mid-size and large vehicles, respectively that travel in the segment. The daily distribution is 49% along northbound and 51% along southbound. The vehicular classifications in the study segment are summarized in **Table 1**.

Table 1 - Vehicular Classification

Classification	Northbound	Southbound	Total	Percent
Small to Mid-Size vehicles	6,700	6,940	13,640	92%
Large vehicles	600	560	1,160	8%
Total (Percent)	**7,300 (49%)**	**7,500 (51%)**	**14,800**	**100%**

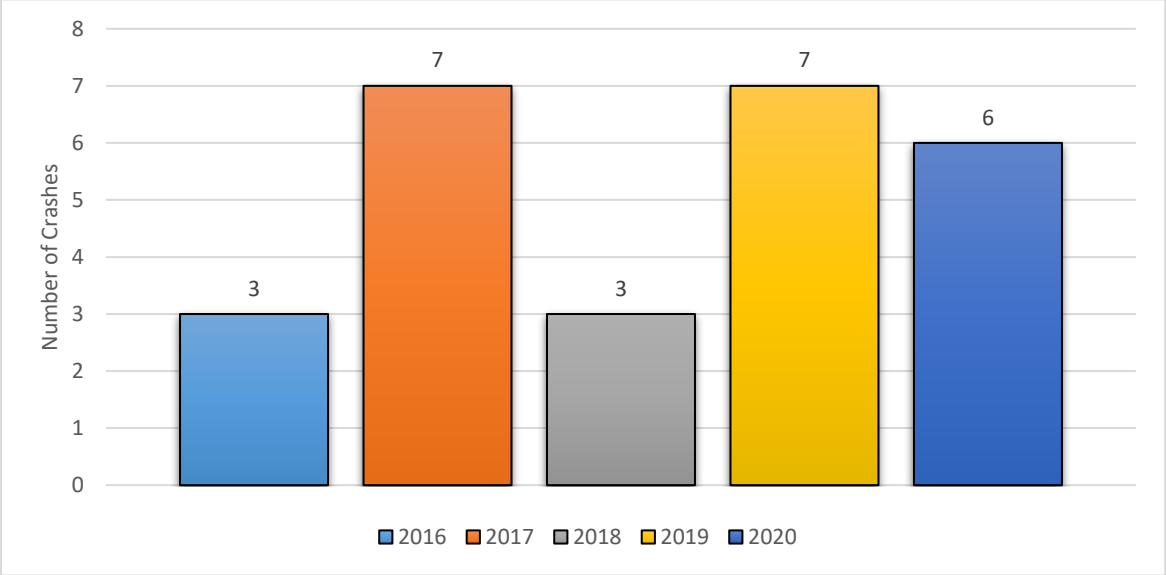
5. Safety Characteristics

Reviewing historic crash and citation information can help identify driver behavior issues that can provide additional information for setting speed the appropriate and safer speed limit.

Crash History

Five years of crash records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. MDT shared crash records in a spreadsheet format. The five-year crash summary by year is shown in **Figure 3**. There were 26 crashes (three minor injury, one possible injury, 21 property damage only, and one unknown type crashes) reported during the analysis period. This corresponds to 5.2 crashes per year or 3.5 crashes per year per mile.

Figure 3 - Five-Year Crash Summary (2016-2020)



19 crashes or 73% of all the crashes were non-junction related. Crash summary by crash type is shown in **Table 2**.

Table 2 - Crash Collision Type

Type	# Crashes
Fire/ Explosion	1
Fixed Object	3
Not Fixed Object Or Debris	1
Parked Vehicle	1
Rear-End	3
Right Angle	3
Roll Over	4
Sideswipe, Same Direction	2
Wild Animal	8
Total	**26**

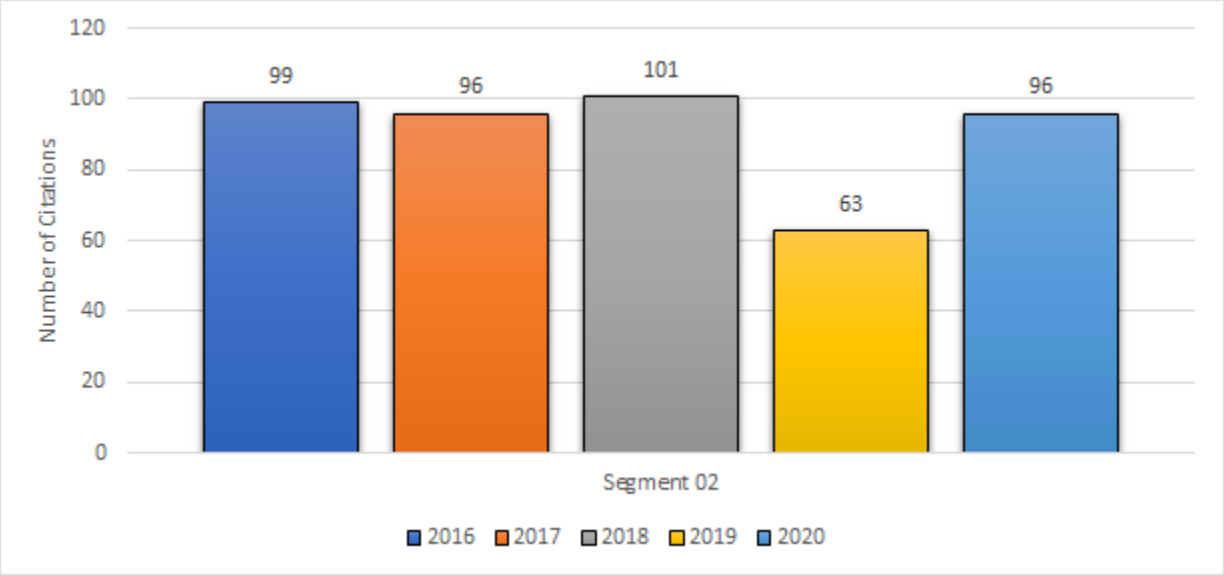
Crashes with wild animals (31%) were the most prominent crash type followed by rollover crashes (15%) in the study segment. The crash data had no supplement officer narratives to identify if speeding was the contributing factor for any of these crashes.

Citation History

The speeding law in Montana 1 § 61-8-303 (3) states: "Subject to the maximum speed limits set forth in subsection (above), a person shall operate a vehicle in a careful and prudent manner and at a reduced rate of speed no greater than is reasonable and prudent under the conditions existing at the point of operation, taking into account the amount and character of traffic, visibility, weather, and roadway conditions." It is critical to note that the law enforcement can issue a ticket for driving a vehicle at unsafe speeds, even if a driver is within the posted speed limit. For example, driving at the posted speed limit on the freeway when there is a blizzard or thick fog. Since these driving conditions are unsafe for you and other drivers, law enforcement is within their rights to issue a speeding ticket as per the speeding laws in Montana.

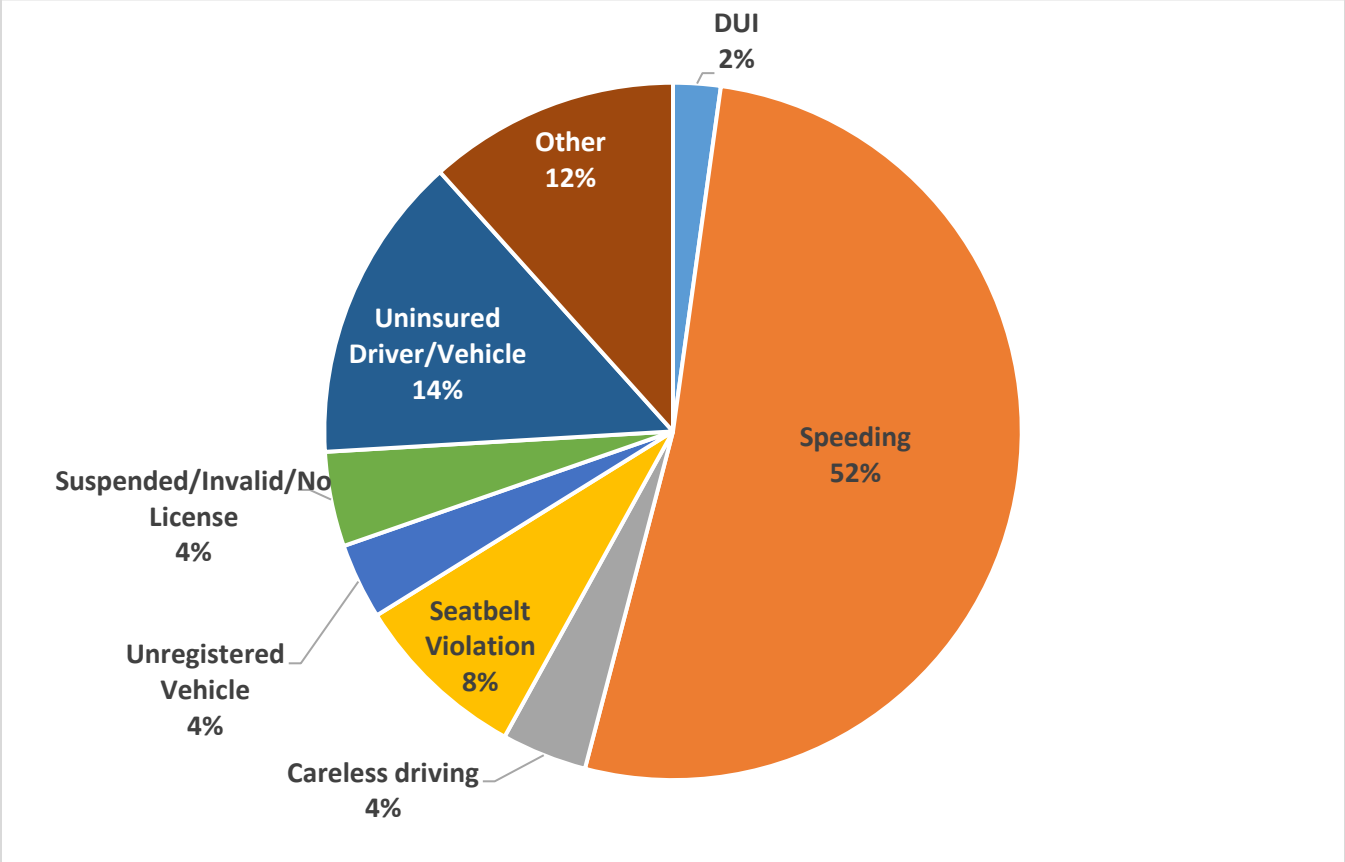
Five years of citation records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. The citation records were shared in a spreadsheet format. The five-year citation summary in the segment is shown in **Figure 4**. There were 455 citations issued in the study segment during the analysis period of which 236 citations (52%) were speeding violations.

Figure 4 - Citation Summary by Year



The greatest number of citations were given in the month of January (13%). The types of citations issued in this segment are shown in **Figure 5**. Speeding (52%), and Uninsured driver/vehicle (14%) were the most prominent types of traffic violations in the study segment.

Figure 5 - Citation Types Issued (2016 - 2020)



6. Speed Characteristics

Engineering Approach

The engineering approach is a two-step process based on operating conditions such as the 85th percentile speed. The 85th percentile is the speed at which 85% of free-flowing traffic is traveling at or below. Once the speed limit is established based on the 85th percentile speed, it can be adjusted (usually downward) based on other factors such as amount of non-motorized traffic, roadway characteristics, and crash history. MDT's procedures for setting speed limits are based on the engineering approach.

MDT uses 85th percentile, 50th percentile, and pace speeds to evaluate speed data. The pace speed is a 10-mph increment in speeds that encompasses the highest portion of observed speeds.

Spot Speed Data

Spot speed studies typically consist of sample sizes totaling at least 100 vehicles with Free Flow Speed (FFS). FFS is the speed of motorists traveling as desired given prevailing conditions such that no preceding vehicle influences the motorists' speed. Unattended pneumatic tubes were placed along the study segment to collect vehicular speed samples for a 24-hour period from August 23 to 24, 2022 near RP 54.9**.** The 24-hour data consisted of all vehicles that traveled along the study segment with various speed profiles including vehicles that influenced a motorist's choice of speed such as vehicular deceleration to make turns, queuing during peak hour, or a platoon.

The road and shoulder surface were clear of surface water or snow during the period when data were recorded. The result of the speed profile in the study segment is shown in **Figure 6** and **Table 3**. For details please see **Appendix B**. The 85th percentile speed was found to be 72-mph and the 50th percentile speed was found to be 63-mph. The 10-mph pace was found to be between 58-mph and 68-mph comprising of 55% of daily vehicles within that 10-mph pace. The 85th percentile speed is slightly higher than the posted speed limit and higher than the upper tail-end of the 10-mph pace range, whereas the 50th percentile speeds were below the posted speed limit and and at the upper tail-end of the 10-mph pace range.

Figure 6 - Speed Profile for All Vehicle Types in Both Direction of Travel

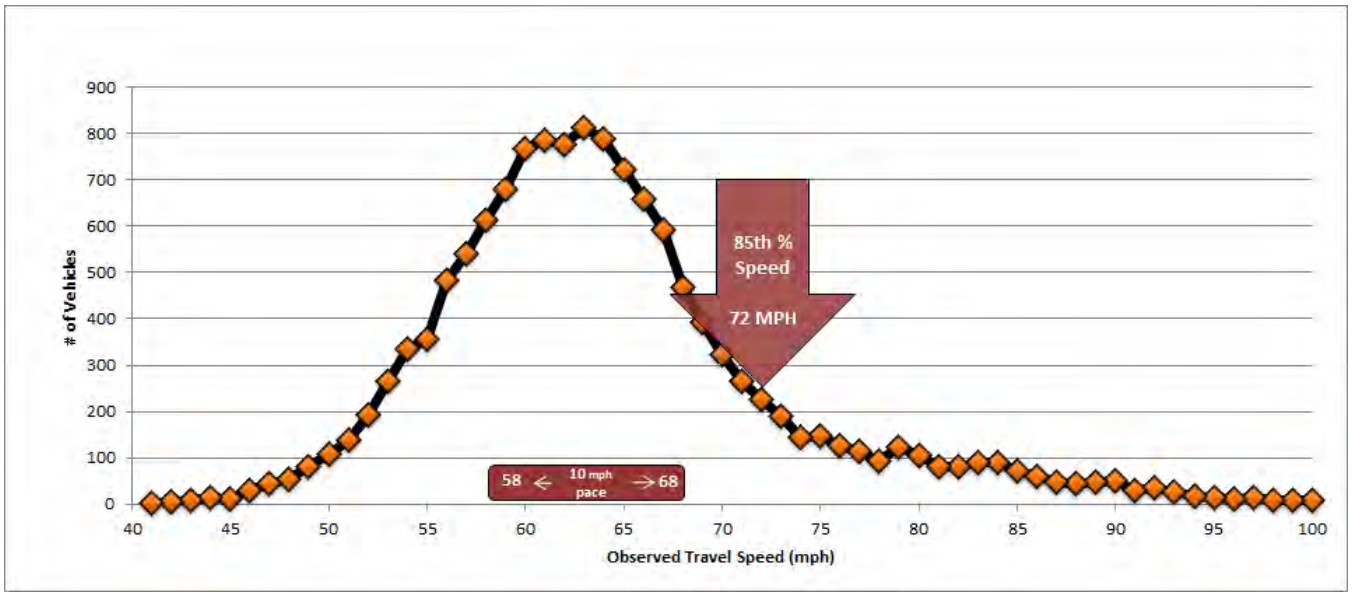


Table 3 - Speed Study Profile

Vehicle Type	Direction	10-mph Pace	% In Pace	85th Percentile Speed	50th Percentile Speed
Small to Mid-size	NB	59-69 mph	52%	74-mph	64-mph
	SB	57-67 mph	58%	70-mph	62-mph
	Both	58-68 mph	55%	72-mph	63-mph
Large	NB	58-68 mph	61%	70-mph	62-mph
	SB	59-69 mph	55%	71-mph	60-mph
	Both	59-69 mph	57%	70-mph	62-mph
All	NB	58-68 mph	52%	74-mph	64-mph
	SB	57-67 mph	58%	70-mph	62-mph
	Both	58-68 mph	55%	72-mph	63-mph

NCHRP

A recent research report from the *National Cooperative Highway Research Program* (NCHRP) has been completed. NCHRP report 17-76: *Development of a Posted Speed Limit Setting Procedure and Tool* collected insights into how the roadway environment influences operating speed and safety (crashes) through a review of literature and the collection and analysis of data from two states. Using those insights along with an understanding of different methods being used and currently being considered for the setting of posted speed limits, the research team developed a speed limit setting procedure along with a tool. The procedure uses fact-based decision rules that consider both driver speed choice and safety associated with the roadway.

There has been a nationwide push over the last several years for the consideration of 50th percentile speed, especially for developed areas. When the roadway conditions are optimal, the suggested speed limit should reflect the 85th percentile speed. When roadway conditions are not favorable to all users or when crashes are a significant concern, then the suggested speed limit should reflect the rounded down 85th percentile or the 50th percentile speed. Drivers frequently select speeds a certain increment above the posted speed limit, anticipating that they will not receive a ticket if they are below the assumed enforcement speed tolerance. Because of these reasons, 50th percentile speed data were also used in the analysis along with the 85th percentile speed data.

The NCHRP 17-76 Speed Limit Setting Tool was used to calculate the recommended speed limit for the study segment based on key factors such as: 85th percentile and 50th percentile speed, roadway characteristics, and crash history. The recommended speed for the study segment based on NCHRP 17-76 was found to be 70-mph along in this segment. Details of the NCHRP 17-76 report is available in **Appendix C**.

7. Conclusion

Vehicular Classification

There are 13,640 and 1,160 daily small to mid-size and large vehicles, respectively that travel in the segment. The daily distribution is 49% along northbound and 51% along southbound.

Safety Characteristics

There were 26 crashes (three minor injury, one possible injury, 21 property damage only, and one unknown type crashes) reported during the analysis period. Crashes with wild animals (31%) were the most prominent crash types followed by rollover crashes (15%) in the study segment.

There were 455 citations issued in the study segment during the analysis period of which 236 citations (52%) were speeding violations.

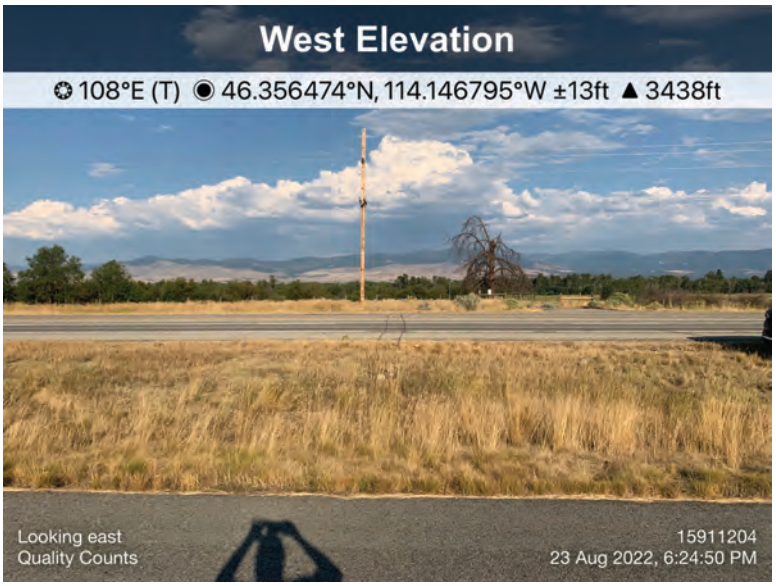
Roadway Characteristics

The segment, RP 54.5 to RP 56.0, being reviewed has a statutory 70-mph speed limit. The 1.5-mile segment is four-lane undivided roadway that is classified as principal arterial. The segment consists of fill sections with some fixed objects within the clear zone. There are shoulder rumble strips present and centerline rumble strips are present in some areas throughout the segment. The shoulders are wide on both sides of the roadway for safe parking of disabled vehicles. The vertical grades and in-slopes are generally flat in the segment. The road conditions are generally in good condition. The northern section of the study segment is mostly rural residential, while the rest of the study segment is rural agricultural. The driveway density in the study segment is less than the maximum number of driveway thresholds for similar type of facility.

Speed Characteristics

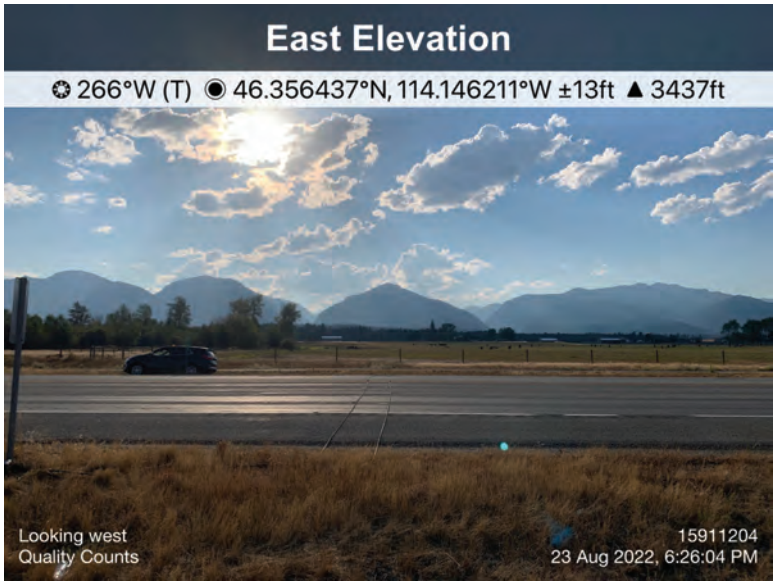
The 85th percentile speed was found to be 72-mph and the 50th percentile speed was found to be 63-mph. The 10-mph pace was found to be between 58-mph and 68-mph comprising of 55% of daily vehicles within that 10-mph pace. The recommended speed for the study segment based on NCHRP 17-76 was found to be 70-mph along in this segment. This indicates that the existing posted speed limit of 70-mph in this segment is reasonable.

