# Appendix A
# Crash Analysis

## Traffic Crash Data Analysis (February 2014)

## Project Safety Analysis (January 2018)

STERLING
HIGHWAY MILE POST 45 TO 60
ALASKA

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# Appendix A
# Crash Analysis:

# Traffic Crash Data Analysis, February 2014

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# Appendix A
# Traffic Crash Data Analysis

STERLING
HIGHWAY MILE POST 45 TO 60
ALASKA

***Prepared for:***

**State of Alaska**
**Department of Transportation and**
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**February 2014**

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# SECTION 1 INTRODUCTION

## 1.1 Overview

This report analyzes Alaska Department of Transportation & Facilities (DOT&PF) crash data for milepost (MP) 45 to 60 of the Sterling Highway (Study Area). A map of the Study Area is provided in Appendix A. This report provides technical support for the Sterling Highway Milepost 45 to 60 Supplemental Environmental Impact Statement (SEIS) that is currently being prepared by the DOT&PF.

## 1.2 Crash Analysis Data and Methodology

Crash analysis was performed through evaluation of historical crash data (2000–2009) for MP 45 to 60 of the Sterling Highway, and comparing the Study Area crash evaluation to the State as a whole. A qualitative analysis is also provided relative to other stretches of the Sterling Highway. These data were used to assess the relative crash rate, identify locations with the highest concentration of crashes, ascertain which crash types are most common, and determine the major factors causing crashes within the Study Area (Sterling Highway MP 45 to 60).

Crash data for the Study Area, the entire Sterling Highway, and statewide was obtained from DOT&PF for the most recently available 10 year period (January 2000 through December 2009). The crash data included crash location and severity, in addition to other crash characteristics such as the cause of the crash and roadway conditions. Average daily traffic within the Sterling Highway Study Area was taken from the DOT&PF Central Region Annual Traffic Volume Report for 2000 to 2009, which represents an average of four locations within the Study Area, and moose-vehicle collision data were provided by the DOT&PF.

# SECTION 2 STUDY AREA CRASH DATA

This section of the report provides the crash data, including crash rate, seasonal crash rate, and crash injury severity, for the Study Area (Sterling Highway MP 45 to 60).

## 2.1 Crash Rate Description

The crash rate of a roadway segment is determined by calculating how many crashes exist per million vehicles per mile within the corridor (CPMVM). To calculate the CPMVM, the following information was used: the number of vehicles that use the highway on an average day, the length of the corridor, the number of days during the study period, and the number of crashes that have occurred during the study period. The formula for computing the crash rate on a roadway segment is as follows:

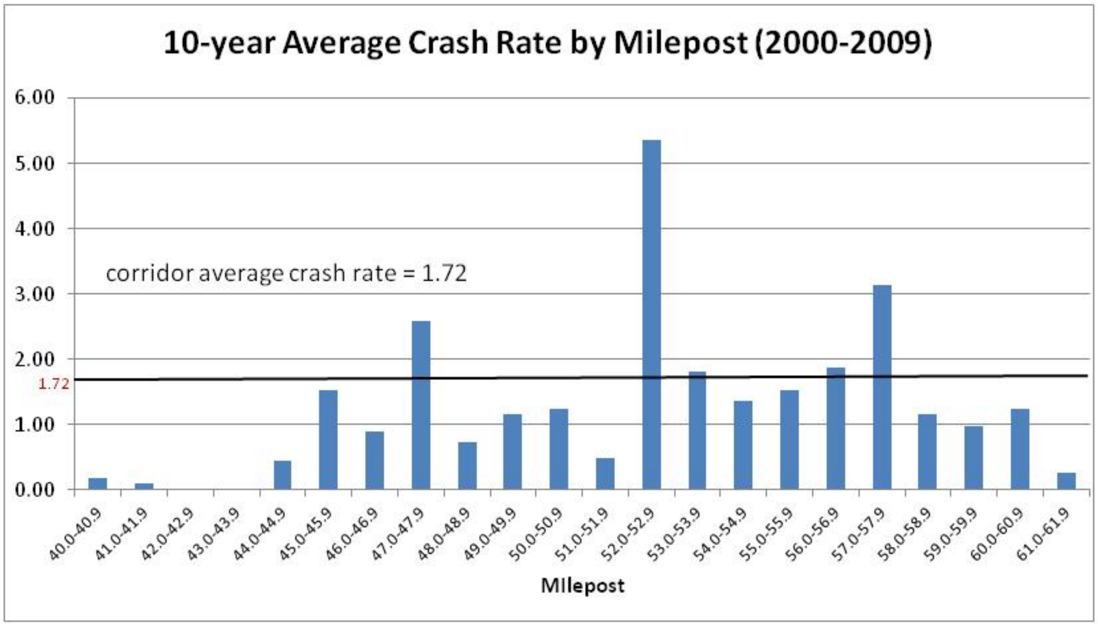
$$\frac{\text{(Total Crashes Within the Study Period)} \times \text{(1,000,000 Vehicle Miles)}}{\text{(Number of Days in Study Period)} \times \text{(Distance of Corridor in Miles)} \times \text{(Average Daily Traffic)}}$$

The CPMVM was calculated using crash data from January 1, 2000 to December 31, 2009. To determine the CPMVM, the number of crashes during the study period was multiplied by one million vehicle miles and then divided by the: number of days in the study period, the distance of the corridor, and the average daily traffic.

### 2.2 Study Area Crash Rate

Within the 15-mile Study Area, 303 crashes occurred between January 1, 2000 and December 31, 2009. The average daily traffic (ADT) on the Sterling Highway during that period was 3,220 vehicles per day.[1] Based on this information, the average crash rate for the corridor was determined to be 1.72 CPMVM. For comparison, the statewide average crash rate for rural primary highways is 1.80. Figure 1 illustrates the 10-year Average Crash Rate by Milepost. Note that the crash rates shown by milepost may not be indicative of where problem areas actually exist within the Study Area.

**Figure 1. Study Area Crash Rate per Milepost from January 2000 to December 2009**




### 2.3 Study Area Seasonal Crash Rate

Crash occurrences on a roadway can vary greatly depending on the season. Although the crash rate computed for the entire year is the measure that is primarily used in this report, it is important to note the crash rate for both the winter and summer seasons in order to understand and address the whole crash potential for the roadway.

For this traffic safety analysis, winter was considered to be the five-month period between November and March, while summer was considered to be the seven-month period between April and October. Between January 1, 2000 and December 31, 2009, there was a winter ADT of 1,635 vehicles and a summer ADT of 4,353 vehicles. The winter and summer crash totals for the Study Area over the 10-year period were 153 and 150 crashes, respectively (Table 1). Although there was less traffic between November and March, there tended to be more crashes during the winter months, when snow and ice were likely present and darkness more prevalent.

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[1] The average daily traffic (ADT) used to compute the accident rate was taken from the Alaska DOT Central Region Annual Traffic Volume Report for 2000 to 2009. This figure represents the average ADT for four locations within the Study Area.

**Table 1. Study Area Seasonal Crash Rate**

| Season | Crash Rate (CPMVM) |
|---|---|
| Winter (Nov. – Mar.) | 4.13 |
| Summer (Apr. – Oct.) | 1.07 |

## 2.4 Study Area Crash Injury Severity (Year-round)

Table 2 (and Appendix B: Table 1) shows the general severity of crashes and the number of different injury types experienced across the Study Area between 2000 and 2009.

**Table 2. Study Area Crash and Personal Injury Summary from January 2000 to December 2009**

| | Crashes | | | | Crash Rate[a] | Statewide Average Rate[b] | Percent above/below the Statewide Average |
|---|---|---|---|---|---|---|---|
| | Fatal | Injury | Property Damage Only | Total | | | |
| Segment 1 (MP 44.5 - 46.59) | 0 | 16 | 18 | 34 | 1.53 | 1.80 | -17.6% |
| Segment 2 (MP 46.6 - 47.79) | 1 | 4 | 19 | 24 | 1.38 | 1.80 | -30.4% |
| Segment 3 (MP 47.8 - 49.39) | 1 | 11 | 11 | 23 | 1.31 | 1.80 | -37.4% |
| Segment 4 (MP 49.40 - 51.29) | 1 | 9 | 18 | 28 | 1.25 | 1.80 | -44.0% |
| Segment 5 (MP 51.3 - 55.09) | 1 | 34 | 75 | 110 | 2.46 | 1.80 | +26.8% |
| Segment 6 (MP 55.1 – 58.2) | 0 | 27 | 50 | 77 | 2.38 | 1.80 | +24.7% |
| **Total** | **4** | **101** | **191** | **296** | | | |

*Notes:*

[a] *The crash rate is the number of crashes per million vehicle miles.*

[b] *The Statewide average rate is for rural primary highways.*

*Source: 2009 Alaska Traffic Crashes, June 2012, Alaska Department of Transportation and Public Facilities*
*http://www.dot.alaska.gov/stwdplng/transdata/pub/accidents/2009_AK_CrashData.pdf*
*From Figure 50, the "rural other principal arterial" statewide crash rate is 1.80.*

Crashes where a fatality was involved require additional investigation to identify conditions that could be rectified to improve safety. There were five fatal crashes that occurred within the Study Area between 2000 and 2009. Appendix B: Table 3 describes each fatality in more detail. Of the five fatal crashes, four were head-on crashes and one was a fixed-object crash.

- **Causes of the Fatal Head-On Crashes:** Two of the head-on crashes were caused by the driver being under influence of alcohol, with one driving at an unsafe speed and the other driving on the wrong side of road. The third head-on crash was caused by a driver who fell asleep behind the wheel, and the fourth was caused by a driver speeding during snow conditions. Therefore, all of the four fatal, head-on crashes were the result of driver behavior.
- **Causes of the Fatal Fixed-Object Crash:** The other fatal crash in the Study Area was a fixed-object crash. This crash, also the result of the driver being under the influence of alcohol and driving at an unsafe speed. The vehicle, traveling above the speed limit, overturned, and crashed into the culvert on the roadway shoulder.

## SECTION 3 ANALYSIS OF CRASH RATES, LOCATIONS, AND TYPES

This section presents an analysis of crash data for the Study Area. The purpose of Section 3 is to reveal trends, provide comparisons, and understand current crash data for MP 45 to 60.

### 3.1 Crash Rate by Milepost

There were three locations that had a much higher crash rate than the Study Area average. Table 3 provides the CPMVM from 2000 to 2009 for three milepost segments of the Study Area that had the highest concentration of crashes. Note that the crash rates for these mileposts may not be indicative of where problem areas actually exist within the Study Area. These three segments will be analyzed in further detail. See Appendix B: Table 1 for more information. A description of each milepost segment is provided below. For comparison, the CPMVM for MP 37- 45 is also provided in Table 3.

