



**APPENDIX A**  
**CRASH DATA ANALYSIS TECHNICAL MEMORANDUM**





**TECHNICAL MEMORANDUM**

RE: **CAMPO Local Road Safety Plan (LRSP) – DRAFT Crash Analysis Technical Memorandum**

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**LIST OF ACRONYMS**

<b>AASHTO</b>	American Association of State Highway and Transportation Officials	<b>LRSP</b>	Local Road Safety Plan
<b>CAMPO</b>	Carson Area Metropolitan Planning Organization	<b>NCATS</b>	Nevada Citation and Accident Tracking System
<b>CEA</b>	Critical Emphasis Area	<b>NDOT</b>	Nevada Department of Transportation
<b>CCR</b>	Critical Crash Rate	<b>NHTSA</b>	National Highway Traffic Safety Administration
<b>EPDO</b>	Equivalent Property Damage Only	<b>PDO</b>	Property Damage Only
<b>FARS</b>	Fatality Analysis Reporting System	<b>SHSP</b>	Strategic Highway Safety Plan
<b>FHWA</b>	Federal Highway Administration	<b>TRINA</b>	Traffic Records Information Access
<b>HSM</b>	Highway Safety Manual	<b>VRU</b>	Vulnerable Road User





## **1. INTRODUCTION**

This crash analysis memorandum summarizes the existing safety context for the Carson Area Metropolitan Planning Area (CAMPO) Local Road Safety Plan (LRSP) based on the latest five years of historical data from 2018 to 2022. A detailed review of the available crash data was completed to identify crashes where factors may be overrepresented. Overrepresentation measures the crash types or contributing factors that are disproportionately high to determine whether they should be prioritized as a safety issue within a planning area. A map of the CAMPO region is shown in **Figure 1**. This technical memorandum is organized into the following sections:

- **Section 1** introduces the LRSP
- **Section 2** describes the data that was obtained for use as part of the crash analysis
- **Section 3** describes the LRSP process and presents guiding materials used in the data analysis
- **Section 4** describes the safety trends observed across CAMPO and presents a short-list of potential priority locations
- **Section 5** describes the network screening methodology presents a list CAMPO Engineering Countermeasures



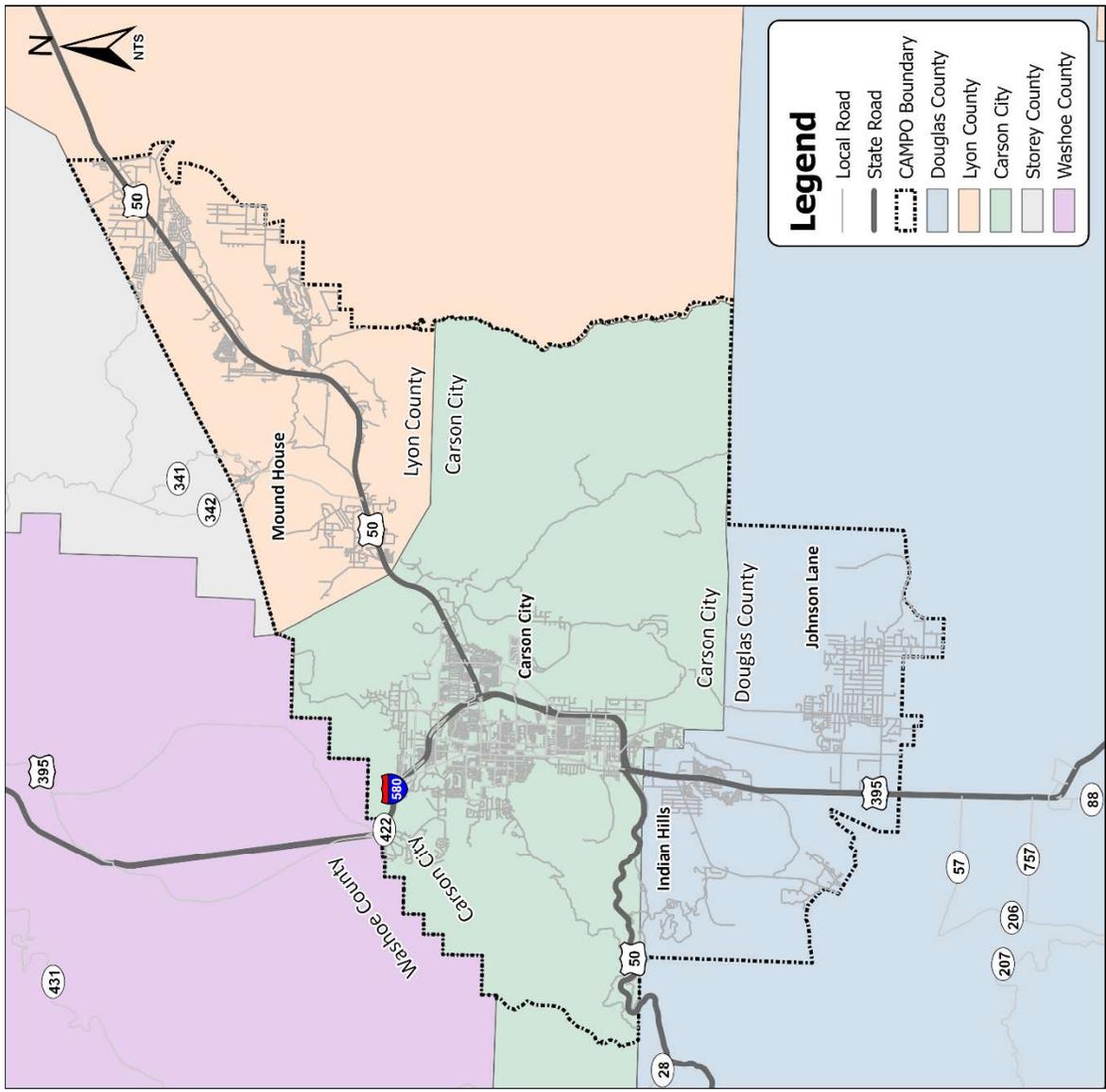


Figure 1 – CAMPO Area Map





## 2. DATA COLLECTION

The following data was obtained from the Nevada Department of Transportation (NDOT) and CAMPO for use as part of the crash analysis for the LRSP.

### 2.1. Crash Data

The latest five years of crash data from 2018 to 2022 was provided by NDOT from the Nevada Citation and Accident Tracking System (NCATS) and the National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS). NCATS injury and property damage only (PDO) crash data for years 2018 to 2021 provided by NDOT was combined with FARS fatal crash data from 2018 to 2021. For 2022, NCATS fatal, injury, and PDO crash data was used because 2022 FARS data has not been made available yet. A breakdown of the crash data sources used for each crash severity by year is shown in **Table 1**.

The crash counts can vary between the two data sources. NCATS uses information from the responding law enforcement officers. For fatal crashes (FARS), additional information is obtained post-crash, including speed studies, crash forensics, officer narratives, and citations issued after the crash. This additional information is compiled and included in the FARS data summary, which is published as final about 1.5 years later (2022 is pending). The additional post-crash information is not always updated in NCATS, resulting in discrepancies between the two data sets. The fatal crash data from 2018 to 2021 was used to compare the CAMPO region fatal crashes to statewide crashes reported in the [Nevada Strategic Highway Safety Plan Dashboard \(SHSP\)](#) for the same timeframe.

**Table 1 – Summary of Crash Data Sources by Year**

Year	Fatal Crash Data	Injury and PDO Crash Data
2018	FARS	NCATS
2019	FARS	NCATS
2020	FARS	NCATS
2021	FARS	NCATS
2022	NCATS	NCATS





## 2.2. Roadway Network

NDOT's functional classification system layer was used to identify the functional classification for roadways in the CAMPO region. NDOT's statewide routes layer was used to identify the segments for which critical crash rates (CCR) were developed. The two layers were joined together resulting in one layer that includes both the roadway name and its functional classification. The functional classification definitions for each classification type are provided below:

- **Principal Arterial:** Principal arterials are intended for the movement of high volumes of traffic at high speeds over long intercity and intracity distances. Roadways in this class may be two-lane or multi-lane facilities. These roadways serve major centers of metropolitan areas, provide a high degree of mobility, and can also provide mobility through rural areas.
- **Minor Arterial:** Minor arterials provide service for trips of moderate length; serve geographic areas that are smaller than those served by the principal arterials and offer connectivity to the principal arterial system. These roadways may be two-lane or multilane roadways and have the capacity to carry medium to high volumes of traffic at medium speeds over short to medium distances.
- **Major Collector:** Collectors serve a critical role in the roadway network by gathering traffic from local roads and funneling them to the arterial network. Collectors serve intercounty (rather than statewide) travel and constitute those routes on which (independent of traffic volume) predominant travel distances are shorter than on arterial routes. Major collector routes are longer in length, have lower connecting driveway densities, have higher speed limits, are spaced at longer intervals, have higher annual average traffic volumes, and may have more travel lanes than their Minor Collector counterparts.
- **Minor Collector:** Minor Collector routes are shorter in length, have higher connecting driveway densities, have lower speed limits, are spaced at smaller intervals, have lower annual average traffic volumes, and may have fewer travel lanes than their Major Collector counterparts.
- **Local Road:** Local Roads are not intended for use in long-distance travel; they are primarily used at the origin or destination end of the trip due to their provision of direct access to abutting land. The primary purpose of these roads is to provide safe and reasonable land access. They are often designed to discourage through traffic.





The functional classifications described were used to identify the "Local Roads" for use in the Local Road Safety Plan. The "Local Roads" include roads owned by local agencies and state highways owned by NDOT. The roadway segments were separated by functional classification to develop crash rates specific to their functional design and capacity. Comparative statistics were stratified by functional classification (i.e., only major arterials are compared to major arterials).

### 2.3. Intersections

Intersections within the CAMPO region were grouped by control type as either signalized or unsignalized. A traffic signal location layer from CAMPO was used to identify signalized intersections within the roadway network. Intersection crashes were identified as crashes occurring within a 250-foot radius of an intersection; all other crashes were considered to be segment crashes in the safety data analysis.

### 2.4. Annual Average Daily Traffic

Traffic volume data was collected from NDOT's Traffic Records Information Access (TRINA) application. This data included average annual daily traffic (AADT) values for roadway segments throughout CAMPO for use in development of crash rates. Local roads where NDOT TRINA data was not available used an assumed 500 vehicles per day (vpd) to calculate the local CCR differential in the occurrence of a crash on that segment.





### 3. LRSP PROCESS

The primary goal of CAMPO and its stakeholders is to maintain a safe, efficient, and sustainable transportation system for their residents and visitors. CAMPO will continue its collaboration with stakeholders to identify and discuss safety issues within the community through the development of the LRSP and its implementation.

Guidance on the LRSP process is provided at both the national (Federal Highway Administration [FHWA]) and state level (NDOT). Both agencies have developed a general framework of data and recommendations to be included in an LRSP. The FHWA encourages:

- The establishment of a working group (stakeholders) to participate in developing an LRSP
- Review crash, traffic, and roadway data to identify areas of concern
- Establish goals, priorities, and countermeasures to recommend improvements at spot locations, systemically, and comprehensively. A systemic approach helps agencies to manage risk, especially on rural and local low volume roadways, as this approach broadens the implementation of improvements by combining crash history and identification of high-risk roadway characteristics to identify low-cost safety improvements.

From NDOT's LRSP website ([Local Road Safety Plan | Nevada Department of Transportation \(nv.gov\)](http://Local Road Safety Plan | Nevada Department of Transportation (nv.gov))), the process for this LRSP includes the following steps:

- Establish leadership
- Analyze the safety data
- Determine emphasis areas
- Identify strategies
- Prioritize and incorporate strategies
- Evaluate and update the LRSP

#### 3.1. Guiding Manuals

The following section describes the analysis process undertaken to evaluate safety within the CAMPO region systematically. Using a network screening process, locations within CAMPO that will most likely benefit from safety enhancements were identified. Using historic crash data, crash risk factors for the entire network were derived. The outcomes inform the identification and prioritization of engineering and non-infrastructure safety countermeasures that address certain roadway characteristics and related behaviors that





contribute to crashes involving all roadway users. This process uses the latest national and state best practices for statistical roadway analysis described in the following sections.

### **Federal Highway Administration Proven Safety Countermeasures**

The FHWA *Proven Safety Countermeasures* includes a collection of 28 countermeasures and strategies that are proven to be effective in reducing fatal and serious injury crashes. One of these strategies is the development of an LRSP to analyze and prioritize roadway safety improvements on Local Roads. An LRSP provides a framework for identifying, analyzing, and prioritizing roadway safety improvements on Local Roads. Agencies that implement LRSPs have experienced a reduction of fatal and serious injury crashes of 17%.<sup>1</sup> LRSPs are tailored to local issues and needs, therefore this LRSP identifies emphasis areas which inform and guide further safety evaluation of CAMPO's transportation network. The emphasis areas include crash type and location, and an analysis of notable relationships between current efforts and crash history. The LRSP analyzes aggregated crash data, and where appropriate, analyzes at specific locations to identify trends, high-crash locations, high-risk locations, and locations with unusual crash history, patterns, or severity. Analyzing crash history within the CAMPO region provides a basis for:

- Identification of challenging safety factors for roadway users to maneuver
- Improvement of safety at identified high-crash locations
- Development of safety measures which align with the Nevada SHSP six "E's" of safety: Equity, Engineering, Education, Enforcement, Emergency Medical Services/Emergency Response/Incident Management, and Everyone

More information from FHWA can be found here: [Proven Safety Countermeasures | FHWA \(dot.gov\)](https://highways.dot.gov/safety/proven-safety-countermeasures/local-road-safety-plans).

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<sup>1</sup> FHWA Proven Safety Countermeasures, Local Road Safety Plans, <https://highways.dot.gov/safety/proven-safety-countermeasures/local-road-safety-plans> accessed on September 15, 2023





### Highway Safety Manual

The first edition of the *Highway Safety Manual* (HSM) was published by the American Association of State Highway and Transportation Officials (AASHTO) in 2010. The HSM presents numerous methods for quantitatively estimating the frequency and severity of crashes at a variety of road and intersection types.<sup>2</sup> This four-part manual is divided into Parts: A) Introduction, Human Factors, and Fundamentals, B) Roadway Safety Management Process, C) Predictive Method, D) Crash Modification Factors.

Chapter 4 of Part B of the HSM discusses the Network Screening Process. The Network Screening Process is a tool for an agency to analyze their entire network and identify and rank locations that, based on the implementation of a countermeasure, are most likely to least likely to see a reduction in the frequency of crashes.

The HSM identifies five steps in this process:<sup>3</sup>

1. **Establish Focus:** Identify the purpose or intended outcome of the network screening analysis. This decision will influence data needs, the selection of performance measures and the screening method that can be applied.
2. **Identify Network and Establish Reference Populations:** Specify the types of sites or facilities being screened (i.e., segments, intersections, geometrics) and identify groupings of similar sites or facilities.
3. **Select Performance Measures:** There are a variety of performance measures available to evaluate the potential to reduce crash frequency at a site. In this step, the performance measure is selected as a function of the screening focus and the data and analytical tools available.
4. **Select Screening Method:** There are three principal screening methods described in this chapter (i.e., ranking, sliding window, peak searching). Each method has advantages and disadvantages; the most appropriate method for a given situation should be selected.
5. **Screen and Evaluate Results:** The final step in the process is to conduct the screening and analysis and evaluate the results.

The HSM provides several performance measures derived from statistical methods used to screen roadway networks to identify high risk locations based on overall crash histories. These performance measures include Average Crash Frequency, Crash Rate, Equivalent Property Damage Only (EPDO) Average Crash Frequency, Relative Severity Index, CCR, and several others. For the purposes of this LRSP, the performance measures chosen to determine to areas of high crash risk are CCR and EPDO.

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<sup>2</sup> AASHTO, *HSM*, 2010, Washington D.C., <http://www.highwaysafetymanual.org/Pages/About.aspx>

<sup>3</sup> AASHTO. *HSM*. 2010. Washington, DC. Page 4-2.





## 4. SAFETY TRENDS

The following sections contain the results of the safety trends which include evaluation of crashes by severity, type, driver behavior, vulnerable road users (VRU) and motorcyclists, and environmental factors. VRUs refer to non-motorized road users, such as pedestrians and bicyclists. Detailed crash data tables and figures are included in **Attachment A**.

### 4.1. Severity Level

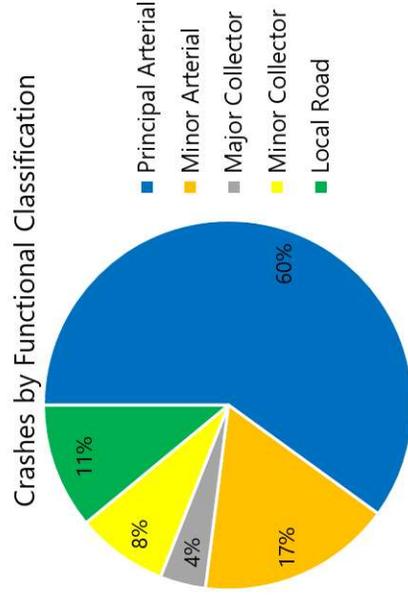
Knowing the impacts of the crash (the injuries or type of damage which occurred) is a key part of assessing the environment and safety factors around the site of the crash. The National Safety Council developed the “KABCO” injury scale, which is frequently used by law enforcement for classifying injuries. The KABCO scale is referenced below.

- K – Fatal
- A – Serious injury
- B – Non-incapacitating injury
- C – Possible injury
- O – PDO (no injury)

### 4.2. CAMPO Crashes on All Roads

From 2018 to 2022, there were 4,565 crashes in the CAMPO region. The breakdown of the crashes by facility type including interstate crashes, crashes on local roadway segments together with state highways, and crashes on signalized and unsignalized intersections is provided in **Table 2**. Of the 4,565 crashes, 35 (0.8%) were fatal and 82 (1.8%) were serious injury crashes. A breakdown of crashes by year is shown in **Table 3**. Though there has been a decrease in the number of crashes between 2018 and 2022, there has been an increase in the number of fatal and serious injury crashes over that same time period as shown in **Figure 2**.

Of the 4,565 crashes, 300 crashes (6.6%) occurred on Interstate 580 (I-580), and 4,265 crashes (93.4%) occurred on Local Roads, as summarized by **Table 2**. Segment crashes over the five-year study period from 2018 to 2022 accounted for 929 crashes (20.4%) and intersection crashes accounted for 3,336 crashes (73.1%). Crashes occurring at signalized intersections accounted





for 30.5% of all crashes, while crashes that occurred at unsignalized intersections made up 42.5% of all crashes. An intersection crash is defined as a crash that occurs within 250 feet of an intersection.

**Table 2 – CAMPO Crashes by Facility Type**

Injury Severity	Total Crashes		Interstate		Local Road Segments		Signalized Intersections		Unsignalized Intersections	
	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage	Count	Percentage
K	35	0.8%	4	0.1%	10	0.2%	7	0.2%	14	0.3%
A	82	1.8%	1	0.0%	21	0.5%	22	0.5%	38	0.8%
B	448	9.8%	22	0.5%	90	2.0%	130	2.8%	206	4.5%
C	749	16.4%	45	1.0%	147	3.2%	266	5.8%	291	6.4%
O	3,251	71.2%	228	5.0%	661	14.5%	969	21.2%	1,393	30.5%
<b>Total</b>	<b>4,565</b>	<b>100%</b>	<b>300</b>	<b>6.6%</b>	<b>929</b>	<b>20.4%</b>	<b>1,394</b>	<b>30.5%</b>	<b>1,942</b>	<b>42.5%</b>

Source: NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NDOT  
 FARS Data (January 1, 2018 to December 31, 2021), provided by NHTSA

**Table 3 – CAMPO Crashes by Severity and Year**

Injury Severity	2018	2019	2020	2021	2022
K	4	8	8	7	8
A	15	11	19	18	19
B	51	99	92	113	93
C	236	189	145	100	79
O	738	805	614	618	476
<b>Total</b>	<b>1,044</b>	<b>1,112</b>	<b>878</b>	<b>856</b>	<b>675</b>

Source: NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NDOT  
 FARS Data (January 1, 2018 to December 31, 2021), provided by NHTSA



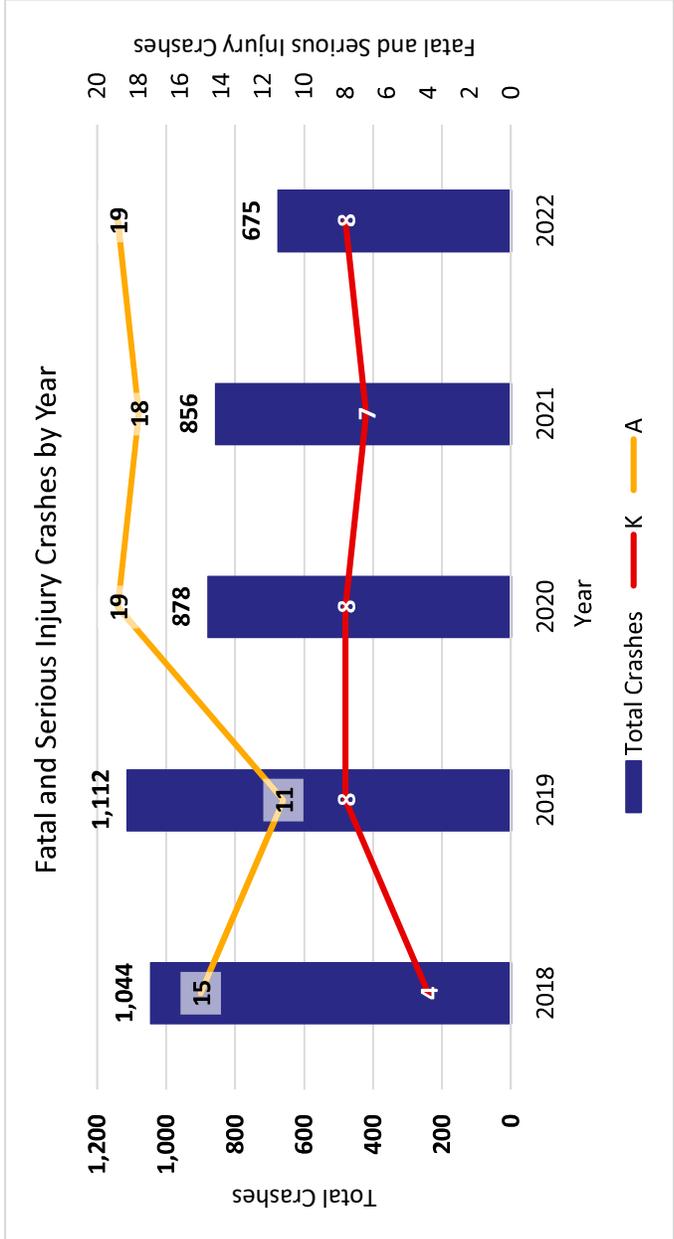
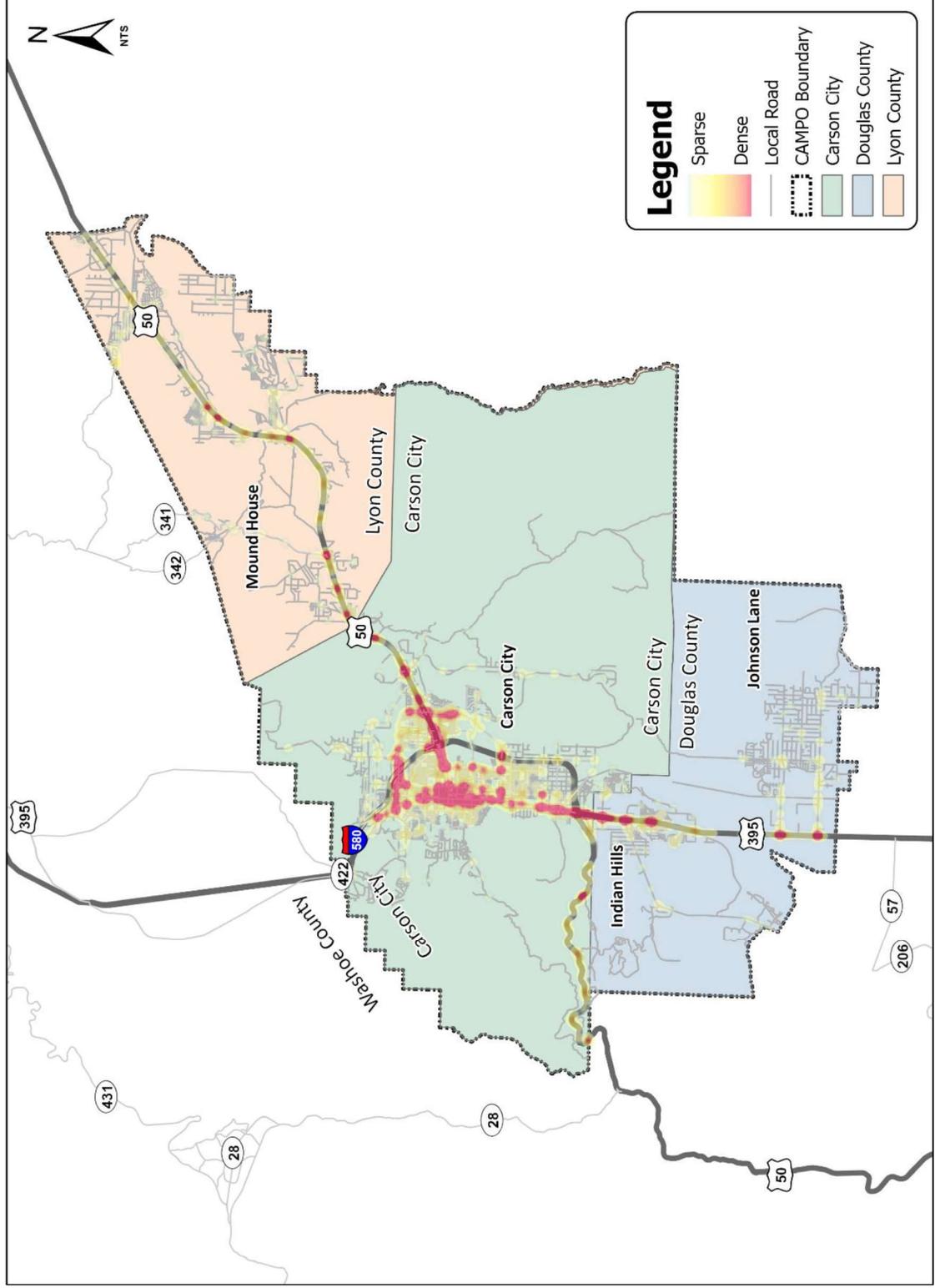


Figure 2 – CAMPO Crashes by Year

CAMPO experienced the highest concentration of crashes within the Carson City limits. Douglas County experienced high crash density where US-395 intersects with Stephanie Way and Johnson Lane. In Lyon County, most crashes occurred along US 50 and are spread out along that stretch of roadway. A heat map illustrating the crash density of all crashes within the CAMPO region is shown in Figure 3.