APPENDIX A – PICTURES


West Elevation
108°E (T) 46.356474°N, 114.146795°W ±13ft ▲3438ft
Looking east
Quality Counts
15911204
23 Aug 2022, 6:24:50 PM


North Elevation
177°S (T) 46.356653°N, 114.146521°W ±16ft ▲3439ft
Looking south
Quality Counts
15911204
23 Aug 2022, 6:25:15 PM

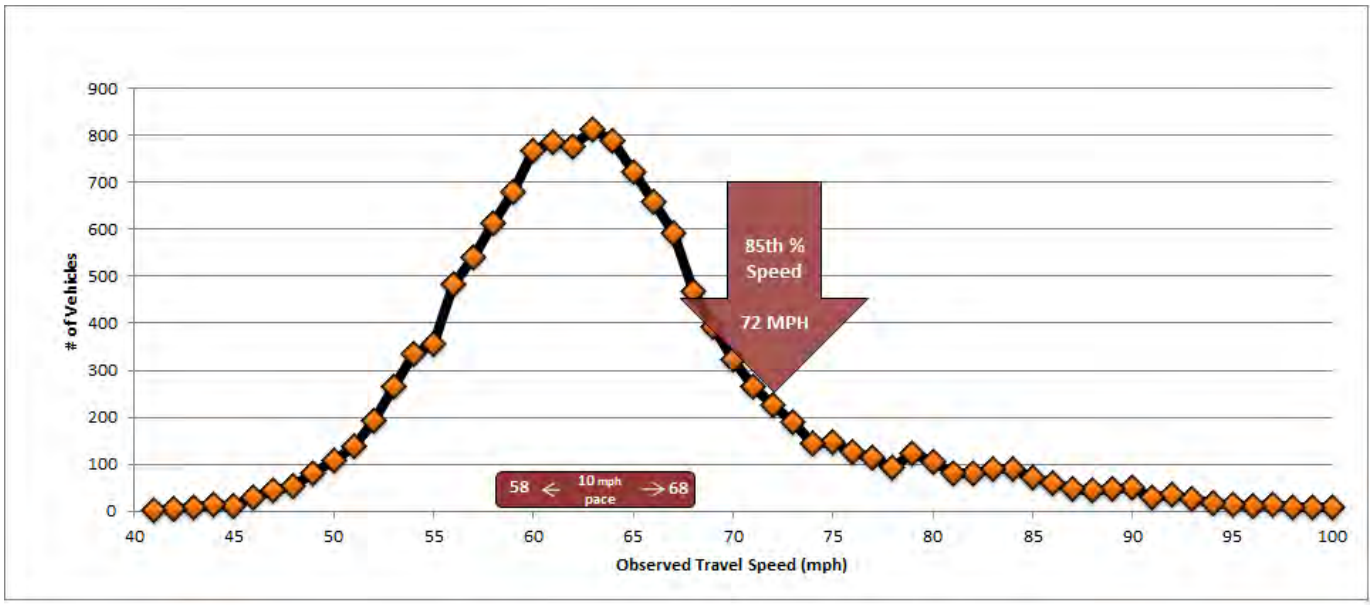

South West Elevation
27°NE (T) 46.356293°N, 114.146602°W ±16ft ▲3437ft
Looking north
Quality Counts
15911204
23 Aug 2022, 6:24:23 PM

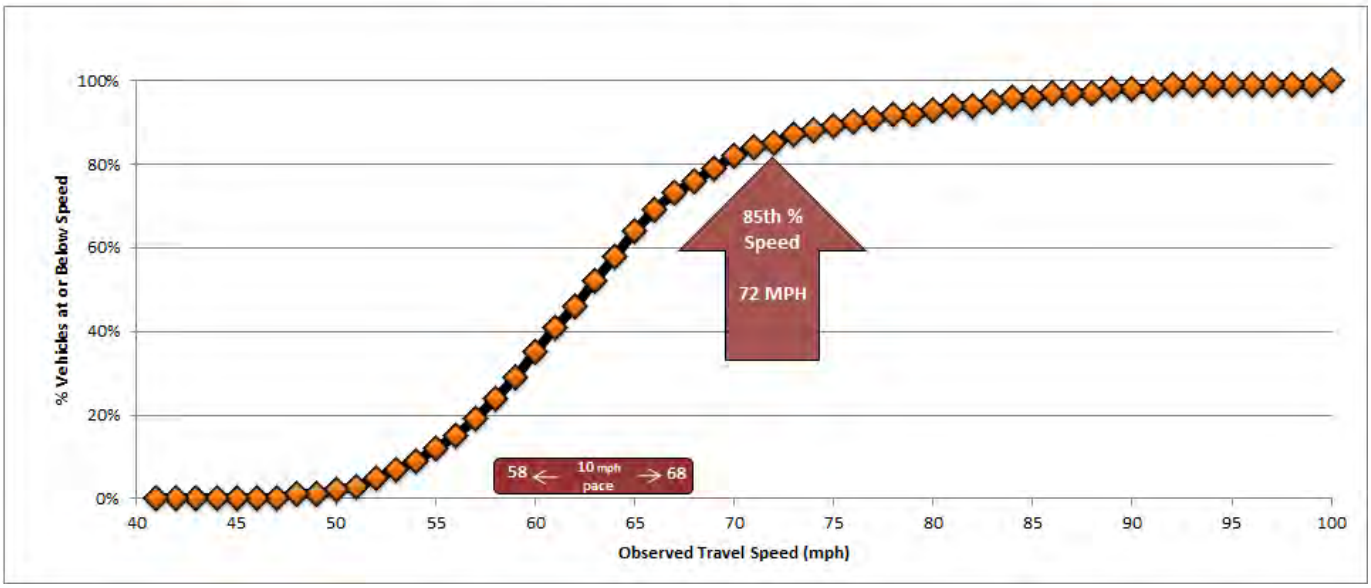

East Elevation
266°W (T) 46.356437°N, 114.146211°W ±13ft ▲3437ft
Looking west
Quality Counts
15911204
23 Aug 2022, 6:26:04 PM

APPENDIX B – SPEED STUDY PROFILES

SPEED SAMPLE SUMMARY (ALL VEHICLES)

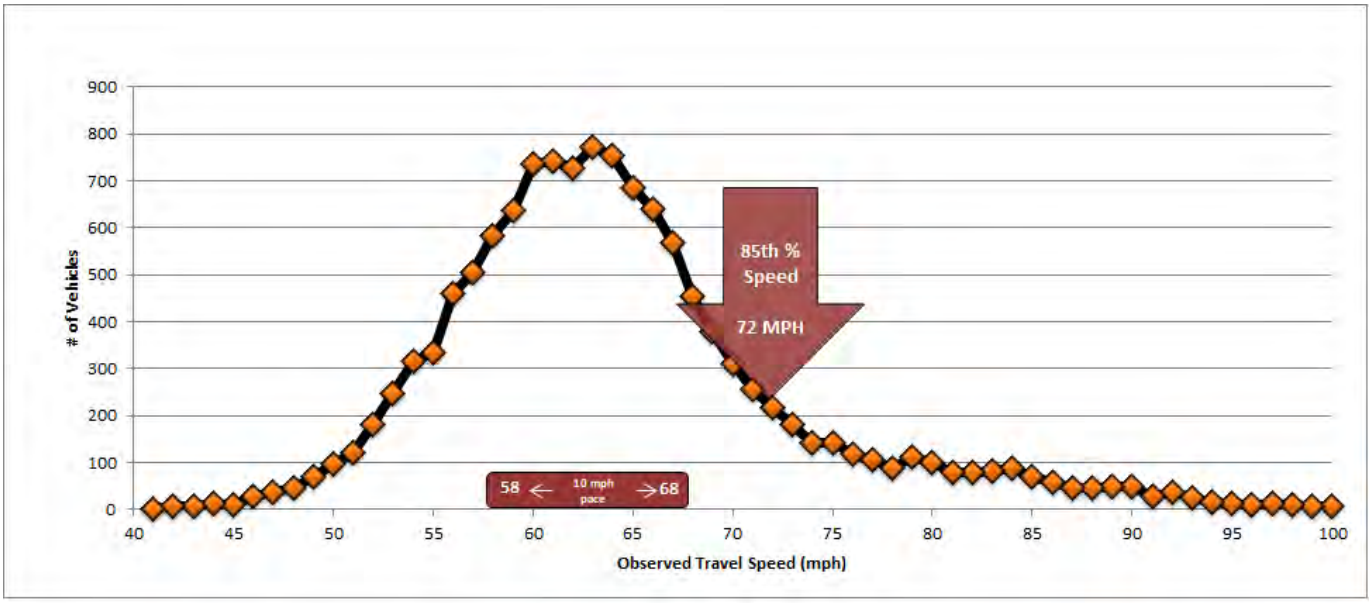
ID:	Segment 2	Speed Limit	70 MPH	Day/Date	Tuesday, August 23, 2022
Roadway:	US 93	Seg. Length:	1.5 MILES	Time:	24-hours
Study Limits:	Hamilton to Victor	Road Type:	Four-Lane, Two way	Sample Loc	46.35648, -114.14636
City/County:	Ravalli	ADT Range:	NB-7300 SB-7500	Weather:	Clear
RP:	54.5 to 56.0	Truck ADT:	NB-600 SB-560	Observer(s):	Quality Counts
85th % Speed:	72	10 mph pace	58-68	Machine:	Tubes
50th % Speed:	63	% in pace	55%		

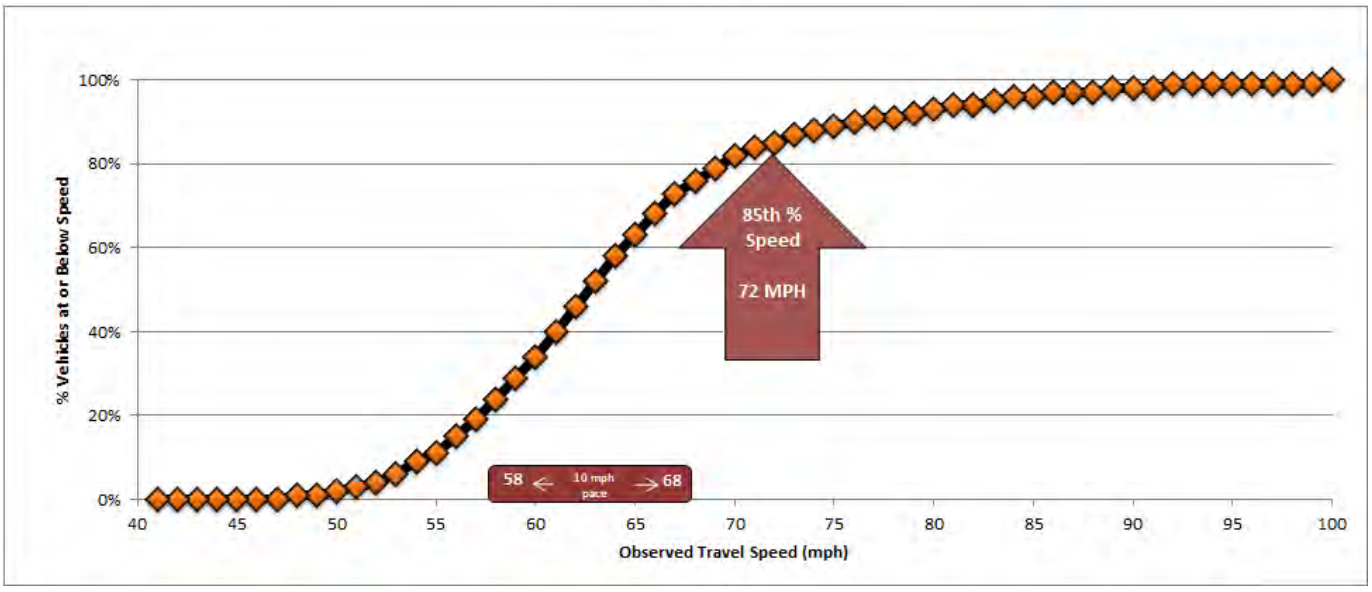




SPEED SAMPLE SUMMARY (PASSENGER VEHICLES)

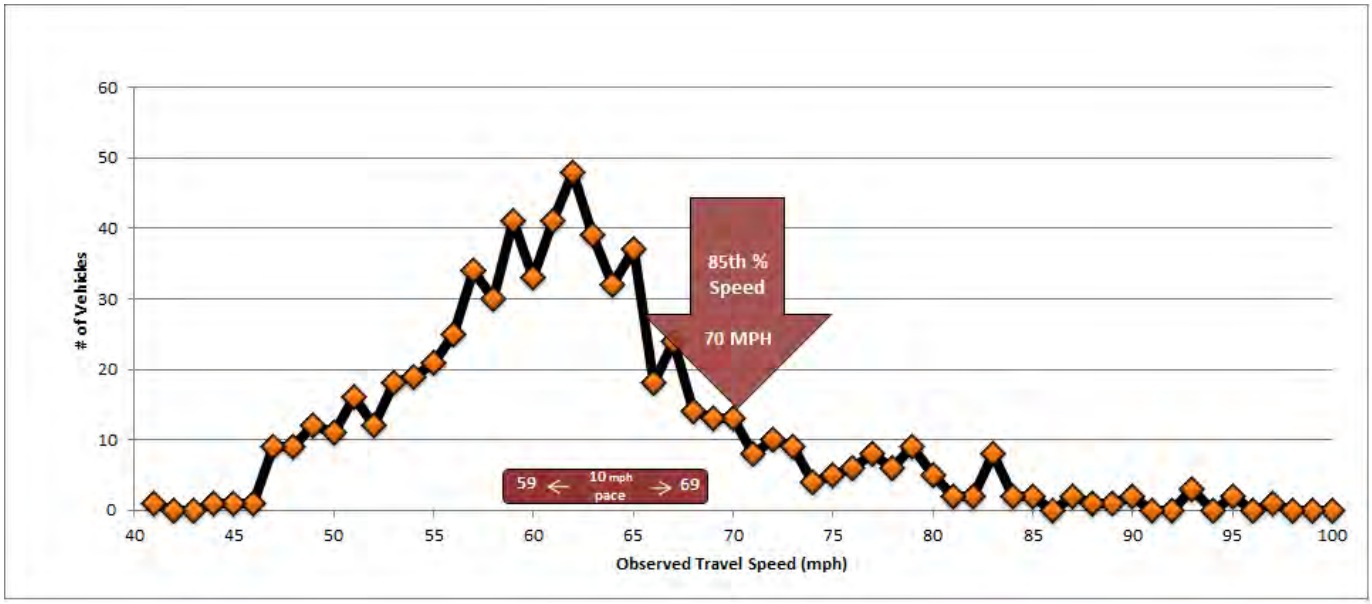
ID:	Segment 2	Speed Limit	70 MPH	Day/Date	Tuesday, August 23, 2022
Roadway:	US 93	Seg. Length:	1.5 MILES	Time:	24-hours
Study Limits:	Hamilton to Victor	Road Type:	Four-Lane, Two way	Sample Loc	46.35648, -114.14636
City/County:	Ravalli	ADT Range:	NB-7300 SB-7500	Weather:	Clear
RP:	54.5 to 56.0	Truck ADT:	NB-600 SB-560	Observer(s):	Quality Counts
85th % Speed:	72	10 mph pace	58-68	Machine:	Tubes
50th % Speed:	63	% in pace	55%		

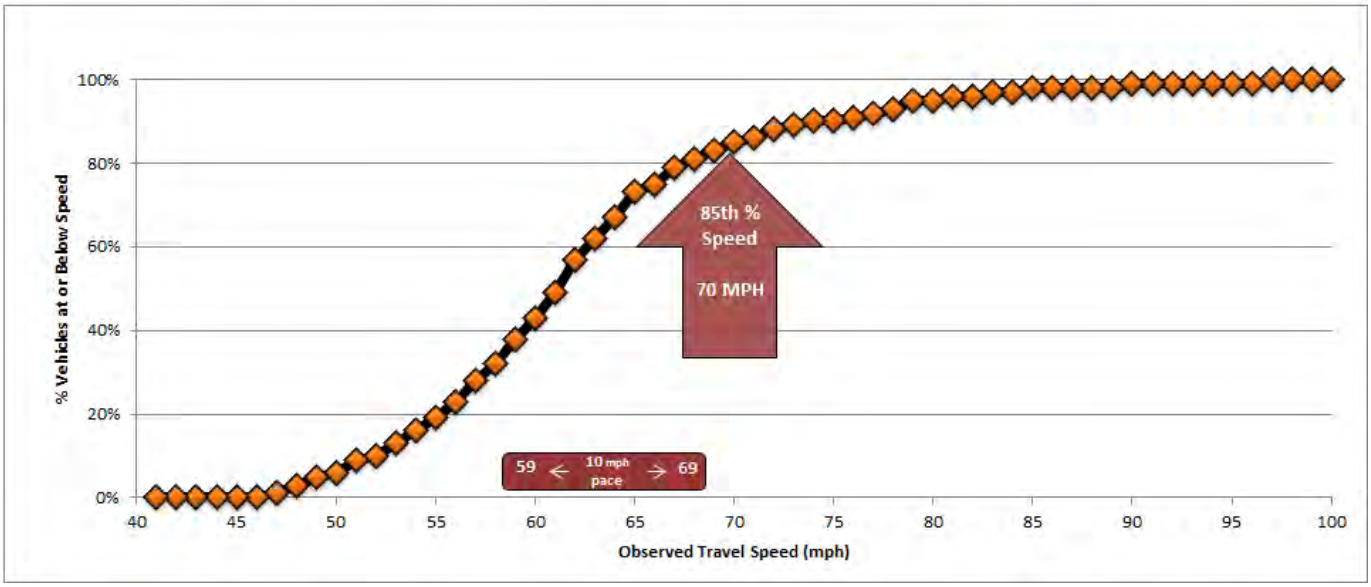




SPEED SAMPLE SUMMARY (TRUCKS)

ID:	Segment 2	Speed Limit	70 MPH	Day/Date	Tuesday, August 23, 2022
Roadway:	US 93	Seg. Length:	1.5 MILES	Time:	24-hours
Study Limits:	Hamilton to Victor	Road Type:	Four-Lane, Two way	Sample Loc	46.35648, -114.14636
City/County:	Ravalli	ADT Range:	NB-7300 SB-7500	Weather:	Clear
RP:	54.5 to 56.0	Truck ADT:	NB-600 SB-560	Observer(s):	Quality Counts
85th % Speed:	70	10 mph pace	59-69	Machine:	Tubes
50th % Speed:	62	% in pace	57%		





APPENDIX C – NCHRP REPORT

NCHRP 17-76 Speed Limit Setting Tool

Input Cells	Description	Output Cells
Site Description Data		
Rural	Roadway context	
Principal arterial	Roadway type	
Yes	Are crash data available?	
Oz Khan, PE	Analyst	
8/23/2022	Date	
US 93 RP: 54.5-56	Roadway name	
4-lane Roadway	Description	
70	Current speed limit (mph)	
A5-Seg-02	Notes	
Analysis Results		
	Speed limit setting group	Undeveloped
	Suggested speed limit (mph)	**70**
Speed Data		
70	Maximum speed limit (mph)	
72	85th-percentile speed (mph)	
63	50th-percentile speed (mph)	
Site Characteristics		
1.5	Segment length (mi)	
14,800	AADT (two-way total) (veh/d)	
4	Number of lanes (two-way total)	
Undivided	Median type	
8	Number of access points (total of both directions)	
12	Lane width (ft)	
11	Shoulder width (ft)	
No	Adverse alignment present?	
Crash Data		
5	Number of years of crash data	
14,800	Average AADT for crash data period (veh/d)	
26	All (KABCO) crashes for crash data period	
0	Fatal & injury (KABC) crashes for crash data period	
	Average KABCO crash rate (crashes / 100 MVMT)	
	Average KABC crash rate (crashes / 100 MVMT)	
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	161.9
	1.3 x average KABC crash rate (crashes / 100 MVMT)	53.5
	Critical KABCO crash rate (crashes / 100 MVMT)	154.6
	Critical KABC crash rate (crashes / 100 MVMT)	59.0

ENGINEERING, REIMAGINED

SPEED STUDY

US Hwy 93 – Hamilton to Victor

Reference Point: 52.0 to 54.5

Ravalli County, MT

January 2023

Speed Study

Hamilton to Victor, Montana

RP: 52.0 to 54.5

January 2023

Prepared for:

Montana Department of Transportation

Prepared by:

KLJ Engineering

Table of Contents

1. Introduction 1
2. Methodology 2
3. Roadway Characteristics 2
4. Vehicular Classification 3
5. Safety Characteristics 3
6. Speed Characteristics 6
7. Conclusion 7

List of Figures

Figure 1 - Study Segment 1
Figure 2 - Five-Year Crash Summary (2016-2020) 4
Figure 3 - Citation Summary by Year 5
Figure 4 - Citation Types Issued (2016 - 2020) 5
Figure 5 - Speed Profile for All Vehicles Types in Both Direction of Travel 6

List of Tables

Table 1 - Vehicular Classification 3
Table 2 - Crash Collision Type 4
Table 3 - Speed Study Profile 7

List of Appendices

Appendix A – Pictures ..... A
Appendix B – Speed Study Profiles ..... B
Appendix C – NCHRP Report C

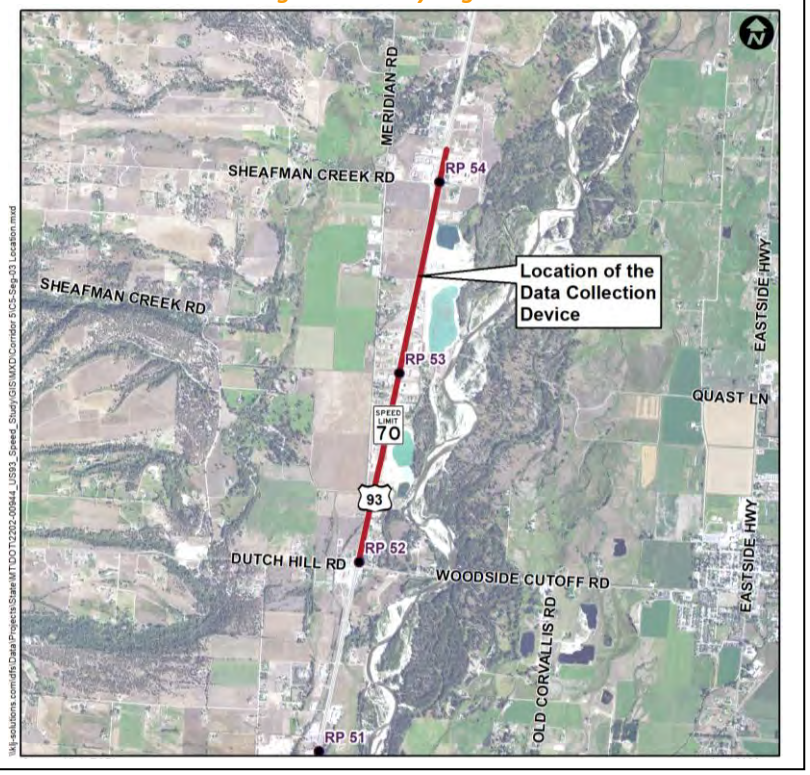
1. Introduction

Speed limits are set to inform motorists of appropriate driving and safe operating speeds under favorable conditions. Speed limits are set at the statutory speed limit unless a traffic engineering investigation study has been conducted and (where applicable) approved by the Transportation Commission. The *Montana Department of Transportation* (MDT) has requested KLJ Engineering to review the posted speed limit along US Hwy 93 from Hamilton to Victor.