**Table 3. Top Study Area and Adjacent Segment Crash Locations (2000-2009)**

| MP | Average Crash Rate (CPMVM) |
|---|---|
| 47.0-47.9 | 2.58 |
| 52.0-52.9 | 5.35 |
| 57.0-57.9 | 3.13 |
| **Total (45-60)** | **1.72** |
| **MP 37-45** | **1.15** |

- MP 47.0 – 47.9 – This segment includes the Cooper Landing Visitor Cabin (MP 47.6), Bean Creek Road (47.7), and Snug Harbor Road (47.9), all of which include intersections and are more heavily populated sections of the highway.
- MP 52.0 – 52.9 – This segment is from Gwin's Lodge and MP 52.9. Gwin's Lodge is comprised of 14 cabins, a restaurant, and a tackle shop. The lodge is the closest accommodation to a world-class fishing spot, the confluence of the Kenai River and Russian River. Although the lodge is a popular destination for locals and tourists alike, it is only open May through September. Only 29 percent of the crashes on this segment between 2000 and 2009 were during the lodge's open season. This implies that root cause of the high frequency of crashes at this

location goes beyond just the high traffic volume associated with operation of the lodge and may be more related to roadway geometry. The curve at MP 52 was upgraded in 2007 and 2008. As 2009 is the last year of the data set, there is not enough data to determine the overall effectiveness the upgrades have on crash reductions.

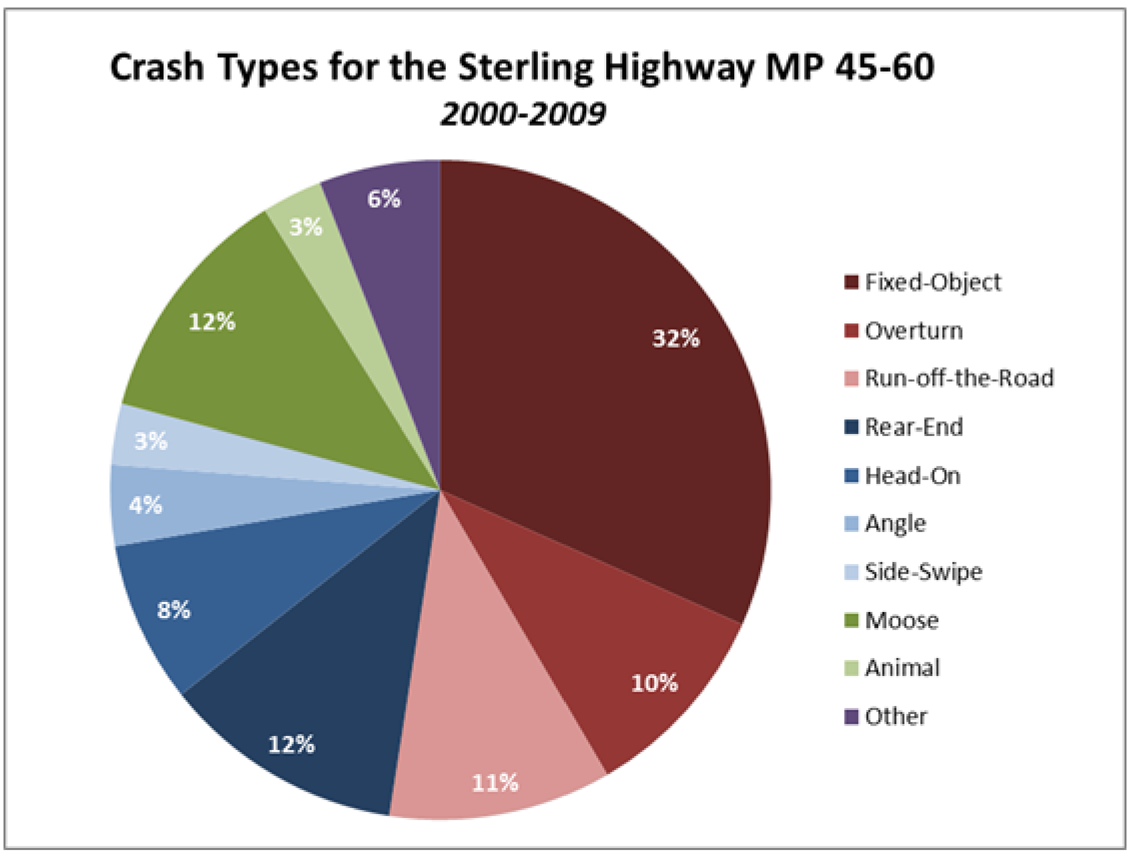
- MP 57 – 57.9 – This segment is from Fuller Lake Trail Head and MP 57.9. It is possible that the higher frequency of crashes at this location may be associated with more people wanting to stop, stay for extend periods of time, and park.

It is likely that the higher crash rates associated with these three Study Area segments are due in part to the fact that they are locations that draw more traffic, have more intersections, and promote stopping and prolonged stays. Further analysis of the crashes that occurred at these key locations is discussed in Section 3.4. It should be noted that this corridor received HSIP signing and delineation in 2007-2008. However, there has not been enough data collected after these improvements to provide any statistically relevant comparisons.

### 3.2 Study Area Crash Type

Between 2000 and 2009, there were a wide variety of crash types, such as: run-off-the-road and fixed-object (e.g. ditches, culverts, and embankments) crashes; head-on, rear-end, and angle collisions; and moose-related crashes (Appendix B: Table 2). Figure 2 illustrates the percentages of crash types within the Study Area during our analysis period. Further description of the common crash types is presented below.

**Figure 2. Crash type within the project area between 2000 and 2009**



### *3.2.1 Fixed-Object/ Overturn/Run-Off-The-Road Crashes*

**Summary:** The majority of corridor crashes involved fixed-objects, vehicle overturns, and vehicles running off of the road. Such crashes comprised 53 percent of the total crashes between 2000 and 2009 (Figure 2). Ditches and culverts were two of the most common fixed-objects involved in crashes, with nearly 20 percent of the total crashes in 2009 involving ditches and culverts.

The large percentage of crashes caused by ditches and culverts reflects the greater trend of non-traffic-lane crashes, whether it is cars running off the road or crashing into ditches, culverts, embankments, or guardrails (Figure 3). Of the 303 crashes that occurred within the project area between 2000 and 2009, 31 occurred on a shoulder, 21 occurred on the roadside, and 39 occurred outside of the traffic-way, in total comprising 30 percent of the total crashes.

**Cause:** Fixed-object/overturn/run-off-the-road crashes commonly result from drivers losing control. This is often the result of: road conditions, excessive speed, close proximity of roadside barriers to moving traffic, or avoidance of other traffic. Often, such crashes are the result of driver behavior or impairment (i.e., fatigue, illness, or under influence of alcohol). The following roadway conditions can contribute to the occurrence of such crashes within the Study Area: roadway design, pavement condition, narrow roadway shoulders, and proximity of guardrail barriers to the roadway. Fixed-object/overturn/run-off-the-road crashes that occurred at high crash locations within the Study Area are evaluated in Section 5 to identify the most relevant roadway conditions.

### *3.2.2 Vehicle Rear-End, Head-On, and Angle Crashes*

**Summary:** Vehicle rear-end, head-on, and angle crashes comprised 24 percent of the total crashes between 2000 and 2009. Only 15 percent of the total corridor crashes were congestion-related, and these were typically rear-end and sideswipe incidents. Within the Study Area, rear-end and sideswipe crashes represented 12 percent and three percent of the total crashes, respectively (AKDOT, MP 45-60, 2000-2009).

Head-on crashes comprised eight percent of the crashes in the Study Area between 2000 and 2009. While the percentage of head-on crashes is lower than other crash types, collision density maps from 2001-2008 (DOT&PF 2010) suggest that MP 45 to 58 is a high head-on crash location compared to other portions of the highway. Due to the fact that MP 45 to 58 maintained a rate of two or more head-on crashes per mile between 2001 and 2007, the State is concerned about the safety of this stretch of roadway. The AKDOT Central Region Traffic Department suggested that efforts be made to mitigate this crash type within the project corridor by using a variety of "Crash Modification Factors" (DOT&PF 2012). These efforts consist of installing 6-inch striping and narrower lanes in an effort to increase speed zone compliance.

**Cause:** Many of the vehicle rear-end, head-on, and angle crashes were the result of driver behavior or impairment (i.e., speeding, driver inattention, failure to yield, or improper lane change/passing). Of the 24 head-on crashes that occurred between 2000 and 2009, over 17 resulted from driver behavior or impairment. In addition, over eight of the 13 angles crashes that occurred in the Study Area were the result of driver behavior or impairment.

### *3.2.3 Moose-Related Crashes*

**Summary:** There were 36 moose-related crashes in the Study Area between 2000 and 2009, representing 12 percent of the total crashes. Moose pose a safety concern within the project area, especially if traffic demand increases over time. Table 4 summarizes data procured from the Central Region Department of the DOT&PF's Moose-Vehicle Collision Rankings 2001-2005 (the latest data available). The purpose of showing this data is to reveal highway segments close to the Study Area that have undergone mitigation as a result of their high frequency of moose-related collisions. Areas of roadway that are within the 95th percentile have may have undergone mitigation such as: off-site habitat/corridors, lighting, fencing, vegetation management, and at-grade warnings. Conversely, areas of roadway that are within the 75th percentile are may have undergone mitigation such as: improved brushing, vegetation management, signing, and winter trails (DOT&PF 2012). Mitigation for moose-related crashes is addressed on a case-by-case basis as funding allows.