Source: NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NDOT  
 FARS Data (January 1, 2018 to December 31, 2021), provided by NHTSA

Figure 3 – CAMPO Region Crash Density (All Crashes) Map





**Crashes by Emphasis Area**

The fatal crash data from 2018 to 2021 was used to compare the CAMPO region fatal crashes to statewide crashes reported in the Nevada Strategic Highway Safety Plan Dashboard (SHSP) for the same timeframe. Fatal and serious injury crashes for all facility types, including interstate, falling under each of the ten SHSP Critical Emphasis Areas (CEA) were reviewed for CAMPO as shown in Table 4 and Figure 4. The CEAs most highly represented by CAMPO fatal and serious injury crashes are Intersection, Impaired Driving, Older Drivers, Speed-Related, and Pedestrians. Three of the top four CEAs identified for CAMPO (Impaired Driving, Intersections, and Speed-Related) are also top CEAs at the statewide level.

**Table 4 – CAMPO and Nevada SHSP CEA Comparison**

Nevada SHSP CEA	CAMPO Region Fatal Crashes	Statewide Fatal Crashes
Intersections	<b>18 (66.7%)</b>	405 (30.0%)
Impaired Driving	9 (33.3%)	547 (40.5%)
Older Drivers	<b>9 (33.3%)</b>	270 (20.0%)
Speed-Related	<b>8 (29.6%)</b>	351 (26.0%)
Pedestrians	<b>8 (29.6%)</b>	298 (22.1%)
Unrestrained	<b>6 (22.2%)</b>	258 (19.1%)
Motorcyclists	4 (14.8%)	261 (19.3%)
Young Drivers	<b>3 (11.1%)</b>	128 (9.5%)
Lane Departures	0 (0.0%)	483 (35.8%)
Work Zones	N/A	N/A
<b>Total Crashes</b>	<b>27 (100.0%)</b>	<b>1,350 (100%)</b>

Source: FARS Data (January 1, 2018 to December 31, 2021), provided by NHTSA

- Note:
1. Intersection crashes are based on a 250-foot influence buffer around each intersection
  2. Percentages add up to more than 100%, as a crash may involve multiple CEAs (i.e., a young driver that was impaired and speeding)
  3. Work Zones CEA was added to the Nevada SHSP after the analysis was completed, and was not included in the analysis for CAMPO



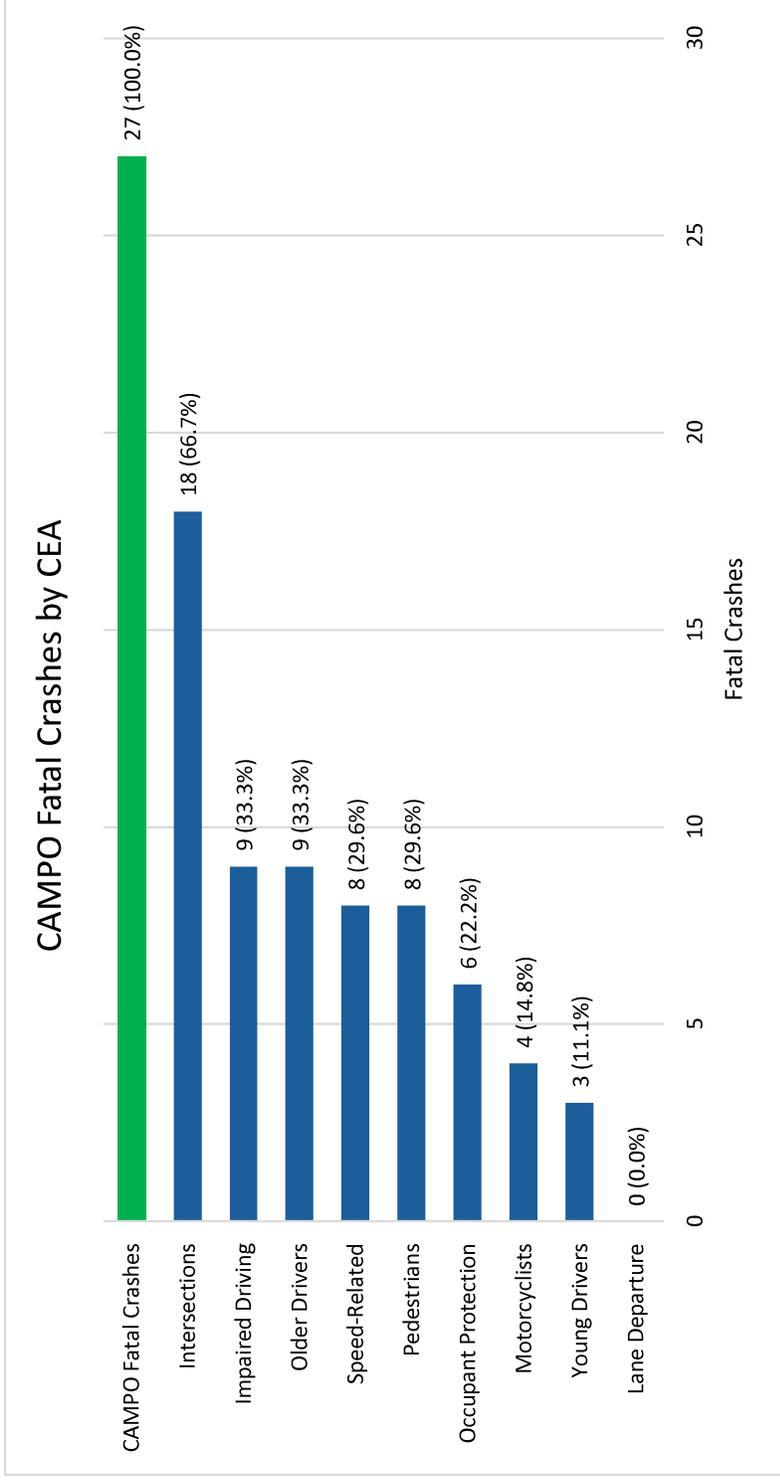


Figure 4 – Crashes by Critical Emphasis Area (2018-2021)

4.3. CAMPO Crashes on Local Roads and State Highways Only

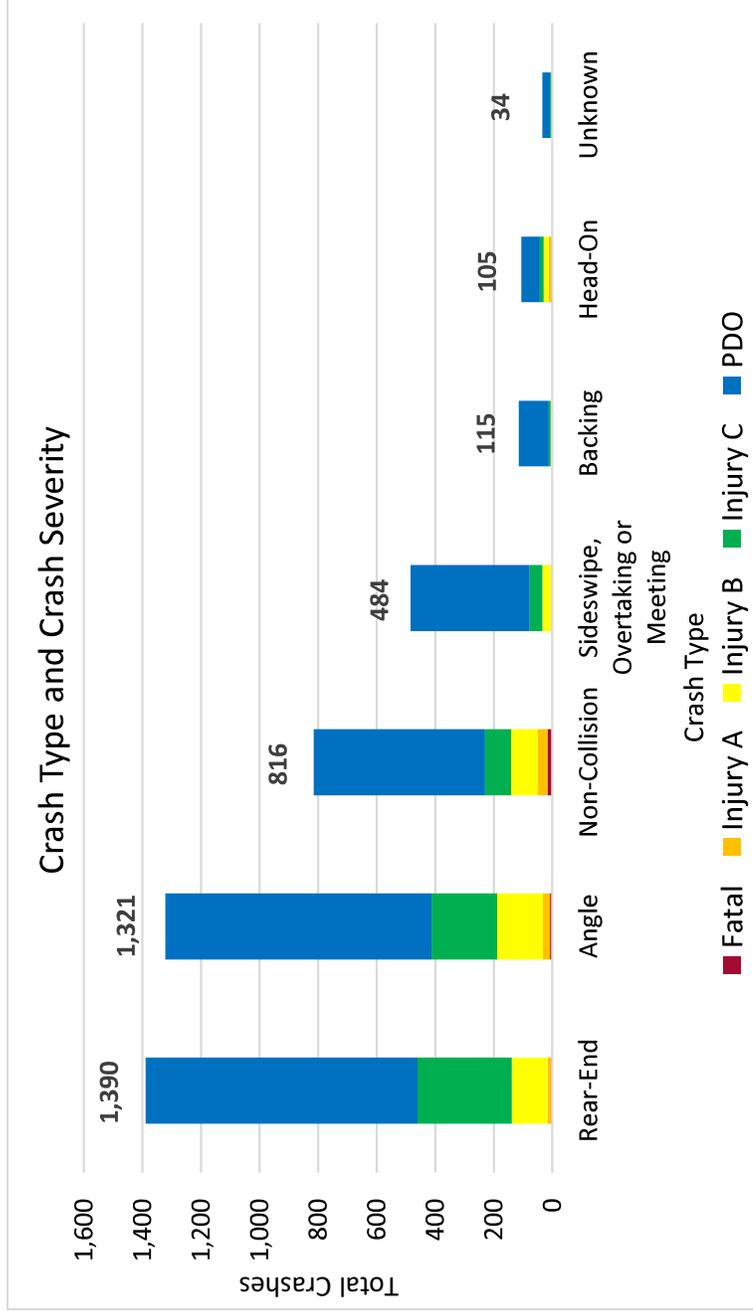
Of the 4,565 crashes that occurred within CAMPO from 2018 to 2022, 4,265 crashes occurred on Local Roads. CAMPO crashes that occurred on Local Roads made up 93.4% of the crashes that occurred within the region. The following section highlights the crashes that occurred on these Local Roads and omits interstate crashes.





**Crash Type**

Crash types were reviewed to gain a better understanding of existing crash factors in the CAMPO region. The most common crash types within the CAMPO region for all crash severities over the last five years were rear-end (1,390, 30.4%) and angle crashes (1,321, 28.9%), as shown in **Figure 5**. Fatal and serious injury crashes within the CAMPO region consisted of rear-end (17, 1.2%), angle (32, 2.4%), non-collision (49, 5.0%), and head-on crashes (11, 10.5%). Fatal and serious injury crashes within the CAMPO region consisted of rear-end (17, 1.2%), angle (32, 2.4%), non-collision (49, 5.0%), and head-on crashes (11, 10.5%). Crash types were a factor in the network screening analysis results further discussed in **Section 4**.



Source: NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NDOT  
 FARS Data (January 1, 2018 to December 31, 2021), provided by NHTSA

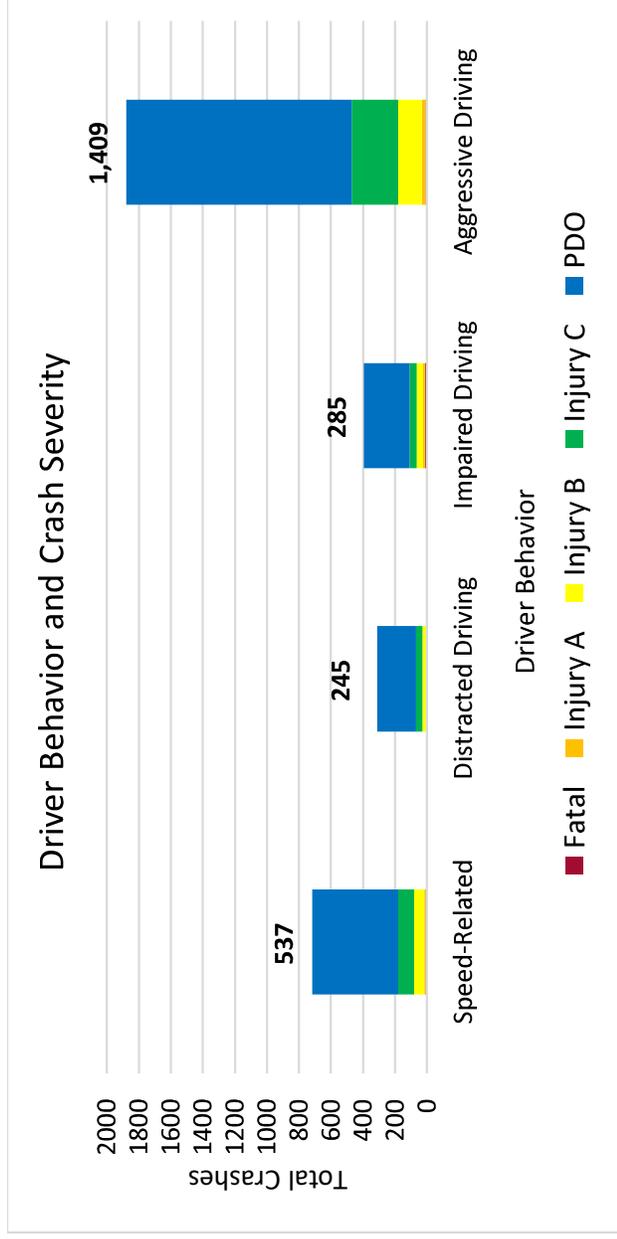
**Figure 5 – Crashes by Crash Type and Injury Severity (2018-2022)**





### Driver Behaviors

The crash data was analyzed for speed-related, distracted driving, impaired driving, and aggressive driving behaviors, which is summarized in **Figure 6**. Aggressive driving resulted in fatal and serious injury crashes (35, 2.5%) more often than other all other driver behaviors. Fatal and serious injury crashes (26, 9.1%) were the result of impaired driving, where fatal crashes most often occurred on local roadway segments (seven crashes, 2.4%) while serious injury crashes most often occurred at unsignalized intersections (eight crashes, 2.8%). Speed-related fatal and serious injury crashes most frequently occurred at unsignalized intersections (6, 5.3%). Of the fatal and serious injury crashes that occurred within the CAMPO region, 8 crashes (7.1%) were events where the driver was reported to exhibit two dangerous driver behaviors, such as speeding and impaired, impaired and distracted, or distracted and speeding. No crashes occurred within the CAMPO region from 2018 to 2022 where the driver was reported to exhibit all three dangerous driver behaviors.



Source: NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NDOT  
 FARS Data (January 1, 2018 to December 31, 2021), provided by NHTSA

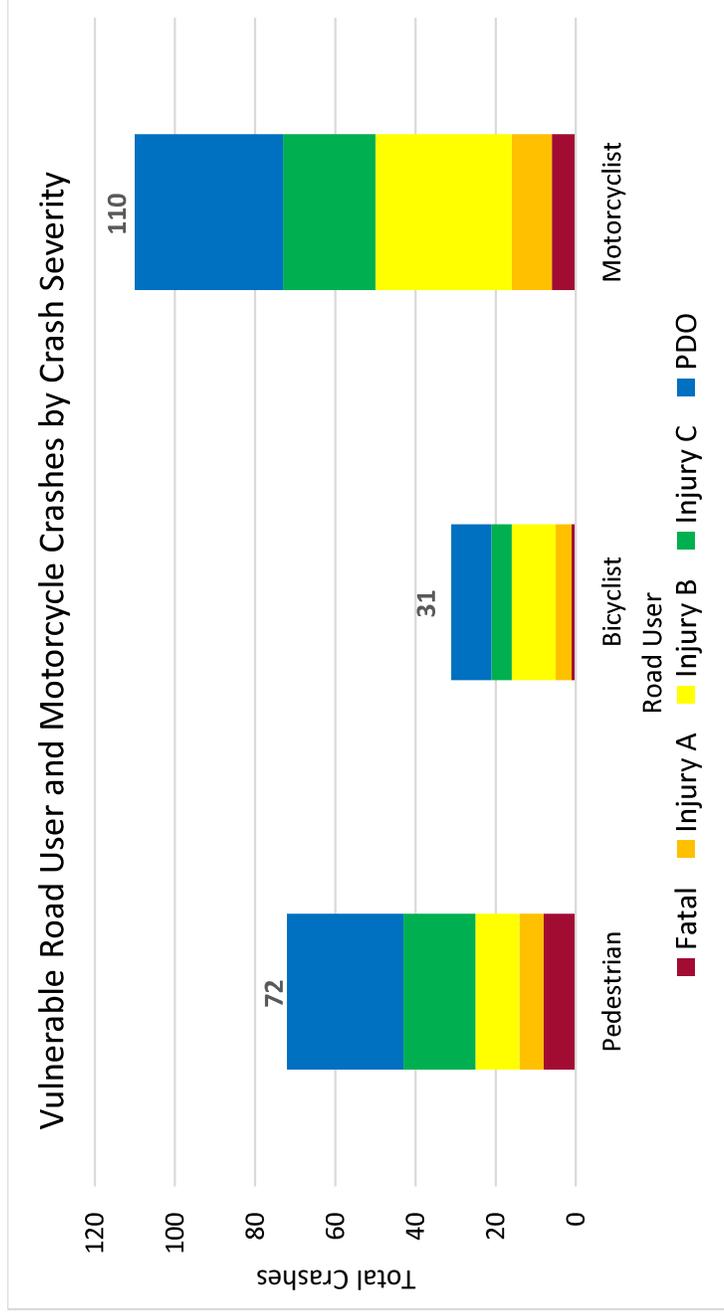
**Figure 6 – Speeding, Distracted Driving, and Impaired Driving Crashes (2018-2022)**





Vulnerable Road Users and Motorcycles

VRUs refer to certain non-motorized road users, such as pedestrians and bicyclists. Motorcyclists were included in the breakdown of other users for this analysis. The breakdown of crashes by VRU and crash severity, in Figure 7, shows that 72 crashes (1.6%) were pedestrian-involved crashes that occurred across CAMPO from 2018 to 2022. Of the pedestrian-involved injury crashes, eight (11.1%) were fatal, and six (8.3%) were reported to have caused serious injury. Bicycle-involved crashes made up 31 crashes (0.7%) that occurred including one fatal (3.2%), and four serious injury crashes (12.9%). Motorcyclists accounted for 110 crashes (2.6%) over the five-year period, including six fatal (5.4%) and 10 serious injury crashes (9.1%). VRU crashes occurred more than twice as frequently at unsignalized intersections than on Local Roads or at signalized intersections.



Source: NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NDOT  
FARS Data (January 1, 2018 to December 31, 2021), provided by NHTSA

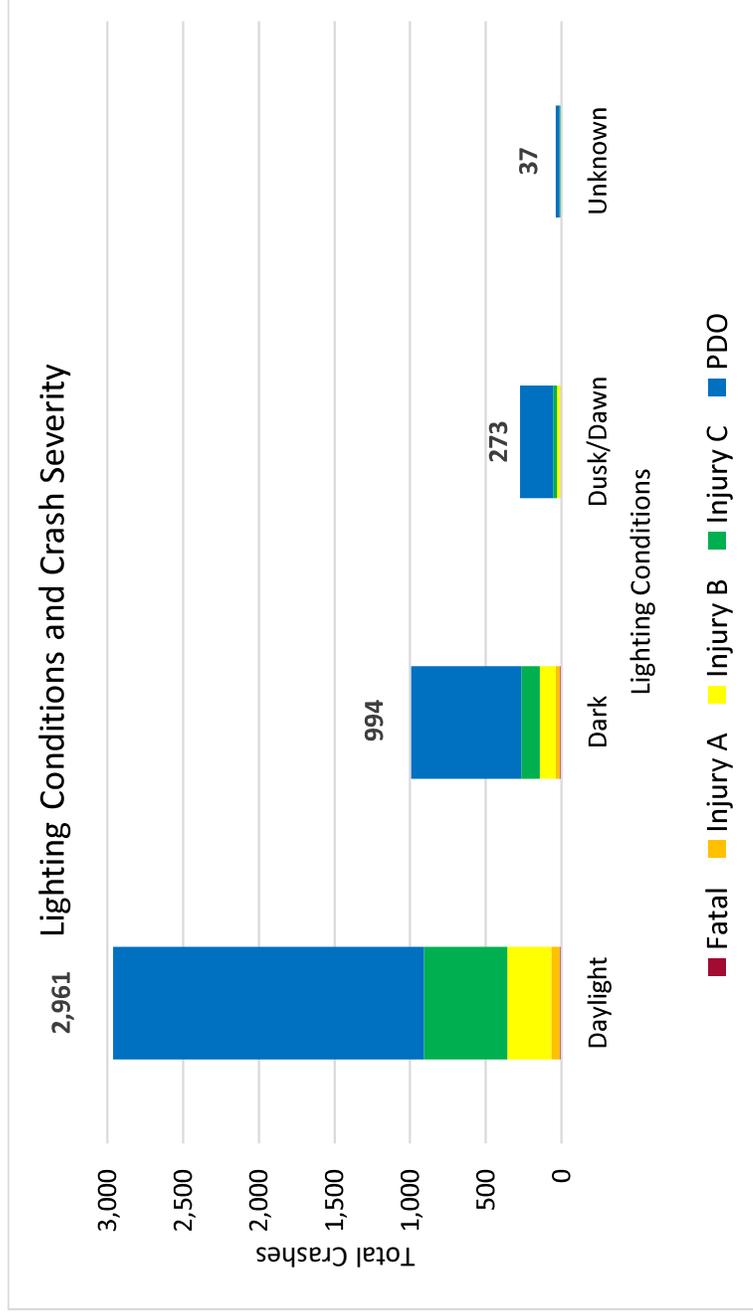
Figure 7 – Pedestrian-, Bicyclist-, and Motorcyclist-Involved Crashes (2018-2022)





Environmental and Roadway Factors

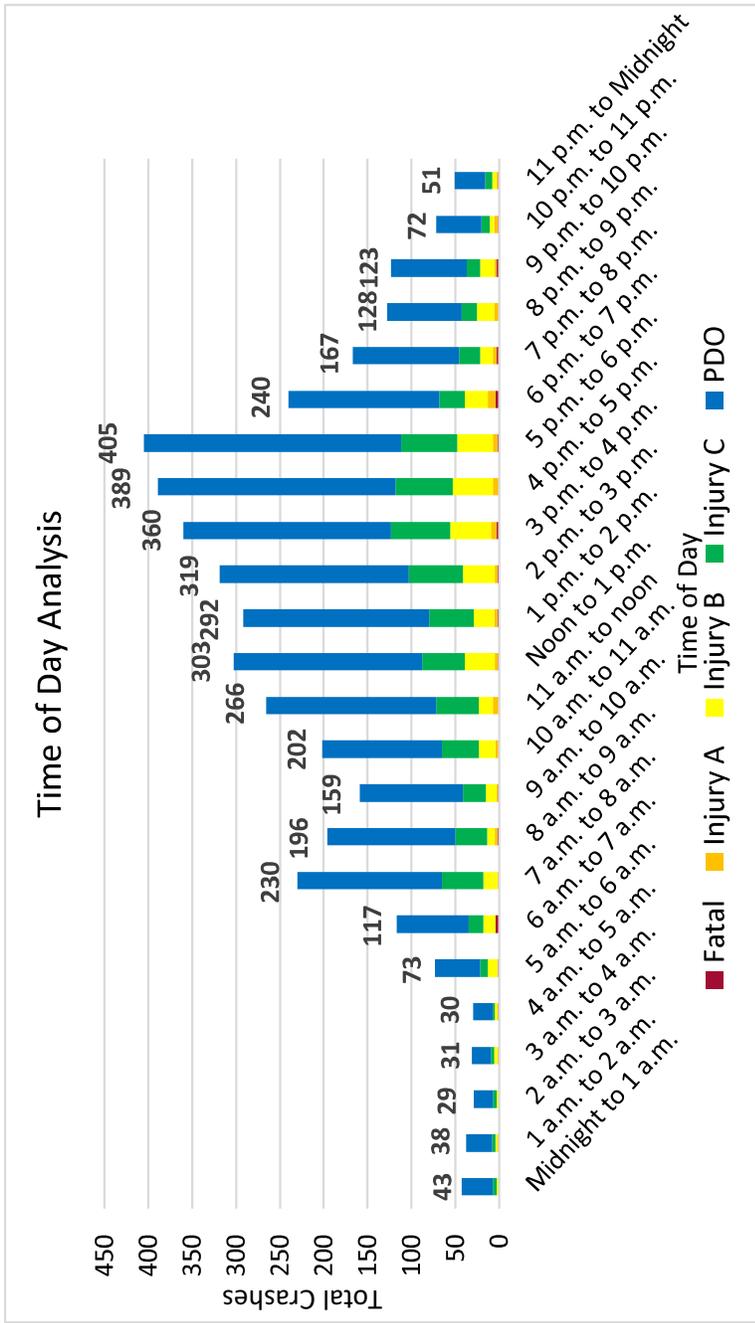
An analysis of the lighting conditions, as summarized in Figure 8, shows fatal crashes occurred about as frequently in daylight (14 crashes, 0.3%) as dark (13 crashes, 0.3%) conditions. The breakdown of crashes by time of day, presented in Figure 9, shows the frequency of fatal and serious injury crashes increases during the typical AM and PM peak periods (6 AM to 9 AM, and 5 PM to 8 PM). The two hours with the highest number of fatal crashes during the five-year period were 6 AM to 7 AM (4 fatal crashes, 0.09%), and 6 PM to 7 PM (4 fatal crashes, 0.09%).