Study Location

The study segment is US Hwy 93 that begins from Reference Point (RP) 52.0 to 54.5 or between 1,000-ft north of Sheafman Creek Rd and 1,000-ft south of Dutch Hill Rd. The 2.5-mile segment is a paved four-lane roadway with a two-way-left-turn-lane (TWLTL) in the center and has a statutory speed limit is 70-mph for regular vehicles and 65-mph for trucks for most of the segment. There is an annual average daily traffic (AADT) of 13,816 that travel along this segment as per 2021 counts reported in MDT's Transportation Data Management System (TDMS). The location of the study segment is shown in **Figure 1**.

Figure 1 - Study Segment



Objective

The purpose of this study is to evaluate the appropriate speed of the roadway. The primary tasks for the study included data collection, data analysis, and recommendations for speed limits along the study segment. As part of this study, an evaluation and cataloging of existing roadway conditions, collection of historical AADT, and crash data will be completed.

Procedures

The steps for setting speed limits include planning, coordination, data collection and analysis, review, and presentation to the stakeholders, and finally, determination or implementation of the speed limits. Quality data and good documentation provides support for the judgments that are made.

Five years of the most recent crash and citation data was also requested and received from the MDT Traffic & Safety Bureau for the analysis.

2. Methodology

For determining the appropriate speed limit, the following parameters were reviewed:

- Roadway Condition/Characteristics
- Crash and Citation History
- Speed Characteristics, and
- Vehicular classes

When considering whether to establish a new posted speed limit or not, surveying and analysis of existing travel speeds is crucial to determining a reasonable posted speed limit. Motorist usually drive at speeds which they perceive as safe, based on the observable roadway conditions. A flat and straight roadway may result in a different travel speed than the posted speed limit due to the driver's observation of the roadway condition.

3. Roadway Characteristics

While speed samples (actual speed measurements of vehicles) are a large part of the necessary data, roadway characteristics should also be considered. Roadway characteristics such as pavement type/conditions, access points, vertical grades, and clear zone assessments data were collected during the field visit on August 23, 2022. Pictures of the study segment are available in **Appendix A**.

Lanes and Shoulders

The typical cross section for this study section consists mainly of one 14-ft center-two-way-left-turn-lane, two 11.5-ft inside travelling lane, two 12-ft outside bituminous travelling lanes, and two nine-ft bituminous shoulders. The pavement is generally in good condition. The shoulders are wide enough for safe parking of disabled vehicles.

Rumble Strips

There are shoulder rumble strips present throughout the segment. Centerline rumble strips are present where there is no TWLTL throughout the segment.

Access Points per Mile

An access point refers to public roads, a business driveway, a private driveway, or a farm field access. Fewer access points per mile means drivers are responding to a reduced number and variety of events. The study section has a combined 43 accesses (eight public, 27 private, and eight field access) within the nearly 2.-mile segment that corresponds to 17.2 accesses points per mile. The recommended primary full-movement and secondary intersection spacing for a rural principal arterial is one-mile and half-mile, respectively. The recommended and maximum density for driveways per mile for a 70-mph principal arterial roadway is no more than 18.8 based on Stopping Sight Distance chart documented in AASHTO Green Book, 5th Edition.

Vertical Grades

Grade is the rate of change of the vertical alignment. Grade affects vehicle speed and vehicle control, particularly for large trucks. The study segment can be described as generally flat.

Roadside Hazard Assessment

The segment generally comprises of fill section with a clear zone that is partially obstructed. There are sections of agricultural fences within the clear zone of the roadway.

In-slope

The in-slope measured at the representative section is generally flat. The in-slope was measured at 6:1 which is considered a recoverable slope. There are driveways along the study segment that have steep slopes because of culverts crossing them. These steep slopes appear to be non-traversable.

Adjacent Development

The northern section of the study segment is mostly rural residential.

Statutory and Advisory Speeds

The statutory speed limit is 70-mph for regular vehicles and 65-mph for trucks for most of the segment with few speed transitions in the south as traffic crosses the Woodside Cutoff intersection that is signal control. There are no advisory speeds along the segment.

Traffic Control

There is a traffic signal at the south end of the study segment, located on Dutch Hill Rd / Woodside Cutoff Rd.

4. Vehicular Classification

Vehicular class data for 24-hour period were collected on August 23, 2022. Vehicle types were categorized to two classifications:

- **Small to Mid-size Vehicles** consisting of motorcycles, passenger vehicles, pickups, vans, buses, conventional vans, and city delivery trucks.
- **Large Vehicles** consisting of single unit four or more axle trucks.

There are 13,560 and 1,340 daily small to mid-size and large vehicles, respectively that travel in the segment. The daily distribution is 50% along northbound and 50% along southbound direction. The vehicular classifications in the study segment are summarized in **Table 1**.

Table 1 - Vehicular Classification

Classification	Northbound	Southbound	Total	Percent
Small to Mid-Size vehicles	6,850	6,710	13,560	91%
Large vehicles	650	690	1,340	9%
Total (Percent)	**7,500 (50%)**	**7,400 (50%)**	**14,900**	**100%**

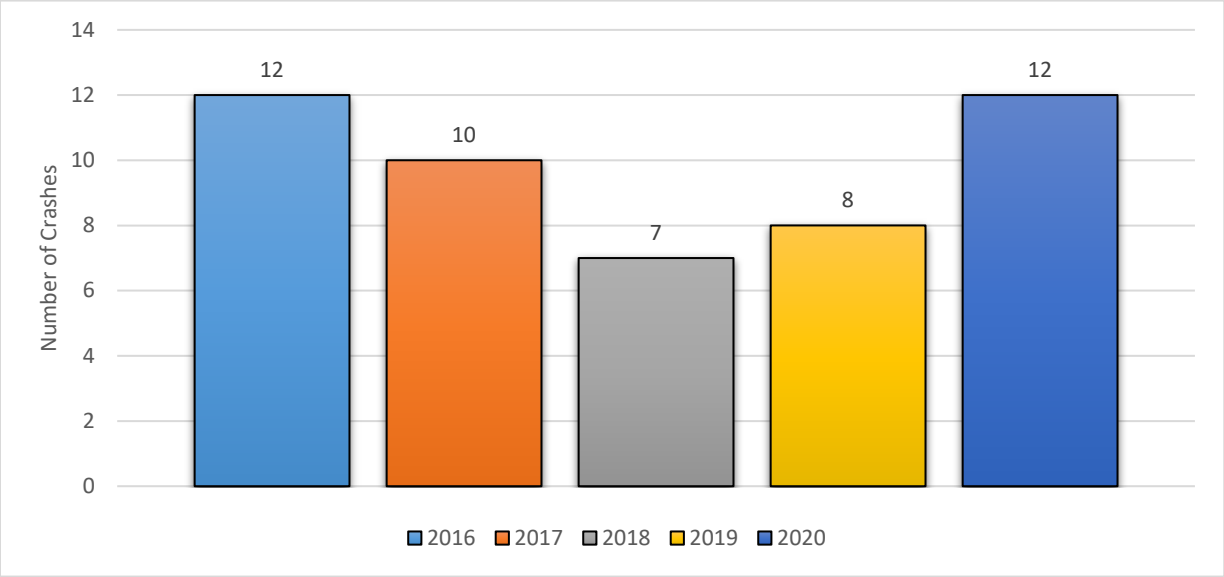
5. Safety Characteristics

Reviewing historic crash and citation information can help identify driver behavior issues that can provide additional information for setting speed the appropriate and safer speed limit.

Crash History

Five years of crash records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. MDT shared crash records in a spreadsheet format. The five-year crash summary by year is shown in **Figure 2**. There were 49 crashes (two fatal, four serious injury, three minor injury, six possible injury, and 34 property damage only crashes) reported during the analysis period. This corresponds to 9.8 crashes per year or 3.9 crashes per year per mile.

Figure 2 - Five-Year Crash Summary (2016-2020)



39 crashes or 80% of all the crashes were non-junction related. Crash summary by crash type is shown in **Table 2**.

Table 2 - Crash Collision Type

Type	# Crashes
Fell/ Jumped From Motor Vehicle	1
Fire/ Explosion	2
Fixed Object	7
Left Turn, Opposite Direction	1
Other	1
Parked Vehicle	1
Pedestrian	1
Rear-End	5
Right Angle	5
Roll Over	3
Sideswipe, Same Direction	2
Wild Animal	20
TOTAL	**49**

Crashes with wild animals (41%) were the most prominent crash types followed by collision with fixed objects (14%) in the study segment. The crash data had no supplement officer narratives to identify if speeding was the contributing factor for any of these crashes.

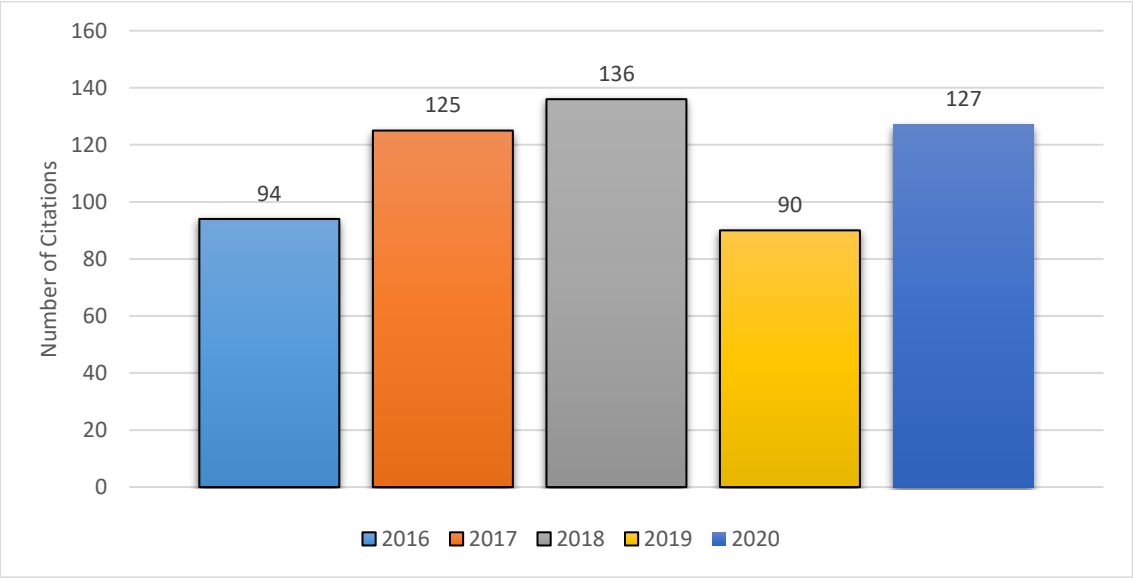
Citation History

The speeding law in Montana 1 § 61-8-303 (4) states: “Subject to the (maximum) statutory speed limits below, a person shall operate a vehicle in a careful and prudent manner and at a reduced rate of speed no greater than is reasonable and prudent under the conditions existing at the point of operation, taking into account the amount and character of traffic, visibility, weather, and roadway conditions.” It is critical to note that the law enforcement can issue a ticket for driving a vehicle at unsafe speeds, even if a driver is within the posted speed limit. For example, driving at the posted speed limit on the freeway when there is a blizzard or thick fog. Since these driving

conditions are unsafe for you and other drivers, law enforcement is within their rights to issue a speeding ticket as per the speeding laws in Montana.

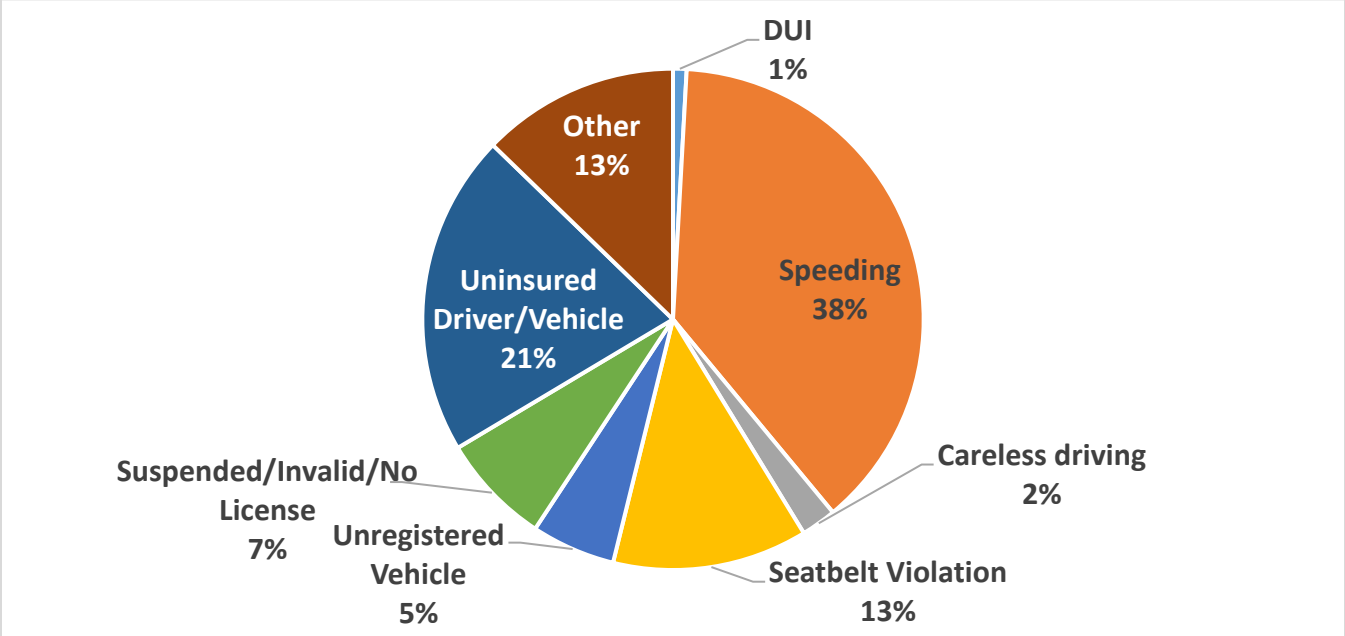
Five years of citation records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. The citation records were in a spreadsheet format. The five-year citation summary in the segment is shown in **Figure 3**. There were 572 citations issued in the study segment during the analysis period of which 218 citations (38%) were speeding violations.

Figure 3 - Citation Summary by Year



The greatest number of citations were given in the month of January (10.5%). The types of citations issued in this segment are shown in **Figure 4**. Speeding (38%), and Uninsured driver/vehicle (21%) were the most prominent types of traffic violations in the study area.

Figure 4 - Citation Types Issued (2016 - 2020)



6. Speed Characteristics

Engineering Approach

The engineering approach is a two-step process based on operating conditions such as the 85th percentile speed. The 85th percentile is the speed at which 85% of free-flowing traffic is traveling at or below. Once the speed limit is established based on the 85th percentile speed, it can be adjusted (usually downward) based on other factors such as amount of non-motorized traffic, roadway characteristics, and crash history. MDT's procedures for setting speed limits are based on the engineering approach.

MDT uses 85th percentile, 50th percentile, and pace speeds to evaluate speed data. The pace speed is a 10-mph increment in speeds that encompasses the highest portion of observed speeds.

Spot Speed Data

Spot speed studies typically consist of sample sizes totaling at least 100 vehicles with Free Flow Speed (FFS). FFS is the speed of motorists traveling as desired given prevailing conditions such that no preceding vehicle influences the motorists' speed. Unattended pneumatic tubes were placed along the study segment to collect vehicular speed samples for a 24-hour period from August 23 to 24, 2022 near RP 53.5**.** The 24-hour data consisted of all vehicles that traveled along the study segment with various speed profiles including vehicles that influenced a motorist's choice of speed such as vehicular deceleration to make turns, queuing during peak hour, or a platoon.

The road and shoulder surface were clear of surface water or snow during the period when data were recorded. The result of the speed profile in the study segment is shown in **Figure 5** and **Table 3**. For details please see **Appendix B**. The 85th percentile speed was found to be 76-mph and the 50th percentile speed was found to be 69-mph. The 10-mph pace was found to be between 66-mph and 76-mph comprising of 57% of daily vehicles within that 10-mph pace. The 85th percentile and 50th percentile speed is higher than the posted speed limit. The 85th percentile speed is at the upper tail-end of the 10-mph pace range, and the 50th percentile speed is within the 10-mph pace range.

Figure 5 - Speed Profile for All Vehicles Types in Both Direction of Travel

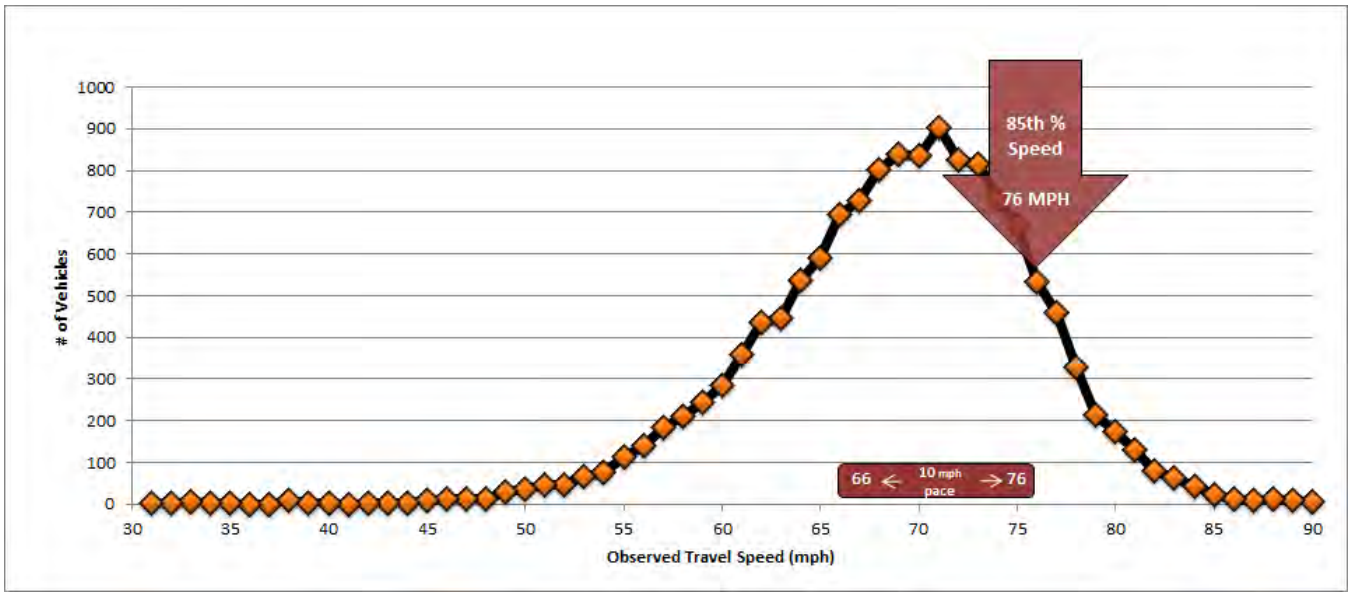


Table 3 - Speed Study Profile

Vehicle Type	Direction	10-mph Pace	% In Pace	85th Percentile Speed	50th Percentile Speed
Small to Mid-size	NB	66-76 mph	55%	75-mph	69-mph
	SB	66-76 mph	59%	76-mph	70-mph
	Both	66-76 mph	57%	76-mph	70-mph
Large	NB	65-75 mph	55%	73-mph	67-mph
	SB	62-72 mph	53%	75-mph	67-mph
	Both	65-75 mph	52%	74-mph	67-mph
All	NB	66-76 mph	55%	75-mph	69-mph
	SB	66-76 mph	59%	76-mph	70-mph
	Both	66-76 mph	57%	76-mph	69-mph

NCHRP

A recent research report from the *National Cooperative Highway Research Program* (NCHRP) has been completed. NCHRP report 17-76: *Development of a Posted Speed Limit Setting Procedure and Tool* collected insights into how the roadway environment influences operating speed and safety (crashes) through a review of literature and the collection and analysis of data from two states. Using those insights along with an understanding of different methods being used and currently being considered for the setting of posted speed limits, the research team developed a speed limit setting procedure along with a tool. The procedure uses fact-based decision rules that consider both driver speed choice and safety associated with the roadway.

There has been a nationwide push over the last several years for the consideration of 50th percentile speed, especially for developed areas. When the roadway conditions are optimal, the suggested speed limit should reflect the 85th percentile speed. When roadway conditions are not favorable to all users or when crashes are a significant concern, then the suggested speed limit should reflect the rounded down 85th percentile or the 50th percentile speed. Drivers frequently select speeds a certain increment above the posted speed limit, anticipating that they will not receive a ticket if they are below the assumed enforcement speed tolerance. Because of these reasons, 50th percentile speed data were also used in the analysis along with the 85th percentile speed data.

The NCHRP 17-76 Speed Limit Setting Tool was used to calculate the recommended speed limit for the study segment based on key factors such as: 85th percentile and 50th percentile speed, roadway characteristics, and crash history. The recommended speed for the study segment based on NCHRP 17-76 was found to be 70-mph along in this segment. Details of the NCHRP 17-76 report is available in **Appendix C**.

7. Conclusion

Vehicular Classification

There are 13,560 and 1,340 daily small to mid-size and large vehicles, respectively that travel in the segment. The daily distribution is 50% along northbound and 50% along southbound.

Safety Characteristics

There were 49 crashes (two fatal, four serious injury, three minor injury, six possible injury, and 34 property damage only crashes) reported during the analysis period. Crashes with wild animals (41%) were the most prominent crash types followed by collision with fixed objects (14%) in the study segment.

There were 572 citations issued in the study segment during the analysis period of which 218 citations (38%) were speeding violations.