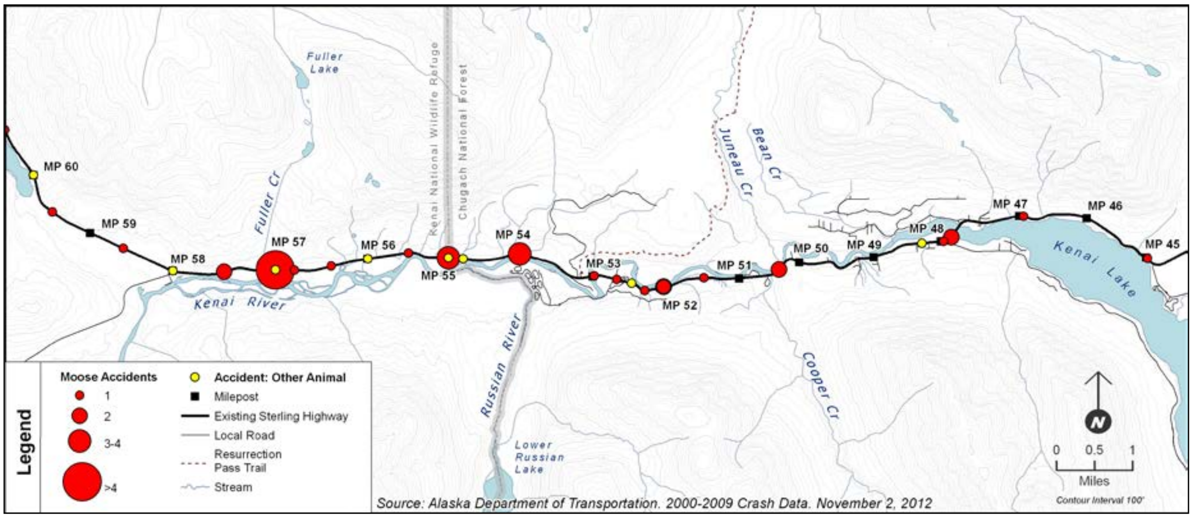
**Table 4. Moose-Vehicle Collision Rankings 2001-2005 & Distance from the Study Area[2]**

| Roadway MP | Threshold Used and Rank | Recorded Collisions per Year | Average Collisions per Mile per Year | Distance from Project Area |
|---|---|---|---|---|
| Sterling Hwy MP 67.3-74.6 | 75th Percentile #27 | 5.2 | 0.7 | ~7.3 miles |
| Sterling Hwy MP 83-118.4 | 75th Percentile #2 | 47.2 | 1.4 | ~23 miles |
| Sterling Hwy MP 87.8-93.3 | 95th Percentile #1 | 18.6 | 3.5 | ~30 miles |
| Sterling Hwy MP 116.4-118.2 | 95th Percentile #15 | 2.4 | 1.5 | ~57 miles |
| Sterling Hwy MP 123.1-134.1 | 75th Percentile #21 | 6.6 | 0.6 | ~63 miles |
| Sterling Hwy MP 128-129 | 95th Percentile #19 | 1.0 | 1.0 | ~68 miles |
| Sterling Hwy MP 133-134 | 95th Percentile #18 | 1.4 | 1.4 | ~73 miles |
| Sterling Hwy MP 163.3-164.8 | 75th Percentile #29 | 1.8 | 1.2 | ~103.3 miles |

A frequency of 8 crashes per mile per year places a stretch of roadway in the 75th percentile (under the threshold moose-vehicle collision values established in 1995, DOT&PF 12/5/03 Memo). Figure 4 shows the number of moose-related collisions between 2000 and 2009 that occurred within the Study Area (recorded to the nearest milepost). The mile segment with the highest number of crashes was MP 57 to 57.9, which experienced eight moose crashes between 2000 and 2009. The mile segment with the second highest number of crashes during that timeframe was MP 54 to 54.9, which experienced five crashes. While none of the one-mile segments within the Study Area currently fall within the 75th percentile, the correlation between the number of moose collisions and increases in traffic make it plausible that the threshold could be met in the future as traffic levels rise (Appendix C: Figure 2).

[2] The 75 percent and 95 percent thresholds are used to determine the level of mitigation suggested to reduce moose crashes. The numerical ranking of each stretch within the 75 percent and 95 percent threshold, respectively, is based upon crash density per mile and crash rate per million vehicle miles (CPMVM).

**Figure 3. Map showing the location and number of crashes involving moose within the Study Area between 2000 and 2009**




## 3.3 High Crash Locations

As presented in Section 3.3, the highest concentration of crashes occurred within segments MP 47.0 to 47.9, MP 52.0 to 52.9, and MP 57.0 to 57.9. Table 5 shows the number of each crash type that occurred at each high crash location.

**Table 5. High Crash Locations Crash Type Summary from January 2000 to December 2009**

| MP | Total Crashes | Fixed-Object/ Overturn/Run-Off-The- Road | Rear-End | Head-On | Angle | Side-Swipe | Animal/Moose | Other |
|---|---|---|---|---|---|---|---|---|
| **47.0-47.9** | **32** | 10 | 10 | 3 | 3 | 1 | 3 | 2 |
| **52.0-52.9** | **65** | 43 | 4 | 5 | 0 | 3 | 6 | 4 |
| **57.0-57.9** | **35** | 22 | 2 | 2 | 0 | 0 | 9 | 0 |

### *3.3.1 Analysis of MP 52.0 to 52.9*

MP 52.0 to 52.9 includes the location of Gwin's Lodge (MP 52.0) and Gwin's Corner (approximately MP 52.3). MP 52.0 to 52.9 experienced 65 crashes over the 10-year time period. At Gwin's Corner, the roadway makes a relatively sharp horizontal curve, resulting in a design speed that is lower than the posted speed limit on the approaching roadways (45 miles per hour).At MP 52, wig wag beacons and large warning signs were added in 2007-2008. At least 43 of the 65 crashes that occurred along this one-mile stretch of roadway (66 percent) occurred on a horizontal curve. Forty-three of the 65 crashes also involved vehicles losing control, leaving the roadway, or crashing into ditches, culverts, embankments, or guardrails. Crashes between vehicles (which include rear-end, head-on, and side-swipe crashes) represented 19 percent of the total crashes. In addition, crashes between vehicles and animals, such as moose, represented another nine percent of the crashes that occurred between MP 52.0 and 52.9

### *3.3.2 Analysis of MP 57.0 to 57.9*

MP 57.0 to 57.9, near the location of the Fuller Lake Trail Head, had the second highest crash rate. Thirty-five crashes occurred at this location between 2000 and 2009. At least 21 of the 35 crashes (60 percent) took place on a horizontal curve in the roadway. Twenty-seven of the 35 crashes (77 percent) occurred while snow or ice was present on the roadway or the pavement was wet. Twenty-two of the 35 crashes (63 percent) involved vehicles: losing control, leaving the roadway, or crashing into ditches, culverts, embankments, or guardrails. In addition, crashes that involved non-fixed objects, such as other vehicles or animals, represented another 26 percent of crashes within this section. There were two head-on crashes and two rear-end crashes that occurred over the 10-year period, representing 12 percent of the total number of crashes.

Along this stretch of the highway, the road has very narrow shoulders and a 6- to 8-inch drop-off from the edge of the pavement. Such a drop-off could cause a vehicle to roll when a driver is was taking corrective action or even pull a vehicle into the ditch once a tire is was off the pavement.

### *3.3.3 Analysis of MP 47.0 to 47.9*

The segment between MP 47.0 and Snug Harbor Road (MP 47.0 to 47.9) includes the Cooper Landing Visitor Cabin (MP 47.6), the Bean Creek Road intersection (MP 47.7), and Snug Harbor Road intersection (MP 47.9). Thirty-two crashes occurred on this segment over the 10-year period. Five crashes occurred at the Cooper Landing Visitor Cabin (MP 47.6), seven crashes occurred at the Bean Creek Road intersection (MP 47.7), and seven crashes occurred at the Snug Harbor Road intersection (MP 47.9). In total, 10 of the 32 crashes (31 percent) were rear-end crashes that occurred while cars were queued to make a left turn onto side streets. Another 31 percent of the crashes were fixed-object/overturn/run-off-the-road crashes that involved vehicles losing control, leaving the roadway, or crashing into ditches, culverts, embankments, or guardrails.

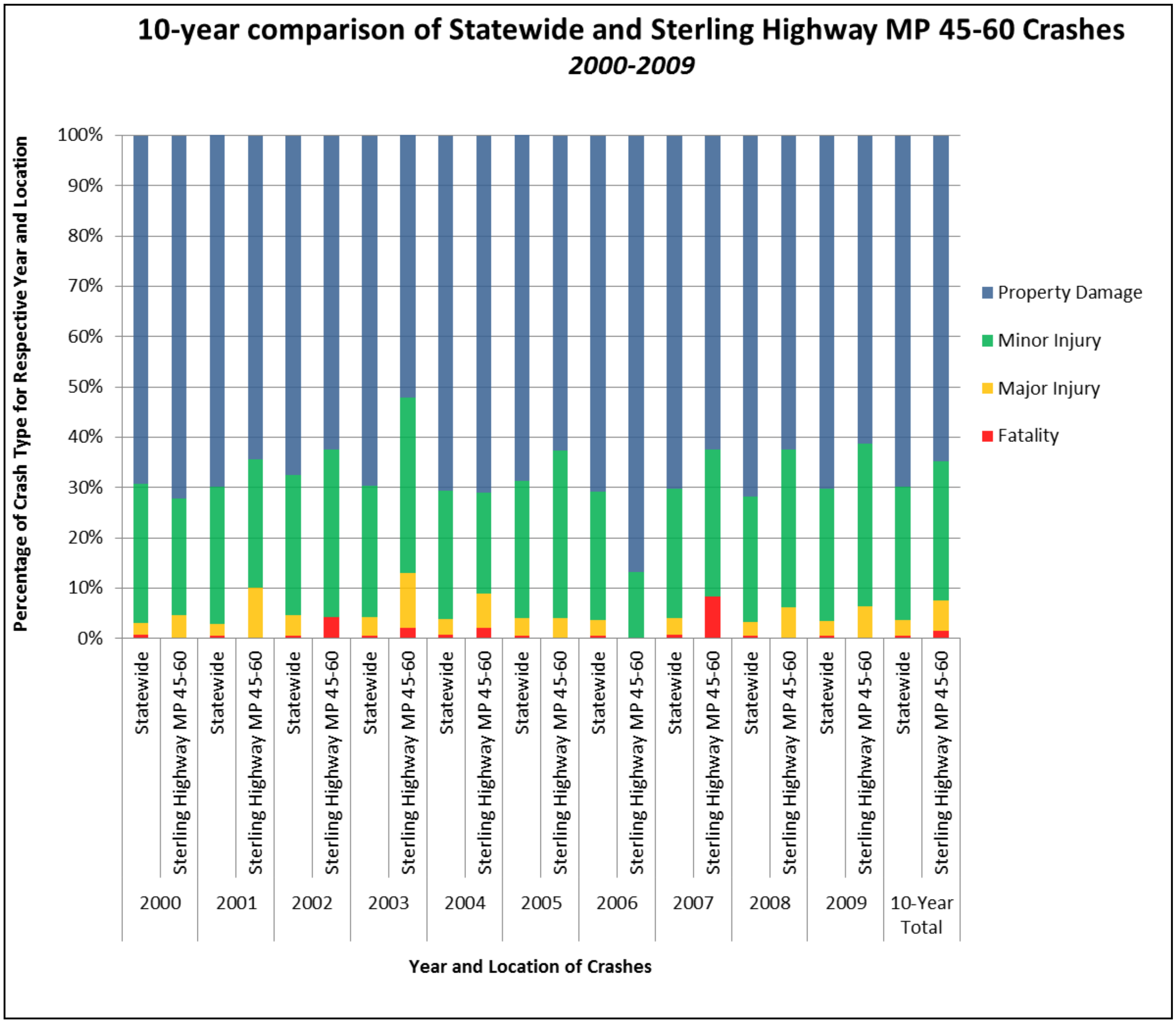
Four of the seven crashes located at the Bean Creek Road intersection (MP 47.7) were rear-end crashes that occurred while cars were queued to make a left turn onto Bean Creek Road. The two angle crashes that occurred were both the result of eastbound traffic trying to make a left turn onto Bean Creek Road. One of the angle crashes was caused by an eastbound, left-turn vehicle failing to yield to the through-traffic from the other direction. The other angle crash was the result of an eastbound, through-vehicle that improperly passed an eastbound-vehicle that was waiting to make a turn onto Bean Creek Road. The only head-on crash was caused by a driver speeding during snow conditions.