Source: NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NDOT  
FARS Data (January 1, 2018 to December 31, 2021), provided by NHTSA

Figure 8 – Crashes by Lighting Condition and Injury Severity (2018-2022)





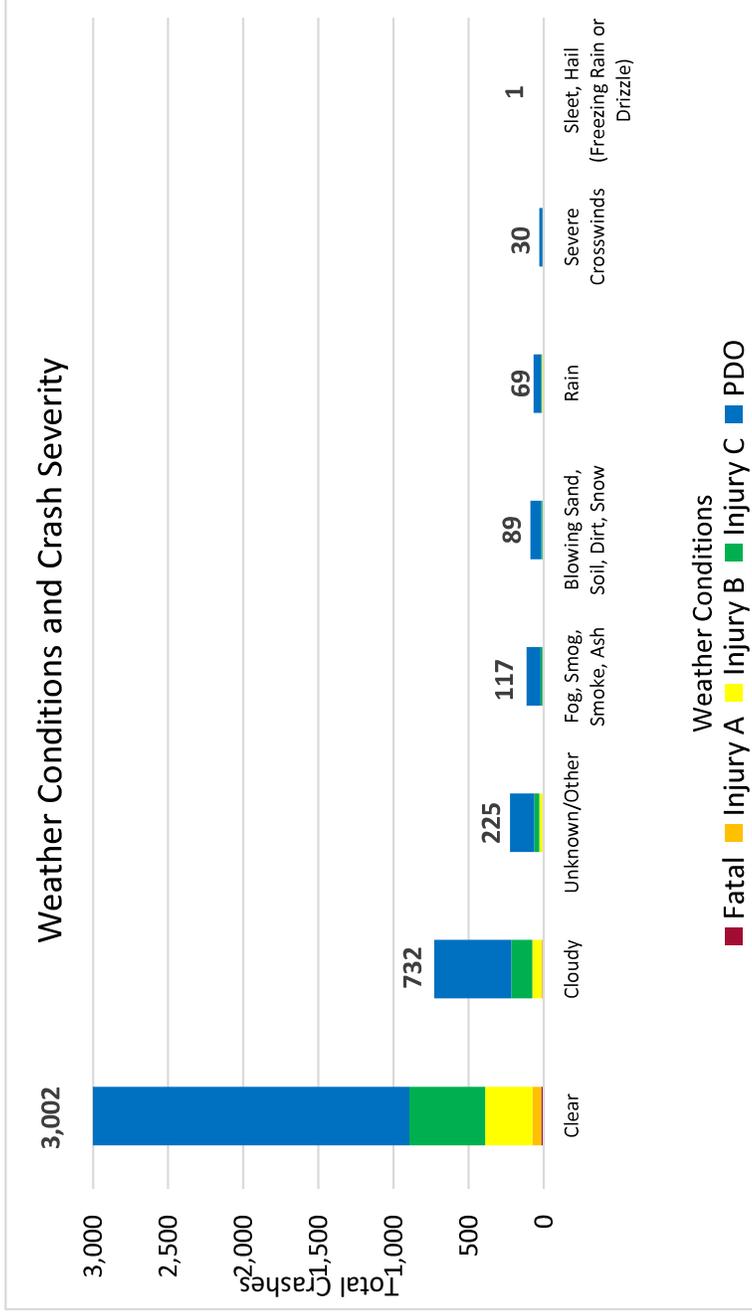
Source: NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NDOT  
 FARS Data (January 1, 2018 to December 31, 2021), provided by NHTSA

**Figure 9 – Crashes by Time of Day and Injury Severity (2018-2022)**





Weather does not appear to be factor in the majority of crashes in the CAMPO region as most crashes occurred during clear conditions. A breakdown of crashes by the most common weather conditions is reported in **Figure 10**. Rainy and snowy conditions accounted for less than 1% of the crashes combined.



Source: NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NDOT  
 FARS Data (January 1, 2018 to December 31, 2021), provided by NHTSA

**Figure 10 – Crashes by Environmental Factors and Injury Severity (2018-2022)**





**Fatal and Serious Injury Crashes on Local Roads**

A summary of fatal and serious injury crashes that occurred on Local Roads, broken down by control type, is shown in **Table 5**, which omits interstate crashes. Local Road segment crashes were further divided by function classification as seen in **Table 6**.

**Table 5 – Local Road Fatal and Serious Injury Crashes by Control Type (2018-2022)**

Injury Severity	Total Crashes		Local Road Segment		Signalized Intersections		Unsignalized Intersections	
K	31	27.6%	10	32.2%	7	22.6%	14	45.2%
A	81	72.3%	21	25.9%	22	27.2%	38	46.9%
<b>Total</b>	<b>112</b>	<b>100%</b>	<b>31</b>	<b>27.7%</b>	<b>29</b>	<b>25.9%</b>	<b>52</b>	<b>46.2%</b>

Source: NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NDOT  
 FARS Data (January 1, 2018 to December 31, 2021), provided by NHTSA

**Table 6 –Segment Fatal and Serious Injury Crashes by Functional Classification (2018-2022)**

Injury Severity	Total Segment Crashes		Principal Arterial		Minor Arterial		Major Collector		Minor Collector		Local	
K	10	27.6%	5	50.0%	2	20.0%	1	10.0%	1	10.0%	1	10.0%
A	21	72.3%	3	14.3%	7	33.3%	2	9.5%	5	23.8%	4	19.0%
<b>Total</b>	<b>31</b>	<b>100.0%</b>	<b>8</b>	<b>25.8%</b>	<b>9</b>	<b>29.0%</b>	<b>3</b>	<b>9.7%</b>	<b>6</b>	<b>19.4%</b>	<b>5</b>	<b>16.1%</b>

Source: NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NDOT  
 FARS Data (January 1, 2018 to December 31, 2021), provided by NHTSA

The locations of fatal and serious injury crashes on Local Roads by crash factor are displayed in the following figures.

- Crash Severity – **Figure 11** through **Figure 14**
- Crash Type – **Figure 15** through **Figure 18**
- Driver Behavior – **Figure 19** through **Figure 22**
- VRU and Motorcyclists – **Figure 23** through **Figure 26**







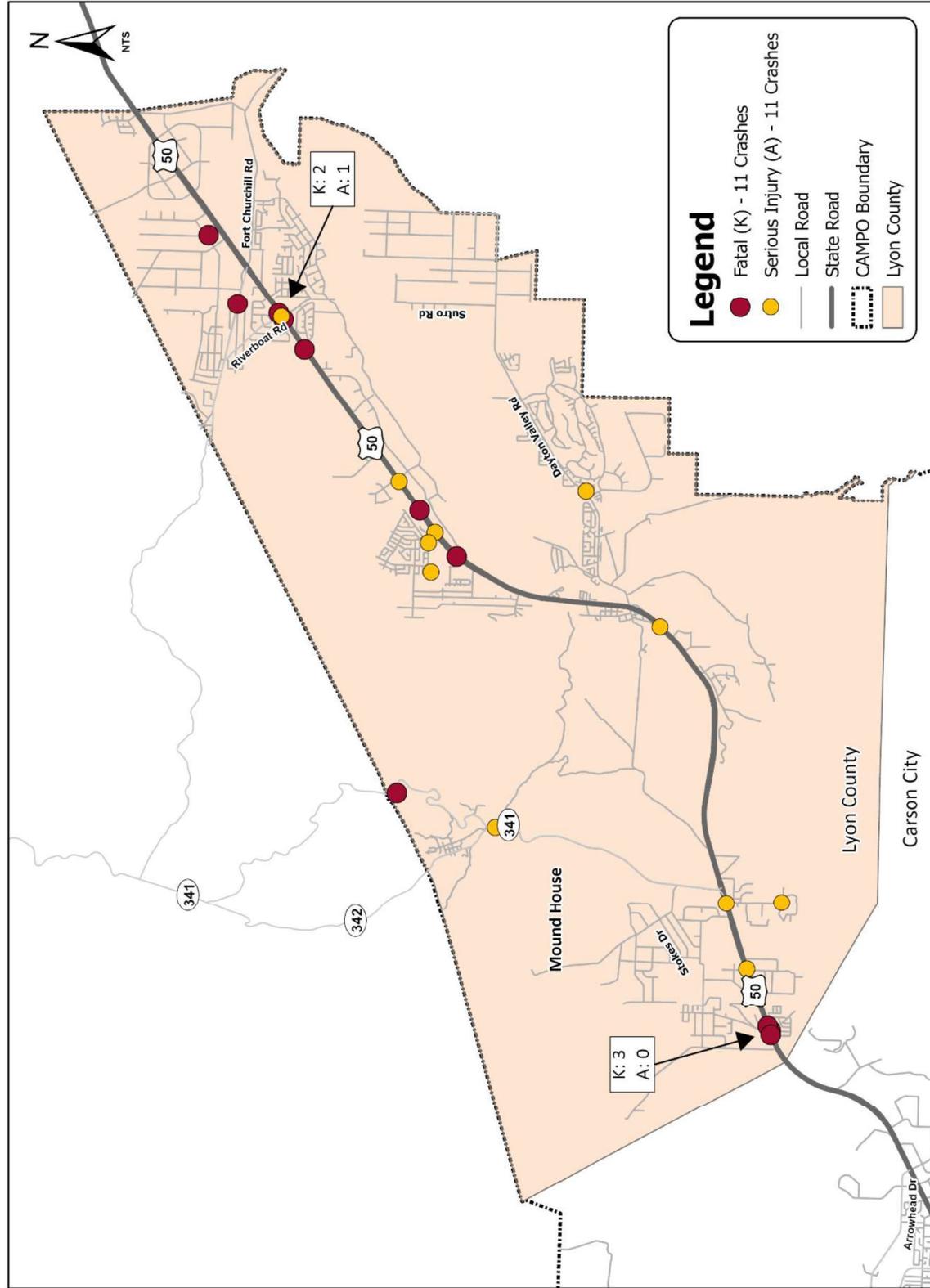


Figure 13 – Lyon County Fatal and Serious Injury Crashes on Local Roads (2018-2022)



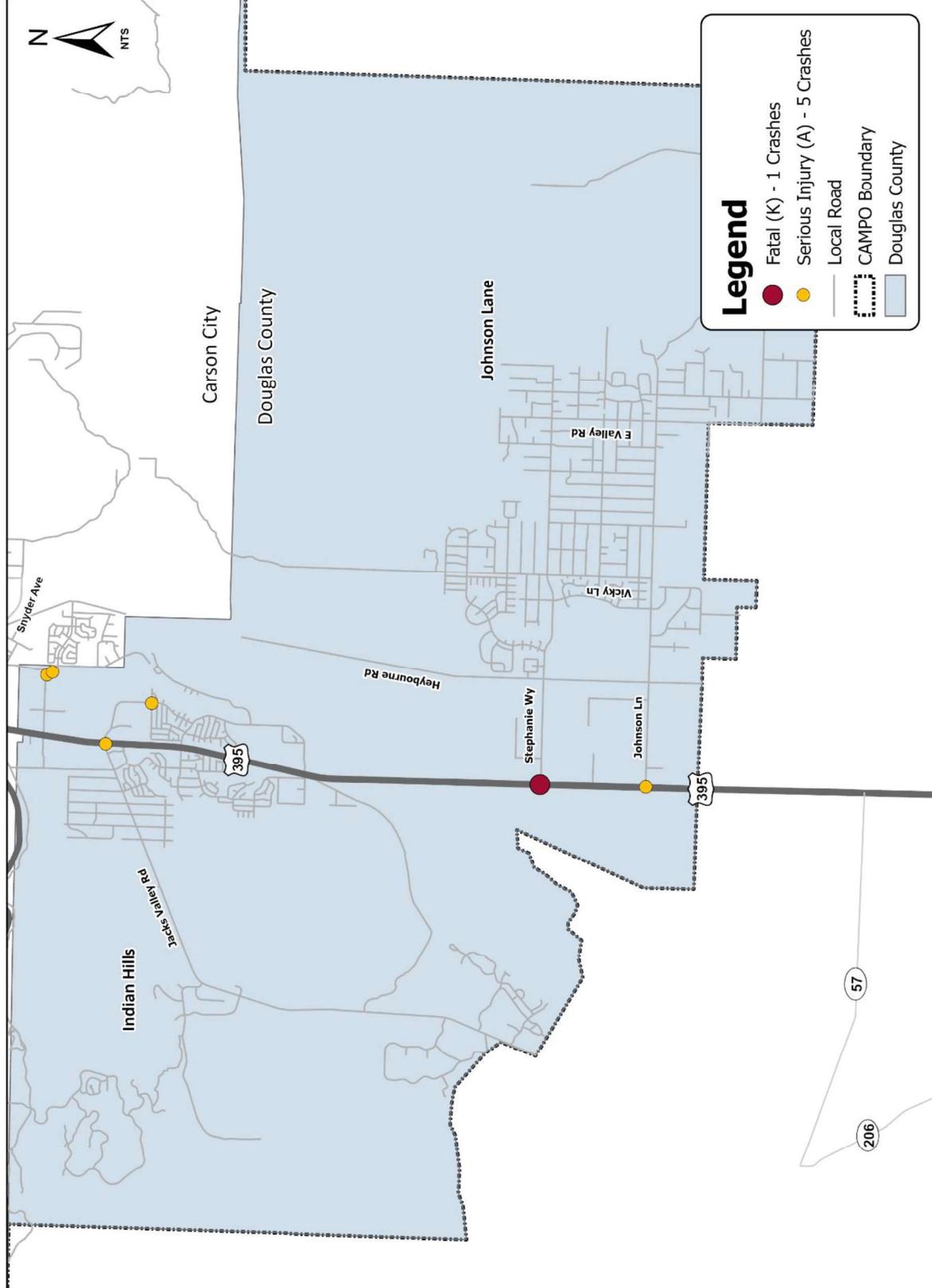


Figure 14 – Douglas County Fatal and Serious Injury Crashes on Local Roads (2018-2022)



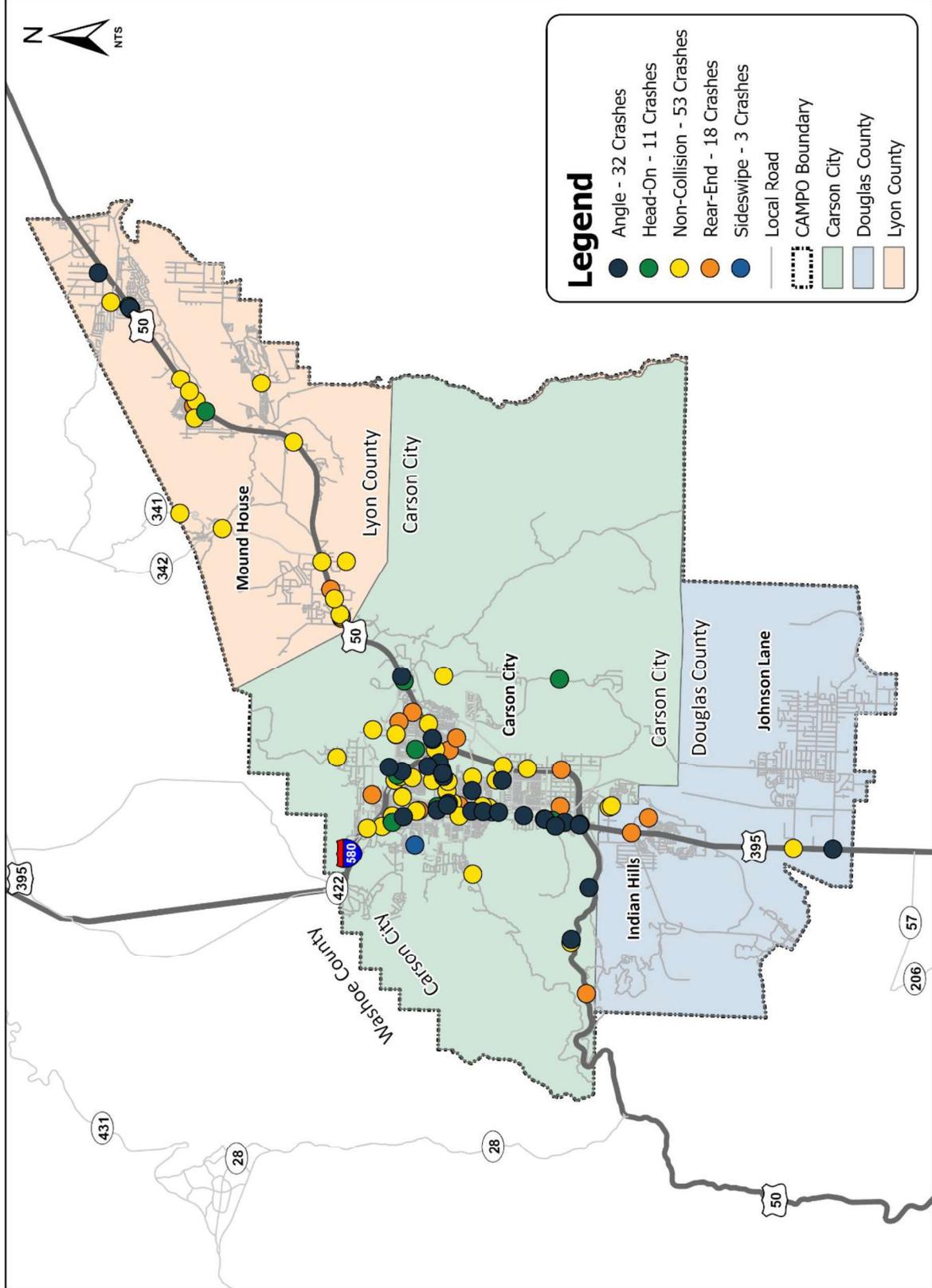


Figure 15 – Fatal and Serious Injury Crashes by Crash Type in CAMPO Region (2018-2022)









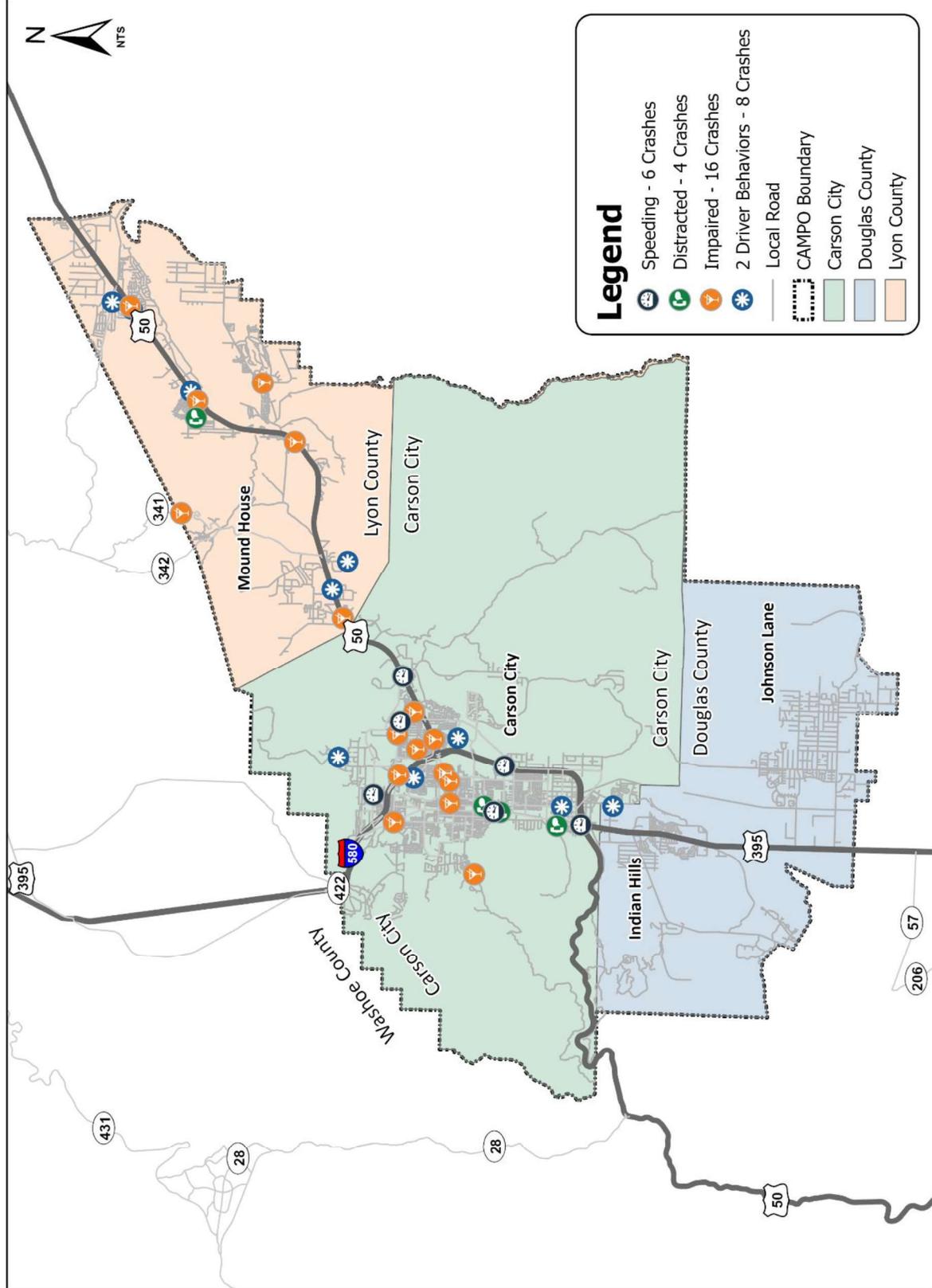


Figure 19 – Fatal and Serious Injury Crashes by Driver Behavior in CAMPO Region (2018-2022)



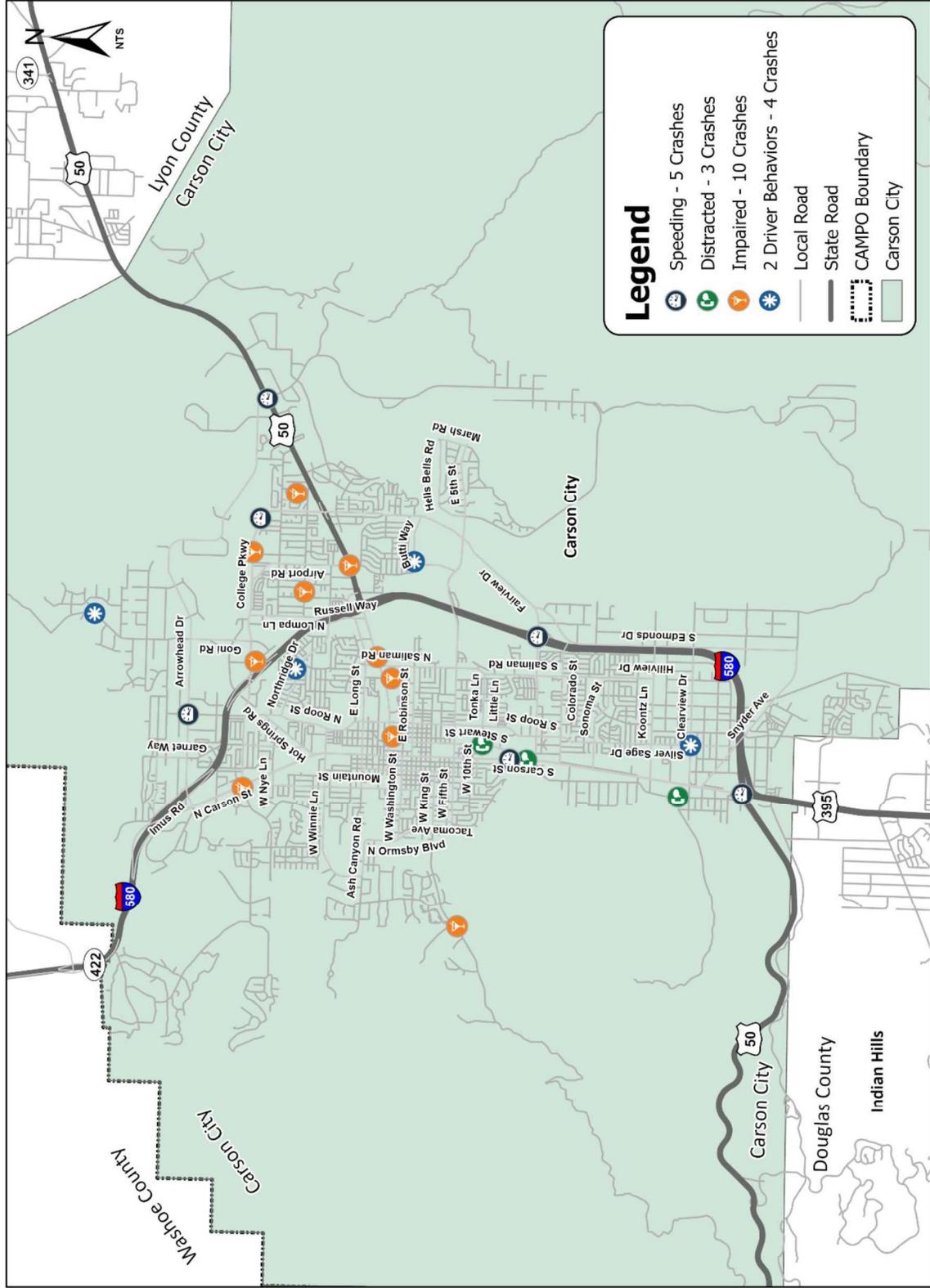


Figure 20 – Fatal and Serious Injury Crashes by Driver Behavior in Carson City (2018-2022)