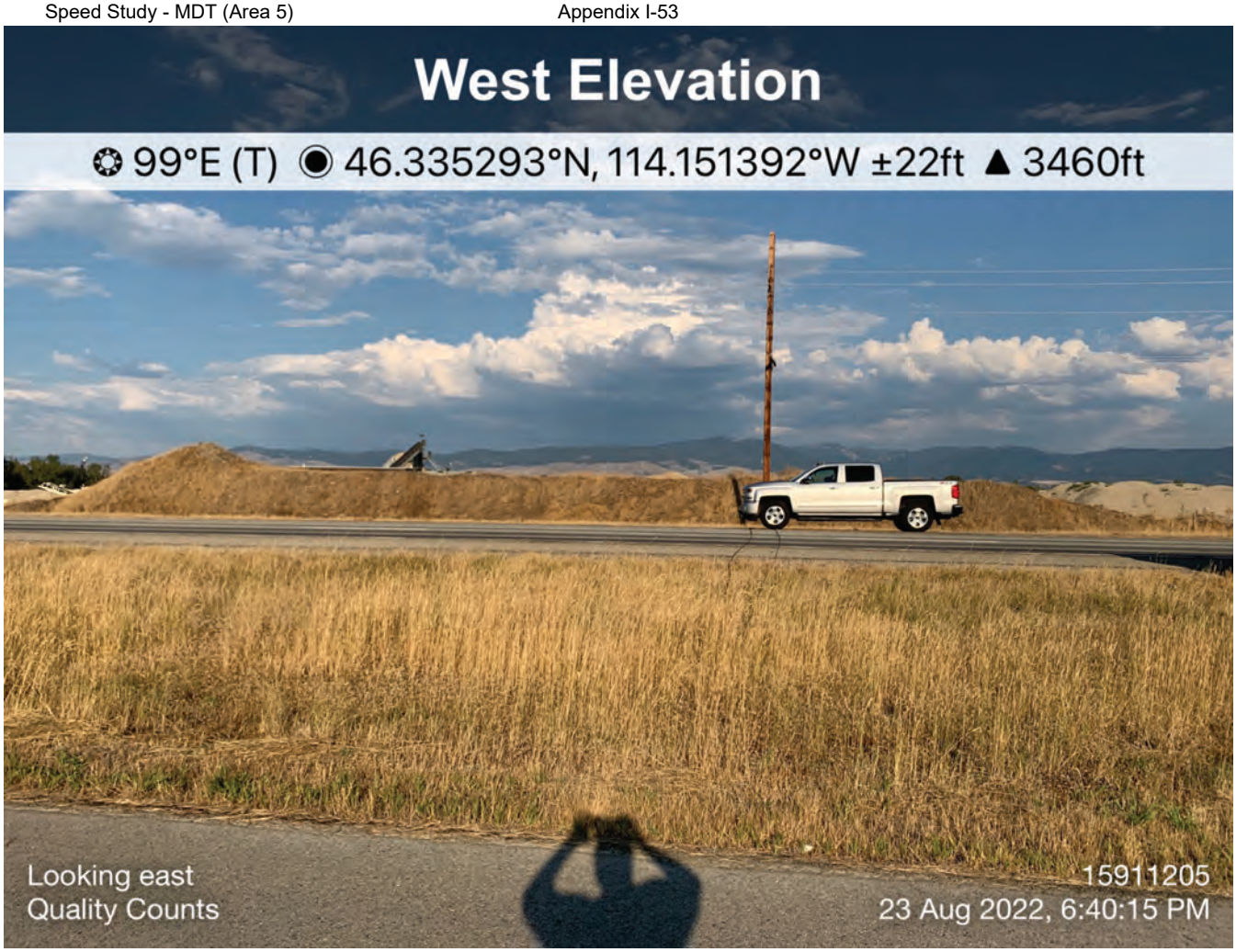
Roadway Characteristics

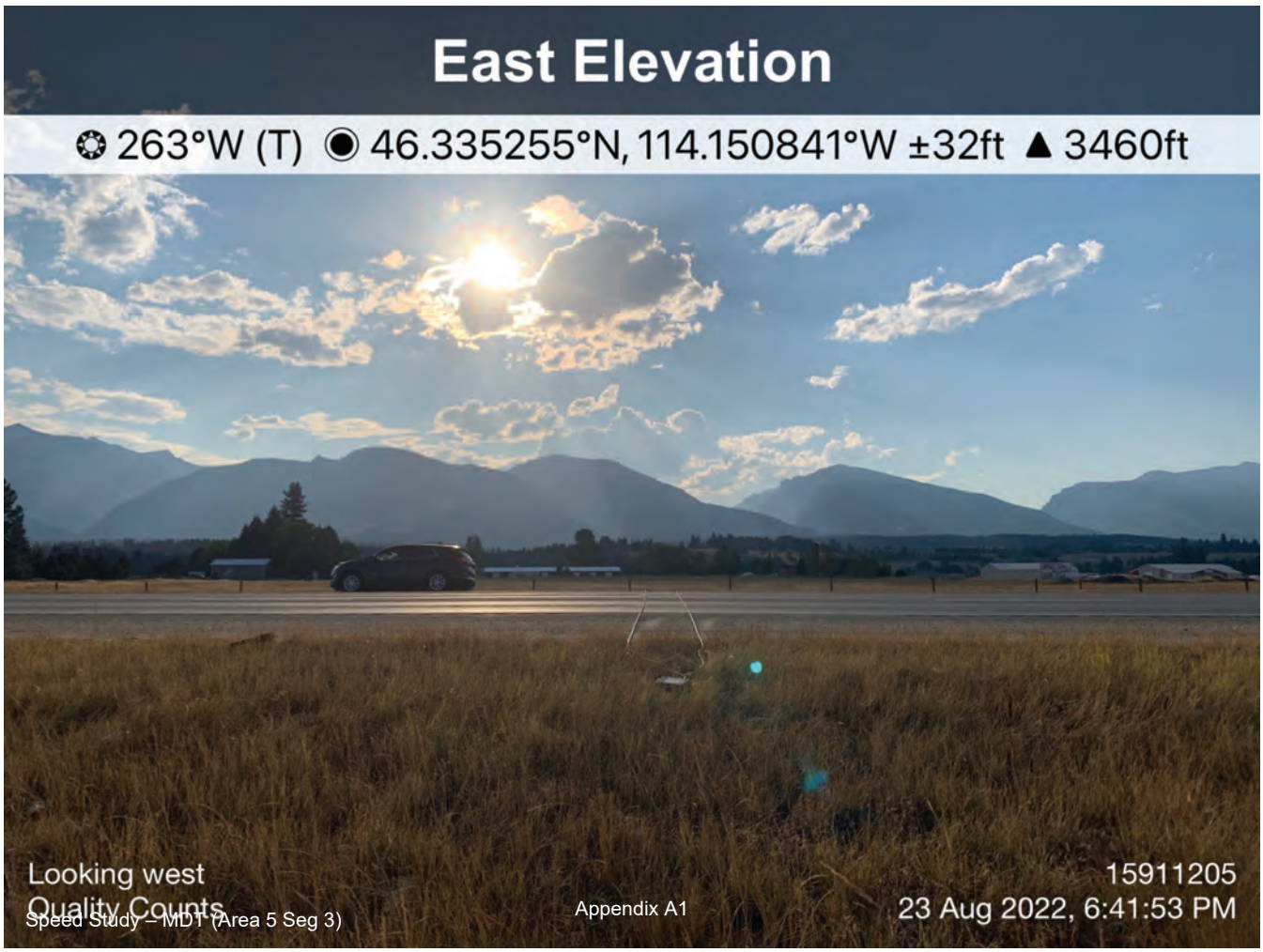
The segment, RP 52.0 to RP 54.5, being reviewed has a statutory speed limit of 70-mph for regular vehicles and 65-mph for trucks. The 2.5-mile segment is a four-lane roadway with a two-way-left-turn lane in the center that is classified as a principal arterial. The segment consists of fill sections with some fixed objects within the clear zone. There are shoulder rumble strips present but no centerline rumble strips present throughout the segment. The shoulders are wide on both sides of the roadway for safe parking of disabled vehicles. The vertical grades and in-slopes are generally flat in the segment. The road conditions are generally in good condition. The northern section of the study segment is mostly rural residential. There is a traffic signal at the south end of the study segment, located on Dutch Hill Rd / Woodside Cutoff Rd. The driveway density in the study segment is more than the maximum number of driveway thresholds for similar type of facility.

Speed Characteristics

The 85th percentile speed was found to be 76-mph and the 50th percentile speed was found to be 69-mph. The 10-mph pace was found to be between 66-mph and 76-mph comprising of 57% of daily vehicles within that 10-mph pace. The recommended speed for the study segment based on NCHRP 17-76 was found to be 70-mph along this segment which is six-mph less than the 85th percentile speed and closer to the 50th percentile speed. There is a history of fatal (two) and injury crashes (13) experienced in the study segment that corresponds to 31% of all crashes. This indicates that the existing speed limit of 70-mph which is closer to 50th percentile speed is reasonable in this segment.

APPENDIX A – PICTURES

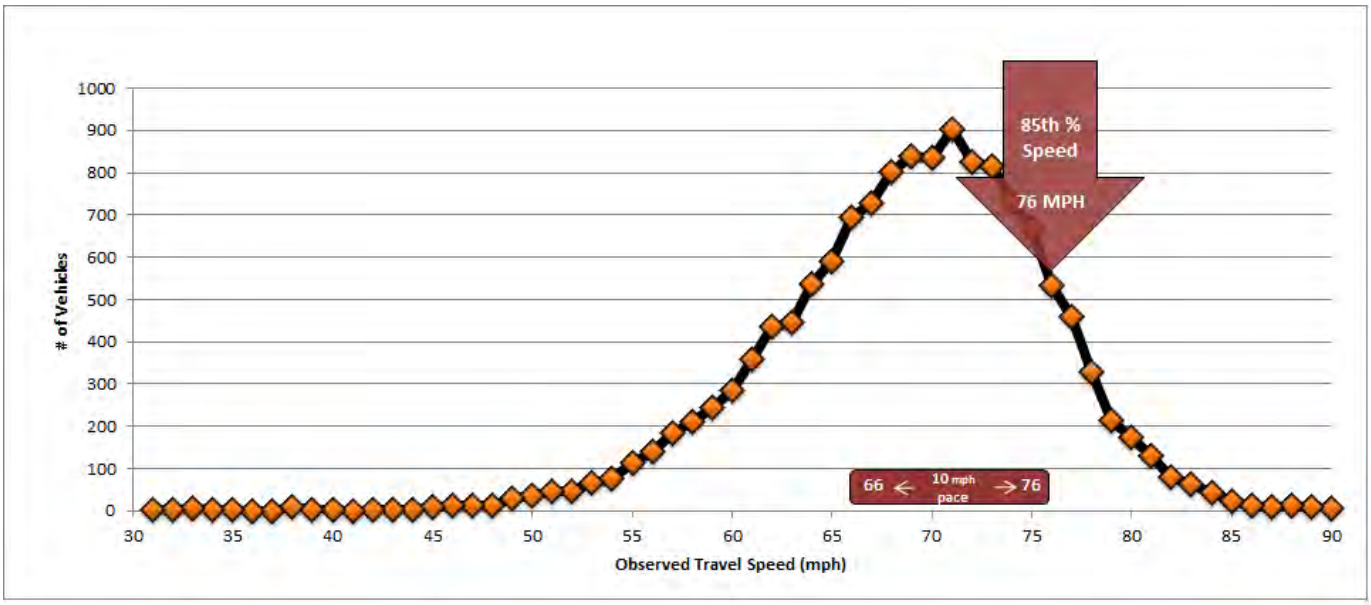

West Elevation
99°E (T) 46.335293°N, 114.151392°W ±22ft 3460ft
Looking east
Quality Counts
15911205
23 Aug 2022, 6:40:15 PM

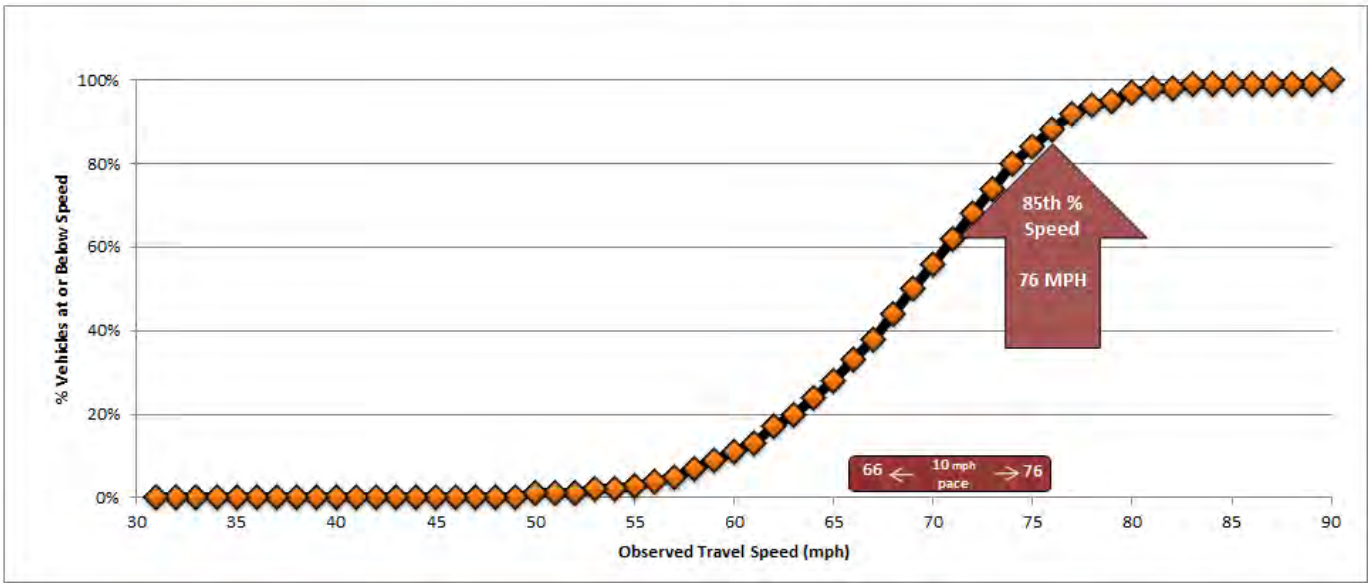

East Elevation
263°W (T) 46.335255°N, 114.150841°W ±32ft 3460ft
Looking west
Quality Counts
15911205
23 Aug 2022, 6:41:53 PM

APPENDIX B – SPEED STUDY PROFILES

SPEED SAMPLE SUMMARY (ALL VEHICLES)

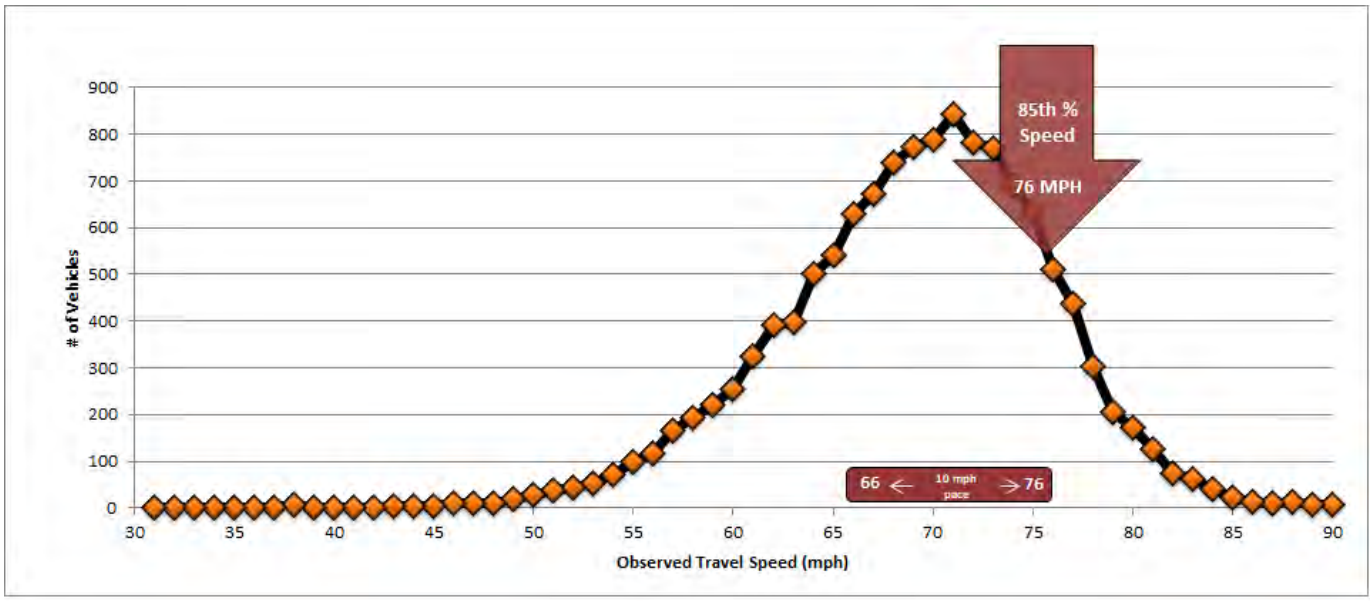
ID:	Segment 3	Speed Limit	70 MPH	Day/Date	Tuesday, August 23, 2022
Roadway:	US 93	Seg. Length:	2.4 MILES	Time:	24-hours
Study Limits:	Hamilton to Victor	Road Type:	Five-Lane, Two way	Sample Loc	46.335217,-114.151013
City/County:	Ravalli	ADT Range:	NB-7500 SB-7400	Weather:	Clear
RP:	52.0 to 54.5	Truck ADT:	NB-650 SB-690	Observer(s):	Quality Counts
85th % Speed:	76	10 mph pace	66-76	Machine:	Tubes
50th % Speed:	69	% in pace	57%		

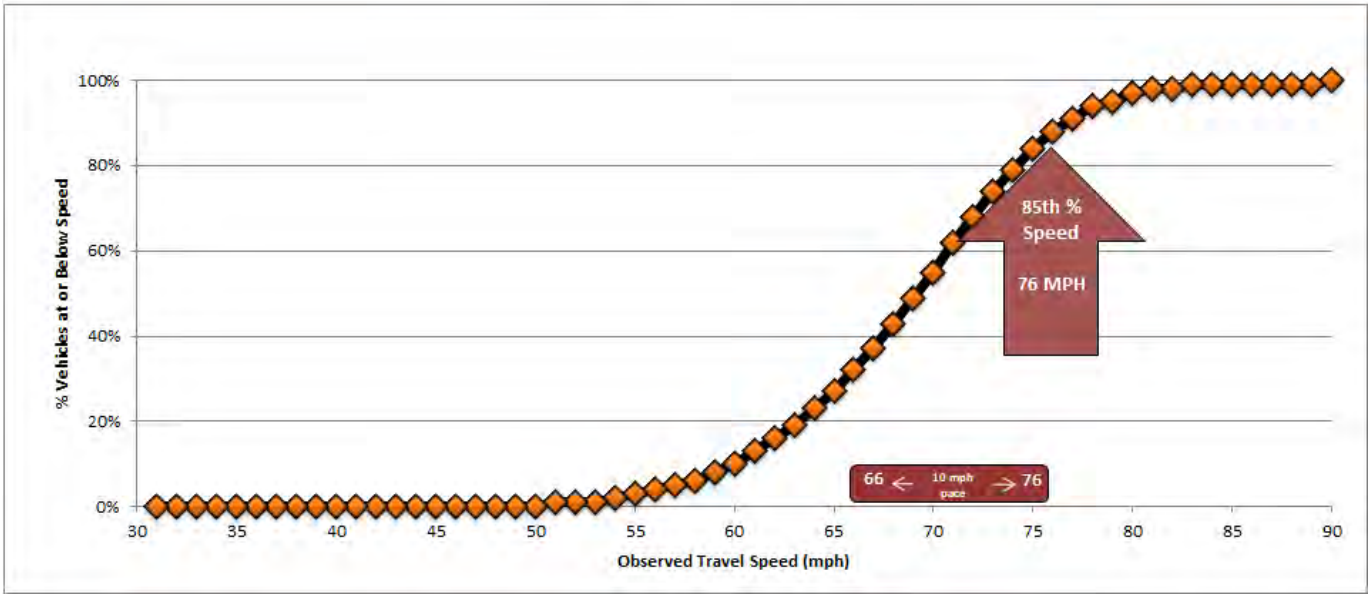




SPEED SAMPLE SUMMARY (PASSENGER VEHICLES)

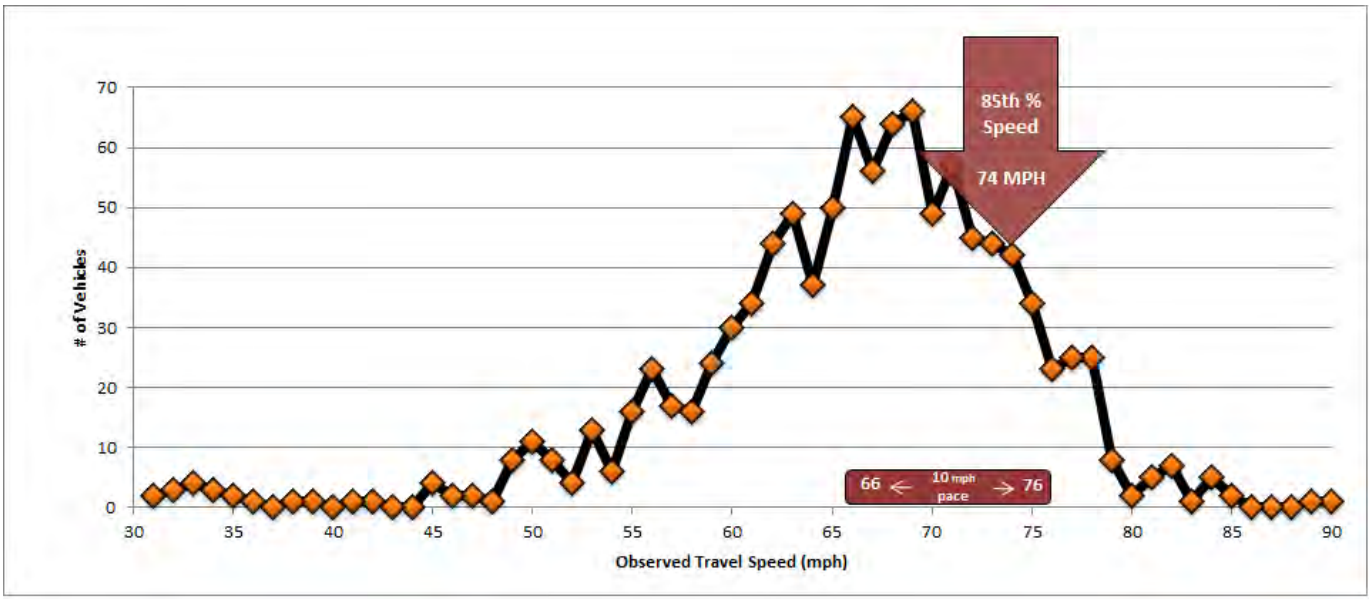
ID:	Segment 3	Speed Limit	70 MPH	Day/Date	Tuesday, August 23, 2022
Roadway:	US 93	Seg. Length:	2.4 MILES	Time:	24-hours
Study Limits:	Hamilton to Victor	Road Type:	Five-Lane, Two way	Sample Loc	46.335217,-114.151013
City/County:	Ravalli	ADT Range:	NB-7500 SB-7400	Weather:	Clear
RP:	52.0 to 54.5	Truck ADT:	NB-650 SB-690	Observer(s):	Quality Counts
85th % Speed:	76	10 mph pace	66-76	Machine:	Tubes
50th % Speed:	70	% in pace	57%		