## 3.4 Comparison of Crash Severity within the Study Area, the Entire Sterling Highway, and Statewide[3]

Figure 4 shows that in addition to having more crashes per vehicle mile than the average state roadway, the crashes within the Study Area also tended to be slightly more severe, on average. Excluding the year 2006, MP 45 to 60 of the Sterling Highway had consistently fewer property damage and minor injury (non-incapacitating injury/possible injury) crashes and a higher proportion of major injury (incapacitating injury) and fatality crashes between 2000 and 2009. Also, during four of the ten years shown (2002, 2003, 2004, and 2007) the Study Area had a higher percentage of fatalities than the statewide average (Figure 4).

[3] It should be noted that the crash rate given for the entire state was based on crash data for all State-owned roadways, which includes a variety of road types.

**Figure 4. Comparison of the proportional severity of crashes statewide and within the project area**




## 3.5 Comparison of Unimproved and Improved Sections of the Sterling Highway

The Sterling Highway was originally constructed in the 1950s. Since then, few improvements have been made to update the road to meet current safety standards and to accommodate larger traffic volumes. The easternmost segment of the Sterling Highway (MP 37 to 45) was reconstructed approximately 12 years ago to improve the roadway geometry. Milepost segment 37 to 45 had similar roadway geometry to the existing conditions in the Study Area prior to the roadway improvements. As indicated in Section 3.1, the improved section of Sterling Highway MP 37 to 45 has a lower CPMVM (1.15) than the Study Area (1.72). While improved road conditions likely contribute to this difference, it is important to note that there are many other variables that also potentially play a role and that safety performance can vary according to the unique characteristics of each segment. For instance, MP 45 to 60 encompasses Cooper Landing and the higher number of driveways, side roads, and concentration of short trips that are associated with the community. While these conditions predispose the MP 45 to 60 segment to being less safe, updating the roadway to better accommodate such safety challenges has the potential to positively impact traffic safety within the Study Area.

## SECTION 4 SUMMARY OF FINDINGS

MP 45 to 60 was found to have more crashes per vehicle mile than the average state roadway. Although the Study Area had fewer crashes per MVM than other sections of the Sterling Highway, its year-round crash rate (1.72 CPMVM) and frequency of injuries (1.5 injuries per mile) was found to be higher than MP 37-45, which is an improved section of the highway.

Between 2000 and 2009, there were a wide variety of crash types, such as: run-off-the-road and fixed-object (e.g. ditches, culverts, and embankments) crashes; head-on, rear-end, and angle collisions; and moose-related crashes. The majority of crashes within the Study Area were fixed-object/overturn/run-off-the-road crashes, accounting for 53 percent of the crashes. Rear-end, head-on, and angle crashes accounted for 12, eight, and four percent of the crashes respectively, while 12 percent of crashes were moose-related.

Between 2000 and 2009, there were five fatal crashes, 20 major injury crashes, and 85 minor injury crashes that occurred within the Study Area. These resulted in five fatalities, 22 major injuries, and 137 minor injuries. Of the five fatal crashes, four were head-on crashes and one was a fixed-object crash. All five of the fatal crashes were the result of driver behavior (e.g. fatigue, under influence of alcohol, or speeding), and therefore none of them was necessarily preventable from a roadway design standpoint.

The highest concentration of crashes occurred within the following sections: MP 52.0 to 52.9, MP 57.0 to 57.9, and MP 47.0 to 47.9.

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# APPENDIX A

## MAP 1 STUDY AREA

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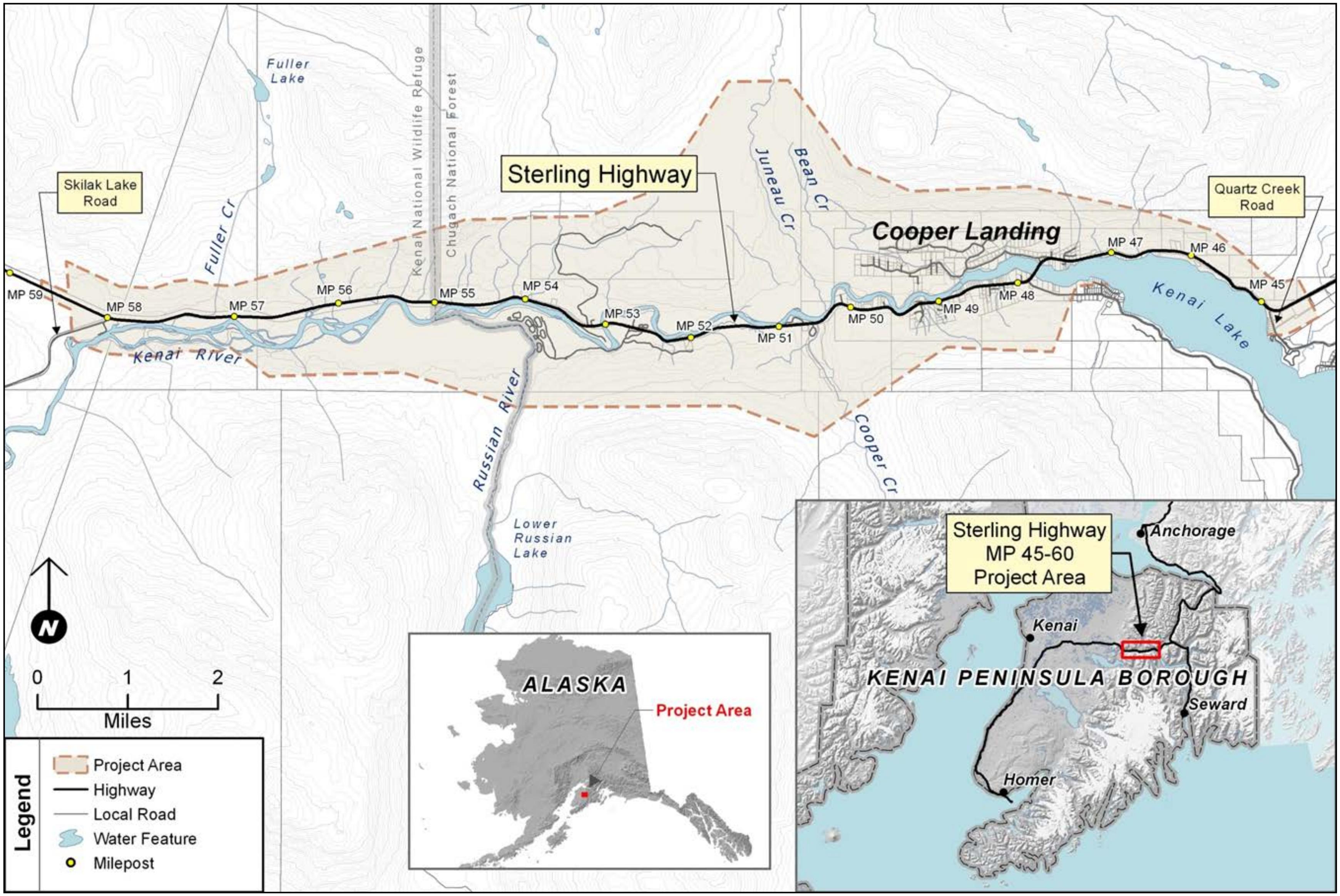


**Map 1. Study Area and Alternatives**

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## APPENDIX B: TABLES

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**Table 1. Sterling Highway Crash Summary per Milepost for the Past Ten Years**

| Crash Summary for Sterling Highway per Milepost from January 2000 to December 2009 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Total** | **Fatal** | | **Major** | | **Minor** | | **PDO** | **2000-2009** | |
| MP | Crashes | *# of crashes* | *# of fatalities* | *# of crashes* | *# of injuries* | *# of crashes* | *# of injuries* | *# of crashes* | *Average AADT* | *Average Crash Rate* |
| 40.0-40.9 | **2** | | | | | | | 2 | 3012 | 0.18 |
| 41.0-41.9 | **1** | | | | | | | 1 | 3012 | 0.09 |
| 42.0-42.9 | **0** | | | | | | | | 3012 | 0.00 |
| 43.0-43.9 | **0** | | | | | | | | 3012 | 0.00 |
| 44.0-44.9 | **5** | | | | | 1 | 1 | 4 | 3012 | 0.45 |
| 45.0-45.9 | **19** | | | 1 | 1 | 9 | 9 | 9 | 3403 | 1.53 |
| 46.0-46.9 | **11** | | | 1 | 1 | 4 | 6 | 6 | 3403 | 0.89 |
| **47.0-47.9** | **32** | 2 | 2 | 1 | 1 | 4 | 8 | 25 | 3403 | 2.58 |
| 48.0-48.9 | **9** | | | 2 | 2 | 4 | 6 | 3 | 3328 | 0.74 |
| 49.0-49.9 | **14** | | | 3 | 3 | 6 | 10 | 5 | 3328 | 1.15 |
| 50.0-50.9 | **15** | 1 | 1 | 1 | 1 | 1 | 1 | 12 | 3328 | 1.23 |
| 51.0-51.9 | **6** | | | | | 3 | 5 | 3 | 3328 | 0.49 |
| **52.0-52.9** | **65** | | | 1 | 1 | 18 | 27 | 46 | 3328 | 5.35 |
| 53.0-53.9 | **20** | 1 | 1 | 2 | 3 | 6 | 10 | 11 | 3027 | 1.81 |
| 54.0-54.9 | **15** | | | 2 | 2 | 2 | 4 | 11 | 3027 | 1.36 |

| Crash Summary for Sterling Highway per Milepost from January 2000 to December 2009 (cont'd.) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Total** | **Fatal** | | **Major** | | **Minor** | | **PDO** | **2000-2009** | |
| MP | Crashes | *# of crashes* | *# of fatalities* | *# of crashes* | *# of injuries* | *# of crashes* | *# of injuries* | *# of crashes* | *Average AADT* | *Average Crash Rate* |
| 55.0-55.9 | **17** | | | 2 | 2 | 1 | 6 | 14 | 3062 | 1.52 |
| 56.0-56.9 | **21** | | | | | 6 | 9 | 15 | 3062 | 1.88 |
| **57.0-57.9** | **35** | | | 1 | 1 | 16 | 24 | 18 | 3062 | 3.13 |
| 58.0-58.9 | **13** | | | 2 | 3 | 2 | 5 | 9 | 3090 | 1.15 |
| 59.0-59.9 | **11** | 1 | 1 | 1 | 1 | 3 | 7 | 6 | 3090 | 0.98 |
| 60.0-60.9 | **14** | | | | | 2 | 3 | 12 | 3090 | 1.24 |
| 61.0-61.9 | **3** | | | | | 1 | 1 | 2 | 3090 | 0.27 |
| **MP45-MP60 Total** | **303** | **5** | **5** | **20** | **22** | **85** | **137** | **193** | **3220** | **1.72** |