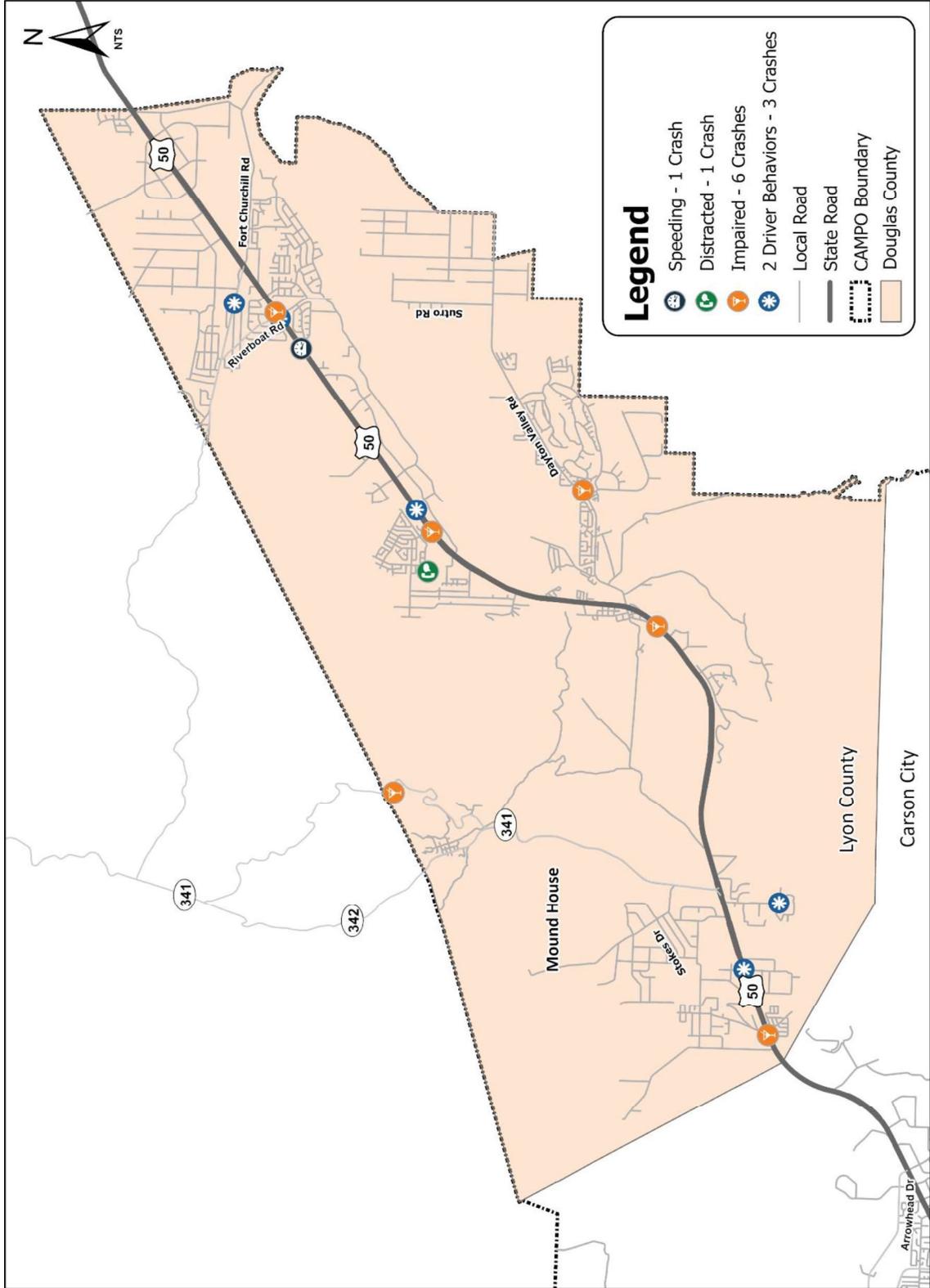


Figure 21 – Fatal and Serious Injury Crashes by Driver Behavior in Lyon County (2018-2022)



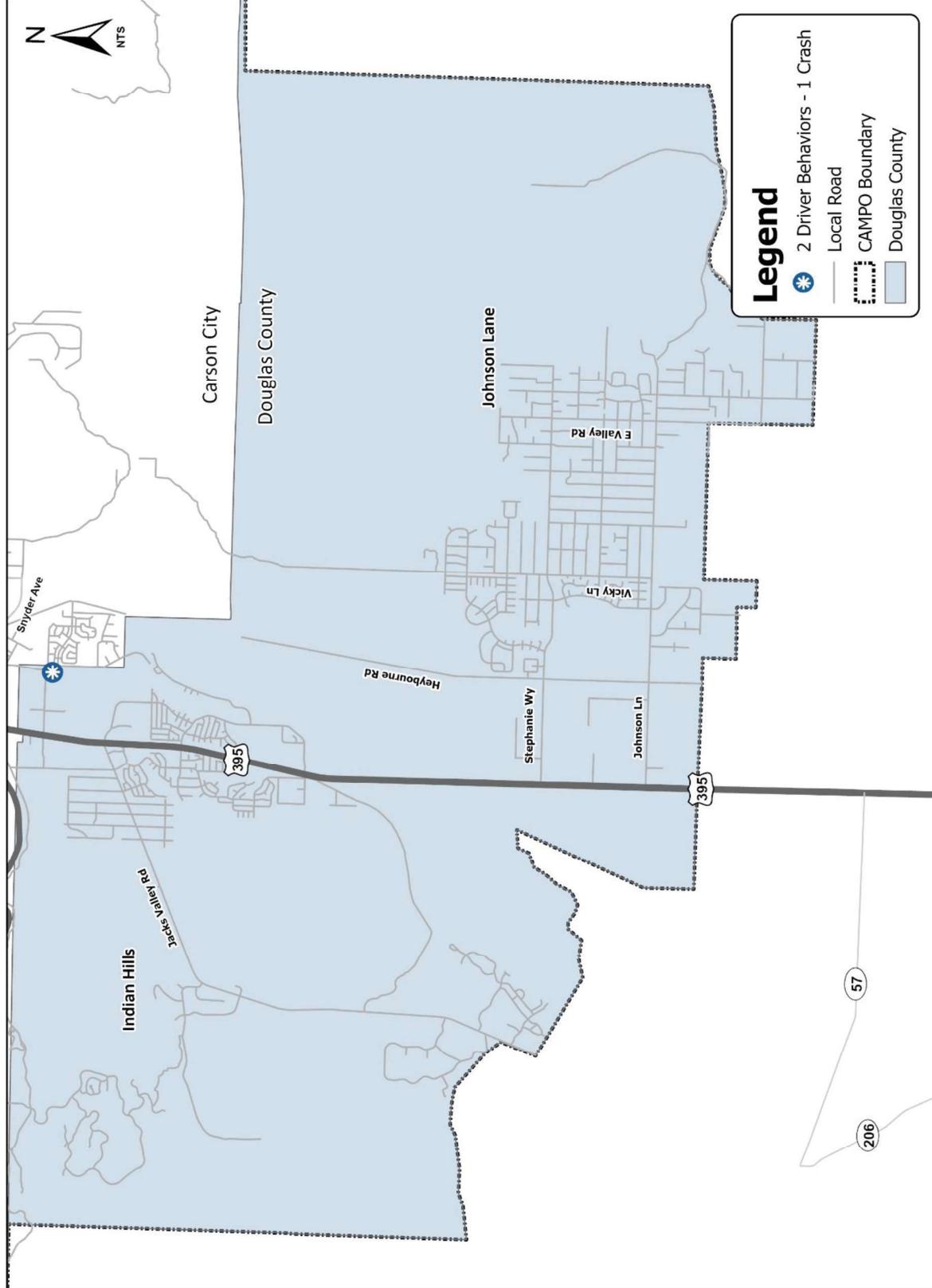


Figure 22 – Fatal and Serious Injury Crashes by Driver Behavior in Douglas County (2018-2022)



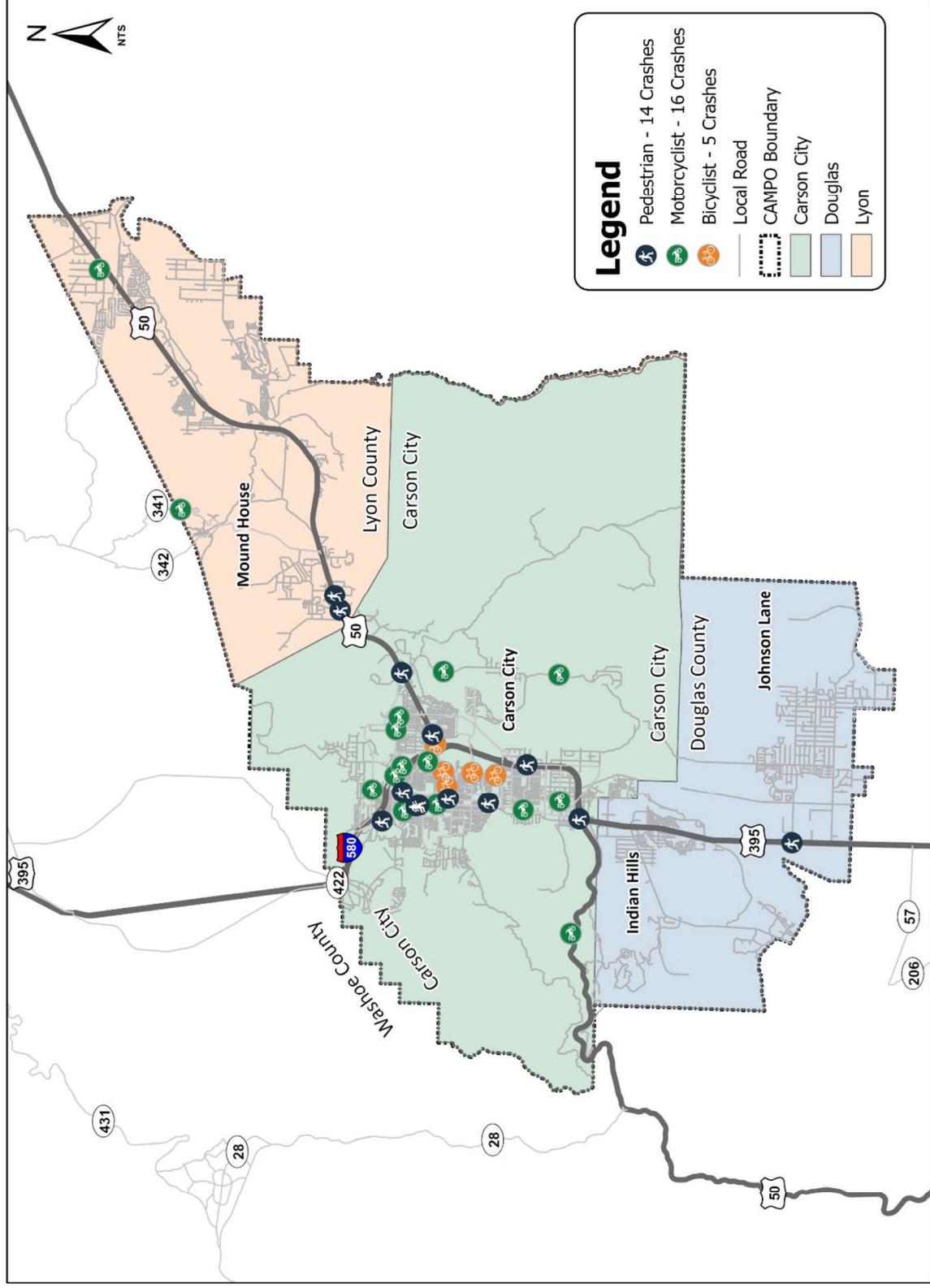


Figure 23 – Fatal and Serious Injury Crashes Involving Vulnerable Road Users and Motorcyclists in CAMPO Region (2018-2022)



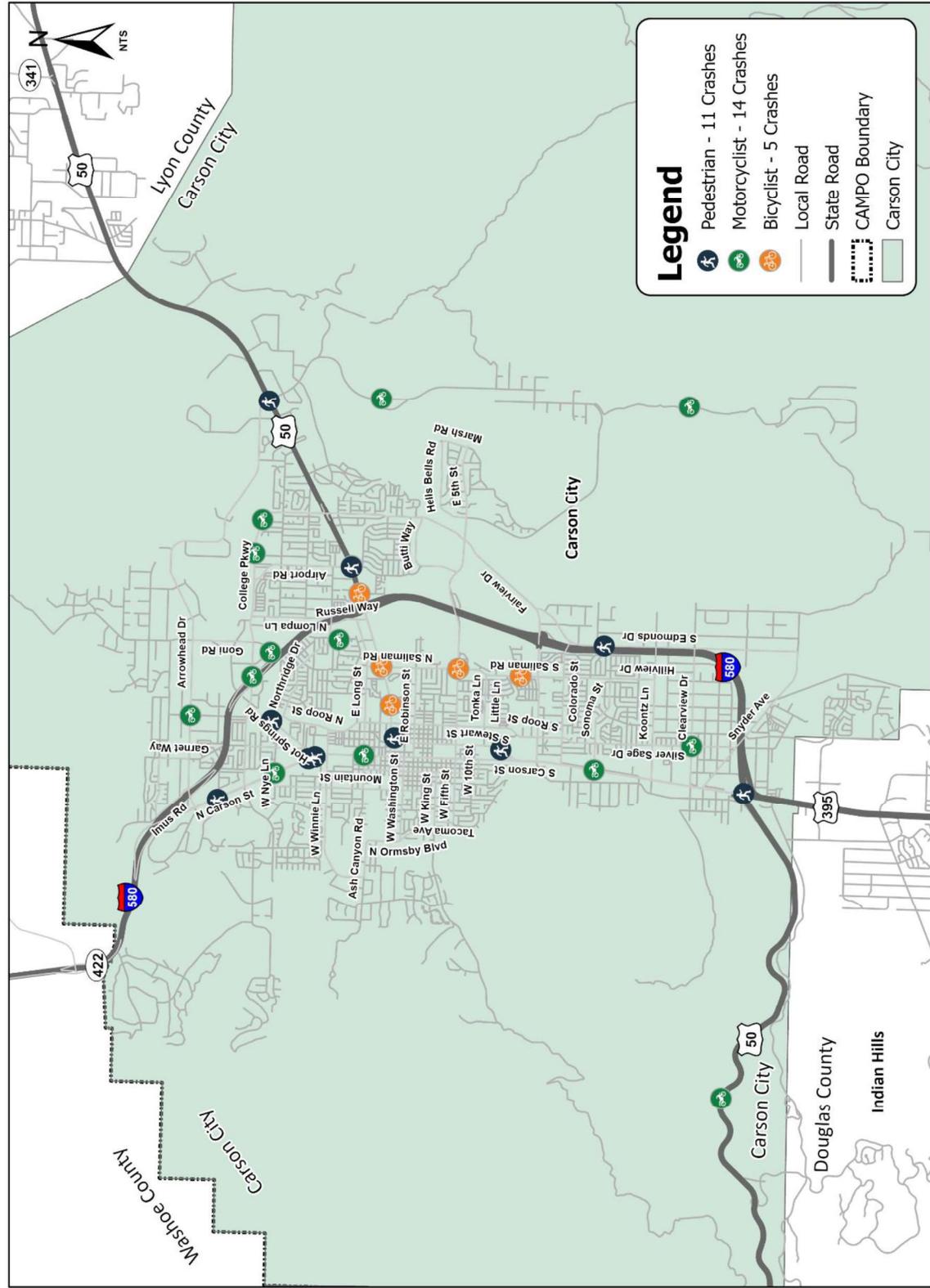


Figure 24 – Fatal and Serious Injury Crashes Involving Vulnerable Road Users and Motorcyclists in Carson City (2018-2022)



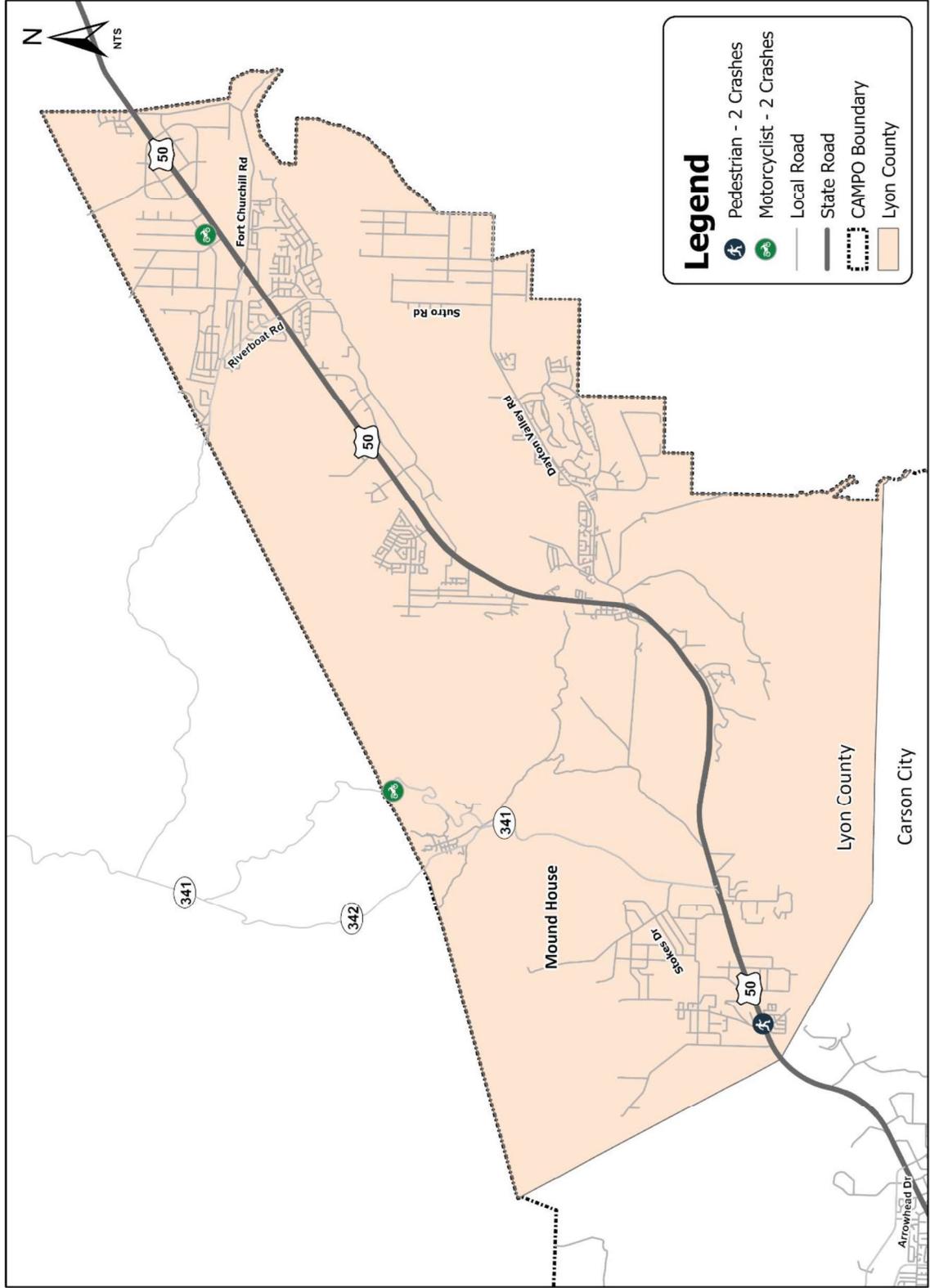


Figure 25 – Fatal and Serious Injury Crashes Involving Vulnerable Road Users and Motorcyclists in Lyon County (2018-2022)



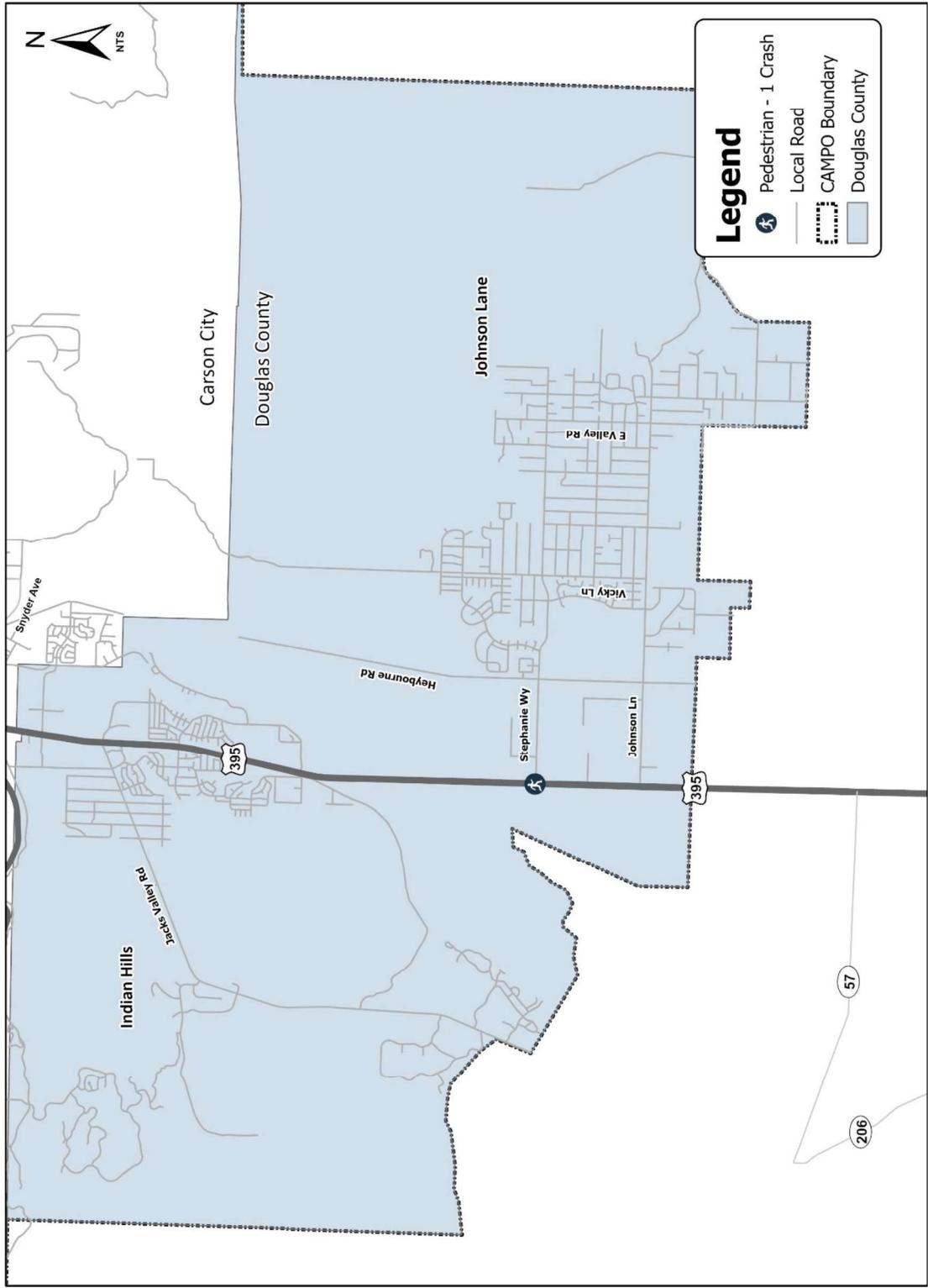


Figure 26 – Fatal and Serious Injury Crashes Involving Vulnerable Road Users and Motorcyclists in Douglas County (2018-2022)





#### 4.4. Key Takeaways from Crash Data

- Though there has been a decrease in the number of crashes between 2018 and 2022, there has been an increase in the number of fatal and serious injury crashes over that same time period.
- Four of the top five CEAs identified for CAMPO (Impaired Driving, Intersections, Speed-Related, and Pedestrians) are also top CEAs at the statewide level.
- Crashes on Local Roads made up 4,265 (93.4%) crashes within the region from 2018 to 2022. 300 (6.6%) crashes occurred on interstate in the same time frame.
- Segment crashes from 2018 to 2022 accounted for 929 crashes (20.4%)
- Intersection crashes accounted for 3,336 crashes (73.0%). Crashes occurring at signalized intersections accounted for 30.5% of all crashes, while crashes that occurred at unsignalized intersections made up 42.5% of all crashes.
- The most common crash types within the CAMPO Region for all crash severities over the last five years were rear-end (1,390, 30.4%) and angle crashes (1,321, 28.9%).
- Crashes on principal arterials occurred more than three times as often as crashes on any other functional classification.
- Crashes that occurred at unsignalized intersections tend to be more severe.
  - Of the crashes that occurred at unsignalized intersections, 14 (45.2%) were fatal crashes and 38 (46.9%) were serious injury crashes.
  - Of crashes that occurred at signalized intersections, 7 (22.6%) were fatal crashes and 22 (27.2%) were serious injury crashes.
  - Of crashes on segments, 10 (32.2%) were fatal crashes and 21 (25.9%) were serious injury crashes.
- Pedestrians were involved in 72 (1.6%) crashes from 2018 to 2022. Of the pedestrian-involved injury crashes, eight (11.1%) were fatal, and six (8.3%) were reported to have caused serious injury.
- Bicycle-involved crashes made up 31 (0.7%) crashes that occurred including one fatal (3.2%), and four serious injury crashes (15.6%).
- Motorcyclists accounted for 110 crashes (2.6%) over the five-year period, including six fatal (5.4%) and 10 serious injury crashes (9.1%).
- Pedestrian and bicycle crashes occurred most often at unsignalized intersections.
- Crashes occurred most often in daylight conditions (2,961, 69.4%), followed by dark conditions, with or without lighting (994, 23.3%).





- The two hours with the highest number of fatal crashes during the five-year period were 6 AM to 7 AM (4 fatal crashes, 0.09%), and 6 PM to 7 PM (4 fatal crashes, 0.09%).
- Weather does not appear to be a contributing factor in crashes as the majority of crashes occurred during clear and cloudy weather conditions. Rainy and snowy conditions accounted for less than 1% of the crashes combined.