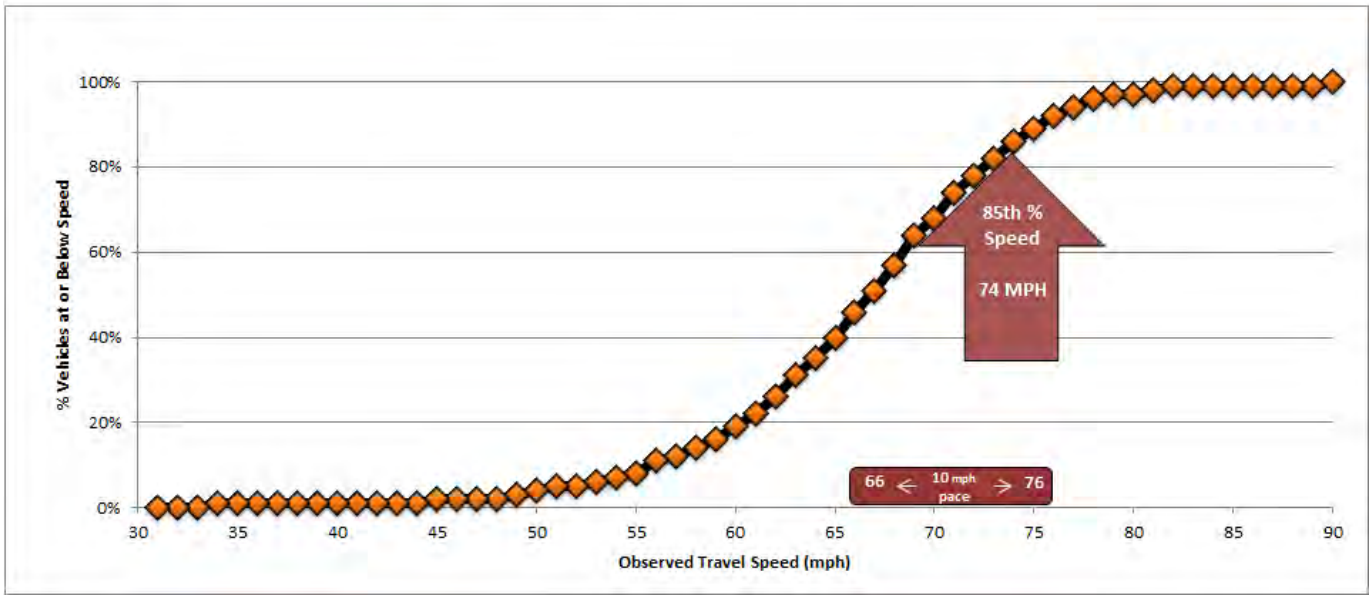




SPEED SAMPLE SUMMARY (TRUCKS)

ID:	Segment 3	Speed Limit	70 MPH	Day/Date	Tuesday, August 23, 2022
Roadway:	US 93	Seg. Length:	2.4 MILES	Time:	24-hours
Study Limits:	Hamilton to Victor	Road Type:	Five-Lane, Two way	Sample Loc	46.335217,-114.151013
City/County:	Ravalli	ADT Range:	NB-7500 SB-7400	Weather:	Clear
RP:	52.0 to 54.5	Truck ADT:	NB-650 SB-690	Observer(s):	Quality Counts
85th % Speed:	74	10 mph pace	65-75	Machine:	Tubes
50th % Speed:	67	% in pace	52%		





APPENDIX C – NCHRP REPORT

NCHRP 17-76 Speed Limit Setting Tool		
Input Cells	*Description*	*Output Cells*
Site Description Data		
Rural	Roadway context	
Principal arterial	Roadway type	
Yes	Are crash data available?	
Oz Khan, PE	Analyst	
8/23/2022	Date	
US 93 RP: 52.0-54.5	Roadway name	
4-lane Roadway	Description	
70	Current speed limit (mph)	
A5-Seg-03	Notes	
Analysis Results		
	Speed limit setting group	Undeveloped
	Suggested speed limit (mph)	**70**
Speed Data		
70	Maximum speed limit (mph)	
76	85th-percentile speed (mph)	
69	50th-percentile speed (mph)	
Site Characteristics		
2.5	Segment length (mi)	
14,900	AADT (two-way total) (veh/d)	
4	Number of lanes (two-way total)	
Undivided	Median type	
51	Number of access points (total of both directions)	
12	Lane width (ft)	
9	Shoulder width (ft)	
No	Adverse alignment present?	
Crash Data		
5	Number of years of crash data	
14,800	Average AADT for crash data period (veh/d)	
49	All (KABCO) crashes for crash data period	
15	Fatal & injury (KABC) crashes for crash data period	
	Average KABCO crash rate (crashes / 100 MVMT)	
	Average KABC crash rate (crashes / 100 MVMT)	
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	161.9
	1.3 x average KABC crash rate (crashes / 100 MVMT)	53.5
	Critical KABCO crash rate (crashes / 100 MVMT)	147.6
	Critical KABC crash rate (crashes / 100 MVMT)	54.7

ENGINEERING, REIMAGINED

SPEED STUDY

US Hwy 93 – Hamilton to Victor

Reference Point: 50.0 to 52.0

Ravalli County, MT

January 2023

Speed Study

Hamilton to Victor, Montana

RP: 50.0 to 52.0

January 2023

Prepared for:

Montana Department of Transportation

Prepared by:

KLJ Engineering

Table of Contents

1. Introduction 1
2. Methodology 2
3. Roadway Characteristics 2
4. Vehicular Classification 4
5. Safety Characteristics 4
6. Speed Characteristics 7
7. Conclusion 8

List of Figures

Figure 1 - Study Segment 1
Figure 2 - Representative Section of US Hwy 93 from RP 50.0 to 52.0 2
Figure 3 - Five-Year Crash Summary (2016-2020) 4
Figure 4 - Citation Summary by Year 6
Figure 5 - Speed Profile 7

List of Tables

Table 1 - Vehicular Classification 4
Table 2 - Crash Collision Type 5
Table 3 - Speed Study Profile 8

List of Appendices

Appendix A – Pictures ..... A
Appendix B – Speed Study Profiles ..... B
Appendix C – NCHRP Report C

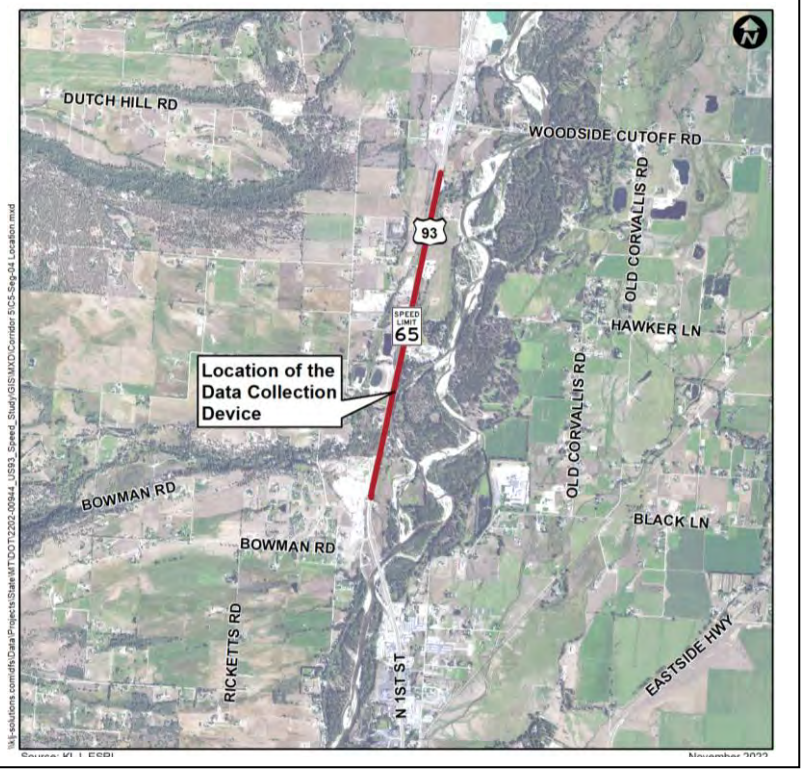
1. Introduction

Speed limits are set to inform motorists of appropriate driving and safe operating speeds under favorable conditions. Speed limits are set at the statutory speed limit unless a traffic engineering investigation study has been conducted and (where applicable) approved by the Transportation Commission. The *Montana Department of Transportation* (MDT) has requested KLJ Engineering to review the posted speed limit along US Hwy 93 from Hamilton to Victor.

Study Location

The study segment is US Hwy 93 that begins from Reference Point (RP) 50.0 to 52.0 or between 1,000-ft north of Bowman Rd and 1,000-ft south of Woodside Cutoff Rd. The two-mile segment is a paved four-lane roadway with a two-way-left-turn lane (TWLTL) in the center and has an approved speed limit of 65-mph. There is an annual average daily traffic (AADT) of 14,417 (based on a weighted average) that travel along this segment as per 2021 counts reported in MDT's Transportation Data Management System (TDMS). vehicles that travel along this segment. The location of the study segment is shown in **Figure 1**.

Figure 1 - Study Segment



Objective

The purpose of this study is to evaluate the appropriate speed of the roadway. The primary tasks for the study included data collection, data analysis, and recommendations for speed limits along the study segment. As part of this study, an evaluation and cataloging of existing roadway conditions, collection of historical AADT, and crash data will be completed.

Procedures

The steps for setting speed limits include planning, coordination, data collection and analysis, review, and presentation to the stakeholders, and finally, determination or implementation of the speed limits. Quality data and good documentation provides support for the judgments that are made.

Five years of the most recent crash and citation data was also requested and received from the MDT Traffic & Safety Bureau for the analysis.

2. Methodology

For determining the appropriate speed limit, the following parameters were reviewed:

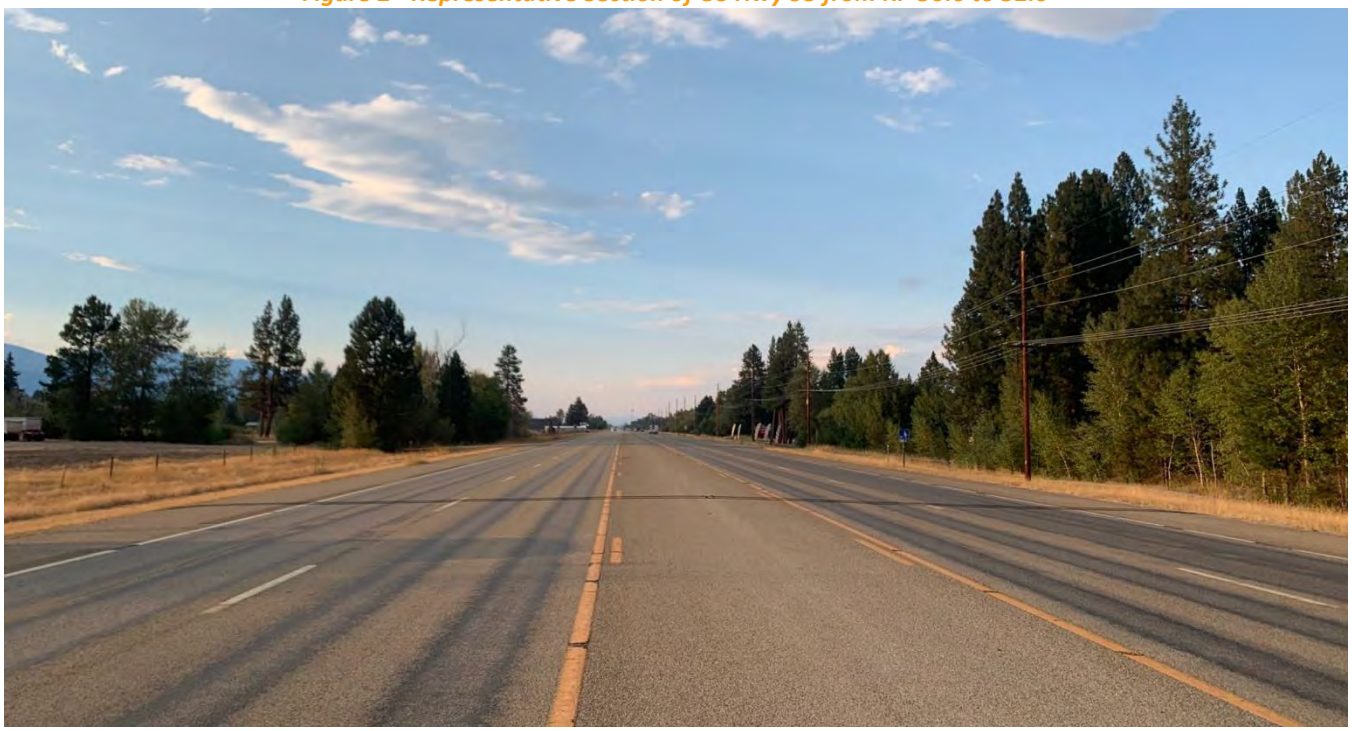
- Roadway Condition/Characteristics
- Crash and Citation History
- Speed Characteristics, and
- Vehicular classes

When considering whether to establish a new posted speed limit or not, surveying and analysis of existing travel speeds is crucial to determining a reasonable posted speed limit. Motorist usually drive at speeds which they perceive as safe, based on the observable roadway conditions. A flat and straight roadway may result in a different travel speed than the posted speed limit due to the driver's observation of the roadway condition.

3. Roadway Characteristics

While speed samples (actual speed measurements of vehicles) are a large part of the necessary data, roadway characteristics should also be considered. Roadway characteristics such as pavement type/conditions, access points, vertical grades, and clear zone assessments data were collected during the field visit on August 23, 2022. **Figure 2** shows the most representative typical section of the study segment. Additional pictures of the study segment are available in **Appendix A**.

Figure 2 - Representative Section of US Hwy 93 from RP 50.0 to 52.0



Lanes and Shoulders

The typical cross section for this study section consists mainly of four 12-ft bituminous traveling lanes, one 15-ft bituminous two-way-left-turn-lane in the center, and two 10-ft bituminous shoulders. The pavement is generally in good condition. The shoulders are wide enough for safe parking of disabled vehicles.

Rumble Strips

There are shoulder rumble strips present throughout the segment. There are no centerline rumple strips present throughout the segment.

Access Points per Mile

An access point refers to public roads, a business driveway, a private driveway, or a farm field access. Fewer access points per mile means drivers are responding to a reduced number and variety of events. The study section has a combined 32 accesses (three public, 22 private, and seven field access) within the nearly two-mile segment that corresponds to 16 accesses points per mile. The recommended primary full-movement and secondary intersection spacing for a rural principal arterial is one-mile and half-mile, respectively. The recommended and maximum density for driveways per mile for a 65-mph roadway is no more than 8.2 based on Stopping Sight Distance tables documented in *MDT Geometric Design Standards (Sept 2016)*.

Vertical Grades

Grade is the rate of change of the vertical alignment. Grade affects vehicle speed and vehicle control, particularly for large trucks. The study segment can be described as generally flat.

Roadside Hazard Assessment

The segment generally comprises of fill section with a clear zone that is partially obstructed. There are sections of roadway with agricultural fence, guardrails and concrete barriers within the clear zone that are protecting from steep slopes and creeks. There is a trail that runs parallel to the roadway on the east side of the roadway that has agricultural fence within the clear zone.

In-slope

The in-slope measured at the representative section is generally flat. The in-slope was measured at 6:1 which is considered a recoverable slope. There are driveways along the study segment that have steep slopes because of culverts crossing them. These steep slopes appear to be non-traversable.

Adjacent Development

The northern section of the study segment is mostly rural residential.

Statutory and Advisory Speeds

The approved speed limit is 65-mph for all other vehicles throughout this segment. The speed limit decreases to 55-mph for a short stretch just to the south before going back up to 65-mph for the rest of the segment. There are no advisory speeds along the segment.

Traffic Control

There is a traffic signal near the north end of the study segment at Woodside Cutoff Rd.

4. Vehicular Classification

Vehicular class data for 24-hour period were collected on August 23, 2022. Vehicle types were categorized to two classifications:

- **Small to Mid-size Vehicles** consisting of motorcycles, passenger vehicles, pickups, vans, buses, conventional vans, and city delivery trucks.
- **Large Vehicles** consisting of single unit four or more axle trucks.

There are 16,160 and 1,340 daily small to mid-size and large vehicles, respectively that travel in the segment. The daily distribution is 50% along northbound and 50% along southbound direction. The vehicular classifications in the study segment are summarized in **Table 1**.

Table 1 - Vehicular Classification

Classification	Northbound	Southbound	Total	Percent
Small to Mid-Size vehicles	7,990	8,170	16,160	92%
Large vehicles	710	630	1,340	8%
Total (Percent)	**8,700 (50%)**	**8,800 (50%)**	**17,500**	**100%**

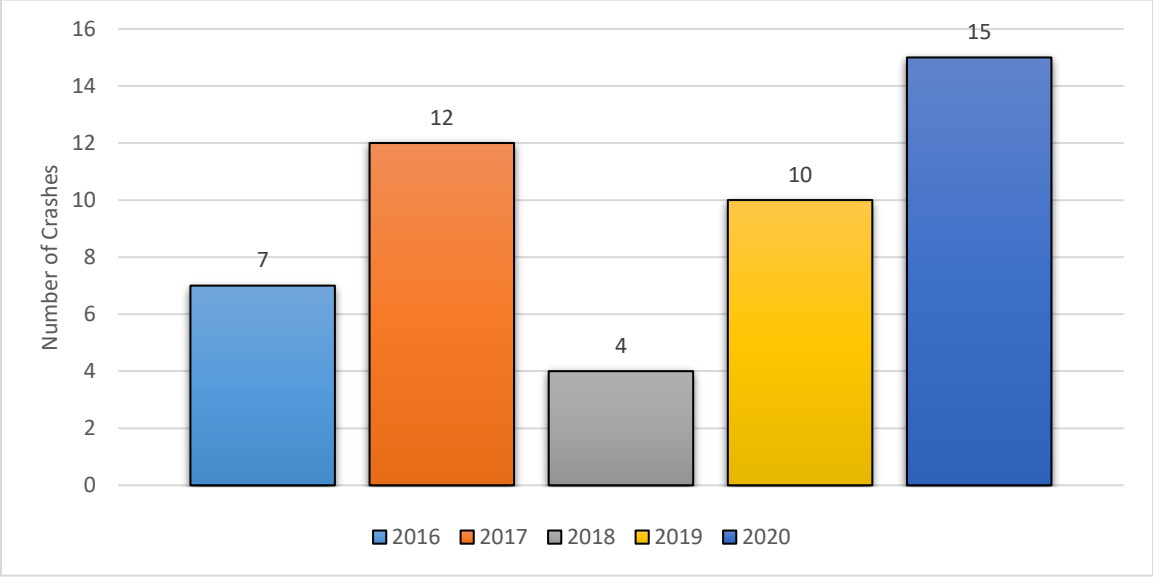
5. Safety Characteristics

Reviewing historic crash and citation information can help identify driver behavior issues that can provide additional information for setting speed the appropriate and safer speed limit.

Crash History

Five years of crash records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. MDT shared crash records in a spreadsheet format. The five-year crash summary by year is shown in **Figure 3**. There were 48 crashes (one fatal, three serious injury, nine minor injury, eight possible injury, and 27 property damage only type crashes) reported during the analysis period. This corresponds to 9.6 crashes per year or 4.8 crashes per year per mile.

Figure 3 - Five-Year Crash Summary (2016-2020)



Thirty-eight crashes or 79% of all the crashes were non-junction related. Crash summary by crash type is shown in **Table 2**.

Table 2 - Crash Collision Type

Type	# Crashes
Fixed Object	8
Jackknife	1
Not Fixed Object or Debris	1
Pedestrian	1
Rear-End	7
Right Angle	7
Roll Over	4
Sideswipe, Same Direction	1
Wild Animal	18
TOTAL	**48**

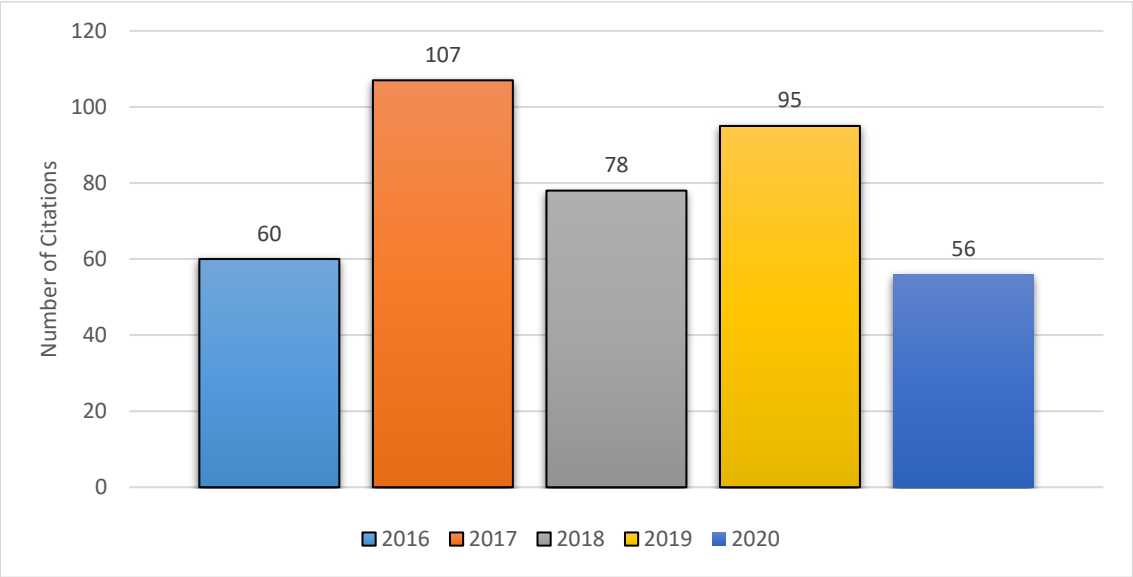
Crashes with wild animals (38%) were the most prominent crash type followed by crashes with fixed objects (17%) in the study segment. The crash data had no supplement officer narratives to identify if speeding was the contributing factor for any of these crashes.