**Table 2. Sterling Highway Crash Type Summary per Milepost for the Past Ten Years**

**Crash Type Summary for Sterling Highway per Milepost from January 2000 to December 2009**

| MP | Total Crashes | Rear-Ends | Head On | Angles | Side-Swipe | Fixed Objects | Over Turn | Ran-off Road | Animal | Moose | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 40.0-40.9 | **2** | | | 1 | | | | | | 1 | |
| 41.0-41.9 | **1** | | | | | | | 1 | | | |
| 42.0-42.9 | **0** | | | | | | | | | | |
| 43.0-43.9 | **0** | | | | | | | | | | |
| 44.0-44.9 | **5** | | | | | 3 | 1 | | | | 1 |
| 45.0-45.9 | **19** | | | | 1 | 13 | 2 | 1 | | 1 | 1 |
| 46.0-46.9 | **11** | 1 | 1 | 2 | 1 | 3 | 2 | | | | 1 |
| 47.0-47.9 | **32** | 10 | 3 | 3 | 1 | 6 | 2 | 2 | | 3 | 2 |
| 48.0-48.9 | **9** | 2 | 1 | 1 | | 3 | | | 1 | 1 | |
| 49.0-49.9 | **14** | 3 | 1 | 1 | | 6 | | 3 | | | |
| 50.0-50.9 | **15** | 2 | 5 | | 2 | 2 | | 1 | | 2 | 1 |
| 51.0-51.9 | **6** | | | 1 | | 2 | | 2 | | 1 | |
| 52.0-52.9 | **65** | 4 | 5 | | 3 | 22 | 10 | 11 | 2 | 4 | 4 |
| 53.0-53.9 | **20** | 3 | 3 | | | 5 | 2 | 4 | | 1 | 2 |
| 54.0-54.9 | **15** | 2 | 1 | | | 3 | 1 | 2 | 1 | 5 | |
| 55.0-55.9 | **17** | 1 | | 1 | | 4 | 2 | 2 | 1 | 4 | 2 |
| 56.0-56.9 | **21** | 3 | | 2 | | 7 | 1 | 2 | 1 | 3 | 2 |

**Crash Type Summary for Sterling Highway per Milepost from January 2000 to December 2009**

| MP | Total Crashes | Rear-Ends | Head On | Angles | Side-Swipe | Fixed Objects | Over Turn | Ran-off Road | Animal | Moose | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 57.0-57.9 | **35** | 2 | 2 | | | 14 | 6 | 2 | 1 | 8 | |
| 58.0-58.9 | **13** | 2 | 1 | | | 4 | 1 | 1 | 1 | 2 | 1 |
| 59.0-59.9 | **11** | | 1 | 2 | | 4 | 1 | 1 | | 1 | 1 |
| 60.0-60.9 | **14** | | | 1 | | 7 | 2 | 1 | 1 | 1 | 1 |
| 61.0-61.9 | **3** | | | | | 2 | | | 1 | | |
| **MP45-MP60 Total** | **303** | **35** | **24** | **13** | **8** | **98** | **30** | **34** | **8** | **36** | **17** |
| **Crash Type Percentage** | **100%** | **12%** | **8%** | **4%** | **3%** | **32%** | **10%** | **11%** | **3%** | **12%** | **6%** |

**Table 3. Description of Fatal Crashes within the Study Area (2000-2009)**

| Fatal Crash # | Description |
|---|---|
| 1 | A head-on collision that took place at MP 47.7 on January 8, 2004 at the intersection of Sterling Highway and Bean Creek Road. It was on a roadway curve during daylight hours with snow on the pavement. This was caused by excessive driver speed during snow conditions. Vehicle 1 was moving too fast for conditions, lost traction, out of control and crashed head-on into vehicle 2, which was traveling in the opposite direction. This crash caused one fatality and one minor injury. |
| 2 | A fixed-object collision that took place at MP 47.9 on June 4, 2002 at the intersection of Sterling Highway and Snug Harbor Road. It was during twilight hours on the dry pavement. The police report stated the driver was under influence of alcohol and drove at an unsafe speed. The vehicle was moving too fast, overturned, out of control and crashed into the culvert on the roadway shoulder. This crash caused one fatality and one minor injury. |
| 3 | A head-on collision that took place at MP 50.5 on August 28, 2003. It was during daylight hours on the dry pavement. The driver in vehicle 1 fell asleep. Vehicle 1 was out of control and crashed head-on into vehicle 2, which was traveling in the opposite direction. This crash caused one fatality. |
| 4 | A head-on collision that took place at MP 53.5 on July 26, 2007. It was on a dark roadway curve without lightings on the dry pavement. The police report stated the driver was under influence of alcohol, drove on the wrong side of roadway, and crashed head-on into vehicle 2 which was traveling in the opposite direction. This crash caused one fatality and one major injury. |
| 5 | A head-on collision that took place at MP 59.5 on May 19, 2007. It was during daylight hours on dry pavement. The police report stated the driver was under influence of alcohol and drove at an unsafe speed. The vehicle was moving too fast, lost traction, out of control, and crashed head-on into vehicle 2 which was traveling in the opposite direction. This crash caused one fatality and one minor injury. |

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## APPENDIX C: FIGURES

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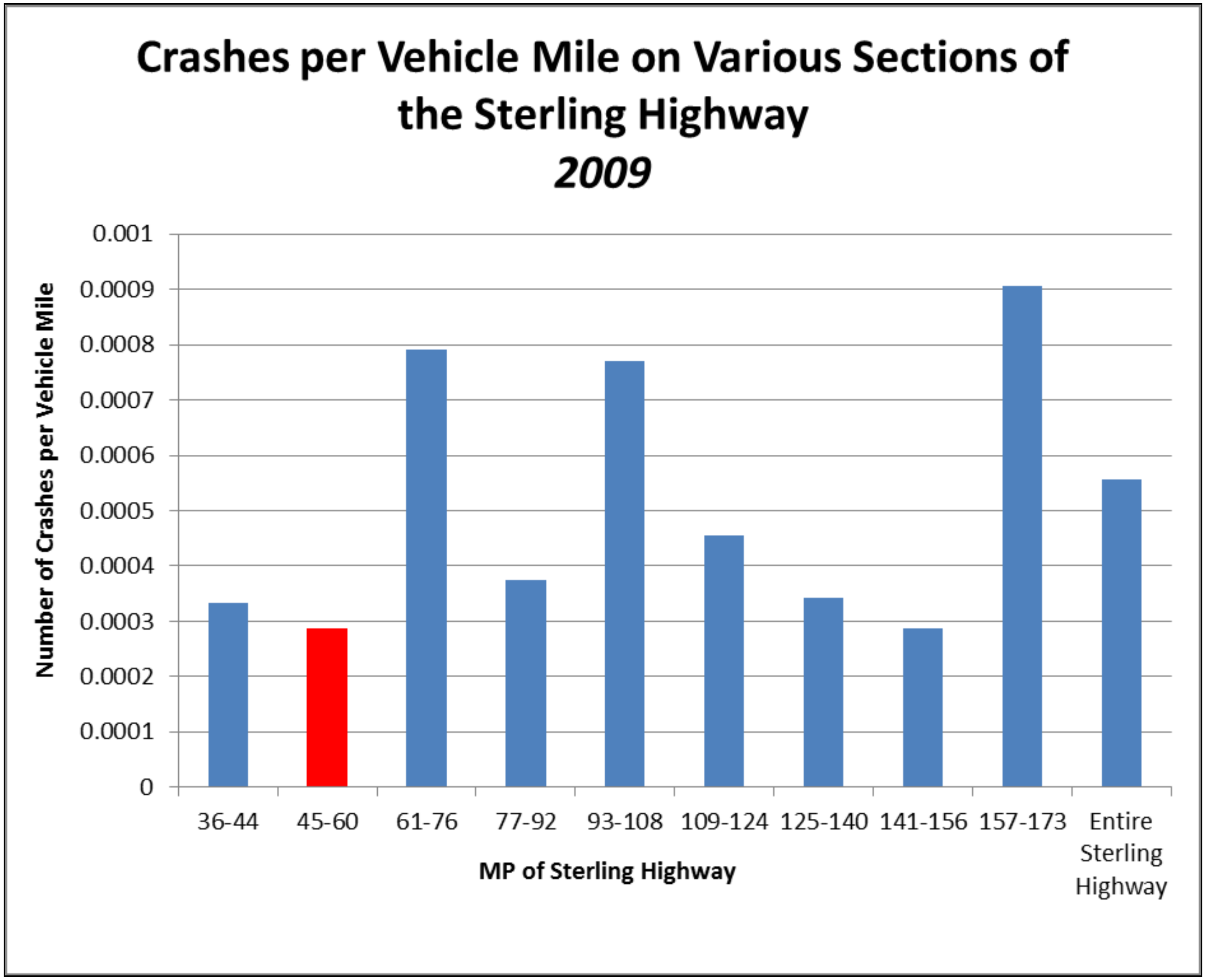


**Figure 1. Graph comparing the number of crashes per vehicle mile experienced within different sections of the Sterling Highway in 2009**