## 5. NETWORK SCREENING METHODOLOGY

The following section describes the analysis process undertaken to evaluate safety within CAMPO using a network screening process to identify locations that will most likely benefit from safety enhancements based on historic crash data and crash risk factors for the entire network. The outcomes informed the identification and prioritization of engineering and non-infrastructure safety countermeasures that address certain roadway characteristics and related behaviors that contribute to motor vehicle crashes as well as active transportation users. This process uses the latest national and state best practices for statistical roadway analysis described in the following sections. Intersections and roadways were analyzed using four crash metrics:

- Number of Crashes
- CCR (HSM Ch. 4)
- Probability of Specific Crash Types Exceeding Threshold Proportion (HSM Ch. 4)
- EPDO (HSM Ch. 4)

The initial steps of the crash analysis established sub-populations of roadway segments and intersections that have similar characteristics. For this LRSP, intersections were grouped by their control type (signalized and unsignalized) and segments by their functional classification (Principal Arterial, Minor Arterial, Major Collector, Minor Collector, and Local). Individual crash rates were calculated for each sub-population. The population level crash rates were then used to assess whether a specific location has more or fewer crashes than expected. These sub-populations were also used to determine typical crash patterns to help identify locations where unusual numbers of specific crash types are occurring.

The network screening process ranked intersections and roadway segments by the number of crashes that occurred at each location over the analysis period, and then identified areas that had more of a given type of crash than would be expected for that type of location. These crash factors were:

- **Crash Severity** – fatal, serious injury, non-incapacitating injury, possible injury, and PDO
- **Crash Type** – angle, rear-end, sideswipe, head-on, hit object, and overturned
- **Driver Behavior** – aggressive, impaired, and distracted driving
- **VRU and Motorcyclists** – pedestrian-, bicyclist-, and motorcyclist-involved crashes
- **Environmental Factors** – lighting and roadway conditions





From the results of the network screening analyses, a list of locations was chosen based on crash activity, CCR, crash severity, crash patterns, location type, and area within the CAMPO region to provide the greatest variety of locations covering the widest range of safety opportunities.

### **5.1. Network Screening Analysis**

The network screening process ranked intersections and roadway segments by the number of crashes that occurred at each location over the analysis period, and then identified areas that had over representation on various crash factors that would be expected for the facility type and location. From the results of the network screening analyses, a short-list of locations was chosen based on crash activity, crash severity, crash patterns, and location type to provide a variety of locations covering a wide cross section of safety challenges and improvement opportunities. Ten locations will be selected for mitigation analysis, and project sheets with site-specific improvements will be developed.

### **5.2. Critical Crash Rate**

The HSM, developed by AASHTO, describes the CCR method, which provides a statistical review of locations to determine where risk is higher than that experienced by other similar locations. It is also the first step in analyzing for patterns that may suggest systemic issues that can be addressed at that location, and proactively at others to prevent new safety challenges from emerging.

The CCR analysis compares the observed crash rate to the expected crash rate at a particular location based on facility type and traffic volume using a locally calculated average crash rate for the specific type of intersection or roadway segment being analyzed. Based on traffic volumes and a weighted crash rate for each facility type, a CCR threshold is established at the 95-percent confidence level to determine locations with higher crash rates that are unlikely to be random. The threshold is calculated for each location individually based on its traffic volume and the crash profile of similar facilities. The local CCR differential is the difference in CCR of a particular facility and the average crash rate for a similar facility within the region. A CCR differential value of greater than zero reflects a location that has a higher crash rate than facilities with similar volumes, while a negative CCR differential value signifies a below-average crash rate. It should be noted that the CCR does not reflect the severity of the crashes occurring at the location, but rather the number of crashes for the given volume.





### CCR Formula

$$R_{c,i} = R_a + \left[ P \times \left[ \sqrt{\frac{R_a}{MEV_i}} \right] + \left[ \frac{1}{(2 \times (MEV_i))} \right] \right]$$

Where,

$R_{c,i}$  = CCR for intersection i

$R_a$  = Weighted average crash rate for reference population

P = P-value for corresponding confidence level

$MEV_i$  = Million entering vehicles for intersection i

### Data Needs

CCR is calculated using:

- Daily Entering Volume (DEV) for intersections, or Vehicle Miles Traveled (VMT) for roadway segments
- Intersection control types to separate them into like populations
- Roadway functional classification to separate them into like populations
- Crash records in Geographic Information Systems (GIS) or tabular form including coordinates or linear measures

### Strengths

- Reduces low volume exaggeration
- Considers variance
- Establishes comparison threshold

### Weaknesses

- Does not account for regression to the mean bias

Source: HSM





### 5.3. Equivalent Property Damage Only

The EPDO method is described in the HSM. This method assigns weighting factors to crashes based on injury level (fatal, serious injury, non-incapacitating injury, possible injury) to develop a PDO score. An EPDO score allows for a fair comparison of crash severity across years or study periods, as this normalized unit considers inflation and cost escalation. Using the EPDO methodology normalizes the data and accounts for the increase in cost from inflation. In this analysis, the injury crash costs were calculated for each location; this value is then divided by the injury cost for a PDO crash. The resulting number is the equivalent number of PDO crashes at each site. This value allows all locations to be compared based on injury crash costs (HSM, Chapter 4).

**EPDO Formula:**

$$EPDO = \frac{(N_K * 7,286,652) + (N_A * 987,209) + (N_B * 141,477) + (N_C * 79,850)}{12,951}$$

Where,

EPDO = Equivalent Property Damage Only (in units of crashes)

N<sub>K</sub> = Number of fatal crashes

N<sub>A</sub> = Number of serious injury crashes

N<sub>B</sub> = Number of non-incapacitating injury crashes

N<sub>C</sub> = Number of possible injury crashes

The crash cost per event, in 2023 dollars, for each crash type along roadway segments is as follows:

- Fatal: \$7,286,652
- Serious Injury: \$987,209
- Non-incapacitating Injury: \$141,477
- Possible Injury: \$79,850
- PDO: \$12,951





### Data Needs

EPDO is calculated using:

- Crash records in GIS or tabular form including coordinates or linear measures
- Intersection control types to separate them into like populations
- Roadway functional classification to separate them into like populations
- EPDO cost to society weighting factors

### Strengths

- Simple
- Considers crash severity

### Weaknesses

- Does not account for regression to the mean bias
- Does not identify a threshold to indicate sites experiencing more crashes than predicted for sites with similar characteristics
- Does not account for traffic volume
- May emphasize locations with a low frequency of severe crashes

Source: HSM

## 5.4. Network Screening Results

An inventory of all roadway segments and intersections with three or more crashes was conducted, and based on the results, 20 preliminary locations, made up of 10 segments, five signalized and five unsignalized intersections were identified for further discussion and potential prioritization for low-cost safety countermeasures. The identification of the 20 locations utilized the network screening results such as the local CCR differential, EPDO score, and crash patterns or clusters of crashes to determine each location. The local CCR is the maximum crash rate expected to occur at that location within the study area. EPDO weighs factors related to the societal costs of fatal, injury, and property damage-only crashes and is assigned to crashes by severity to develop an EPDO score that considers the frequency and severity of crashes.

Segments or intersections that did not rank high based solely on crash history, through the use of the local CCR differential and EPDO score, but that shared similar roadway characteristics to locations with high local CCR differential and EPDO score can benefit from applications of countermeasures systemically. Incorporating this approach allows agencies to manage risk, especially on rural and local low volume roadways where crashes can be spread out with minimal repeat crashes at a given location, or where crash history does not exist. For example, portions from E College Parkway from I-580 to US-50 had a high local CCR differential while others did not, in





this case, the entire segment of E College Parkway from I-580 to US-50 was selected since the roadway segment had similar characteristics that could improve safety along the entire corridor even when crash history did not exist at those locations.

These priority locations are segments at which improvements can be made based on the identification of subsegments from the network screening analysis. The top five signalized and unsignalized preliminary priority intersections are listed in **Table 7** and **Table 8**, respectively. The top 10 preliminary priority segments are listed in **Table 9**.

**Table 7 – Preliminary List of Locations (Signalized Intersections)**

Intersection	Crashes	Local CCR Differential	EPDO
S Carson Street/US-395 & US-50/I-580	121	0.30	1,469
Airport Road & William Street	54	0.01	1,284
N Saliman Road & US-50	49	0.28	180
Emerson Drive & E College Parkway	43	0.32	118
S Saliman Road & Fairview Drive	26	0.98	185

**Table 8 – Preliminary List of Locations (Unsignalized Intersections)**

Intersection	Crashes	Local CCR Differential	EPDO
N Carson Street & W Nye Lane	25	0.39	704
Cardelli Road & US-50	17	0.09	713
Goni Road & Old Hot Springs Road	11	0.51	208
Hot Springs Road & Pine Lane	9	0.57	170
S Edmonds Drive & Clearview Drive	8	1.10	104





**Table 9 – Preliminary List of Priority Locations (Segments)**

Segment	Identified Subsegment			Crashes	Local CCR Differential	EPDO
	Subsegment	Cross Street 1	Cross Street 2			
S Carson Street from US-50 to Stewart Street (2.27 mi)	US-395N/S Carson Street	W Appian Way	I-50/I-580	18	0.89	18
E College Parkway from I-580 to US-50 (2.21 mi)	E College Pkwy	E Nye Lane	Lukens Lane	7	0.24	98
	E College Pkwy	US-50	Sherman Lane	7	1.93	11
N Carson Street from Long Street to I-580 (2.07 mi)	N Carson Street	Hot Springs Road	W Nye Lane	12	0.30	121
S Curry Street from Lake Glen Drive to Curry Circle (1.02 mi)	S Curry Street	Curry Circle	Lake Glen Drive	7	0.82	34
William Street from Minnesota Street to I-580 (1.50 mi)	E William Street	Humboldt Lane	Rand Street	7	0.28	76
S Curry Street from Koontz Lane to Clearview Drive (0.39 mi)	S Curry Street	W Clearview Drive	Koontz Lane	6	1.76	87
Saliman Road from Long Street to Fairview Drive	Saliman Rd	Seely Loop	US-50	4	0.74	23
Topsy Lane from US-395 to Center Drive (0.62 mi)	Topsy Ln	Lyla Lane	Center Drive	4	0.75	163
Sierra Vista Lane from Pinion Hills Drive to Mexican Dam Road (1.9 mi)	Sierra Vista Ln	Pinion Hills Drive	Mexican Dam Road	5	1.78	76
Research Way from Goni Road to E College Parkway (0.22 mi)	Research Way	Goni Road	E College Parkway	3	10.69	580





The top three roadway segments with the highest local CCR differential values were:

- Research Way from Goni Road to East College Parkway (10.69)
- College Parkway from US-50 to Sherman Lane (1.98)
- Sierra Vista Lane from Pinion Hills Drive to Mexican Dam Road (1.78)

The top three roadway segments with the EPDO values are:

- Research Way from Goni Road to East College Parkway (580)
- Topsy Lane from Lyla Lane to Center Drive (163)
- N Carson Street from Hot Springs Road to Nye Lane (121)

The top three intersections with the highest local CCR differentials were:

- S Edmonds Drive and Clearview Drive (1.10)
- S Saliman Rd & Fairview Dr (0.98)
- Hot Springs Road and Pine Lane (0.57)

The top three intersections with the EPDO values are:

- South Carson Street/US-395 and US-50/ I-580 (1,469)
- Airport Road and William Street (1,284)
- Cardelli Road and US-50 (713)

The final list of priority locations was selected from the criteria presented in the Network Screening Analysis and based on input from stakeholders. Eight of the 10 priority locations were selected from the list of preliminary priority locations, while the intersections in Lyon and Douglas counties were selected based on stakeholder input and the desire to include locations from each of the three counties within the CAMPO region as part of the LRSP process. A field review of the 10 priority locations will be conducted to identify issues and concerns and apply recommendations that are both location-specific and systemic. The final list of priority intersections is shown in **Table 10** and the list of priority segments is shown in **Table 11**. The priority locations are displayed in **Figure 27**. The results of the network screening analysis are shown in **Attachment B** and **Attachment C**. All intersections and roadway segments with three or more crashes are presented in **Attachment B** and **Attachment C**, respectively. The appendices are color-coded to highlight crash trends and emphasis areas for further study and development.





**Table 10 – List of Priority Intersections**

Intersection	Crashes
US-395 & Topsy Lane (Signalized)	78
Airport Road & US-50 (Signalized)	54
N Carson Street & W Nye Lane (Unsignalized)	25
Goni Road & Old Hot Springs Road (Unsignalized)	11
Highlands Drive & US-50 (Unsignalized)	6

**Table 11 – List of Priority Segments**

Segment	Crashes
S Carson Street from US-50 to Stewart Street (2.27 mi)	208
N Carson Street from Long Street to I-580 (2.07 mi)	163
E College Parkway from I-580 to US-50	139
Saliman Road from Long Street to Fairview Drive	124
S Curry Street from Lake Glen Drive to Curry Circle (1.02 mi)	7



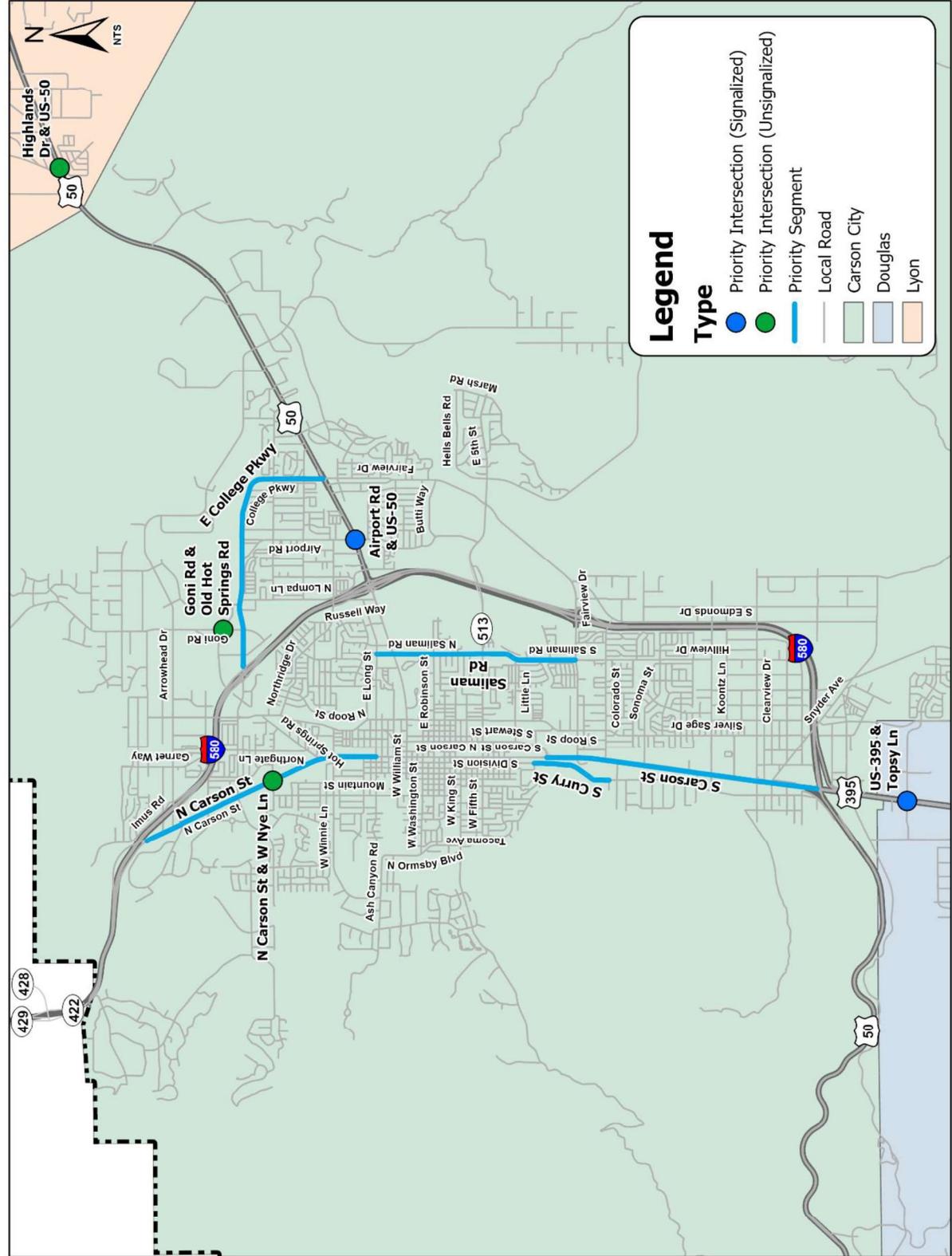


Figure 27 – CAMPO Priority Locations for Low-Cost Safety Measure Countermeasures





### 5.5. CAMPO Engineering Countermeasures

Countermeasures that may be considered in the reduction of high crash CEAs are listed in **Table 12**, these countermeasures can be used in site specific and system applications.

**Table 12 – CAMPO Engineering Countermeasures Toolbox**

Countermeasure	Also Addresses		CMF/CRF	Intersection/ Segment	Site Specific/ Systemic	CMF Applies to	
	Pedestrian	Bicycle				All Crash Types	Nighttime
Improve signal timing (coordination) (CMF ID 3072)			Varies/Varies	SI	Systemic	X	
Install Intersection Lighting (NDOT Planning Level CMF US-10)	X		0.90/10%	US	Systemic	X	X
Install Left Turn Lane When Warranted (NDOT Planning Level CMF SI-03)			0.76/24%	SI	Systemic	X	
Change from Permitted-Protected to Protected on Major Approach (NDOT Planning Level CMF SI-07)			0.58/42%	SI	Site Specific	X	
Convert signal from pedestal-mounted to mast arm (NDOT Planning Level CMF SI-09)			0.66/34%	SI	Site Specific	X	
Replace standard stop sign with flashing LED stop sign (CMF ID 6602)			0.58/42%	US	Site Specific	X	

\*Denotes FHWA Proven Safety Countermeasure  
 Note: SI = Signalized Intersection and UI = Unsignalized Intersection





**Table 12 – CAMPO Engineering Countermeasures Toolbox (Continued)**

Countermeasure	Also Addresses		CMF/CRF	Intersection/ Segment	Site Specific/ Systemic	CMF Applies to	
	Pedestrian	Bicycle				All Crash Types	Nighttime
Install raised median (CMF ID 10984)			0.72/28%	Segment	Site Specific	X	
Install pedestrian median fencing (CMF ID: 5258)	X		0.88/12%	Segment	Site Specific		
Install pedestrian countdown timer (NDOT Planning Level CMF BP-04)	X		0.30/70%	SI	Systemic		
Install advanced yield or stop markings and signs (CMF ID 9018)	X	X	0.89/11%	US	Site Specific		
Add 3-Inch Yellow Retroreflective Sheeting to Signal Backplates (NDOT Planning Level CMF SI-10)			0.85/15%	SI	Systemic	X	
Install Dynamic Speed Feedback Sign (CMF ID: 6885)			0.95/5%	Segment	Site Specific	X	

\*Denotes FHWA Proven Safety Countermeasure  
 Note: SI = Signalized Intersection and US = Unsignalized Intersection





**Table 12 – CAMPO Engineering Countermeasures Toolbox (Continued)**

Countermeasure	Also Addresses		CMF/CRF	Intersection/ Segment	Site Specific/ Systemic	CMF Applies to	
	Pedestrian	Bicycle				All Crash Types	Nighttime
Install right-turn lane When Warranted (NDOT Planning Level CMF US-07)			0.78/22%	US	Site Specific	X	
Install Raised Median with or without marked Crosswalk (Uncontrolled) (CMF ID 8799)	X		0.68/32%	US	Site Specific		
Install flashing beacons at stop-controlled intersections (NDOT Planning Level CMF US-24)			0.95/5%	US	Site Specific	X	
Clear sight triangles (NDOT Planning Level CMF US-16)			0.53/47%	US	Systemic	X	
Add flashing yellow arrow turn phase (NDOT Planning Level CMF SI-08)			0.85/15%	SI	Site Specific	X	
Install Chevron Signs, Curve Warning Signs, and Subsequent Flashing Beacons (CMF: 1914)			0.52/48%	Segment (Curves)	Site Specific	X	
Rectangular Rapid Flashing Beacon (RRFB) (NDOT Planning level CMF BP-03)	X		0.53/47%	SI/US/Segment	Site Specific	X	

\*Denotes FHWA Proven Safety Countermeasure  
 Note: SI = Signalized Intersection and US = Unsignalized Intersection





**Table 12 – CAMPO Engineering Countermeasures Toolbox (Continued)**

Countermeasure	Also Addresses		CMF/CRF	Intersection/ Segment	Site Specific/ Systemic	CMF Applies to	
	Pedestrian	Bicycle				All Crash Types	Nighttime
Install all-way STOP control (NDOT Planning Level CMF US-22)			0.41/59%	US	Site Specific	X	
Upgrade existing markings to wet-reflective pavement markings (CMF ID 8102)			0.89/11%	Segment	Systemic	X	
Retroreflective strips on signposts (Part of Implement Systemic Signing and Marking Improvements at Stop-Controlled Intersections (NDOT Planning Level CMF US-17)			0.75/25%	US	Systemic	X	
Replace TWLTL with Raised Median (CMF ID: 2514)			0.77/23%	Segment	Site Specific	X	
Install Raised Median with Marked Crosswalk (Uncontrolled) (CMF:175)			0.54/46%	UI/Segment	Site Specific	X	
Install On-Street Bike Facility (NDOT Planning Level CMF BP-05)		X	0.40/60%	Segment	Site Specific	X	
Crosswalk Visibility Enhancements (FHWA Proven Safety Countermeasures)	X		0.58/42%	SI/US	Systemic	X	

\*Denotes FHWA Proven Safety Countermeasure; Note: SI = Signalized Intersection and US = Unsignalized Intersection





**Table 12 – CAMPO Engineering Countermeasures Toolbox (Continued)**

Countermeasure	Also Addresses		CMF/CRF	Intersection/ Segment	Site Specific/ Systemic	CMF Applies to	
	Pedestrian	Bicycle				All Crash Types	Nighttime
Implement Systemic Signing and Marking Improvements at Stop-Controlled Intersections (NDOT Planning Level CMF US-17)			0.81/19%	US	Systemic	X	
Change Right-Turn Lane Geometry to Increase Line of Sight (Intersection Level) (CMF ID: 8496)			0.56/44%	SI/US	Site Specific	X	
Increase Length of Signal Phases to Allow Pedestrians More Crossing Time (CMF ID: 5252)			0.49/51%	SI	Site Specific	X	
Resurface Pavement (CMF ID: 10280)	X		0.79/21%	SI	Systemic	X	
Lower Posted Speed Limit (CMF ID: 11288)			0.86/14%	Segment	Systemic	X	
Improve Street Lighting Illuminance and Uniformity (CMF ID: 11026)			0.70/30%	Segment	Site Specific	X	
Provide Highway Lighting (FHWA Proven Safety Countermeasures; CMF ID: 192)			0.67/33%	Segment	Site Specific	X	

\*Denotes FHWA Proven Safety Countermeasure  
 Note: SI = Signalized Intersection and US = Unsignalized Intersection





**Table 12 – CAMPO Engineering Countermeasures Toolbox (Continued)**

Countermeasure	Also Addresses		CMF/CRF	Intersection/ Segment	Site Specific/ Systemic	CMF Applies to	
	Pedestrian	Bicycle				All Crash Types	Nighttime
Install Advanced Street Name Signs (NDOT Planning Level CMF SI-13)			0.98/2%	SI	Systemic	X	
Install Reduced Conflict Intersection (S-Island, J-Turn, or RCUT) (NDOT Planning Level CMF US-02)			Varies/Varies	US	Site Specific	X	
Convert Non-Signalized Urban Intersection to Roundabout (NDOT Planning Level CMF US-14)			0.29/71%	US	Site Specific	X	
Install a Pedestrian Hybrid Beacon (PHB or HAWK) (NDOT Planning Level CMF BP-02)			0.40/60%	Segment	Site Specific	X	
Implement Leading Pedestrian Interval (NDOT Planning Level CMF BP-05)	X		0.64/36%	SI	Site Specific	X	
Improve Pavement Friction - High Friction Surface Treatment (HFST) (NDOT Planning Level CMF CS-02)	X		0.65/35%	SI/US/Segment	Systemic	X	
Prohibit On-Street Parking (CMF ID: 153)			0.80/20%	Segment	Site Specific	X	

\*Denotes FHWA Proven Safety Countermeasure  
 Note: SI = Signalized Intersection and US = Unsignalized Intersection





**ATTACHMENT A**  
**CRASH DATA ANALYSIS TABLES**



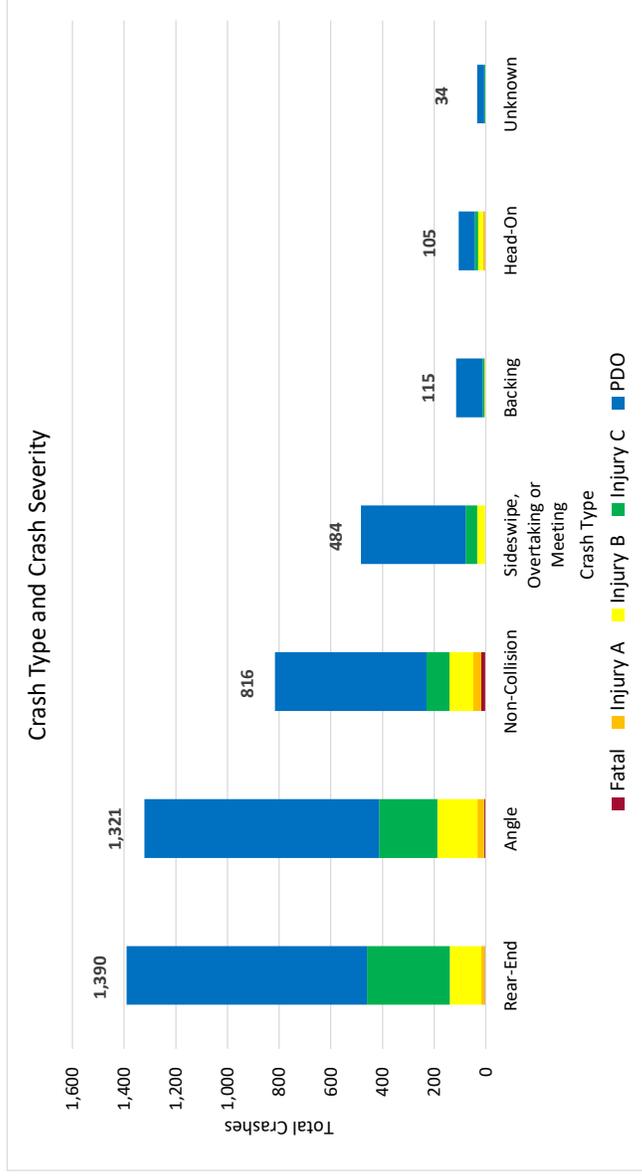
Attachment

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Overall Crash Data		Pedestrian		Bicycle		Motorcycle		Bus		
<i>Fatal</i>	31	0.7%	8	11.4%	1	3.2%	6	5.7%	1	5.6%
<i>Injury A</i>	81	1.9%	6	8.6%	4	12.9%	10	9.4%	0	0.0%
<i>Injury B</i>	426	10.0%	11	15.7%	11	35.5%	32	30.2%	1	5.6%
<i>Injury C*</i>	704	16.5%	18	25.7%	5	16.1%	22	20.8%	1	5.6%
<i>Property Damage Only (PDO)</i>	3,023	70.9%	27	38.6%	10	14.3%	36	34.0%	15	83.3%
<b>Total</b>	<b>4,265</b>	<b>100%</b>	<b>70</b>	<b>100% (1.6%)</b>	<b>31</b>	<b>100% (0.7%)</b>	<b>106</b>	<b>100% (2.5%)</b>	<b>18</b>	<b>100% (0.4%)</b>