Citation History

The speeding law in Montana 1 § 61-8-303 (3) states: "Subject to the maximum speed limits set forth in subsection (above), a person shall operate a vehicle in a careful and prudent manner and at a reduced rate of speed no greater than is reasonable and prudent under the conditions existing at the point of operation, taking into account the amount and character of traffic, visibility, weather, and roadway conditions." It is critical to note that the law enforcement can issue a ticket for driving a vehicle at unsafe speeds, even if a driver is within the posted speed limit. For example, driving at the posted speed limit on the freeway when there is a blizzard or thick fog. Since these driving conditions are unsafe for you and other drivers, law enforcement is within their rights to issue a speeding ticket as per the speeding laws in Montana.

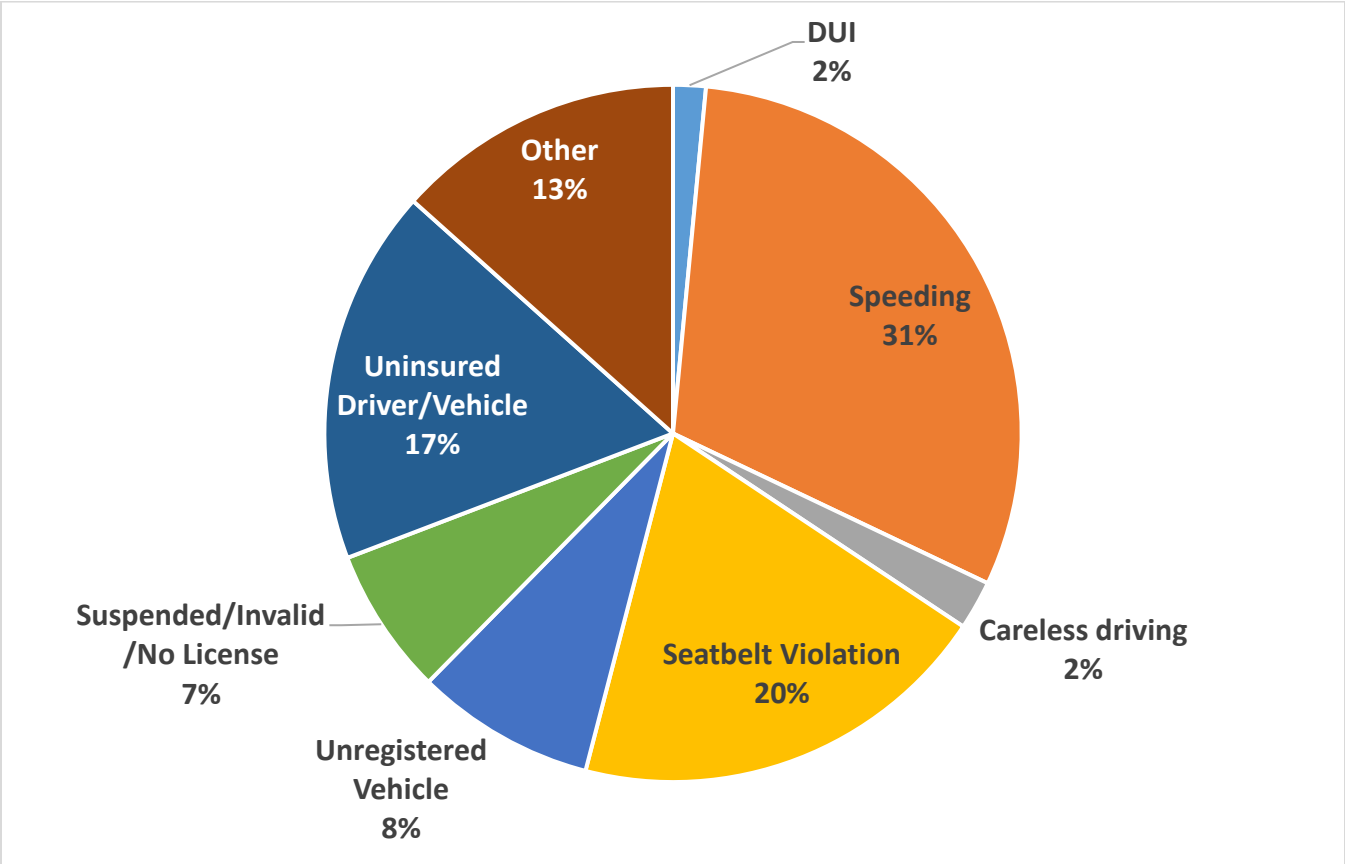
Five years of citation records between January 1, 2016, through December 31, 2020, were requested from the MDT Traffic & Safety Bureau. The citation records were in a spreadsheet format. The five-year citation summary in the segment is shown in **Figure 4**. There were 396 citations issued in the study segment during the analysis period of which 121 citations (31%) were speeding violations.

Figure 4 - Citation Summary by Year



The greatest number of citations were given in the month of November (12%). The types of citations issued in this segment are shown in **Figure 5**. Speeding (31%), and Seatbelts (20%) were the most prominent types of traffic violations in the study area.

Figure 5 - Citation Types Issued (2016 - 2020)



6. Speed Characteristics

Engineering Approach

The engineering approach is a two-step process based on operating conditions such as the 85th percentile speed. The 85th percentile is the speed at which 85% of free-flowing traffic is traveling at or below. Once the speed limit is established based on the 85th percentile speed, it can be adjusted (usually downward) based on other factors such as amount of non-motorized traffic, roadway characteristics, and crash history. MDT's procedures for setting speed limits are based on the engineering approach.

MDT uses 85th percentile, 50th percentile, and pace speeds. The pace speed is a 10-mph increment in speeds that encompasses the highest portion of observed speeds.

Spot Speed Data

Spot speed studies typically consist of sample sizes totaling at least 100 vehicles with Free Flow Speed (FFS). FFS is the speed of motorists traveling as desired given prevailing conditions such that no preceding vehicle influences the motorists' speed. Unattended pneumatic tubes were placed along the study segment to collect vehicular speed samples for a 24-hour period from August 23 to 24, 2022 near RP 50.5**.** The 24-hour data consisted of all vehicles that traveled along the study segment with various speed profiles including vehicles that influenced a motorist's choice of speed such as vehicular deceleration to make turns, queuing during peak hour, or a platoon.

The road and shoulder surface were clear of surface water or snow during the period when data were recorded. The result of the speed profile in the study segment is shown in **Figure 6** and **Table 3**. For details please see **Appendix B**. The 85th percentile speed was found to be 72-mph and the 50th percentile speed was found to be 66-mph. The 10-mph pace was found to be between 62-mph and 72-mph comprising of 61% of daily vehicles within that 10-mph pace. The 85th percentile and 50th percentile speed is higher than the posted speed limit. The 85th percentile speed is at the upper tail-end of the 10-mph pace range, whereas the 50th percentile speeds were within the 10-mph pace range.

Figure 6 - Speed Profile for All Vehicle Types in Both Direction of Travel

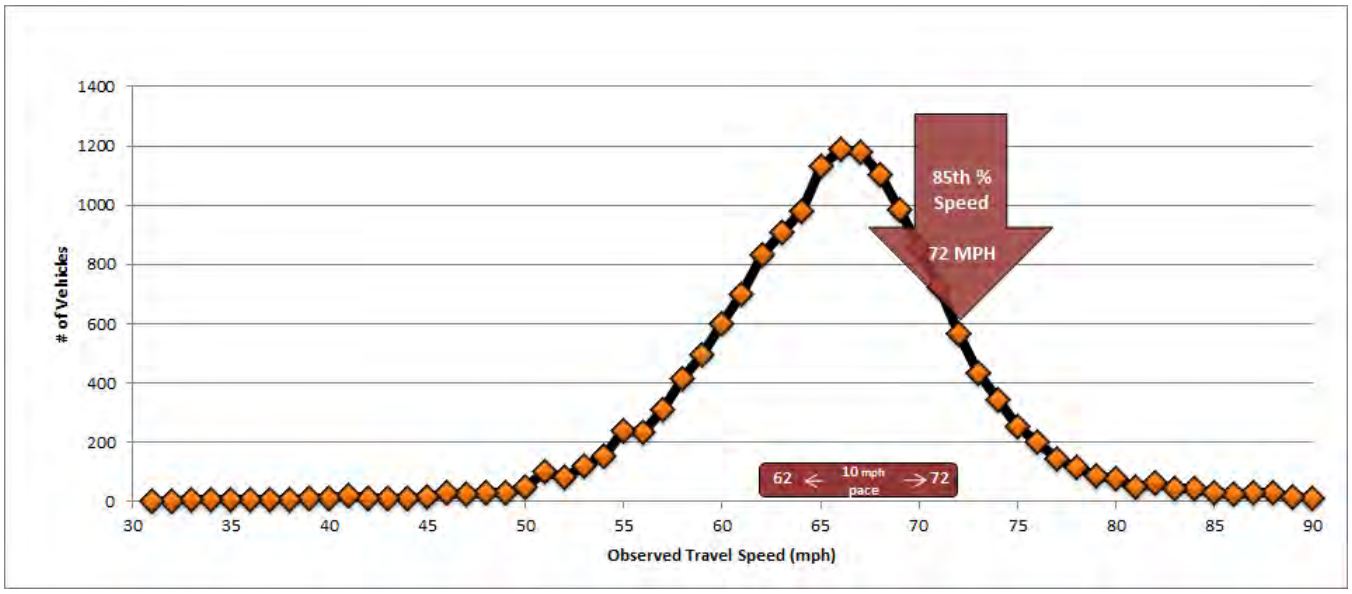


Table 3 - Speed Study Profile

Vehicle Type	Direction	10-mph Pace	% In Pace	85th Percentile Speed	50th Percentile Speed
Small to Mid-size	NB	63-73 mph	71%	71-mph	67-mph
	SB	60-70 mph	55%	73-mph	65-mph
	Both	62-72 mph	61%	72-mph	66-mph
Large	NB	62-72 mph	70%	69-mph	65-mph
	SB	57-67 mph	53%	74-mph	64-mph
	Both	60-70 mph	61%	71-mph	65-mph
All	NB	63-73 mph	71%	71-mph	67-mph
	SB	60-70 mph	54%	73-mph	65-mph
	Both	62-72 mph	61%	72-mph	66-mph

NCHRP

A recent research report from the *National Cooperative Highway Research Program* (NCHRP) has been completed. NCHRP report 17-76: *Development of a Posted Speed Limit Setting Procedure and Tool* collected insights into how the roadway environment influences operating speed and safety (crashes) through a review of literature and the collection and analysis of data from two states. Using those insights along with an understanding of different methods being used and currently being considered for the setting of posted speed limits, the research team developed a speed limit setting procedure along with a tool. The procedure uses fact-based decision rules that consider both driver speed choice and safety associated with the roadway.

There has been a nationwide push over the last several years for the consideration of 50th percentile speed, especially for developed areas. When the roadway conditions are optimal, then the suggested speed limit should reflect the rounded down 85th percentile or the 50th percentile speed. When roadway conditions are not favorable to all users or when crashes are a significant concern, then the suggested speed limit should reflect the rounded down 85th percentile or the 50th percentile speed. Drivers frequently select speeds a certain increment above the posted speed limit, anticipating that they will not receive a ticket if they are below the assumed enforcement speed tolerance. Because of these reasons, 50th percentile speed data were also used in the analysis along with the 85th percentile speed data.

The NCHRP 17-76 Speed Limit Setting Tool was used to calculate the recommended speed limit for the study segment based on key factors such as: 85th percentile and 50th percentile speed, roadway characteristics, and crash history. The recommended speed for the study segment based on NCHRP 17-76 was found to be 65-mph along in this segment. Details of the NCHRP 17-76 report is available in **Appendix C**.

7. Conclusion

Vehicular Classification

There are 16,160 and 1,340 daily small to mid-size and large vehicles, respectively that travel in the segment. The daily distribution is 50% along northbound and 50% along southbound.

Safety Characteristics

There were 48 crashes (one fatal, three serious injury, nine minor injury, eight possible injury, and 27 property damage only type crashes) reported during the analysis period. Crashes with wild animals (38%) were the most prominent crash types followed by crashes with fixed objects (17%) in the study segment.

There were 396 citations issued in the study segment during the analysis period of which 121 citations (31%) were speeding violations.

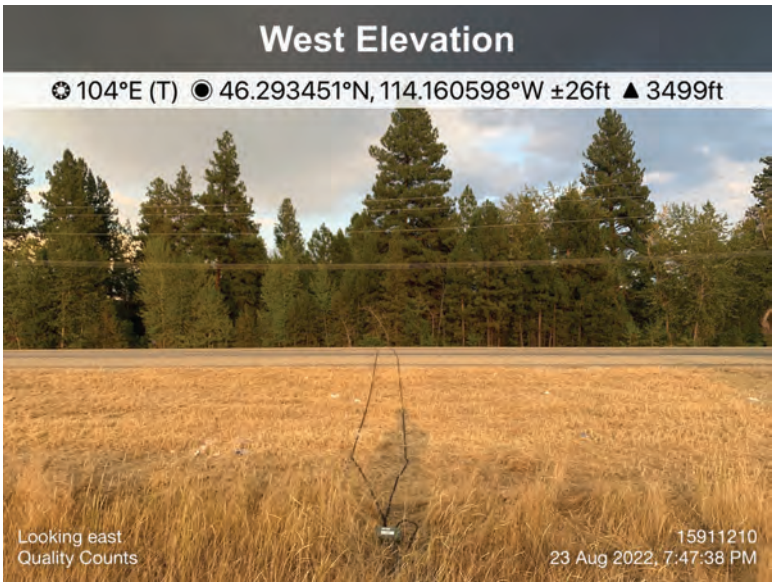
Roadway Characteristics

The segment, RP 50.0 to RP 52.0, being reviewed has a posted 65-mph speed limit for all vehicles. The two-mile segment is a paved four-lane roadway with a two-way-left-turn-lane in the center that is classified as principal arterial. The segment consists of fill sections with some fixed objects within the clear zone. There are shoulder rumble strips present but no centerline rumble strips present throughout the segment. The shoulders are wide on both sides of the roadway for safe parking of disabled vehicles. The vertical grades and in-slopes are generally flat in the segment. The road conditions are generally in good condition. The segment is mostly rural residential. The driveway density in the study segment is more than the maximum number of driveway thresholds for similar type of facility.

Speed Characteristics

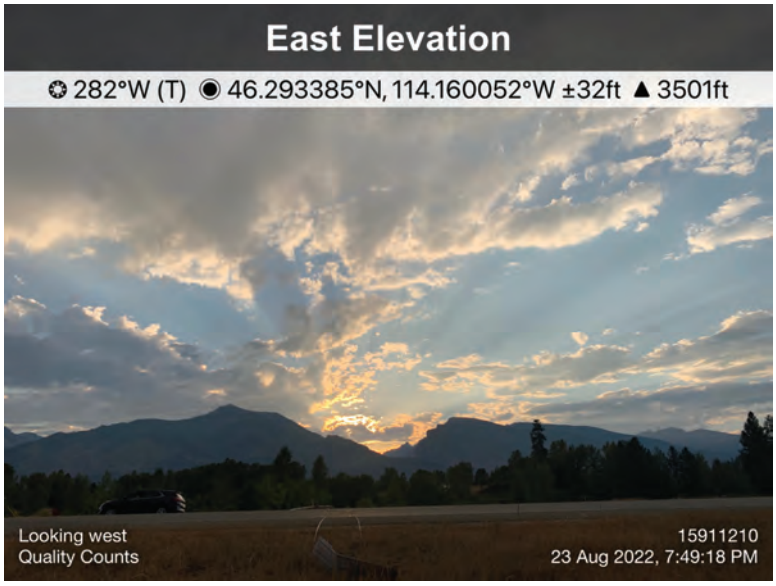
The 85th percentile speed was found to be 72-mph and the 50th percentile speed was found to be 66-mph. The 10-mph pace was found to be between 62-mph and 72-mph comprising of 61% of daily vehicles within that 10-mph pace. The recommended speed for the study segment based on NCHRP 17-76 was found to be 65-mph along in this segment. This indicates that the existing posted speed limit of 65-mph in this segment is reasonable.

APPENDIX A – PICTURES


West Elevation
104°E (T) 46.293451°N, 114.160598°W ±26ft ▲3499ft
Looking east
Quality Counts
15911210
23 Aug 2022, 7:47:38 PM


South Elevation
17°N (T) 46.293205°N, 114.160352°W ±22ft ▲3500ft
Looking north
Quality Counts
15911210
23 Aug 2022, 7:47:11 PM

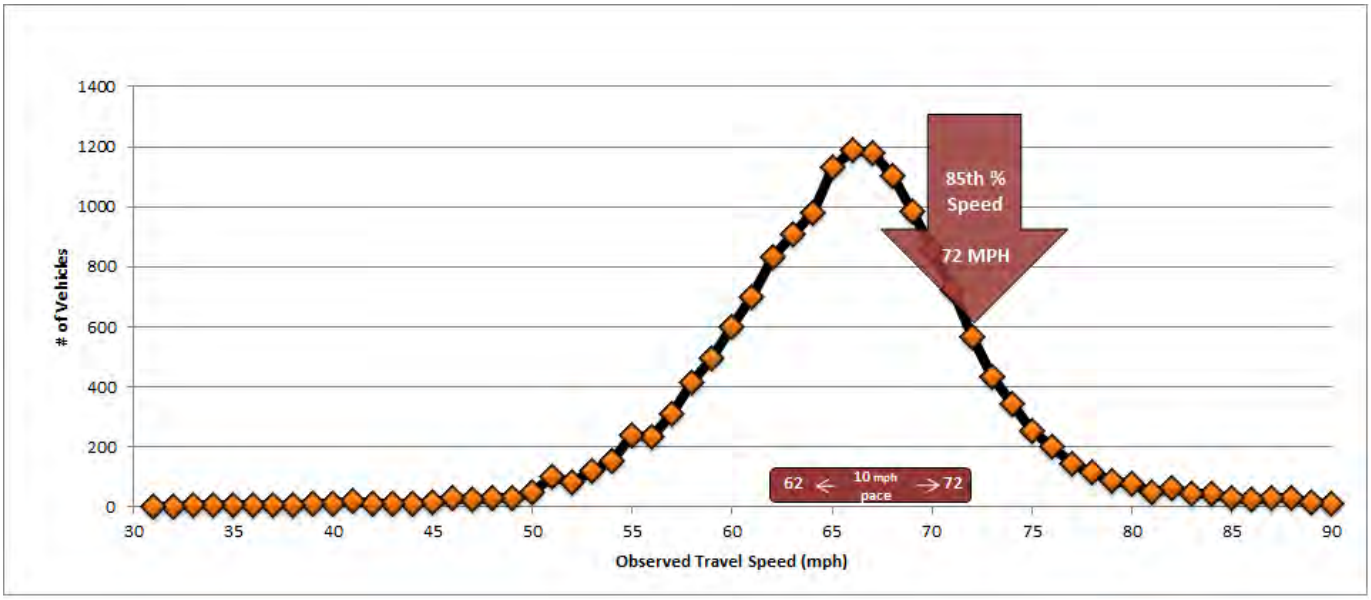

North Elevation
183°S (T) 46.293666°N, 114.160301°W ±13ft ▲3504ft
Looking south
Quality Counts
15911210
23 Aug 2022, 7:48:47 PM

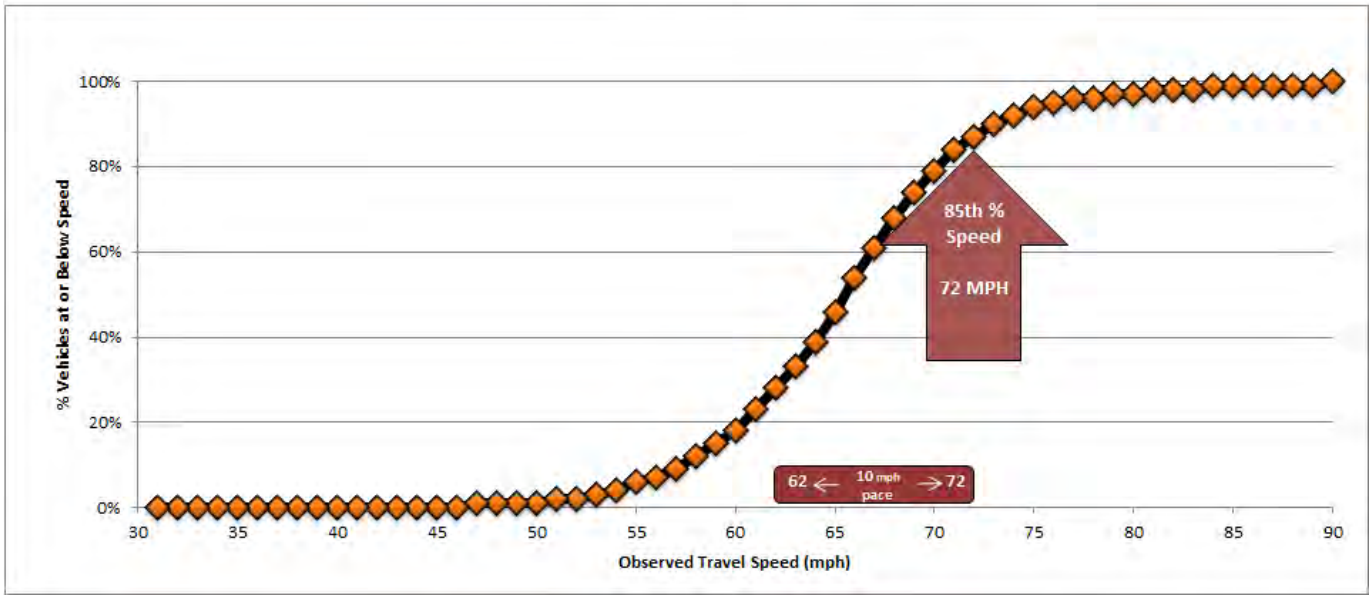

East Elevation
282°W (T) 46.293385°N, 114.160052°W ±32ft ▲3501ft
Looking west
Quality Counts
15911210
23 Aug 2022, 7:49:18 PM