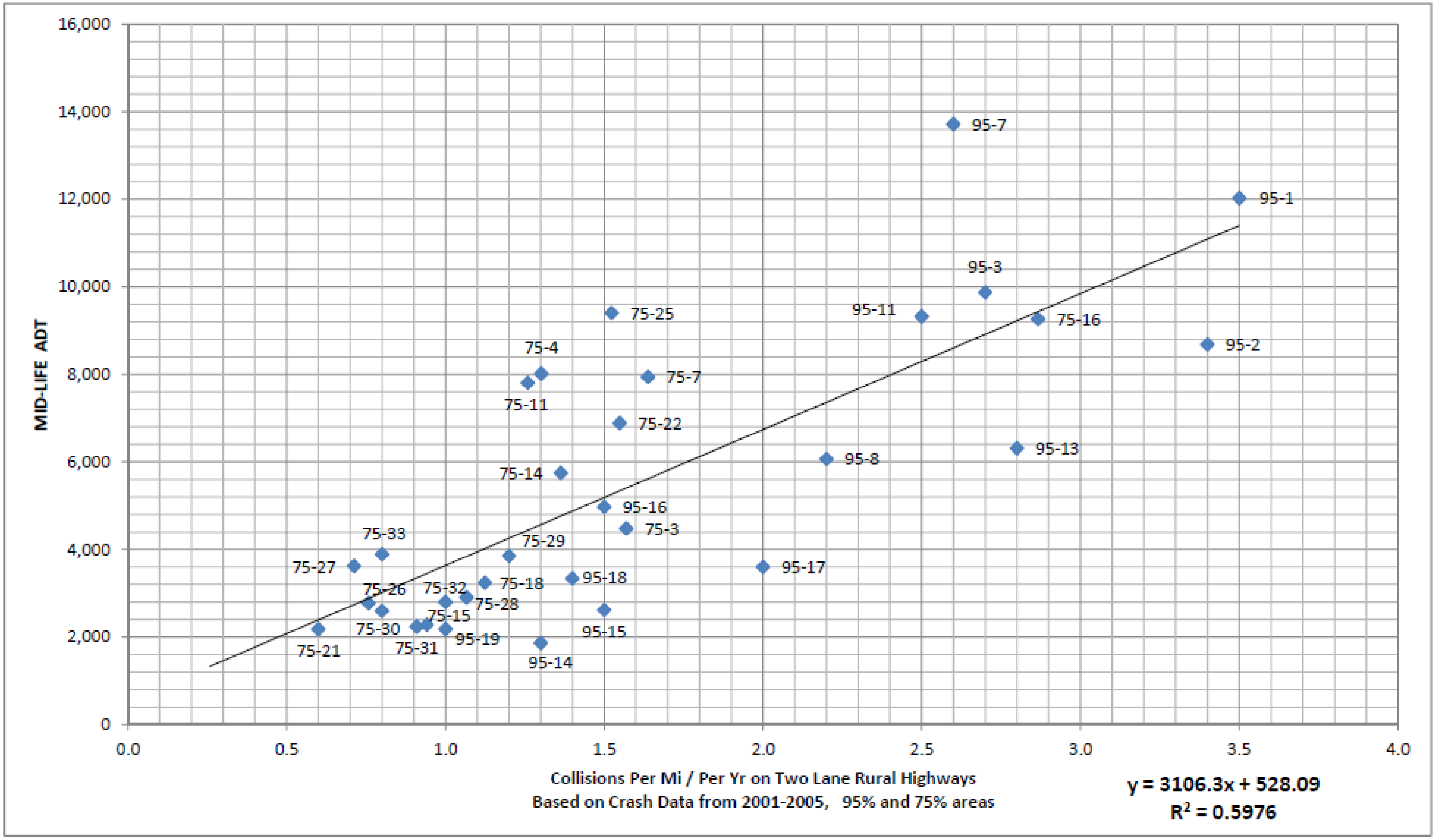


**Figure 2. Correlation between increases in traffic volume and the number of moose collisions on two-lane roads at low elevations (less than 200ft) (Thomas 2012)**

# Appendix A
# Crash Analysis:

# Project Safety Analysis, January 2018

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# Memo

| | |
|---|---|
| Date: | Monday, January 22, 2018 |
| Project: | Sterling Highway Milepost 45 to 60 |
| To: | Kelly Summers, PE |
| From: | Beth Wemple, PE, Samuel Klump, EIT, and John McPherson, AICP |
| Subject: | **Sterling Highway MP 45–60 Project Safety Analysis** |

## Background

HDR conducted a future conditions safety analysis of the five alternative alignments under consideration in the Sterling Highway Milepost (MP) 45–60 project. The analysis focused on forecasted crash frequency and rate for the roadway segments and intersections in 2043, and a retrospective 2012 existing conditions safety analysis for comparison purposes.

Total crashes, fatal and injury crashes, and property-damage-only crashes were estimated for future conditions on the segments and intersections on the corridor. In addition to predicted crash frequency, future crash rates were also calculated and compared to the most recent available statewide averages crash rates for comparable facilities.

Existing crash conditions were evaluated and documented separately in the *Traffic Crash Data Analysis* report (HDR 2014)[1].

## Methods and Data

Future crash frequency and severity for the No Build Alternative and four build alternatives were estimated using American Association of State Highway and Transportation Officials (AASHTO) *Highway Safety Manual* (HSM) Predictive Method procedures. When available, calibration factors were also applied to the default Safety Performance Functions (SPFs) in the HSM Predictive Method. Calibration factors account for differences in safety performance across jurisdictions. The University of Alaska Anchorage recently developed the following HSM SPF calibration factors applicable to this project:

- Two-lane rural highways = 1.25
- Three-legged stop-controlled intersections = 0.81
- Four-legged stop-controlled intersections = 0.81

The HSM Predictive Method uses forecasted traffic volumes (Annual Average Daily Traffic, or AADT) as part of the analysis. Table 1 summarizes the traffic volumes applied. These volumes

[1] HDR. 2014. *Traffic Crash Data Analysis*. Appendix A of the Sterling Highway Milepost 45 to 60 Environmental Impact Statement. Available on the internet athttp://sterlinghighway.net/Documents/Appendix%20A%20Crash%20Report-Aug2014web.pdf

were taken from the Sterling Highway *2014 Traffic Study Update* (Lounsbury & Associates, Inc. 2014)[2].

**Table 1: 2043 Safety Analysis Traffic Volumes**

| Category | Description | 2043 AADT |
|---|---|---|
| **Through-Traffic** | Traffic bypassing Cooper Landing and continuing along the highway to other destinations | 2,820 |
| **Local Traffic** | Traffic accessing the Cooper Landing area | 1,300 |
| **East of MP 46.1** | Local traffic east of MP 46.1, after the diverge for new alignments | 4,135 |
| **West of MP 55.3** | Local traffic west of MP 55.3, the diverge point for new alignments | 3,825 |

Source: Lounsbury & Associates, Inc. 2014

The project future analysis year is 2043. Annual safety benefits would accrue, starting in the opening year.

## Analysis Scenarios

Four safety analyses were performed:

- **Analysis I – 2043 Build: Proposed Improvements Only** compares forecasted safety performance for the proposed National Highway System (NHS) route, which, for the build alternatives, includes improvements on existing and new alignments. This analysis does not include forecasted conditions on the Old Sterling Highway (i.e., the section of Sterling Highway that becomes local access). Specifically, this analysis evaluated:
  - Combined segment and intersection crash frequency
  - Intersection-only crash frequency
  - Segment-only crash frequency
  - Segment-only average crash rate
- **Analysis II – 2043 Build: System Performance** predicts future safety performance on the new NHS route *and* the Old Sterling Highway route, which provides recreational and local access to the Cooper Landing developed area. AADT counts were included for both through-traffic bypassing Cooper Landing on the new alignments and local traffic. In this analysis, the predicted number of crashes on the proposed alignments is combined with the

[2] Lounsbury & Associates, Inc. 2014. *2014 Traffic Study Update.* Sterling Highway Milepost 45–60, ADOT&PF Project 53014. Prepared for HDR Alaska, Inc. Available on the internet at http://www.sterlinghighway.net/Documents/Final_Sterling-Highway_Traffic-Study-Update_02_10_14.pdf

future predicted number of crashes on the Old Sterling Highway and shows the effect of each alternative on the entire system from MP 45 to 60. Specifically, this analysis evaluated:

- Combined segment and intersection crash frequency
- Segment-only average crash rate

- **Analysis III – 2043 Build: Existing High Crash Locations** analyzes predicted future crash conditions within segments MP 47.0–47.9, MP 52.0–52.9, and MP 57.0–57.9 along the existing highway for each build alternative and the No Build Alternative. The *Traffic Crash Data Analysis* (HDR, 2014)[3] identified these locations as experiencing the highest concentration of crashes from 2000 to 2009. However, these locations were not predicted to have the highest concentration of crashes in the HSM predictive future year analysis. The following were evaluated for this analysis:

  - Combined segment and intersection crash frequency
  - Segment-only average crash rate

- **Analysis IV – 2012 No Build: Existing Conditions** analyzes the No Build Alternative, like in Analyses I and II, but with 2012 AADT. This analysis was conducted for comparative purposes.

## Analysis I – 2043 NHS (Proposed Improvements Only)

### Segment and Intersection Crashes

#### CRASH FREQUENCY

In the future year (2043), it is estimated the Juneau Creek Alternative will have the lowest number of total and fatal/injury crashes. As compared to the future No Build condition, there would be 70.5 percent fewer crashes (all severities) and 70.7 percent fewer fatal/injury crashes. The results shown in Table 2 are predicted intersection and segment crashes in the year 2043 for all alternatives; it should be noted that there would be benefits every year beginning in the opening year. Predicted crashes would increase as a function of growth in AADT. Note that rounding causes slight inequalities in summations of subcategories of crashes for the tables throughout this memo.

Each of the build alternatives is predicted to have lower crash frequency and severity than the No Build Alternative due to the safety benefits associated with providing wide shoulders, clear zones, and passing lanes. All four build alternatives propose 8-foot-wide shoulders, passing lanes along portions of the alignment, and 30-foot-wide clear zones. In the No Build Alternative, shoulder widths are limited to 1–2 feet (or less); passing lanes are not present; and clear zone widths, where present, are less than 25 feet.

[3] HDR. 2014. *Traffic Crash Data Analysis*. Appendix A of the Sterling Highway Milepost 45 to 60 Environmental Impact Statement. Available on the internet at http://sterlinghighway.net/Documents/Appendix%20A%20Crash%20Report-Aug2014web.pdf

**Table 2: 2043 Future Predicted Crashes (Intersections and Segments)**

| | No Build | Cooper Creek | G South | Juneau Creek | Juneau Creek Variant |
|---|---|---|---|---|---|
| **Total Crashes/Year** | 33.2 | 12.4 | 11.4 | 9.8 | 10.0 |
| **Fatal and Injury Crashes/Year** | 10.9 | 4.1 | 3.7 | 3.2 | 3.3 |
| **Property Damage Only Crashes/Year** | 22.3 | 8.3 | 7.6 | 6.6 | 6.8 |
| **Percent Difference From Total No Build Crashes** | -- | -62.5 | -65.7 | -70.5 | -69.7 |

The Juneau Creek Alternative shows the greatest decrease in crashes because it has the longest alignment of new roadway. In contrast, the Cooper Creek Alternative carries more local traffic and deviates the least from the existing alignment.

Truck crashes for each alternative were also predicted based on analysis of the 10-year crash data[4] from 2000 to 2009 along Sterling Highway within the project limits. Of the total 303 crashes that occurred along the highway, 8.5 percent involved a commercial truck or motorhome. Truck crashes were predicted by applying this percentage to the total number of predicted crashes in 2043. As a result, 2.8 truck crashes are predicted for the No Build Alternative. Predicted truck crashes for the build alternatives vary from 0.8 to 1.1 crashes, with the highest number predicted for the Juneau Creek Alternative.

## Intersection Only Crashes

### CRASH FREQUENCY

Future predicted crashes for all intersections are shown in Appendix A, Graph A1 and Graph A2. The number of intersections varies in each alternative.[5] The No Build Alternative has the most intersections (9) while the Juneau Creek and Juneau Creek Variant alternatives have the least (4). The total predicted crashes, as well as fatal/injury and property damage only crashes, do not vary significantly between the four build alternatives because they each bring the highway up to current standards. Geometry, intersection type, and lighting are all constant for intersections in each of the four build alternatives; therefore, predicted crashes are approximately the same for the intersections.