	Crash Type										Total
	Fatal and Injury			PDO							
	Fatal	Injury A	Injury B	Injury C	Sum	PDO					
<b>Rear-End</b>	4	13	122	321	460	930					1,390
	0.3%	0.9%	8.8%	23.1%	33.1%	66.9%					32.6%
<b>Angle</b>	7	25	156	225	413	908					1,321
	0.5%	1.9%	11.8%	17.0%	31.3%	68.7%					31.0%
<b>Non-Collision</b>	17	32	92	88	229	587					816
	2.1%	3.9%	11.3%	10.8%	28.1%	71.9%					19.1%
<b>Sideswipe, Overtaking or Meeting</b>	0	3	30	45	78	406					484
	0.0%	0.6%	6.2%	9.3%	16.1%	83.9%					11.3%
<b>Backing</b>	0	0	5	8	13	102					115
	0.0%	0.0%	4.3%	7.0%	11.3%	88.7%					2.7%
<b>Head-On</b>	3	8	19	12	42	63					105
	2.9%	7.6%	18.1%	11.4%	40.0%	60.0%					2.5%
<b>Unknown</b>	0	0	2	5	7	27					34
	0.0%	0.0%	5.9%	14.7%	20.6%	79.4%					0.8%
<b>Total Crashes</b>	<b>31</b>	<b>81</b>	<b>426</b>	<b>704</b>	<b>1,242</b>	<b>3,023</b>					<b>4,265</b>

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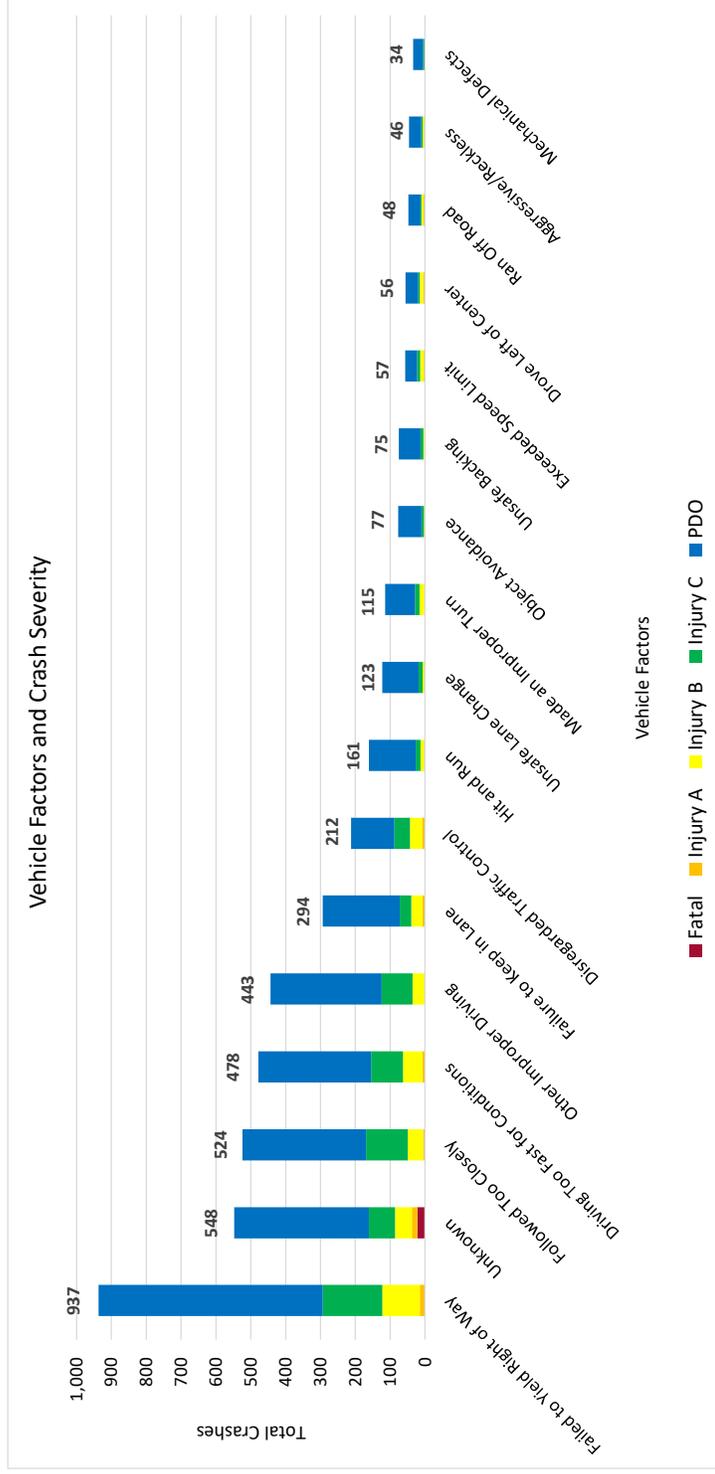
	Vehicle Factors*							PDO	Total
	Fatal and Injury								
	Fatal	Injury A	Injury B	Injury C	Sum				
<b>Failed to Yield Right of Way</b>	0	15	108	171	294		643	937	
	0.0%	1.6%	11.5%	18.2%	31.4%		68.6%	22.0%	
<b>Unknown</b>	22	16	48	75	161		387	548	
	4.0%	2.9%	8.8%	13.7%	29.4%		70.6%	12.8%	
<b>Followed Too Closely</b>	2	4	44	119	169		355	524	
	0.4%	0.8%	8.4%	22.7%	32.3%		67.7%	12.3%	
<b>Driving Too Fast for Conditions</b>	0	8	55	92	155		323	478	
	0.0%	1.7%	11.5%	19.2%	32.4%		67.6%	11.2%	
<b>Other Improper Driving</b>	0	1	35	89	125		318	443	
	0.0%	0.2%	7.9%	20.1%	28.2%		71.8%	10.4%	
<b>Failure to Keep in Lane</b>	0	8	32	33	73		221	294	
	0.0%	2.7%	10.9%	11.2%	24.8%		75.2%	6.9%	
<b>Disregarded Traffic Control</b>	1	8	34	45	88		124	212	
	0.5%	3.8%	16.0%	21.2%	41.5%		58.5%	5.0%	
<b>Hit and Run</b>	0	3	10	14	27		134	161	
	0.0%	1.9%	6.2%	8.7%	16.8%		83.2%	3.8%	
<b>Unsafe Lane Change</b>	0	0	7	12	19		104	123	
	0.0%	0.0%	5.7%	9.8%	15.4%		84.6%	2.9%	
<b>Made an Improper Turn</b>	1	1	14	13	29		86	115	
	0.9%	0.9%	12.2%	11.3%	25.2%		74.8%	2.7%	

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<b>Object Avoidance</b>	0	0	3	7	10	67	77
	0.0%	0.0%	3.9%	9.1%	13.0%	87.0%	1.8%
<b>Unsafe Backing</b>	1	0	4	8	13	62	75
	1.3%	0.0%	5.3%	10.7%	17.3%	82.7%	1.8%
<b>Exceeded Speed Limit</b>	0	4	10	9	23	34	57
	0.0%	7.0%	17.5%	15.8%	40.4%	59.6%	1.3%
<b>Drove Left of Center</b>	1	5	9	5	20	36	56
	1.8%	8.9%	16.1%	8.9%	35.7%	64.3%	1.3%
<b>Ran Off Road</b>	2	2	6	3	13	35	48
	4.2%	4.2%	12.5%	6.3%	27.1%	72.9%	1.1%
<b>Aggressive/Reckless</b>	1	2	4	4	11	35	46
	2.2%	4.3%	8.7%	8.7%	23.9%	76.1%	1.1%
<b>Mechanical Defects</b>	0	0	1	5	6	28	34
	0.0%	0.0%	2.9%	14.7%	17.6%	82.4%	0.8%
<b>Overcorrecting</b>	0	2	1	0	3	15	18
	0.0%	11.1%	5.6%	0.0%	16.7%	83.3%	0.4%
<b>Wrong Way</b>	0	2	1	0	3	9	12
	0.0%	16.7%	8.3%	0.0%	25.0%	75.0%	0.3%
<b>Driverless Vehicle</b>	0	0	0	0	0	7	7
	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.2%
<b>Total Instances</b>	31	81	426	704	1,242	3,023	4,265
<b>Total Crashes</b>	31	81	426	704	1,242	3,023	4,265

\*Note: Vehicle factors are based on Vehicle 1 (V1) inputs. Blank entries are included in the Other/Unknown factor.

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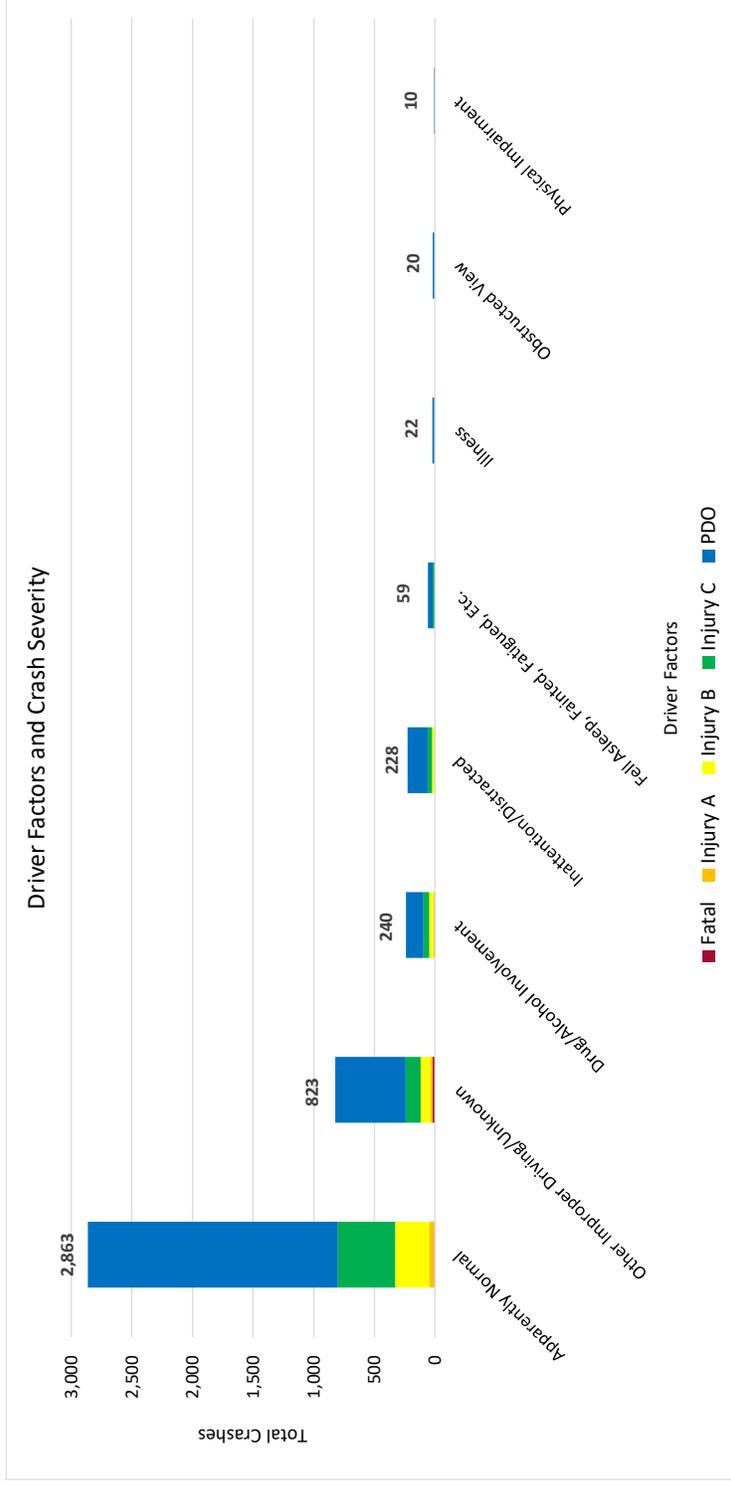


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	Driver Factors*							PDO	Total
	Fatal and Injury			Sum	PDO	Total			
	Fatal	Injury A	Injury B				Injury C		
<b>Apparently Normal</b>	7	43	279	474	803	2,060	2,863		
	0.2%	1.5%	9.7%	16.6%	28.0%	72.0%	67.1%		
<b>Other Improper Driving/Unknown</b>	21	20	80	122	243	580	823		
	2.6%	2.4%	9.7%	14.8%	29.5%	70.5%	19.3%		
<b>Drug/Alcohol Involvement</b>	2	13	34	47	96	144	240		
	0.8%	5.4%	14.2%	19.6%	40.0%	60.0%	5.6%		
<b>Inattention/Distracted</b>	1	2	22	38	63	165	228		
	0.4%	0.9%	9.6%	16.7%	27.6%	72.4%	5.3%		
<b>Fell Asleep, Fainted, Fatigued, Etc.</b>	0	0	5	14	19	40	59		
	0.0%	0.0%	8.5%	23.7%	32.2%	67.8%	1.4%		
<b>Illness</b>	0	1	3	3	7	15	22		
	0.0%	4.5%	13.6%	13.6%	31.8%	68.2%	0.5%		
<b>Obstructed View</b>	0	1	2	5	8	12	20		
	0.0%	5.0%	10.0%	25.0%	40.0%	60.0%	0.5%		
<b>Physical Impairment</b>	0	1	1	1	3	7	10		
	0.0%	10.0%	10.0%	10.0%	30.0%	70.0%	0.2%		
<b>Total Instances</b>	31	81	426	704	1,242	3,023	4,265		
<b>Total Crashes</b>	31	81	426	704	1,242	3,023	4,265		

\*Note: Driver factors are based on Vehicle 1 (V1) inputs. Blank entries are included in the Other/Unknown factor.

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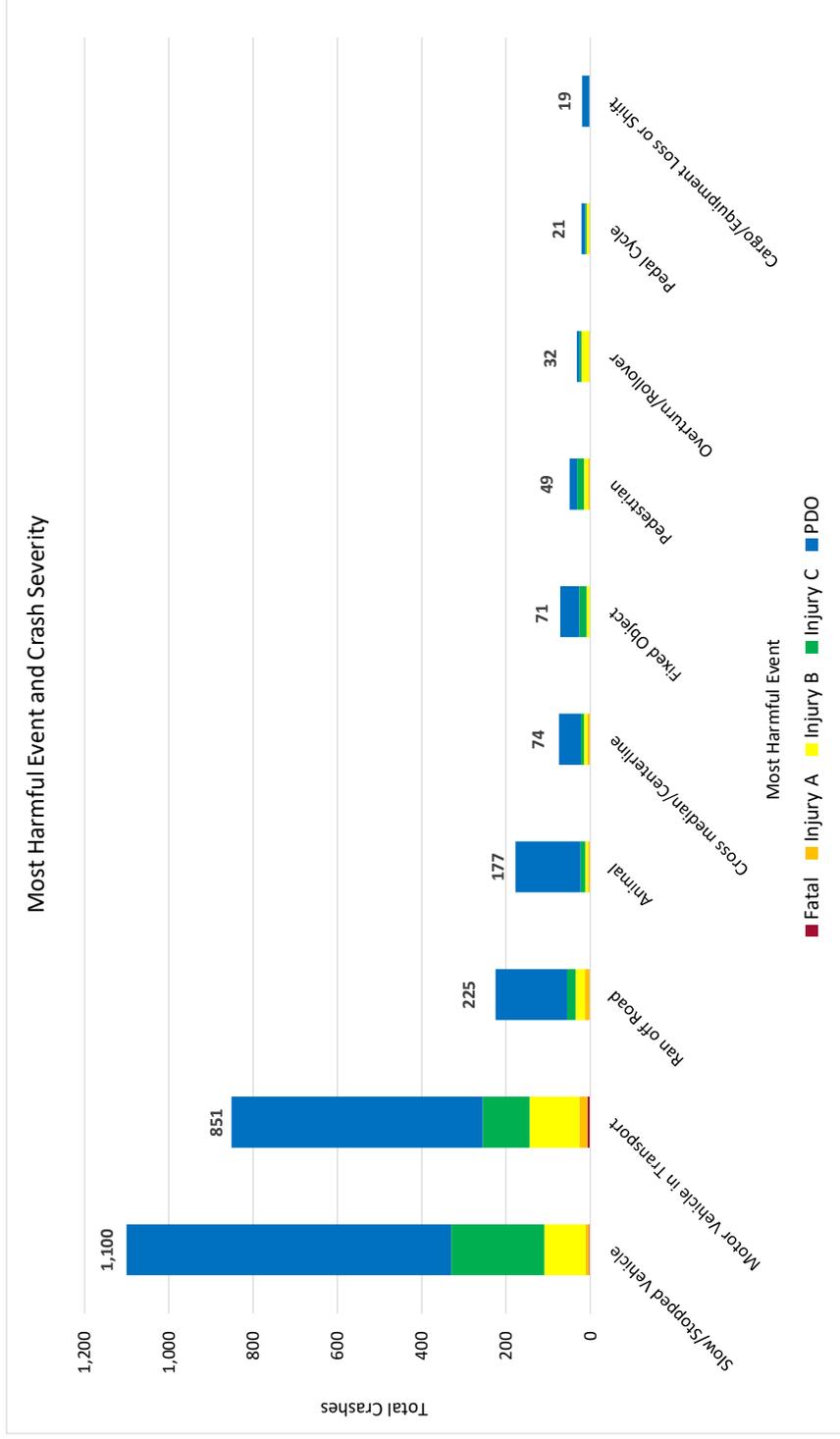


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	Most Harmful Event*										PDO	Total			
	Fatal		Fatal and Injury						Sum	PDO			Total		
	Injury A	Injury B	Injury C	Injury A	Injury B	Injury C	Injury C								
<b>Slow/Stopped Vehicle</b>	3	8	98	221	221	330	770	1,100	0.3%	0.7%	8.9%	20.1%	30.0%	70.0%	25.8%
<b>Motor Vehicle in Transport</b>	7	19	118	111	111	255	596	851	0.8%	2.2%	13.9%	13.0%	30.0%	70.0%	20.0%
<b>Ran off Road</b>	0	13	22	20	20	55	170	225	0.0%	5.8%	9.8%	8.9%	24.4%	75.6%	5.3%
<b>Animal</b>	1	4	7	11	11	23	154	177	0.6%	2.3%	4.0%	6.2%	13.0%	87.0%	4.2%
<b>Cross median/Centerline</b>	0	7	8	7	7	22	52	74	0.0%	9.5%	10.8%	9.5%	29.7%	70.3%	1.7%
<b>Fixed Object</b>	0	1	8	17	17	26	45	71	0.0%	1.4%	11.3%	23.9%	36.6%	63.4%	1.7%
<b>Pedestrian</b>	0	5	10	16	16	31	18	49	0.0%	10.2%	20.4%	32.7%	63.3%	36.7%	1.1%
<b>Overturn/Rollover</b>	0	3	18	4	4	25	7	32	0.0%	9.4%	56.3%	12.5%	78.1%	21.9%	0.8%
<b>Pedal Cycle</b>	0	3	6	3	3	12	9	21	0.0%	14.3%	28.6%	14.3%	57.1%	42.9%	0.5%
<b>Cargo/Equipment Loss or Shift</b>	0	0	0	2	2	2	17	19	0.0%	0.0%	0.0%	10.5%	10.5%	89.5%	0.4%
<b>Parked Motor Vehicle</b>	0	0	0	1	1	1	13	14	0.0%	0.0%	0.0%	7.1%	7.1%	92.9%	0.3%
<b>Fire/Explosion</b>	0	0	0	0	0	0	11	11	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.3%
<b>Guardrail Face</b>	1	0	0	0	0	1	4	5	20.0%	0.0%	0.0%	0.0%	20.0%	80.0%	0.1%
<b>Total Crashes</b>	<b>31</b>	<b>81</b>	<b>426</b>	<b>704</b>	<b>704</b>	<b>1,242</b>	<b>3,023</b>	<b>4,265</b>							

\*Note: Most Harmful Event is based on Vehicle 1 (V1) input. Blank entries in Most Harmful Event refer to the first listing in Vehicle 1 (V1) All Events. Blank entries in both Most Harmful Event and All Events are included in the Other/Unknown category.

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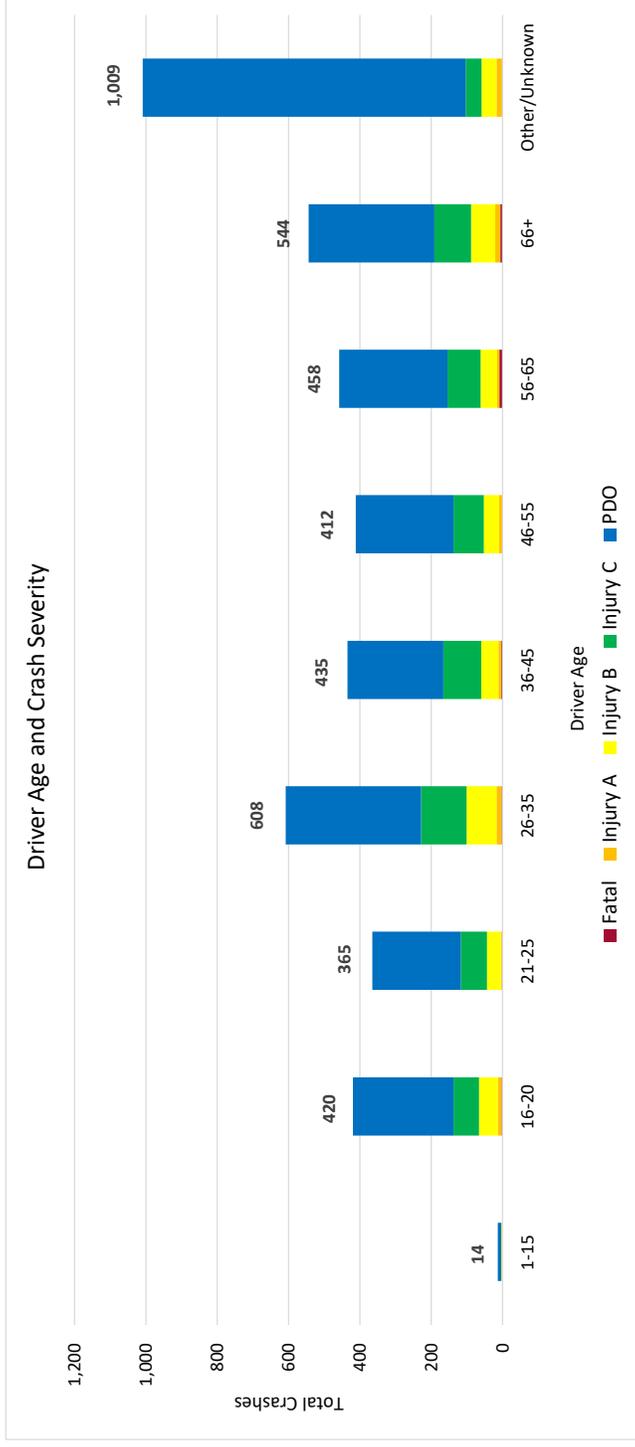


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	Driver Age*							PDO	Total
	Fatal and Injury			Sum	PDO	Total			
	Fatal	Injury A	Injury B				Injury C		
<b>1-15</b>	0	0	4	0	4	10	14		
	0.0%	0.0%	28.6%	0.0%	28.6%	71.4%	0.3%		
<b>16-20</b>	3	11	52	72	138	282	420		
	0.7%	2.6%	12.4%	17.1%	32.9%	67.1%	9.8%		
<b>21-25</b>	2	3	39	73	117	248	365		
	0.5%	0.8%	10.7%	20.0%	32.1%	67.9%	8.6%		
<b>26-35</b>	3	14	84	128	229	379	608		
	0.5%	2.3%	13.8%	21.1%	37.7%	62.3%	14.3%		
<b>36-45</b>	4	8	48	106	166	269	435		
	0.9%	1.8%	11.0%	24.4%	38.2%	61.8%	10.2%		
<b>46-55</b>	1	9	43	85	138	274	412		
	0.2%	2.2%	10.4%	20.6%	33.5%	66.5%	9.7%		
<b>56-65</b>	9	7	46	93	155	303	458		
	2.0%	1.5%	10.0%	20.3%	33.8%	66.2%	10.7%		
<b>66+</b>	7	14	68	102	191	353	544		
	1.3%	2.6%	12.5%	18.8%	35.1%	64.9%	12.8%		
<b>Other/Unknown</b>	2	15	42	45	104	905	1,009		
	0.2%	1.5%	4.2%	4.5%	10.3%	89.7%	23.7%		
<b>Total Crashes</b>	<b>31</b>	<b>81</b>	<b>426</b>	<b>704</b>	<b>1,242</b>	<b>3,023</b>	<b>4,265</b>		

\*Note: Driver age is based on Vehicle 1 (V1) input. Blank entries are included in the Other/Unknown category.