APPENDIX B – SPEED STUDY PROFILES

SPEED SAMPLE SUMMARY (ALL VEHICLES)

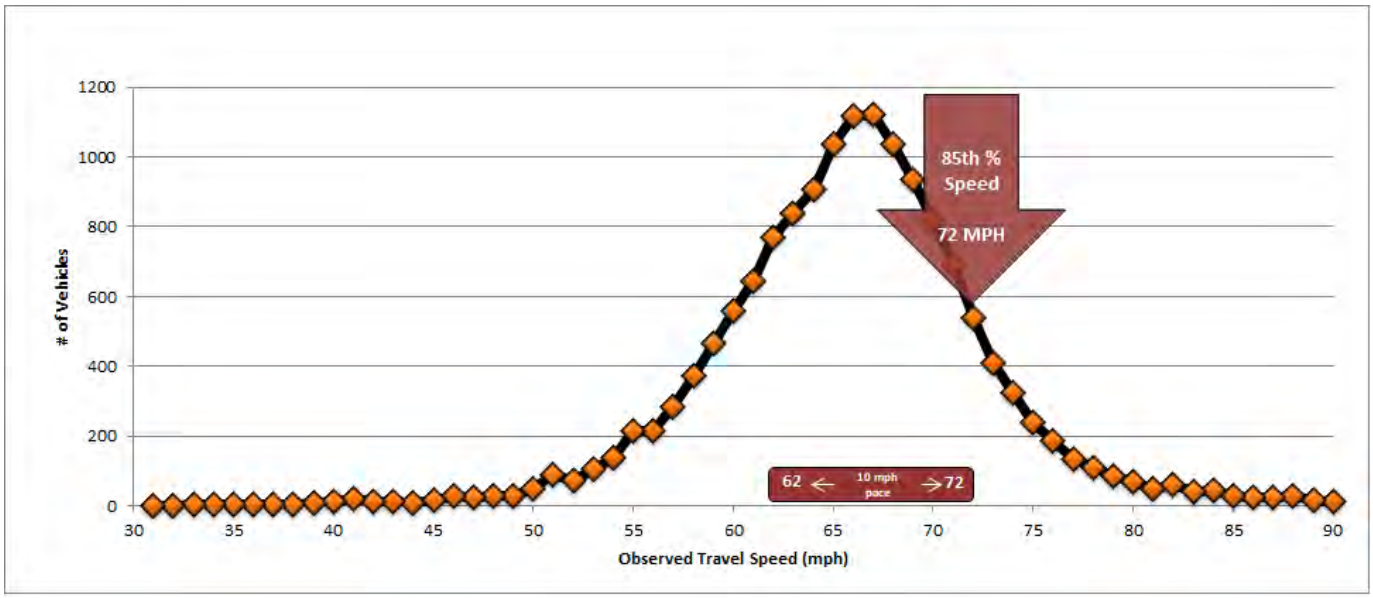
ID:	Seg-04	Speed Limit	65 MPH	Day/Date	Tuesday, August 23, 2022
Roadway:	US 93	Seg. Length:	2 MILES	Time:	24-hours
Study Limits:	Hamilton to Victor	Road Type:	Five-Lane, Two way	Sample Loc	46.29341,-114.160249
City/County:	Ravalli	ADT Range:	NB-8700 SB-8800	Weather:	Clear
RP:	50.0 to 52.0	Truck ADT:	NB-710 SB-630	Observer(s):	Quality Counts
85th % Speed:	72	10 mph pace	62-72	Machine:	Tubes
50th % Speed:	66	% in pace	61%		

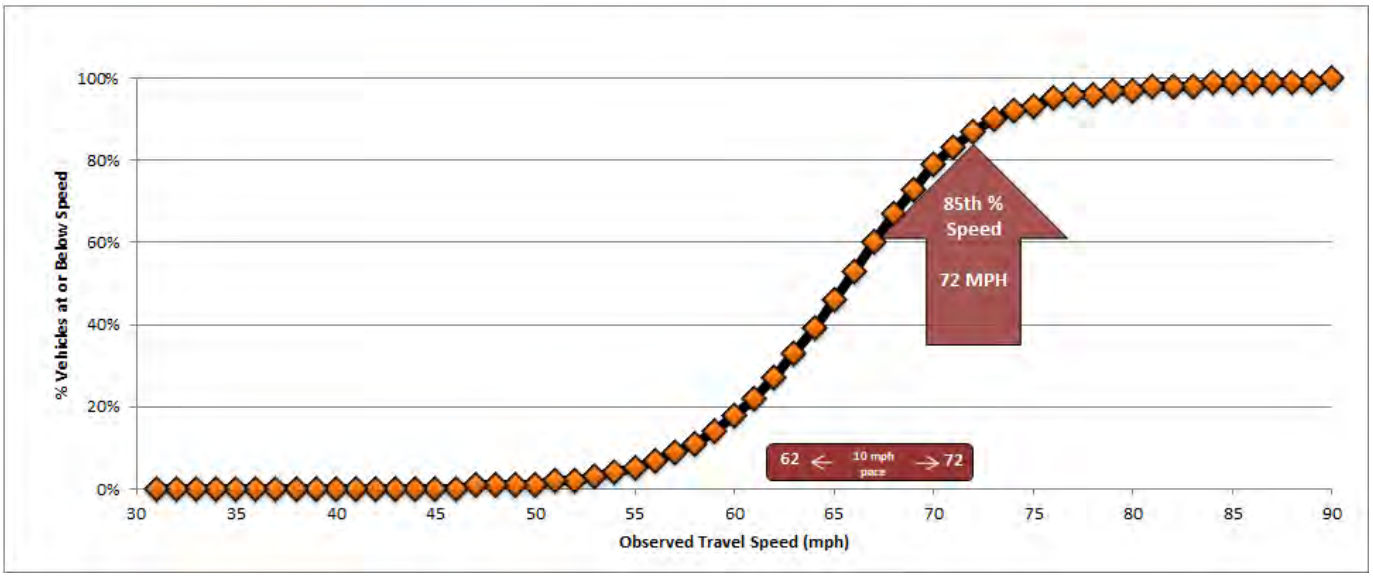




SPEED SAMPLE SUMMARY (PASSENGER VEHICLES)

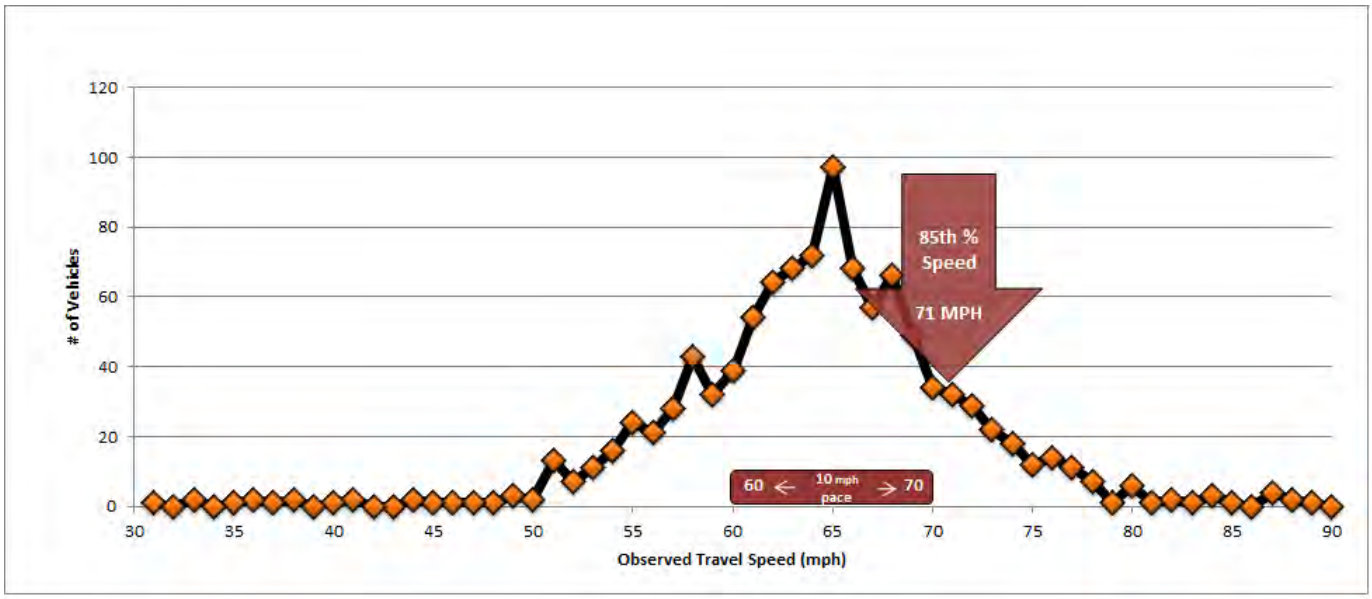
ID:	Seg-04	Speed Limit	65 MPH	Day/Date	Tuesday, August 23, 2022
Roadway:	US 93	Seg. Length:	2 MILES	Time:	24-hours
Study Limits:	Hamilton to Victor	Road Type:	Five-Lane, Two way	Sample Loc	46.29341,-114.160249
City/County:	Ravalli	ADT Range:	NB-8700 SB-8800	Weather:	Clear
RP:	50.0 to 52.0	Truck ADT:	NB-710 SB-630	Observer(s):	Quality Counts
85th % Speed:	72	10 mph pace	62-72	Machine:	Tubes
50th % Speed:	66	% in pace	61%		

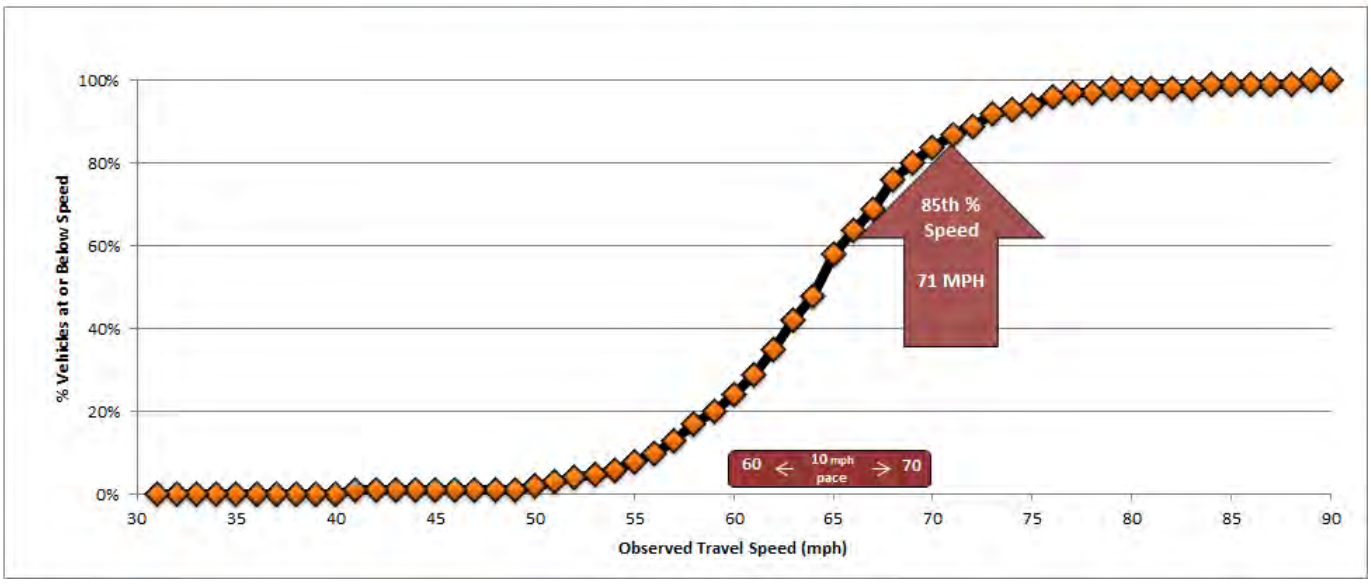




SPEED SAMPLE SUMMARY (TRUCKS)

ID:	Seg-04	Speed Limit	65 MPH	Day/Date	Tuesday, August 23, 2022
Roadway:	US 93	Seg. Length:	2 MILES	Time:	24-hours
Study Limits:	Hamilton to Victor	Road Type:	Five-Lane, Two way	Sample Loc	46.29341,-114.160249
City/County:	Ravalli	ADT Range:	NB-8700 SB-8800	Weather:	Clear
RP:	50.0 to 52.0	Truck ADT:	NB-710 SB-630	Observer(s):	Quality Counts
85th % Speed:	71	10 mph pace	60-70	Machine:	Tubes
50th % Speed:	65	% in pace	61%		





APPENDIX C – NCHRP REPORT

NCHRP 17-76 Speed Limit Setting Tool

Input Cells	Description	Output Cells
Site Description Data		
Rural	Roadway context	
Principal arterial	Roadway type	
Yes	Are crash data available?	
Oz Khan, PE	Analyst	
8/23/2022	Date	
US 93 RP: 50.0-52.0	Roadway name	
5-lane Roadway	Description	
65	Current speed limit (mph)	
A5-Seg-04	Notes	

Analysis Results	
Speed limit setting group	Undeveloped
Suggested speed limit (mph)	**65**

Speed Data	
65	Maximum speed limit (mph)
72	85th-percentile speed (mph)
66	50th-percentile speed (mph)

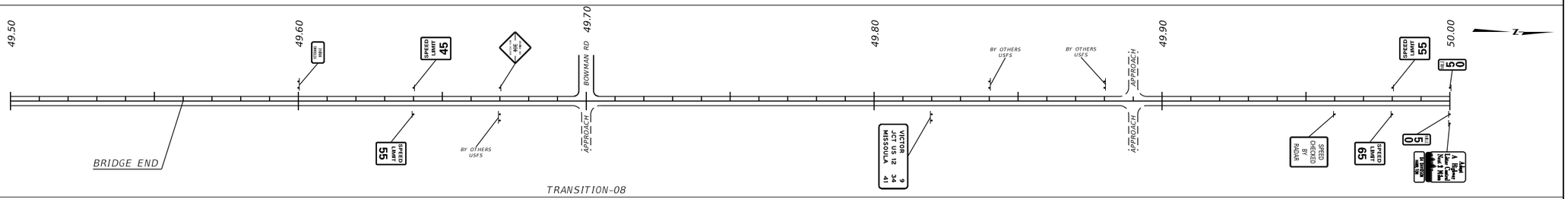
Site Characteristics	
2	Segment length (mi)
17,500	AADT (two-way total) (veh/d)
5	Number of lanes (two-way total)
Undivided	Median type
32	Number of access points (total of both directions)
12	Lane width (ft)
10	Shoulder width (ft)
No	Adverse alignment present?

Crash Data		
5	Number of years of crash data	
14,800	Average AADT for crash data period (veh/d)	
48	All (KABCO) crashes for crash data period	
21	Fatal & injury (KABC) crashes for crash data period	
	Average KABCO crash rate (crashes / 100 MVMT)	
	Average KABC crash rate (crashes / 100 MVMT)	
	1.3 x average KABCO crash rate (crashes / 100 MVMT)	161.9
	1.3 x average KABC crash rate (crashes / 100 MVMT)	53.5
	Critical KABCO crash rate (crashes / 100 MVMT)	150.4
	Critical KABC crash rate (crashes / 100 MVMT)	56.4

APPENDIX II – STRAIGHT-LINE DIAGRAMS

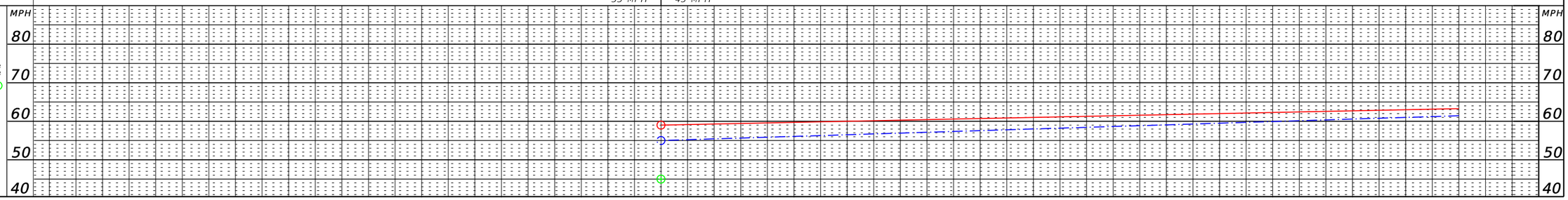
Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY
HAMILTON
Location TO MISSOULA
County RAVALLI/MISSOULA
Roadway C000007 (US 93)
RP from 49.50 to 59.10
Scale 1 UNIT = 0.10 MILES
Date JANUARY 2023



	NB	SB
Roadway Width	80-FEET	
Number of Striped Lanes	4	
Type of Divider	UNDIVIDED	
Average Daily Traffic	17,900	
Direction		
Number of Vehicles	8,800 VEH	9,100 VEH
85th Percentile	59 MPH	60 MPH
50th Percentile	50 MPH	53 MPH
10 MPH Pace (% in Pace)	45-55 MPH (45%)	49-59 MPH (60%)
Existing Speed Zone	55 MPH	45 MPH

SPEED PROFILE

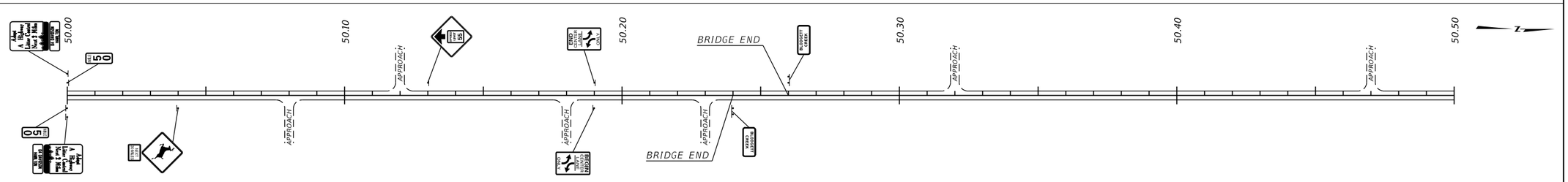


LEGEND
Road Signs
85th Percentile NB SB
Lower Limit of Pace

Remarks:

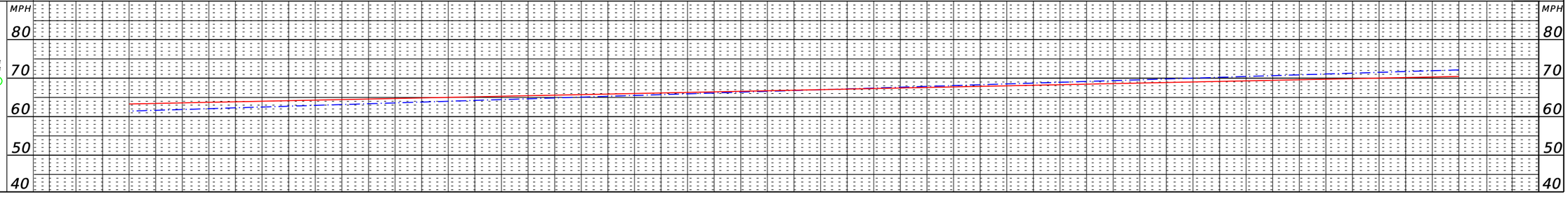
Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY
HAMILTON
Location TO MISSOULA
County RAVALLI/MISSOULA
Roadway C000007 (US 93)
RP from 49.50 to 59.10
Scale 1 UNIT = 0.10 MILES
Date JANUARY 2023



Roadway Width	
Number of Striped Lanes	
Type of Divider	
Average Daily Traffic	
Direction	
Number of Vehicles	
85th Percentile	
50th Percentile	
10 MPH Pace (% in Pace)	
Existing Speed Zone	

SPEED PROFILE

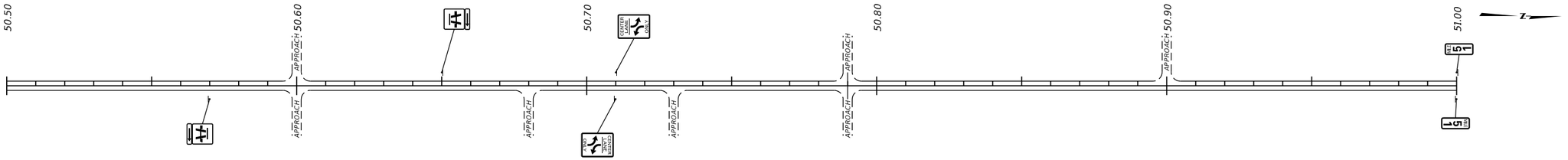


LEGEND
Road Signs
85th Percentile NB SB
Lower Limit of Pace

Remarks:

Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY
HAMILTON
Location TO MISSOULA
County RAVALLI/MISSOULA
Roadway C000007 (US 93)
RP from 49.50 to 59.10
Scale 1 UNIT = 0.10 MILES
Date JANUARY 2023



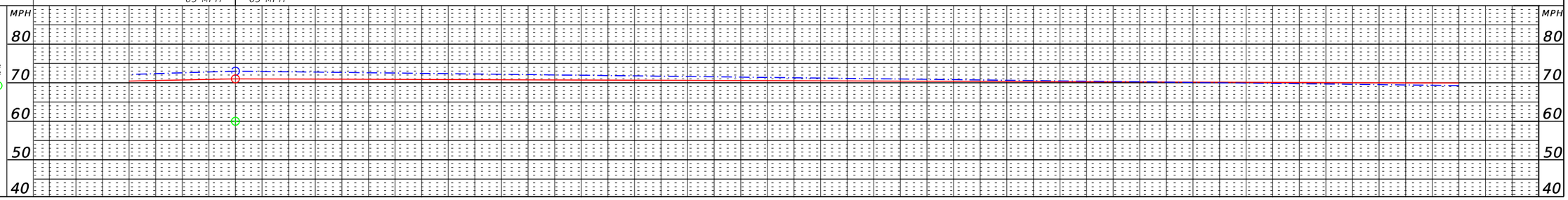
SEGMENT-04

Roadway Width	84-FEET	
Number of Striped Lanes	4	
Type of Divider	TWLTL	
Average Daily Traffic	17,500	
Direction	NB	SB
Number of Vehicles	8,700 VEH	8,800 VEH
85th Percentile	71 MPH	73 MPH
50th Percentile	67 MPH	65 MPH
10 MPH Pace (% in Pace)	63-73 MPH (71%)	60-70 MPH (54%)
Existing Speed Zone	65 MPH	65 MPH