[4] HDR. 2014. *Traffic Crash Data Analysis*. Appendix A of the Sterling Highway Milepost 45 to 60 Environmental Impact Statement. Available on the internet at http://sterlinghighway.net/Documents/Appendix%20A%20Crash%20Report-Aug2014web.pdf

This includes the intersections with the ends of the Old Sterling Highway. Not included are subsidiary collectors, driveways, and pullouts without permanent traffic control that occur along the existing alignment.

Table 3 compares predicted intersection crashes for the No Build and proposed future conditions at the intersections of Skilak Lake Road/Sterling Highway and Quartz Creek Road/Sterling Highway. These two intersections are highlighted because they are common to all five alternatives (see Appendix A). It is forecast that in all alternatives, the intersections of Skilak Lake Road/Sterling Highway and Quartz Creek Road/Sterling Highway will have fewer crashes compared to the No Build Alternative. The build alternatives at these locations include dedicated left and right turn lanes. The addition of a dedicated left turn lane is predicted to decrease intersection crashes by 60 percent, while adding a right turn lane is predicted to decrease intersection crashes by 25 percent.

**Table 3: 2043 Future Predicted Crashes – Skilak Lake Road/Sterling Highway and Quartz Creek/Sterling Highway**

| | No Build | | Proposed Conditions | |
|---|---|---|---|---|
| | Skilak Lake Road/Sterling Highway | Quartz Creek/Sterling Highway | Skilak Lake Road/Sterling Highway | Quartz Creek/Sterling Highway |
| **Total Crashes/Year** | 0.30 | 0.27 | 0.09 | 0.10 |
| **Fatal and Injury Crashes/Year** | 0.13 | 0.11 | 0.04 | 0.04 |
| **Property Damage Only Crashes/Year** | 0.18 | 0.16 | 0.05 | 0.06 |

### Segment Only Crashes

#### CRASH FREQUENCY

The HSM Predictive Method requires dividing the corridor into multiple segments according to roadway geometric characteristics (e.g., lane width, presence of passing lanes, grade, horizontal alignment, type and width of shoulders). For example, 35 segments were identified in the Juneau Creek Alternative, and 42 segments were identified in the Cooper Creek Alternative. Table 4 shows the summary of crashes on segments only (excluding intersections). All four build alternatives would have fewer segment crashes than the future No Build Alternative, with the Juneau Creek Alternative having the lowest number of forecasted segment crashes.

Driveways and traffic volume are a major predictor of crash frequency and severity on two-lane rural highways. Considering only the new alignments, the Juneau Creek alternatives will have the fewest driveways and greatest separation of traffic volumes (i.e., the split between the traffic remaining on Old Sterling Highway and the “through” traffic on the Juneau Creek Alternative is separated for the greatest length); therefore, these options will have the lowest predicted number of crashes (Table 4).

**Table 4: 2043 Future Predicted Crashes, MP 45–60 (Segments Only)**

| | No Build | Cooper Creek | G South | Juneau Creek | Juneau Creek Variant |
|---|---|---|---|---|---|
| **Total Crashes/Year** | 30.5 | 11.2 | 10.6 | 9.2 | 9.5 |
| **Fatal and Injury Crashes/Year** | 9.8 | 3.6 | 3.4 | 3.0 | 3.0 |
| **Property Damage Only Crashes/Year** | 20.7 | 7.6 | 7.2 | 6.3 | 6.4 |
| **Percent Difference From Total No Build Crashes** | -- | -63.2 | -65.1 | -69.7 | -68.9 |

### CRASH RATE

The average segment crash rate for the future No Build Alternative and each of the build alternatives is shown in Table 5. The statewide average crash rate for rural two-lane road segments is 2.3 crashes per million vehicle miles traveled (VMT), as published in the Alaska DOT&PF 2017 Highway Safety Improvement Program Handbook for Federal Fiscal Year 2018. As shown in Table 5, the No Build Alternative predicts a crash rate in 2043 that is approximately 32 percent lower than the existing statewide average for rural principal arterials. Table 5 also shows the forecast 2043 crash rate for each alternative. As shown, all would perform better than the existing statewide average and better than the future No Build condition; however, the Juneau Creek Alternative would show the greatest reduction compared to the No Build Alternative.

Each of the build alternatives are predicted to have lower crash rates than the No Build Alternative due to improving the facility to meet current NHS standards. In particular, each build alternative proposes 8-foot-wide paved shoulders, 30-foot-wide clear zone widths, and passing lanes on certain segments of highway. By contrast, the No Build Alternative subjects drivers to unfavorable conditions; most notably 1 to 2-foot-wide gravel shoulders, no clear zone widths along portions of the alignment, and no passing lanes.

**Table 5: 2043 Future Predicted Average Segment Crash Rates, MP 45–60**

| | No Build | Cooper Creek | G South | Juneau Creek | Juneau Creek Variant |
|---|---|---|---|---|---|
| **Total Crashes/Year** | 30.5 | 11.2 | 10.6 | 9.2 | 9.5 |
| **Total Crashes/Million VMT** | 1.57 | 0.69 | 0.67 | 0.61 | 0.62 |
| **Statewide Average Crash Rate (Crashes per Million VMT)** | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 |
| **Percent Difference From Statewide Average Crash Rate** | -31.8% | -70.1% | -70.8% | -73.6% | -72.9% |

# Analysis II – 2043 Build: System Performance

## Segment and Intersection Crashes

### CRASH FREQUENCY

For overall system performance (new and rebuilt alignment improvements plus the remaining Old Sterling Highway through Cooper Landing without any improvements), the HSM Predictive Method shows that each of the alternatives provides substantial improvements compared to the No Build Alternative—a 49 to 53 percent reduction in total crashes (for each category; see Table 6).

The analysis shows that the Cooper Creek Alternative would have slightly fewer total and fatal/injury crashes in 2043 (Table 6) as compared to the other alternatives. This is because more of the old highway is upgraded and therefore more of the traffic benefits from improvements that meet standards. However, this prediction does not consider the influence of mixed through and local travel on conflicts, accessibility, and mobility in the Cooper Landing developed area. The Juneau Creek alternatives remove more through-traffic through more of the Cooper Landing developed area than the other alternatives. In addition, speed is not a variable in the HSM Predictive Method for two-lane rural highways. Therefore, the model does not account for the differential travel speeds and driving behaviors and expectations between local-access and through-travelers in the Cooper Landing developed area. This mix can lead to an increase in crashes due to the differing driver behaviors.

Similar to the analysis for Table 2, the build alternatives have lower crash frequency and severity than the No Build Alternative due to the safety benefits associated with providing shoulders, clear zones, and passing lanes.

Truck crashes in this analysis were predicted similarly to those in Analysis I. As a result, 2.8 truck crashes are predicted for the No Build Alternative. Predicted truck crashes for the build alternatives vary from 1.3 to 1.4 crashes, with the Cooper Creek Alternative predicted to have the least number.

**Table 6: 2043 Future Predicted Crashes, MP 45–60 (Intersections and Segments)**

| | No Build | Cooper Creek | G South | Juneau Creek | Juneau Creek Variant |
|---|---|---|---|---|---|
| **Total Crashes/Year** | 33.2 | 15.5 | 15.6 | 16.8 | 16.9 |
| **Fatal and Injury Crashes/Year** | 10.9 | 5.1 | 5.1 | 5.5 | 5.5 |
| **Property Damage Only Crashes/Year** | 22.3 | 10.3 | 10.5 | 11.3 | 11.4 |
| **Percent Difference From Total No Build crashes** | -- | -53.4 | -53.1 | -49.3 | -48.9 |

### Segment Only Crashes

#### CRASH RATES

The average segment crash rate for each alternative is shown in Table 7. The statewide average crash rate for rural two-lane road segments is 2.3 crashes per million VMT, as published in the Alaska DOT&PF 2017 Highway Safety Improvement Program Handbook, for Federal Fiscal Year 2018. As shown, all build alternative segments would perform better than the existing statewide average and all build alternatives make substantial improvements as compared to the No Build Alternative.

**Table 7: 2043 Future Predicted Average Segment Crash Rates, MP 45–60**

| | No Build | Cooper Creek | G South | Juneau Creek | Juneau Creek Variant |
|---|---|---|---|---|---|
| **Total Crashes/Year** | 30.5 | 14.0 | 14.5 | 15.7 | 15.9 |
| **Total Crashes/Million VMT** | 1.57 | 0.79 | 0.81 | 0.82 | 0.83 |
| **Statewide Average Crash Rate (Crashes per Million VMT)** | 2.3 | 2.3 | 2.3 | 2.3 | 2.3 |
| **Percent Difference From Statewide Average Crash Rate** | -31.8 | -65.8 | -64.8 | -64.4 | -64.1 |

### Traffic Crash Cost Analysis

Crash costs associated with crashes of varying severity levels were published by Alaska DOT&PF in the Highway Safety Improvement Program 2017 Handbook.[6] A cost analysis for each of the four build alternatives and the No Build Alternative was performed over a 20-year period from 2024–2043. AADTs for each year from 2024–2042 were obtained by applying a -1 percent growth rate[7] to the 2043 projected AADTs. A total of 604 crashes are predicted for the No Build Alternative in the 20-year period, of which 8 fatal crashes, 33 major injury crashes, and 153 minor injury crashes are predicted, resulting in a total cost of $87.25 million. The total cost due to traffic crashes for each alternative is shown below in Table 8.

The Cooper Creek alternative is predicted to result in the most cost savings from traffic collisions in the 20-year period when compared to the other build alternatives due to the least number of predicted crashes.

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[6] The following crash costs were published: Fatality: $2,003,000, Major Injury: $1,001,000, Minor Injury: $200,000, Property Damage Only: $20,000 (http://dot.alaska.gov/stwddes/dcstraffic/assets/pdf/hsip/hsip_hdbk_170101.pdf)

[7] Lounsbury & Associates, Inc. 2014. *2014 Traffic Study Update* Sterling Highway Milepost 45–60, ADOT&PF Project 53014. Prepared for HDR Alaska, Inc. Available on the internet at http://sterlinghighway.net/Documents/Appendix%20A%20Crash%20Report-Aug2014web.pdf

**Table 8: Total Cost of Traffic Crashes from 2024–2043**

| | No Build | Cooper Creek | G South | Juneau Creek | Juneau Creek Variant |
|---|---|---|---|---|---|
| **Total Cost ($Million)** | 87.25 | 40.65 | 40.94 | 44.20 | 44.55 |
| **Total Cost Savings Compared to No Build ($Million)** | -- | 46.60 | 46.31 | 43.05 | 42.70 |

## Analysis III – Existing High Crash Locations

All four build alternatives are predicted to substantially decrease frequency of crashes along the existing high crash segments from MP 47–47.9, MP 52–52.9, and MP 57–57.9. Crashes are predicted to decrease for the Cooper Creek Alternative due to improvement of the existing facility to meet current NHS standards. Though the Juneau Creek and Juneau Creek Variant alternatives do not propose improvements to the existing highway at these segments, the greatest decrease in crashes is predicted due to a rerouting of through-traffic along new NHS alignments. Predicted crashes along existing high crash segments are shown in Table 9. Crashes along MP 52–52.9 are predicted to decrease by 68 percent for the Juneau Creek and Juneau Creek Variant alternatives. All four build alternatives are predicted to decrease crashes by 55 percent along MP 57–57.9.