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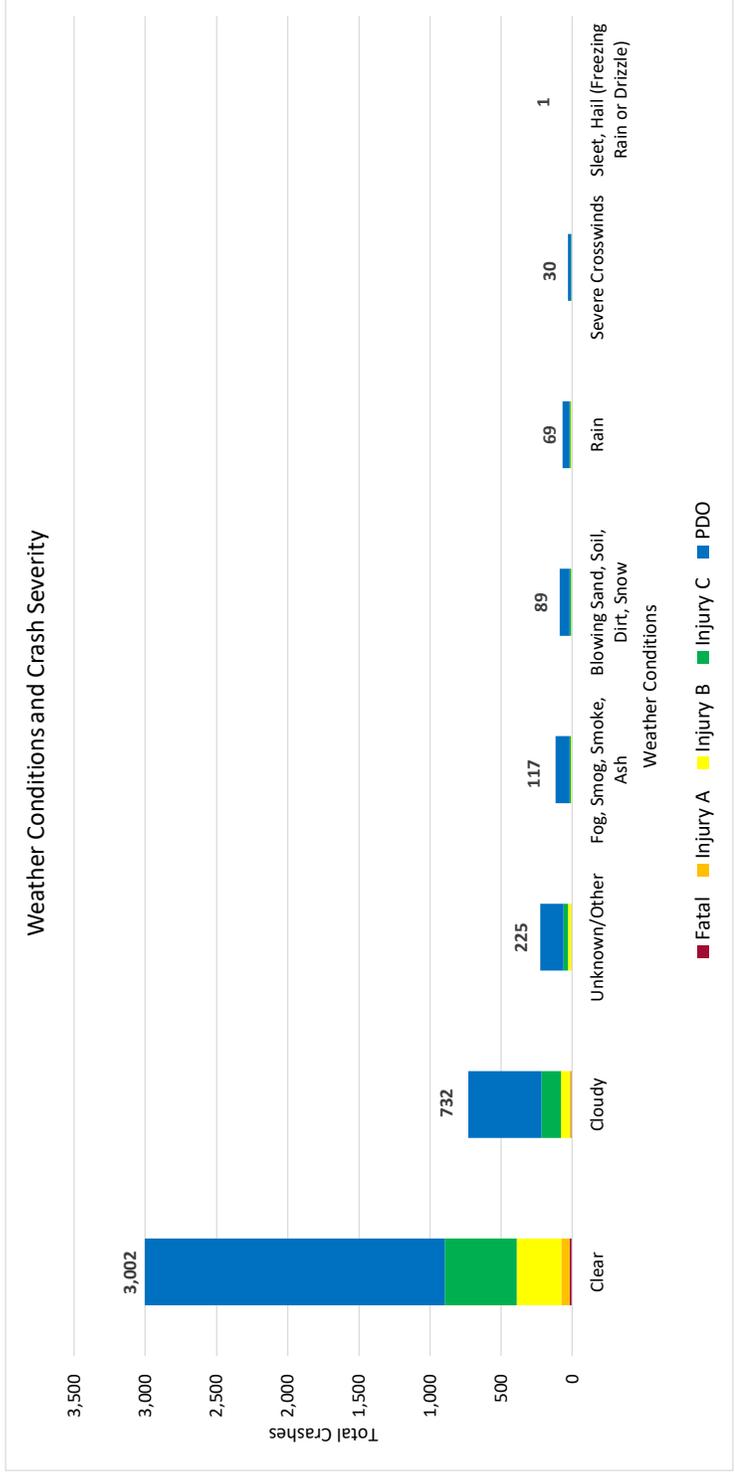


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	Weather Conditions							PDO	Total
	Fatal and Injury				Sum	PDO	Total		
	Fatal	Injury A	Injury B	Injury C					
<b>Clear</b>	19	59	313	505	896	2,106	3,002		
	0.6%	2.0%	10.4%	16.8%	29.8%	70.2%	70.4%		
<b>Cloudy</b>	8	11	60	138	217	515	732		
	1.1%	1.5%	8.2%	18.9%	29.6%	70.4%	17.2%		
<b>Unknown/Other</b>	2	7	22	32	63	162	225		
	0.9%	3.1%	9.8%	14.2%	28.0%	72.0%	5.3%		
<b>Fog, Smog, Smoke, Ash</b>	0	1	10	9	20	97	117		
	0.0%	0.9%	8.5%	7.7%	17.1%	82.9%	2.7%		
<b>Blowing Sand, Soil, Dirt, Snow</b>	0	2	7	10	19	70	89		
	0.0%	2.2%	7.9%	11.2%	21.3%	78.7%	2.1%		
<b>Rain</b>	0	1	11	7	19	50	69		
	0.0%	1.4%	15.9%	10.1%	27.5%	72.5%	1.6%		
<b>Severe Crosswinds</b>	2	0	3	3	8	22	30		
	6.7%	0.0%	10.0%	10.0%	26.7%	73.3%	0.7%		
<b>Sleet, Hail (Freezing Rain or Drizzle)</b>	0	0	0	0	0	1	1		
	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%		
<b>Total Instances</b>	29	81	423	701	1,171	3,023	4,265		
<b>Total Crashes</b>	31	81	426	704	1,242	3,023	4,265		

\*Note: The percentage in each column is based on the number of crashes for the specific weather condition. The "Total" row percentage is the percent of overall crashes. It is possible to have multiple weather factors listed per crash. Thus the sum of the percentages in the columns may be more than 100%.

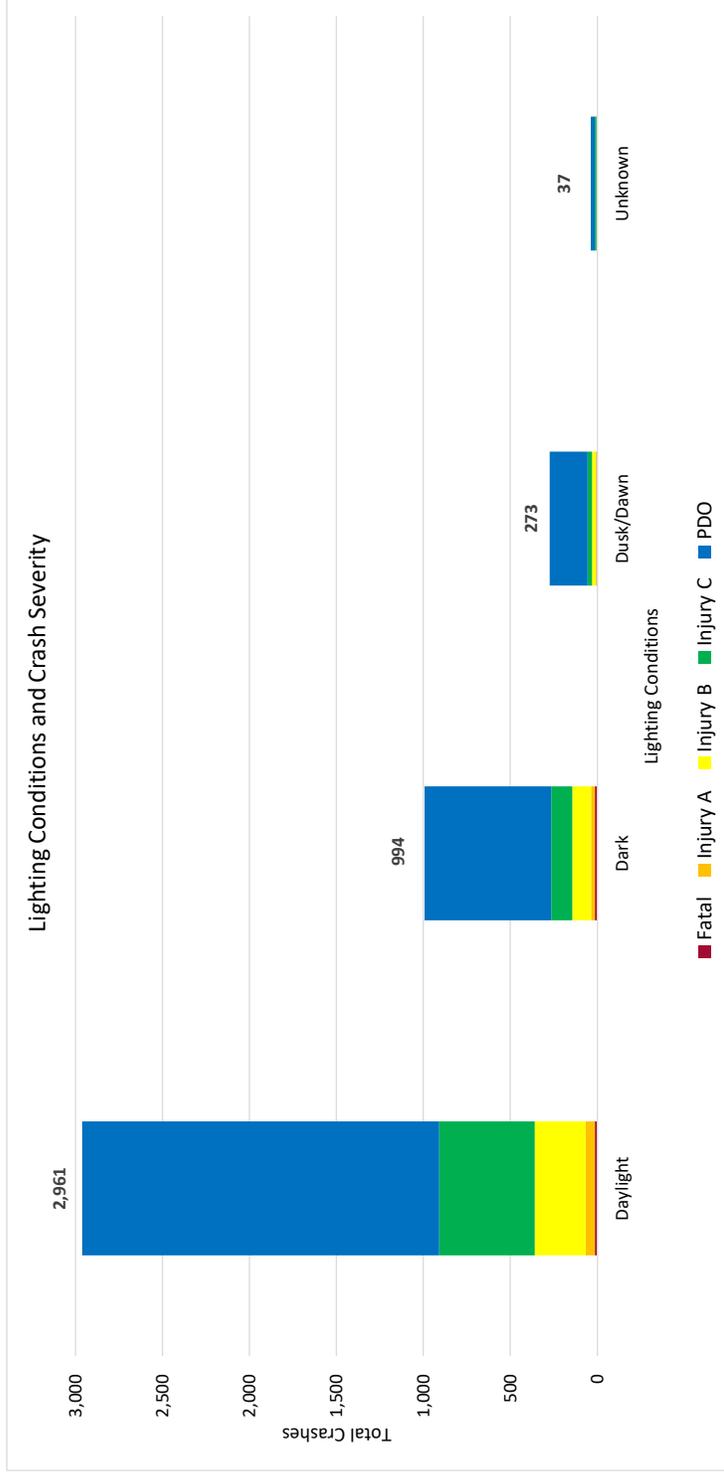
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		Lighting Conditions							PDO	Total
		Fatal and Injury			Injury C			Sum		
	Fatal	Injury A	Injury B	Injury C						
<b>Daylight</b>	14	53	292	550			909	2,052	2,961	
	0.5%	1.8%	9.9%	18.6%			30.7%	69.3%	69.4%	
<b>Dark</b>	13	23	107	121			264	730	994	
	1.3%	2.3%	10.8%	12.2%			26.6%	73.4%	23.3%	
<b>Dusk/Dawn</b>	4	5	22	24			55	218	273	
	1.5%	1.8%	8.1%	8.8%			20.1%	79.9%	6.4%	
<b>Unknown</b>	0	0	5	9			14	23	37	
	0.0%	0.0%	13.5%	24.3%			37.8%	62.2%	0.9%	
<b>Total Crashes</b>	<b>31</b>	<b>81</b>	<b>426</b>	<b>704</b>			<b>1,242</b>	<b>3,023</b>	<b>4,265</b>	

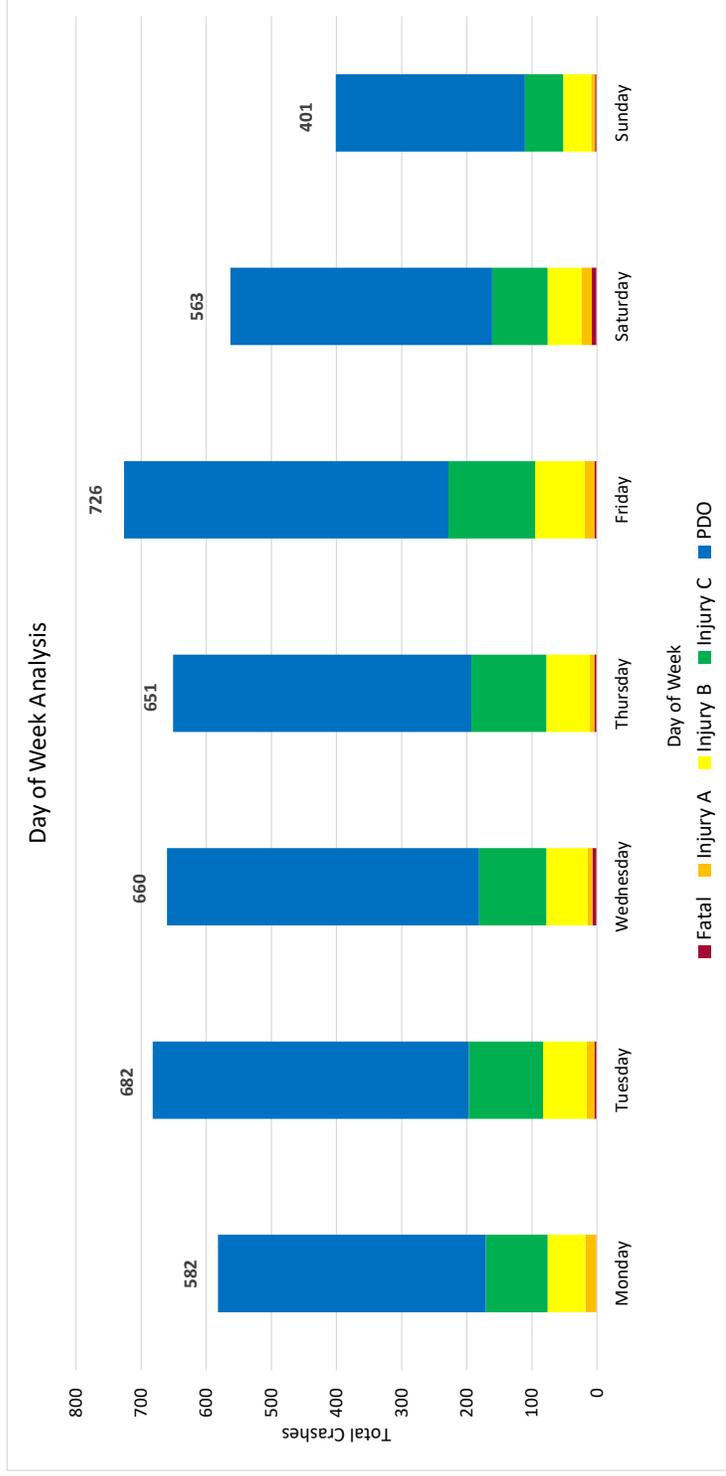
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	Day of Week										Total
	Fatal and Injury					Sum	PDO	Total			
	Fatal	Injury A	Injury B	Injury C	Injury						
<b>Monday</b>	1	17	58	95	171	411	582				
	0.2%	2.9%	10.0%	16.3%	29.4%	70.6%	13.6%				
<b>Tuesday</b>	4	12	67	114	197	485	682				
	0.6%	1.8%	9.8%	16.7%	28.9%	71.1%	16.0%				
<b>Wednesday</b>	7	8	63	103	181	479	660				
	1.1%	1.2%	9.5%	15.6%	27.4%	72.6%	15.5%				
<b>Thursday</b>	4	7	67	115	193	458	651				
	0.6%	1.1%	10.3%	17.7%	29.6%	70.4%	15.3%				
<b>Friday</b>	4	15	76	133	228	498	726				
	0.6%	2.1%	10.5%	18.3%	31.4%	68.6%	17.0%				
<b>Saturday</b>	8	16	52	85	161	402	563				
	1.4%	2.8%	9.2%	15.1%	28.6%	71.4%	13.2%				
<b>Sunday</b>	3	6	43	59	111	290	401				
	0.7%	1.5%	10.7%	14.7%	27.7%	72.3%	9.4%				
<b>Total Crashes</b>	<b>31</b>	<b>81</b>	<b>426</b>	<b>704</b>	<b>1,242</b>	<b>3,023</b>	<b>4,265</b>				

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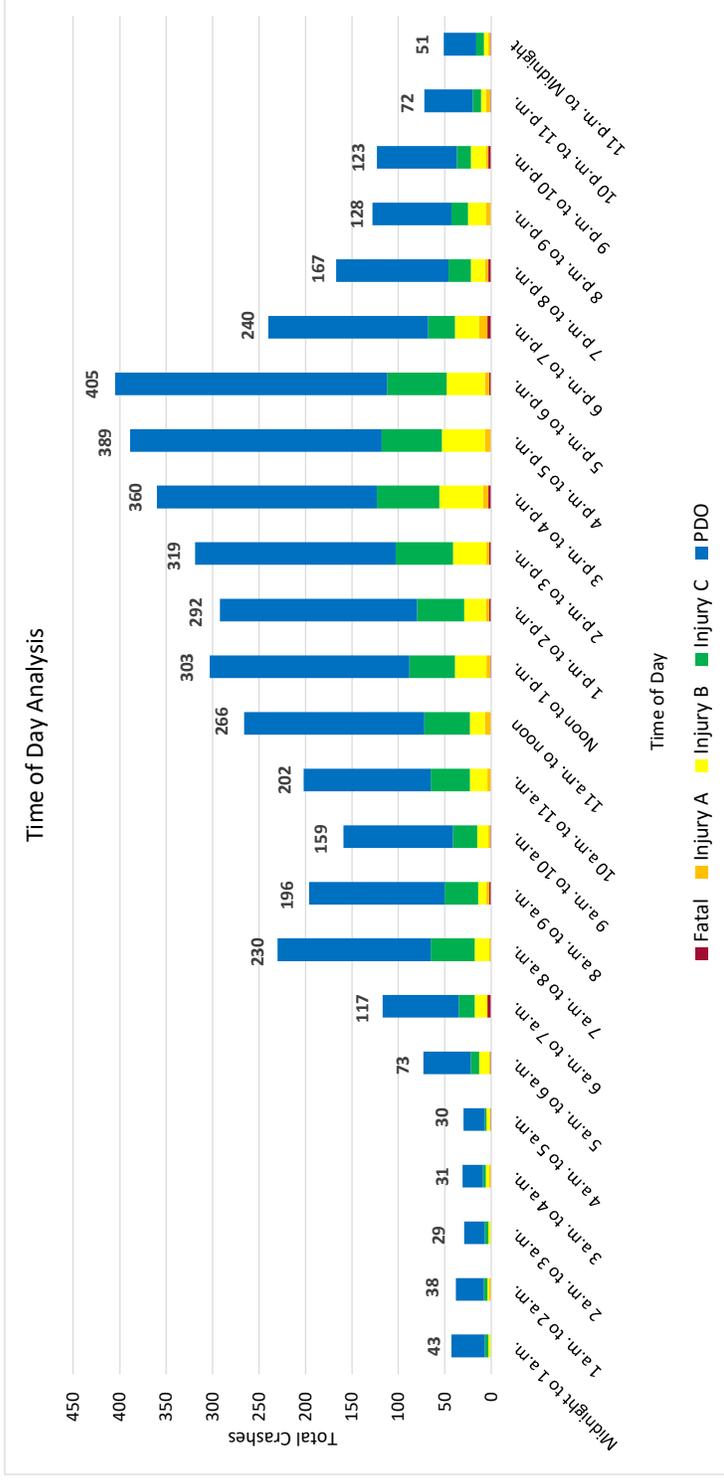
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	Time of Day										PDO	Total	
	Fatal and Injury					Injury							
	Fatal	Injury A	Injury B	Injury C	Sum	Injury A	Injury B	Injury C	Sum	Injury C			
<b>Midnight to 1 a.m.</b>	0	0	3	4	7	0.0%	0.0%	7.0%	9.3%	16.3%	36	43	1.0%
<b>1 a.m. to 2 a.m.</b>	0	2	2	4	8	0.0%	5.3%	5.3%	10.5%	21.1%	30	38	0.9%
<b>2 a.m. to 3 a.m.</b>	0	0	3	4	7	0.0%	0.0%	10.3%	13.8%	24.1%	22	29	0.7%
<b>3 a.m. to 4 a.m.</b>	0	2	4	3	9	0.0%	6.5%	12.9%	9.7%	29.0%	22	31	0.7%
<b>4 a.m. to 5 a.m.</b>	1	0	4	2	7	3.3%	0.0%	13.3%	6.7%	23.3%	23	30	0.7%
<b>5 a.m. to 6 a.m.</b>	1	1	11	9	22	1.4%	1.4%	15.1%	12.3%	30.1%	51	73	1.7%
<b>6 a.m. to 7 a.m.</b>	4	0	14	17	35	3.4%	0.0%	12.0%	14.5%	29.9%	82	117	2.7%
<b>7 a.m. to 8 a.m.</b>	0	2	16	47	65	0.0%	0.9%	7.0%	20.4%	28.3%	166	230	5.4%
<b>8 a.m. to 9 a.m.</b>	2	3	9	36	50	1.0%	1.5%	4.6%	18.4%	25.5%	146	196	4.6%
<b>9 a.m. to 10 a.m.</b>	1	2	12	26	41	0.6%	1.3%	7.5%	16.4%	25.8%	118	159	3.7%
<b>10 a.m. to 11 a.m.</b>	0	4	19	42	65	0.0%	2.0%	9.4%	20.8%	32.2%	137	202	4.7%
<b>11 a.m. to noon</b>	0	7	16	49	72	0.0%	2.6%	6.0%	18.4%	27.1%	194	266	6.2%

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<b>Noon to 1 p.m.</b>	1	4	34	49	88	216	303
	0.3%	1.3%	11.2%	16.2%	29.0%	71.3%	7.1%
<b>1 p.m. to 2 p.m.</b>	2	4	23	51	80	212	292
	0.7%	1.4%	7.9%	17.5%	27.4%	72.6%	6.8%
<b>2 p.m. to 3 p.m.</b>	2	3	36	62	103	216	319
	0.6%	0.9%	11.3%	19.4%	32.3%	67.7%	7.5%
<b>3 p.m. to 4 p.m.</b>	3	6	47	67	123	237	360
	0.8%	1.7%	13.1%	18.6%	34.2%	65.8%	8.4%
<b>4 p.m. to 5 p.m.</b>	0	7	46	65	118	271	389
	0.0%	1.8%	11.8%	16.7%	30.3%	69.7%	9.1%
<b>5 p.m. to 6 p.m.</b>	2	5	41	64	112	293	405
	0.5%	1.2%	10.1%	15.8%	27.7%	72.3%	9.5%
<b>6 p.m. to 7 p.m.</b>	4	9	26	29	68	172	240
	1.7%	3.8%	10.8%	12.1%	28.3%	71.7%	5.6%
<b>7 p.m. to 8 p.m.</b>	3	4	15	24	46	121	167
	1.8%	2.4%	9.0%	14.4%	27.5%	72.5%	3.9%
<b>8 p.m. to 9 p.m.</b>	0	6	19	18	43	85	128
	0.0%	4.7%	14.8%	14.1%	33.6%	66.4%	3.0%
<b>9 p.m. to 10 p.m.</b>	3	3	16	15	37	86	123
	2.4%	2.4%	13.0%	12.2%	30.1%	69.9%	2.9%
<b>10 p.m. to 11 p.m.</b>	1	5	5	9	20	52	72
	1.4%	6.9%	6.9%	12.5%	27.8%	72.2%	1.7%
<b>11 p.m. to Midnight</b>	1	2	5	8	16	35	51
	2.0%	3.9%	9.8%	15.7%	31.4%	68.6%	1.2%
<b>Total Crashes</b>	<b>31</b>	<b>81</b>	<b>426</b>	<b>704</b>	<b>1,242</b>	<b>3,023</b>	<b>4,265</b>

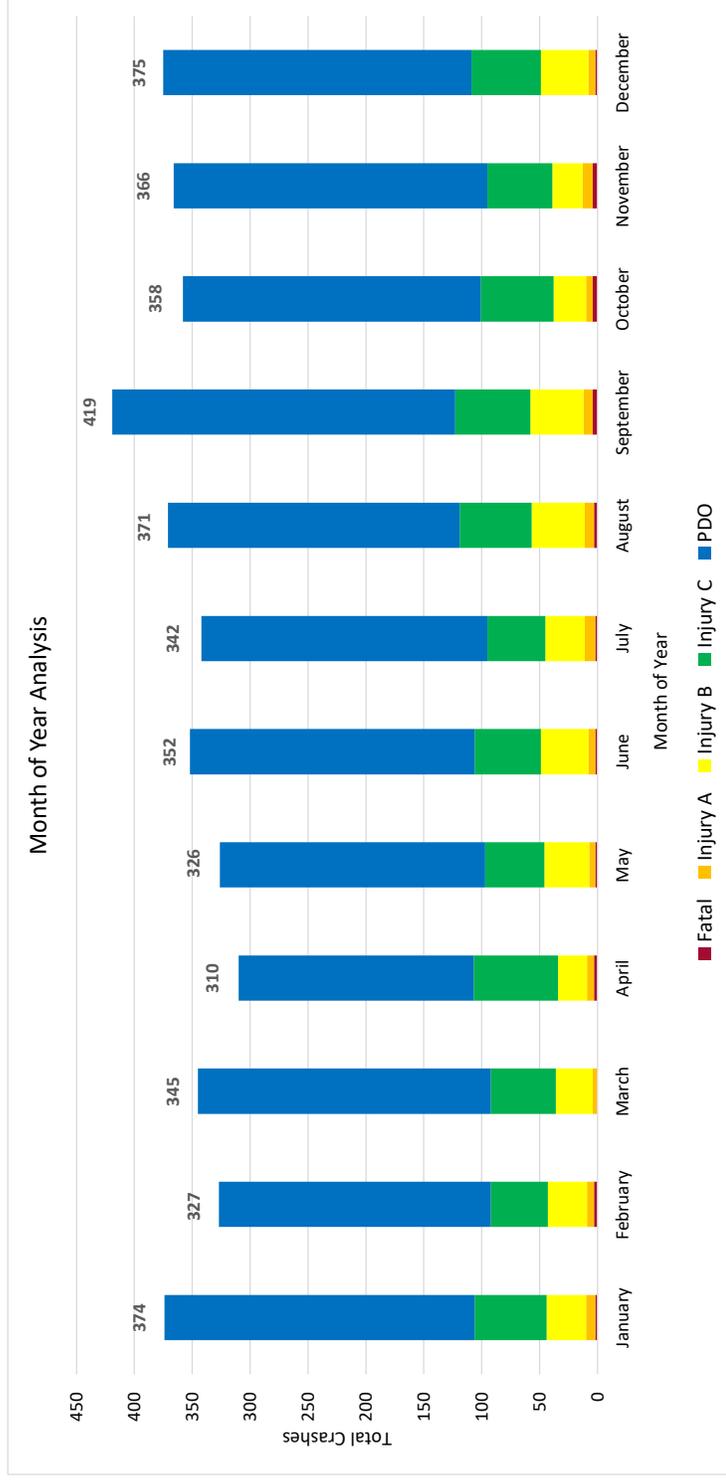
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	Month of Year										PDO	Total	
	Fatal and Injury			Sum	Fatal and Injury			Sum	PDO	Total			
	Fatal	Injury A	Injury B		Injury C	Fatal	Injury A						Injury B
<b>January</b>	2	8	34	106	268	374	0.5%	2.1%	9.1%	16.6%	28.3%	71.7%	8.8%
<b>February</b>	3	6	34	92	235	327	0.9%	1.8%	10.4%	15.0%	28.1%	71.9%	7.7%
<b>March</b>	0	4	32	92	253	345	0.0%	1.2%	9.3%	16.2%	26.7%	73.3%	8.1%
<b>April</b>	3	6	25	107	203	310	1.0%	1.9%	8.1%	23.5%	34.5%	65.5%	7.3%
<b>May</b>	2	5	39	97	229	326	0.6%	1.5%	12.0%	15.6%	29.8%	70.2%	7.6%
<b>June</b>	2	6	41	106	246	352	0.6%	1.7%	11.6%	16.2%	30.1%	69.9%	8.3%
<b>July</b>	2	9	34	95	247	342	0.6%	2.6%	9.9%	14.6%	27.8%	72.2%	8.0%
<b>August</b>	3	8	46	119	252	371	0.8%	2.2%	12.4%	16.7%	32.1%	67.9%	8.7%
<b>September</b>	4	8	46	123	296	419	1.0%	1.9%	11.0%	15.5%	29.4%	70.6%	9.8%
<b>October</b>	4	6	28	101	257	358	1.1%	1.7%	7.8%	17.6%	28.2%	71.8%	8.4%
<b>November</b>	4	9	26	95	271	366	1.1%	2.5%	7.1%	15.3%	26.0%	74.0%	8.6%
<b>December</b>	2	6	41	109	266	375	0.5%	1.6%	10.9%	16.0%	29.1%	70.9%	8.8%
<b>Total Crashes</b>	<b>31</b>	<b>81</b>	<b>426</b>	<b>1,242</b>	<b>3,023</b>	<b>4,265</b>							