SPEED PROFILE

LEGEND
Road Signs
85th Percentile NB SB
Lower Limit of Pace

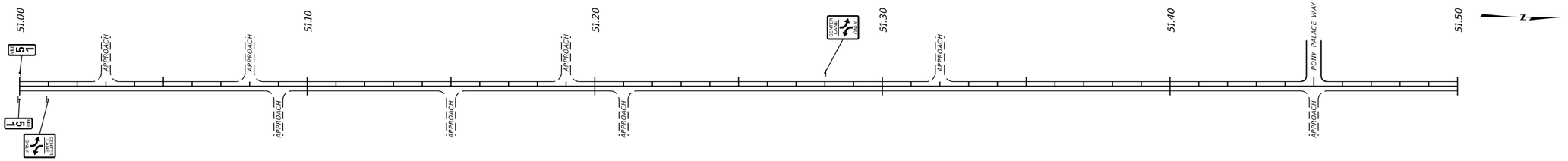
Remarks:



Sheet 3 of 11

Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY
HAMILTON
Location TO MISSOULA
County RAVALLI/MISSOULA
Roadway C000007 (US 93)
RP from 49.50 to 59.10
Scale 1 UNIT = 0.10 MILES
Date JANUARY 2023



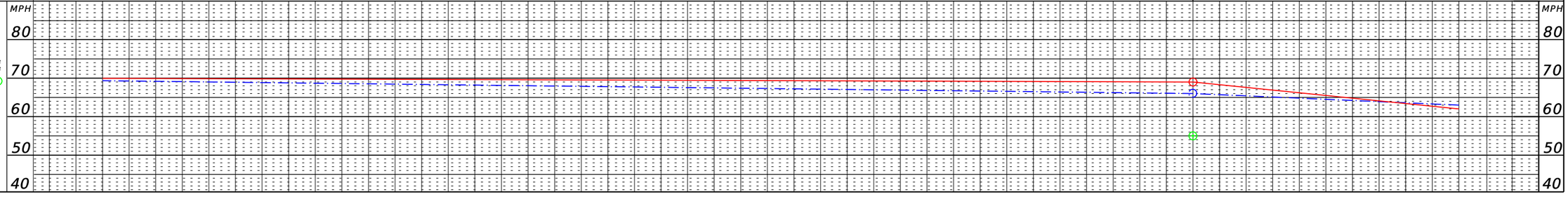
TRANSITION-07

Roadway Width	70-FEET	
Number of Striped Lanes	4	
Type of Divider	UNDIVIDED	
Average Daily Traffic	17,300	
Direction	NB	SB
Number of Vehicles	8,600 VEH	8,700 VEH
85th Percentile	69 MPH	66 MPH
50th Percentile	64 MPH	60 MPH
10 MPH Pace (% in Pace)	59-69 MPH (67%)	55-65 MPH (65%)
Existing Speed Zone	65 MPH	55 MPH

SPEED PROFILE

LEGEND
Road Signs
85th Percentile NB SB
Lower Limit of Pace

Remarks:



Sheet 4 of 11

Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY

HAMILTON

Location TO MISSOULA

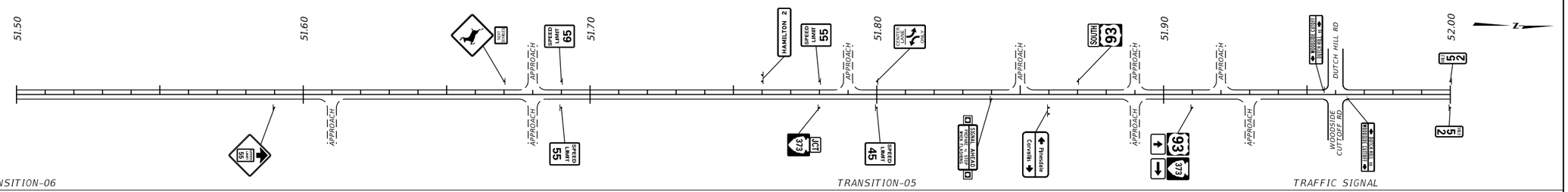
County RAVALLI/MISSOULA

Roadway C000007 (US 93)

RP from 49.50 to 59.10

Scale 1 UNIT = 0.10 MILES

Date JANUARY 2023



Roadway Width	86-FEET	86-FEET
Number of Striped Lanes	4	4
Type of Divider	TWLTL	TWLTL
Average Daily Traffic	16,500	17,000
Direction	NB / SB	NB / SB
Number of Vehicles	8,800 VEH / 7,700 VEH	8,400 VEH / 8,600 VEH
85th Percentile	62 MPH / 63 MPH	56 MPH / 57 MPH
50th Percentile	56 MPH / 57 MPH	50 MPH / 51 MPH
10 MPH Pace (% in Pace)	52-62 MPH (66%) / 52-62 MPH (60%)	46-56 MPH (57%) / 47-57 MPH (58%)
Existing Speed Zone	55 MPH / 65 MPH	45 MPH / 55 MPH

SPEED PROFILE

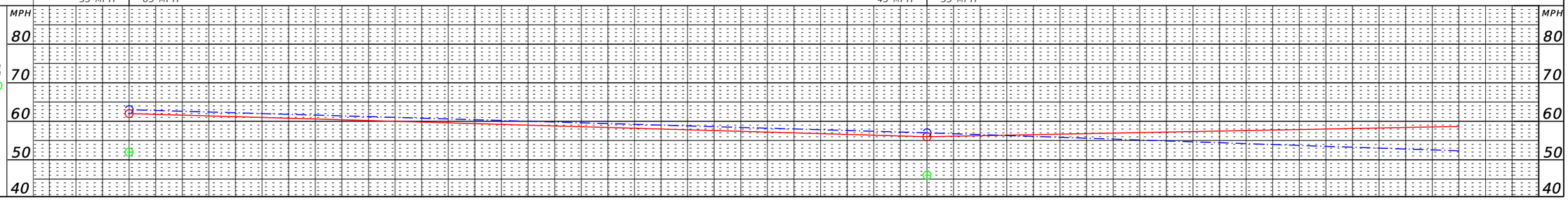
LEGEND

Road Signs

85th Percentile NB SB

Lower Limit of Pace

Remarks:



Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY

HAMILTON

Location TO MISSOULA

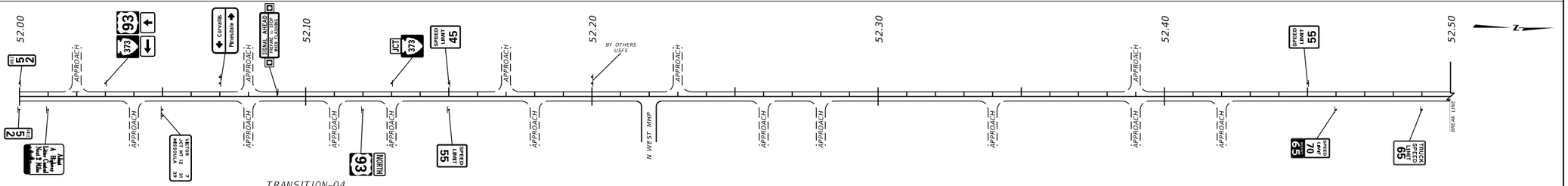
County RAVALLI/MISSOULA

Roadway C000007 (US 93)

RP from 49.50 to 59.10

Scale 1 UNIT = 0.10 MILES

Date JANUARY 2023



Roadway Width	86-FEET	
Number of Striped Lanes	4	
Type of Divider	TWLTL	
Average Daily Traffic	16,100	
Direction	NB	SB
Number of Vehicles	7,800 VEH	8,300 VEH
85th Percentile	60 MPH	50 MPH
50th Percentile	53 MPH	45 MPH
10 MPH Pace (% in Pace)	49-59 MPH (59%)	41-51 MPH (69%)
Existing Speed Zone	55 MPH	45 MPH

SPEED PROFILE

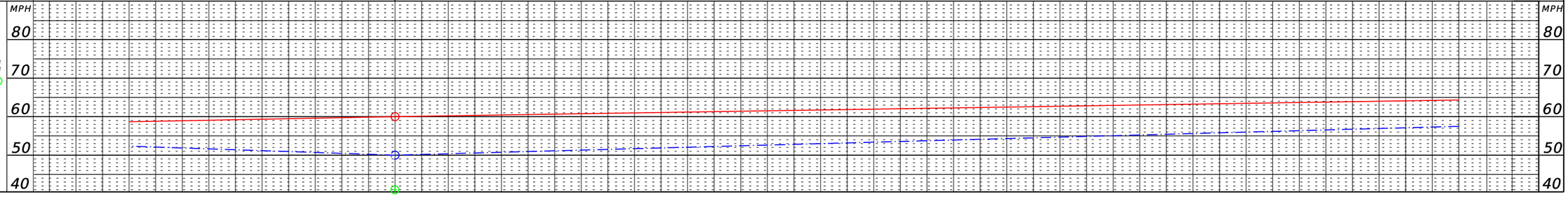
LEGEND

Road Signs

85th Percentile NB SB

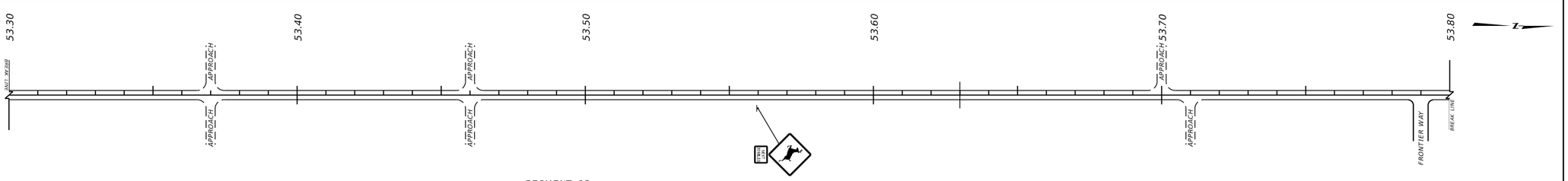
Lower Limit of Pace

Remarks:



Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY
HAMILTON
Location TO MISSOULA
County RAVALLI/MISSOULA
Roadway C000007 (US 93)
RP from 49.50 to 59.10
Scale 1 UNIT = 0.10 MILES
Date JANUARY 2023

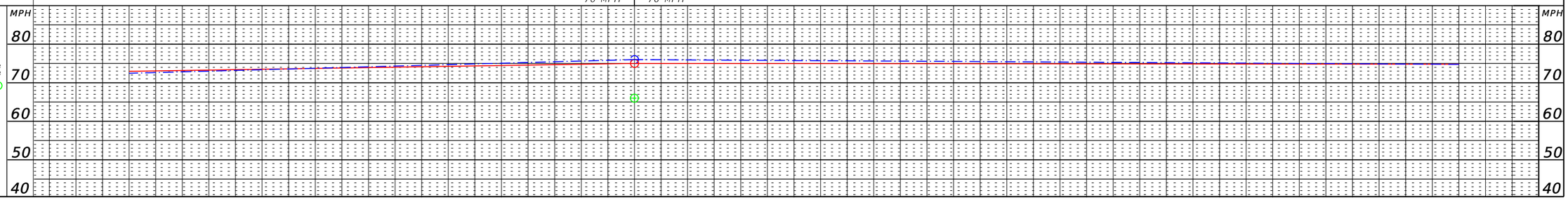


SEGMENT-03

Roadway Width	76-FEET	
Number of Striped Lanes	4	
Type of Divider	UNDIVIDED	
Average Daily Traffic	14,900	
Direction	NB	SB
Number of Vehicles	7,500 VEH	7,400 VEH
85th Percentile	75 MPH	76 MPH
50th Percentile	69 MPH	70 MPH
10 MPH Pace (% in Pace)	66-76 MPH (55%)	66-76 MPH (59%)
Existing Speed Zone	70 MPH	70 MPH

SPEED PROFILE

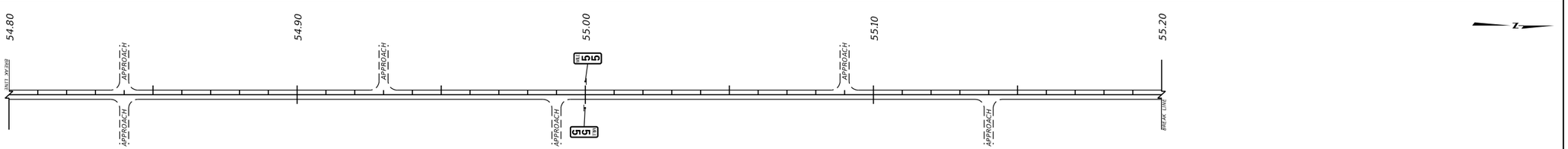
LEGEND
Road Signs
85th Percentile NB SB
Lower Limit of Pace



Remarks:

Construction Project Number	N/A
Curves/Grades	

SPEED ZONE SURVEY
HAMILTON
Location TO MISSOULA
County RAVALLI/MISSOULA
Roadway C000007 (US 93)
RP from 49.50 to 59.10
Scale 1 UNIT = 0.10 MILES
Date JANUARY 2023

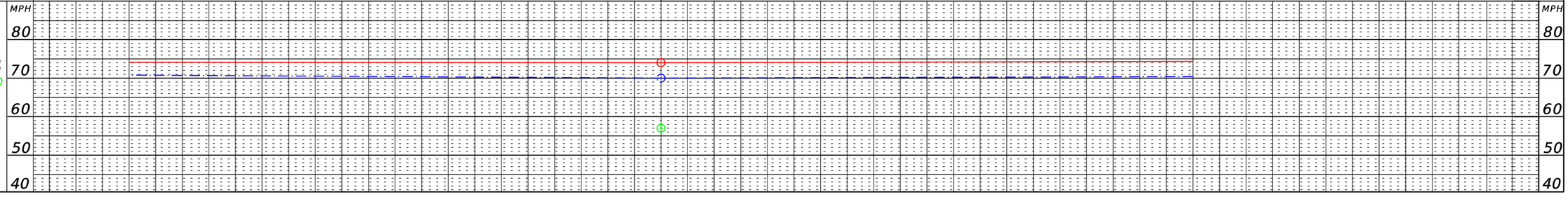


SEGMENT-02

Roadway Width	70-FEET	
Number of Striped Lanes	4	
Type of Divider	UNDIVIDED	
Average Daily Traffic	14,800	
Direction	NB	SB
Number of Vehicles	7,300 VEH	7,500 VEH
85th Percentile	74 MPH	70 MPH
50th Percentile	64 MPH	62 MPH
10 MPH Pace (% in Pace)	58-68 MPH (52%)	57-67 MPH (58%)
Existing Speed Zone	70 MPH	70 MPH

SPEED PROFILE

LEGEND
Road Signs
85th Percentile NB SB
Lower Limit of Pace



Remarks:

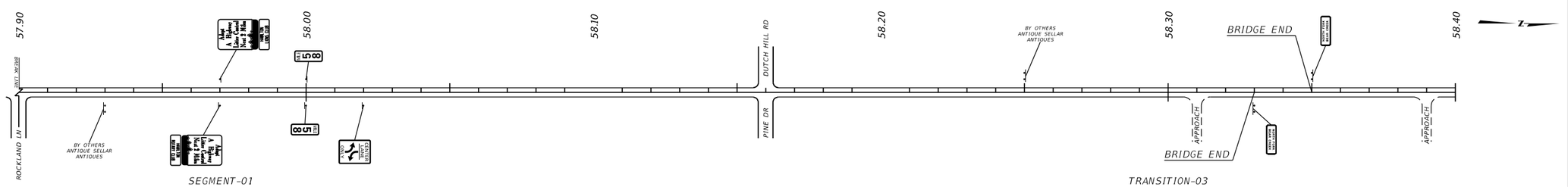
Construction Project Number	N/A
Curves/Grades	

KLJ

SPEED ZONE SURVEY

HAMILTON

Location TO MISSOULA
County RAVALLI/MISSOULA
Roadway C000007 (US 93)
RP from 49.50 to 59.10
Scale 1 UNIT = 0.10 MILES
Date JANUARY 2023

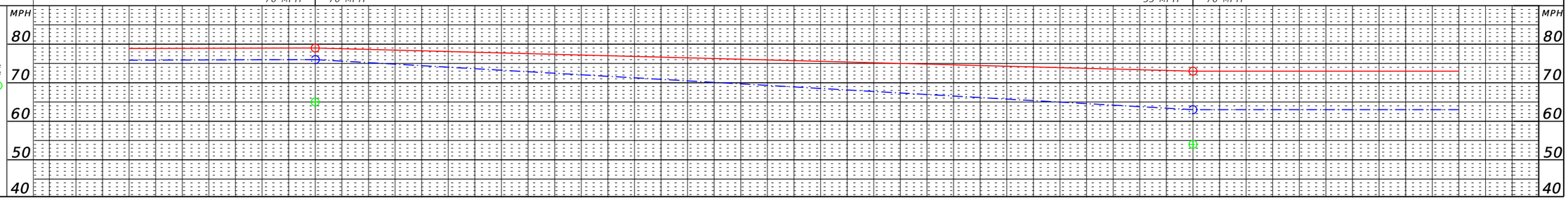


	SEGMENT-01		TRANSITION-03	
Roadway Width	86-FEET		86-FEET	
Number of Striped Lanes	4		4	
Type of Divider	TWLTL		TWLTL	
Average Daily Traffic	13,200		16,200	
Direction	NB	SB	NB	SB
Number of Vehicles	6,100 VEH	7,100 VEH	8,100 VEH	8,100 VEH
85th Percentile	79 MPH	76 MPH	73 MPH	63 MPH
50th Percentile	70 MPH	70 MPH	59 MPH	61 MPH
10 MPH Pace (% in Pace)	65-75 MPH (44%)	65-75 MPH (55%)	54-64 MPH (61%)	56-66 MPH (59%)
Existing Speed Zone	70 MPH	70 MPH	55 MPH	70 MPH

SPEED PROFILE

LEGEND
Road Signs
85th Percentile NB SB
Lower Limit of Pace

Remarks:



Sheet 9 of 11

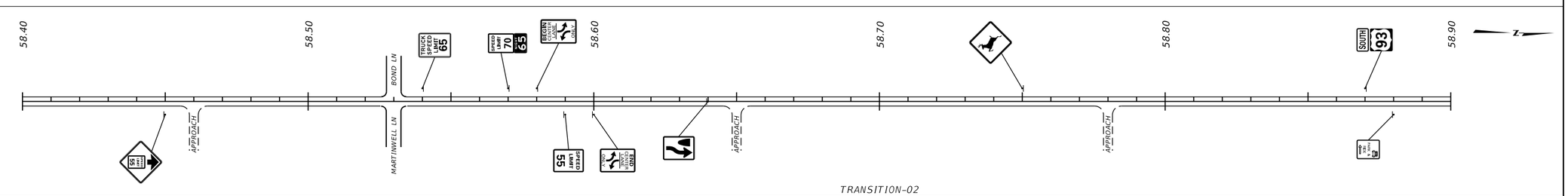
Construction Project Number	N/A
Curves/Grades	

KLJ

SPEED ZONE SURVEY

HAMILTON

Location TO MISSOULA
County RAVALLI/MISSOULA
Roadway C000007 (US 93)
RP from 49.50 to 59.10
Scale 1 UNIT = 0.10 MILES
Date JANUARY 2023

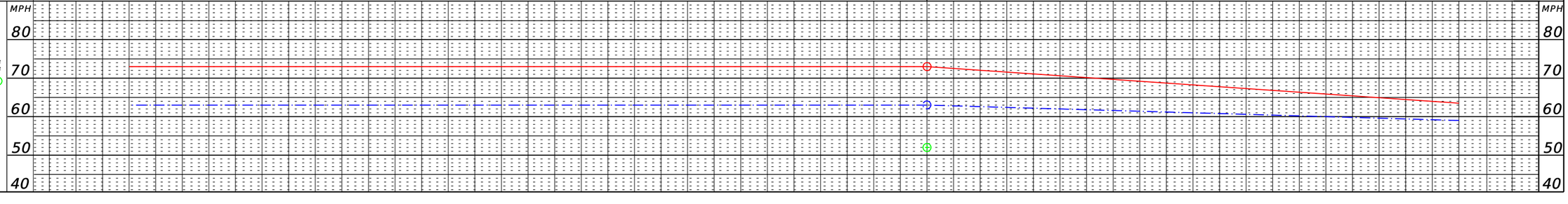


	TRANSITION-02	
Roadway Width	86-FEET	
Number of Striped Lanes	4	
Type of Divider	TWLTL	
Average Daily Traffic	14,400	
Direction	NB	SB
Number of Vehicles	7,300 VEH	7,100 VEH
85th Percentile	73 MPH	63 MPH
50th Percentile	64 MPH	57 MPH
10 MPH Pace (% in Pace)	58-68 MPH (48%)	52-62 MPH (62%)
Existing Speed Zone	55 MPH	70 MPH/65 MPH TRUCKS

SPEED PROFILE

LEGEND
Road Signs
85th Percentile NB SB
Lower Limit of Pace

Remarks:

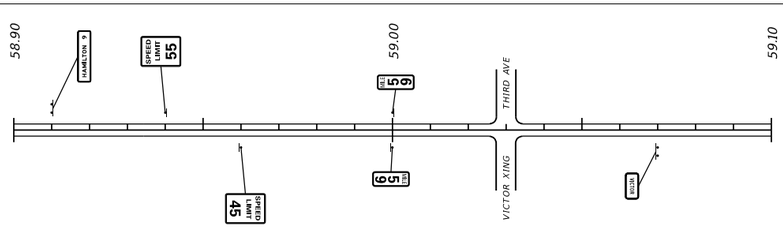


Sheet 10 of 11

Construction Project Number	N/A
Curves/Grades	

KLJ

SPEED ZONE SURVEY
HAMILTON
Location TO MISSOULA
County RAVALLI/MISSOULA
Roadway C000007 (US 93)
RP from 49.50 to 59.10
Scale 1 UNIT = 0.10 MILES
Date JANUARY 2023



TRANSITION-01

Roadway Width	86-FEET	
Number of Striped Lanes	4	
Type of Divider	TWLTL	
Average Daily Traffic	14,200	
Direction	NB	SB
Number of Vehicles	7,100 VEH	7,100 VEH
85th Percentile	54 MPH	55 MPH
50th Percentile	48 MPH	50 MPH
10 MPH Pace (% in Pace)	44-54 MPH (65%)	46-56 MPH (68%)
Existing Speed Zone	45 MPH	55 MPH

SPEED PROFILE

LEGEND
Road Signs
85th Percentile NB SB
Lower Limit of Pace

Remarks:

Sheet 11 of 11