**Table 9: 2043 Future Predicted Crashes at High Crash Locations**

| | No Build | Cooper Creek | G South | Juneau Creek | Juneau Creek Variant |
|---|---|---|---|---|---|
| **Total Crashes - MP 47 to 47.9** | 3.1 | 1.6 | 1.0 | 1.0 | 1.0 |
| **Total Crashes - MP 52 to 52.9** | 2.2 | 0.9 | 0.9 | 0.7 | 0.7 |
| **Total Crashes - MP 57 to 57.9** | 2.2 | 1.0 | 1.0 | 1.0 | 1.0 |

The Cooper Creek Alternative is predicted to result in the lowest crash rate of all alternatives for all three existing high crash segments, due to improvement of these segments to meet NHS standards as outlined in Analysis I (Table 10). Although crash rates will be slightly higher under the G South, Juneau Creek, and Juneau Creek Variant alternatives compared to the No Build Alternative from MP 47–47.9, the number of crashes are predicted to decrease. This is because predicted number of traffic crashes do not increase in direct 1:1 proportion to increased AADT.

While the predicted crash rates are lower than the existing crash rates along these segments,[8] the prediction is useful as a relative comparison of predicted crash rates of build alternatives compared to the No Build Alternative. Of the three segments, MP 47–47.9 is predicted to have the highest frequency of crashes due to high driveway density.

**Table 10: 2043 Future Predicted Average Segment Crash Rates, MP 45-60 (Segments Only)**

| | No Build | Cooper Creek | G South | Juneau Creek | Juneau Creek Variant |
|---|---|---|---|---|---|
| **Total Crashes/Million VMT - MP 47 to 47.9** | 1.84 | 1.03 | 1.95 | 1.95 | 1.95 |
| **Total Crashes/Million VMT - MP 52 to 52.9** | 1.51 | 0.79 | 0.78 | 1.42 | 1.42 |
| **Total Crashes/Million VMT - MP 57 to 57.9** | 1.33 | 0.78 | 0.78 | 0.78 | 0.78 |

## Analysis IV – Existing Conditions Analysis 2012

Table 11 shows the results of the predictive safety analysis conducted on the existing roadway using 2012 AADT. The analysis was identical to Analysis I, except for using 2012 AADT inputs instead of 2043 AADT. This analysis presents a control analysis to compare results from the HSM Predictive Method against actual collected crash report data.

**Table 11: 2012 Predicted Crashes for Existing Conditions**

| | Segments & Intersections | Segments Only | Intersections Only |
|---|---|---|---|
| **Total Crashes/Year** | 24.5 | 22.7 | 1.8 |
| **Fatal and Injury Crashes/Year** | 8.1 | 7.3 | 0.8 |
| **Property Damage Only Crashes/Year** | 16.5 | 15.4 | 1.1 |

The current crash data show approximately 300 crashes within the project limits in the 2000–2009 10-year period, or 30 crashes per year. The HSM Method retrospectively forecasts 24.5 crashes/year—5.5 crashes/year fewer than actual crash data reports. Though this shows a difference between the predicted and observed crash data, a number of crash related factors are not accounted for in the predictive method, including animal crashes, parked vehicles, and loss of cargo. When these causes of crashes are taken out of the existing published data, there are approximately 25 crashes/year—0.5 crashes/year more than the model predicts for 2012, or a 2 percent difference. Based on this analysis, the predictive method appears to accurately account for crashes within the limitations of the methodology.

[8] HDR. 2014. *Traffic Crash Data Analysis*. Appendix A of the Sterling Highway Milepost 45 to 60 Environmental Impact Statement. Available on the internet athttp://sterlinghighway.net/Documents/Appendix%20A%20Crash%20Report-Aug2014web.pdf

## Summary

Each of the build alternatives is predicted to make substantial contributions to safety as compared to the No Build Alternative. Of the optional build alternatives, the Juneau Creek Alternative would result in the fewest crashes per year on the NHS in the design year (2043). Constructing this alignment will have the potential to reduce the number of crashes by approximately 70 percent on the NHS as compared to the No Build Alternative. Considering the new NHS route and the Old Sterling Highway as a system, the Cooper Creek Alternative would result in the lowest number of crashes per year in the future (slightly lower than the Juneau Creek Alternative). For all alternatives, the sections of the highway transitioning from old-to-new or new-to-old cross-section may, over time, experience crashes as drivers adjust their behaviors to different roadway characteristics.

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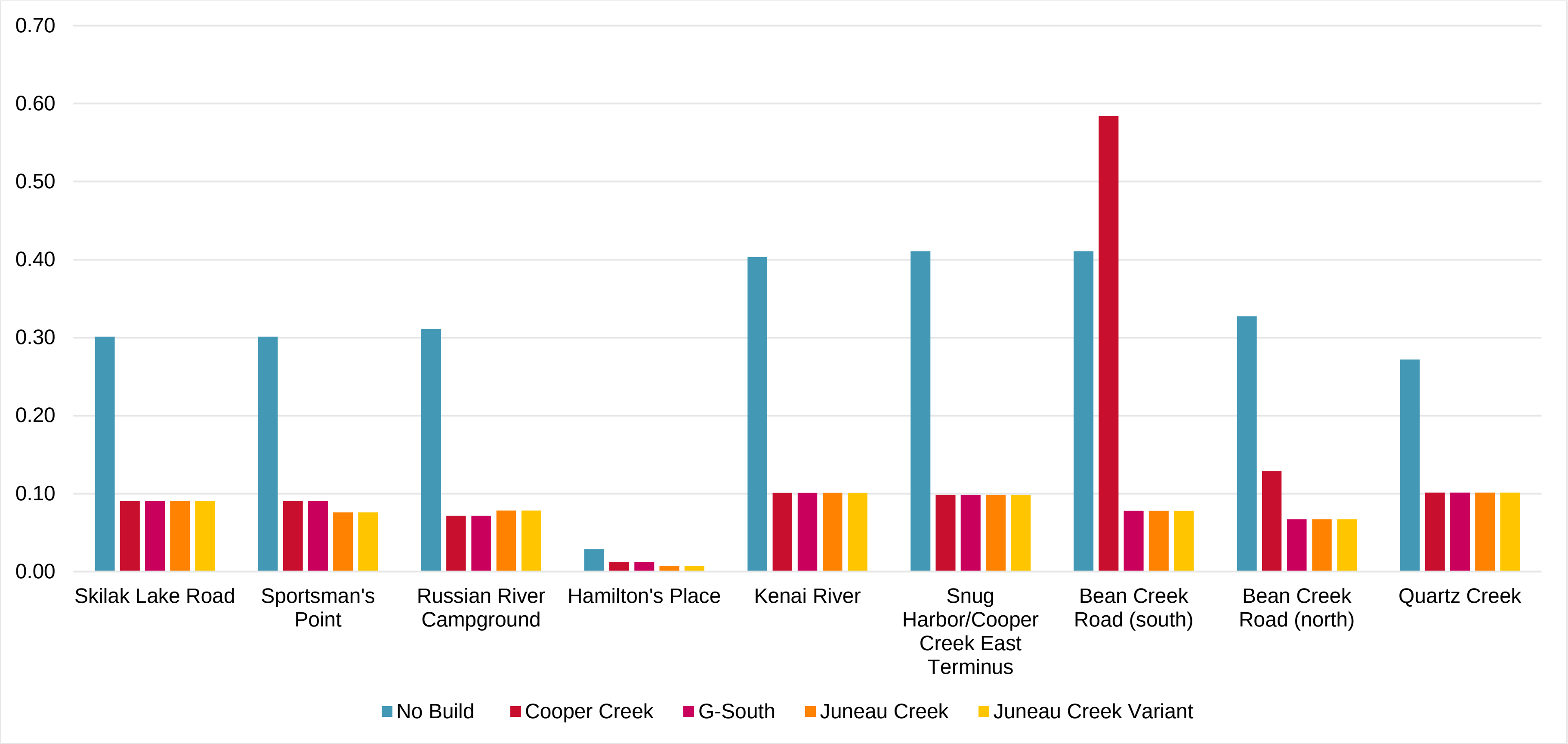
# Appendix A: Intersection Crash Frequency

**Graph A1: Future Predicted Crashes at Intersections along Existing Alignment**



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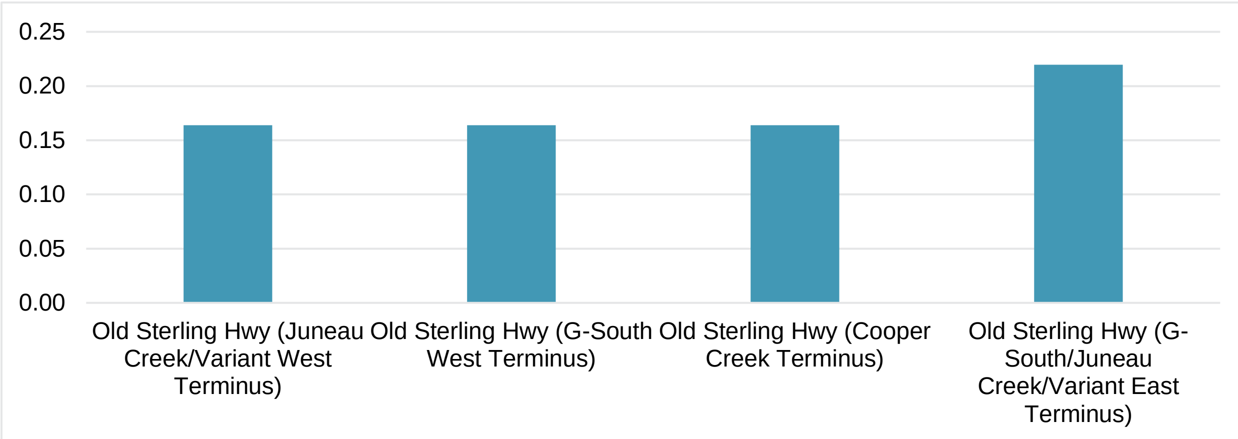
**Graph A2: Future Predicted Crashes at Intersections along New Alignments**



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