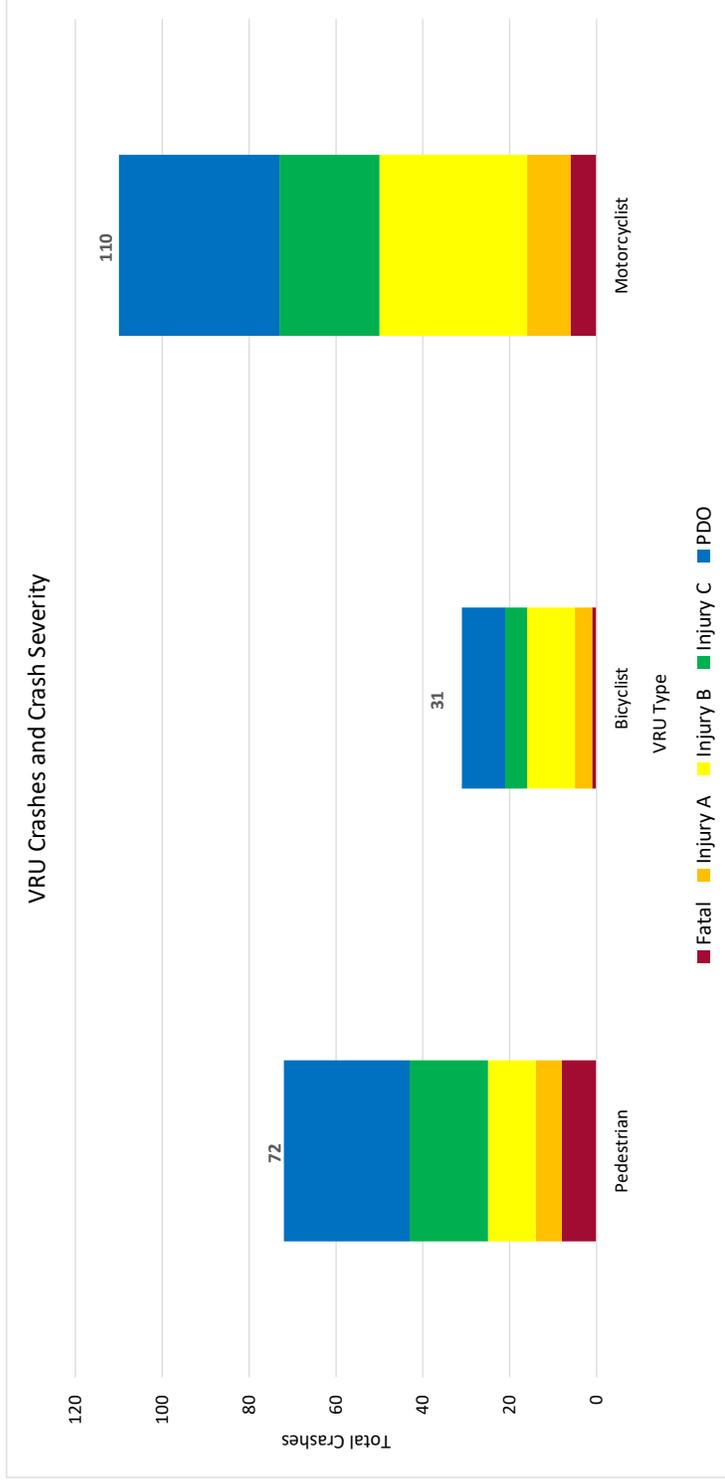
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		VRU						
		Fatal and Injury			Sum	PDO	Total	
Fatal	Injury A	Injury B	Injury C					
<b>Pedestrian</b>	8	6	11	18	43	29	72	
	11.1%	8.3%	15.3%	25.0%	59.7%	40.3%	1.7%	
<b>Bicyclist</b>	1	4	11	5	21	10	31	
	3.2%	12.9%	35.5%	16.1%	67.7%	32.3%	0.7%	
<b>Motorcyclist</b>	6	10	34	23	73	37	110	
	5.5%	9.1%	30.9%	20.9%	66.4%	33.6%	2.6%	
<b>Bus</b>	1	0	1	1	3	15	18	
	5.6%	0.0%	5.6%	5.6%	16.7%	83.3%	0.4%	
<b>Total Crashes</b>	<b>31</b>	<b>57</b>	<b>228</b>	<b>324</b>	<b>640</b>	<b>1,281</b>	<b>1,921</b>	

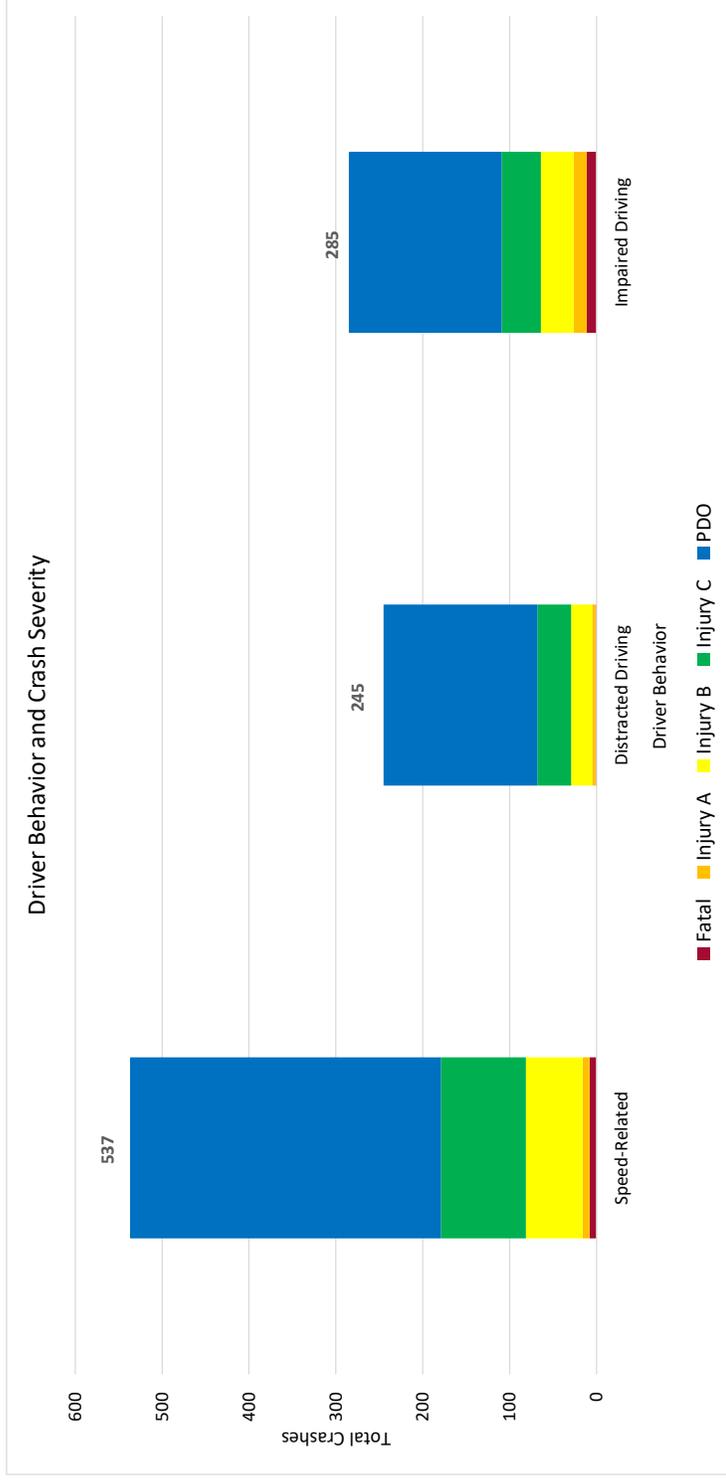
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		<u>Driver Behavior</u>							
		Fatal and Injury							
		Fatal	Injury A	Injury B	Injury C	Sum	PDO	Total	
<b>Speed-Related</b>		8	65	98		179	358	537	
		1.5%	12.1%	18.2%		33.3%	66.7%	12.6%	
<b>Distracted Driving</b>		1	24	39		68	177	245	
		0.4%	9.8%	15.9%		27.8%	72.2%	5.7%	
<b>Impaired Driving</b>		11	38	45		109	176	285	
		3.9%	13.3%	15.8%		38.2%	61.8%	6.7%	
<b>Aggressive Driving</b>		9	145	292		471	938	1,409	
		0.6%	10.3%	20.7%		33.4%	66.6%	33.0%	
<b>Total Crashes</b>		<b>29</b>	<b>52</b>	<b>272</b>	<b>474</b>	<b>827</b>	<b>1649</b>	<b>2476</b>	

January 01, 2018 to December 31, 2022  
Local Roads and State Highways Only





# **ATTACHMENT B**

## **INTERSECTION NETWORK SCREENING RESULTS**



Attachment



Kimley  Horn

Intersection	Crashes	Local CCR Differential <sup>1</sup>	EPDO <sup>2</sup>	K	A	B	C	O	Angle	Sideswipe	Rear End	Head On	Hit Object	Overturned	Pedestrian	Bicycle	Aggressive	Impaired	Distracted	Dark	Wet																																																																														
																						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78
<b>Signalized Intersections</b>																																																																																																			
US-395 & US-50/I-580	121	0.30	1469	2	1	7	31	80	22	3	67	5	2	2	1	0	0	50	9	5	3																																																																														
US-395 & TOPSY LN	78	0.38	147	0	0	5	15	58	10	1	54	0	1	1	0	0	33	4	13	14	2																																																																														
FAIRVIEW DR & US-50	61	0.29	135	0	0	9	6	46	21	2	30	0	2	1	0	0	22	2	5	8	2																																																																														
AIRPORT RD & E WILLIAM ST	54	0.01	1284	2	1	3	8	40	12	0	26	0	5	1	1	1	16	1	2	9	1																																																																														
N SALIMAN RD & E WILLIAM ST	49	0.28	180	0	1	5	8	35	17	3	15	1	1	0	0	1	20	1	2	6	3																																																																														
N LOMPA LN & US-50	46	-0.07	205	0	1	5	12	28	17	1	19	0	2	0	1	1	18	2	3	11	4																																																																														
EMERSON DR & E COLLEGE PKWY	43	0.33	118	0	0	8	5	30	13	0	17	4	1	0	0	0	15	1	0	10	1																																																																														
N ROOP ST & E WILLIAM ST	41	0.20	65	0	0	2	7	32	10	1	23	0	2	0	1	1	20	2	3	6	1																																																																														
RESEARCH WAY & E COLLEGE PKWY	41	0.39	53	0	0	2	5	34	16	0	17	0	1	0	1	0	20	0	3	2	0																																																																														
CLEAR CREEK RD & US-395	39	-0.34	121	0	0	6	9	24	4	2	24	1	3	0	2	0	17	2	5	8	2																																																																														
US-395 & MICA DR	36	-0.19	65	0	0	2	7	27	8	1	21	0	4	1	0	0	19	0	2	8	0																																																																														
US-395 & JACKS VALLEY RD/N SUNRIDGE DR	35	-0.34	146	0	1	3	6	25	6	5	19	1	0	0	1	0	15	3	2	8	0																																																																														
S CARSON ST & W CLEARVIEW DR	34	-0.07	47	0	0	2	4	28	8	0	15	0	0	1	0	0	13	0	3	6	0																																																																														
US-50 & ARROWHEAD DR/N DEER RUN RD	32	-0.13	1312	2	1	5	9	15	6	0	19	2	3	0	1	0	16	2	6	4	0																																																																														
N CARSON ST & E WINNIE LN	31	-0.04	71	0	0	2	8	21	10	0	10	0	3	0	0	1	16	1	5	0	0																																																																														
N CARSON ST & W COLLEGE PKWY	29	-0.15	215	0	2	4	3	20	9	0	12	1	2	0	1	0	10	4	3	4	1																																																																														
US-395 & STEPHANIE WAY	26	-0.38	70	0	0	3	6	17	3	1	13	1	1	0	0	0	11	3	2	4	1																																																																														
US-395 & JOHNSON LN	26	-0.43	119	0	1	0	7	18	6	0	14	0	2	0	0	0	11	3	1	5	0																																																																														
S CARSON ST & KOONTZ LN	26	-0.13	709	1	1	3	6	15	11	2	12	0	0	0	0	0	17	0	2	4	3																																																																														
N STEWART ST & E WILLIAM ST	26	-0.11	135	0	1	2	6	17	14	0	4	0	1	0	1	0	11	3	3	5	2																																																																														
N ROOP ST & E LONG ST	26	0.24	87	0	0	4	7	15	14	0	7	0	0	1	0	0	13	1	0	1	1																																																																														
S SALIMAN RD & FAIRVIEW DR	26	0.98	185	0	1	6	7	12	18	1	1	2	0	0	1	0	6	0	1	6	0																																																																														
US-395 & MEDICAL PKWY/ARROWHEAD DR	23	-0.26	79	0	0	5	4	14	6	0	12	1	1	0	0	0	13	2	0	2	0																																																																														
S CARSON ST & W 5TH ST	23	-0.04	106	0	1	1	3	18	11	0	5	1	0	0	1	0	10	4	0	3	0																																																																														
N CARSON ST & E WILLIAM ST	22	-0.28	40	0	0	2	3	17	7	1	6	0	3	0	2	1	5	0	1	2	1																																																																														
E COLLEGE PKWY & RETAIL DR	21	-0.26	42	0	0	1	5	15	8	1	7	0	0	0	0	0	9	0	1	2	0																																																																														
S SALIMAN RD & E 5TH ST	21	0.03	110	0	1	2	2	16	12	0	3	1	2	0	0	1	6	1	1	3	0																																																																														
US-50/E WILLIAM ST & GOLD DUST WAY	21	-0.46	135	0	1	2	6	12	8	1	5	0	4	0	0	1	9	2	0	4	0																																																																														

3/27/2024

1. Local Critical Crash Rate
2. Equivalent Property Damage Only



Intersection	Crashes	Local CCR Differential <sup>1</sup>	EPDO <sup>2</sup>	K	A	B	C	O	Angle	Sideswipe	Rear End	Head On	Hit Object	Overtuned	Pedestrian	Bicycle	Aggressive	Impaired	Distracted	Dark	Wet
S ROOP ST & FAIRVIEW DR	20	0.05	57	0	0	3	4	13	7	2	6	0	0	0	0	0	8	0	2	2	1
N ROOP ST & HOT SPRINGS RD	18	0.10	12	0	0	0	2	16	1	0	14	1	1	0	0	0	13	0	2	2	0
N CARSON ST & W LONG ST	17	-0.29	264	0	3	1	4	9	9	0	3	2	2	0	3	0	5	0	1	3	2
US-50 & I-580 CENTRAL RAMPS	17	-0.53	29	0	0	1	3	13	6	0	9	0	1	0	0	0	6	0	2	5	0
E COLLEGE PKWY & I-580 CENTRAL RAMPS	16	-0.59	68	0	0	4	4	8	4	2	5	0	4	2	0	0	6	1	0	5	0
S CARSON ST & EAGLE STATION LN	14	-0.46	110	0	1	2	2	9	7	0	4	1	1	1	0	0	2	1	0	2	0
N CARSON ST & HOT SPRINGS RD	14	-0.47	87	0	1	1	0	12	3	0	8	0	2	0	1	0	6	0	3	6	1
S CARSON ST & FAIRVIEW DR	14	-0.47	61	0	0	5	1	8	0	2	8	0	1	0	0	0	6	1	0	2	0
US-50 & FORTUNE DR	14	-0.54	101	0	1	0	4	9	0	0	9	0	4	1	0	0	6	2	2	6	0
N STEWART ST & E ROBINSON ST	13	-0.15	34	0	0	2	2	9	6	0	3	0	0	1	0	0	7	1	0	1	0
N LOMPA LN & E COLLEGE PKWY	13	-0.41	12	0	0	0	2	11	5	0	7	1	0	0	0	0	8	1	1	2	0
US-50 & MAIN ST	13	-0.59	37	0	0	0	6	7	5	0	7	0	0	0	0	0	2	0	1	1	0
N CARSON ST & W WASHINGTON ST	12	-0.51	12	0	0	0	2	10	3	0	6	0	0	0	0	0	5	0	2	2	0
S ROOP ST & LITTLE LN	12	-0.08	45	0	0	3	2	7	2	1	3	1	3	1	2	0	3	0	1	1	0
GONI RD & E COLLEGE PKWY	11	-0.59	29	0	0	1	3	7	2	1	3	0	2	0	0	0	5	1	0	1	0
N ROOP ST & E WINNIE LN	10	-0.45	6	0	0	0	1	9	1	0	6	0	0	0	0	0	8	0	0	2	0
FAIRVIEW DR WB TO I-850 N & I-580 NB RAMP	10	-0.45	23	0	0	1	2	7	2	0	2	1	2	1	0	0	4	1	0	1	0
N CARSON ST & W MUSSEY ST	9	-0.49	29	0	0	1	3	5	2	0	4	0	1	0	0	0	5	2	0	0	1
FAIRVIEW DR & I-580 SB RAMP	9	-0.57	23	0	0	1	2	6	6	0	2	0	0	0	0	0	1	1	0	3	0
S STEWART ST & E 5TH ST	8	-0.58	18	0	0	0	3	5	5	0	2	0	1	1	0	0	2	0	0	3	1
N CARSON ST & W ROBINSON ST	7	-0.66	29	0	0	1	3	3	2	0	3	0	1	0	1	0	1	1	1	2	1
N STEWART ST & E WASHINGTON ST	6	-0.65	11	0	0	1	0	5	4	0	0	0	2	0	0	0	2	0	2	1	0
N ROOP ST & NORTHRIDGE DR	6	-0.61	12	0	0	0	2	4	3	0	3	0	0	0	1	1	1	0	0	1	0
FAIRVIEW DR & PHEASANT DR	6	-0.62	0	0	0	0	0	6	3	0	1	0	1	0	1	0	2	1	0	2	0
N STEWART ST & E KING ST	5	-0.68	11	0	0	1	0	4	4	0	1	0	0	0	0	0	0	0	0	0	0
S STEWART ST & N ROOP ST	5	-0.71	0	0	0	0	0	5	2	0	1	0	0	0	0	0	1	1	0	0	0
N ROOP ST & E ROBINSON ST	5	-0.67	6	0	0	0	1	4	3	0	2	0	0	0	0	0	3	0	0	1	0
TOPSY LN & CLEAR CREEK PLAZA	5	-0.71	0	0	0	0	0	5	1	0	3	0	0	0	0	0	1	0	0	0	0
S ROOP ST & E 5TH ST	4	-0.76	6	0	0	0	1	3	3	0	1	0	0	0	0	0	1	0	0	1	0

3/27/2024

1. Local Critical Crash Rate
2. Equivalent Property Damage Only



Intersection	Crashes	Local CCR Differential <sup>1</sup>	EPDO <sup>2</sup>	K	A	B	C	O	Angle	Sideswipe	Rear End	Head On	Hit Object	Overturned	Pedestrian	Bicycle	Aggressive	Impaired	Distracted	Dark	Wet
<b>Unsignalized Intersections</b>																					
N ROOP ST & E WASHINGTON ST	3	-0.27	11	0	0	1	0	2	1	0	1	0	0	1	0	0	0	1	0	0	0
US-50 & I-580 NB RAMP	48	1.11	101	0	0	3	11	34	4	0	34	0	3	0	0	1	25	1	3	7	0
US-50 & I-580 SB RAMP	29	0.95	37	0	0	0	6	23	3	1	17	0	2	0	0	0	13	1	2	2	0
N CARSON ST & W NYE LN	25	0.39	704	1	1	2	7	14	14	0	6	0	0	0	0	0	6	1	1	2	0
S CARSON ST & S STEWART ST	24	0.50	89	0	1	0	2	21	9	2	5	0	2	0	0	0	8	1	1	6	0
NICHOLS LN & US-50	22	0.03	65	0	0	2	7	13	3	1	16	0	1	1	0	0	9	1	2	4	0
E COLLEGE PKWY & E NYE LN	21	0.90	59	0	0	2	6	13	13	0	4	0	2	1	1	0	3	2	1	4	1
S CARSON ST & KOONTZ LN	20	1.51	18	0	0	0	3	17	12	0	3	0	0	0	1	0	3	1	0	3	0
N STEWART ST & E LONG ST	20	1.22	73	0	0	5	3	12	16	0	0	1	0	0	1	0	6	0	1	1	0
SR341 & US-50	20	0.11	40	0	0	2	3	15	6	0	1	1	5	0	0	0	6	2	0	8	1
RAND AVE & US-50	18	0.11	106	0	1	1	3	13	10	1	4	0	0	0	0	0	4	1	0	2	1
S CARSON ST & W OVERLAND ST	17	0.00	112	0	1	1	4	11	5	1	7	2	0	1	0	0	10	0	0	2	0
HUMBOLDT LN & E LONG ST	17	0.09	45	0	0	3	2	12	8	0	6	0	0	0	0	0	6	2	0	3	1
CARDELLI RD & US-50	17	0.09	713	1	1	4	5	6	10	0	1	1	1	0	1	0	1	1	1	3	0
N LOMPA LN & CARMINE ST	16	0.95	39	0	0	3	1	12	8	0	4	1	1	0	0	0	4	1	0	3	1
US-50 & FLINT RD	15	-0.07	51	0	0	3	3	9	1	0	3	0	3	0	0	0	1	0	2	3	0
US-50 & RIVER RD	15	-0.01	615	1	0	2	5	7	6	0	1	1	2	0	0	0	4	4	0	4	1
MERCURY WAY & US-50	14	-0.11	18	0	0	0	3	11	4	0	8	0	0	0	0	0	4	0	0	0	0
IMPERIAL WAY & E COLLEGE PKWY	13	0.25	615	1	0	2	5	5	6	0	4	0	1	0	0	0	4	0	0	1	1
S CURRY ST & W 5TH ST	13	0.38	17	0	0	1	1	11	8	0	2	0	0	0	0	0	4	0	0	0	0
NORTHGATE LN & E COLLEGE PKWY	13	0.21	28	0	0	2	1	10	7	0	3	0	0	0	0	0	3	0	0	1	0
BROWN ST & US-50	13	-0.06	45	0	0	3	2	8	7	0	3	0	0	0	0	0	3	0	0	1	1
N CARSON ST & E PARK ST	12	0.03	17	0	0	1	1	10	1	0	7	0	1	0	0	0	6	1	3	1	0
RUSSELL WAY & US-50	12	-0.07	31	0	0	0	5	7	3	0	9	0	0	0	0	0	8	0	0	4	1
JULIUS LN & US-50	12	-0.13	104	0	1	2	1	8	1	0	2	0	7	1	2	0	3	1	1	4	0
N CARSON ST & SILVER OAK DR	11	0.00	586	1	0	1	2	7	6	0	1	0	3	0	1	0	2	0	0	4	0
S CARSON ST & W APPION WAY	11	-0.13	22	0	0	2	0	9	2	1	6	0	0	0	0	0	5	0	1	0	0
SONOMA ST & US-395	11	-0.04	99	0	1	1	2	7	4	0	3	0	1	0	0	0	3	1	2	1	0

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1. Local Critical Crash Rate
2. Equivalent Property Damage Only



Intersection	Crashes	Local CCR Differential <sup>1</sup>	EPDO <sup>2</sup>	K	A	B	C	O	Angle	Sideswipe	Rear End	Head On	Hit Object	Overturned	Pedestrian	Bicycle	Aggressive	Impaired	Distracted	Dark	Wet
N ROOP ST & E MUSSER ST	11	0.42	17	0	0	1	1	9	9	0	1	1	0	0	0	0	3	0	0	2	0
US-50 & OXOBY LOOP	11	-0.05	12	0	0	0	2	9	4	0	4	2	1	0	0	0	5	0	0	3	0
MARKET ST & RETAIL DR	11	0.60	6	0	0	0	1	10	6	0	1	1	0	0	0	0	3	0	0	0	0
N SALIMAN RD & E ROBINSON ST	11	0.53	29	0	0	1	3	7	5	0	3	1	1	0	0	0	3	1	0	2	0
GONI RD & OLD HOT SPRINGS RD	11	0.51	208	0	2	4	2	3	10	0	1	0	0	0	0	0	2	0	0	2	1
RUSSELL WAY & E LONG ST	11	0.59	12	0	0	0	2	9	5	0	3	1	0	0	0	0	4	1	0	3	0
FAIRVIEW DR & GORDON ST	11	0.24	33	0	0	3	0	8	6	1	1	0	1	1	1	0	3	1	0	4	1
EMPIRE RANCH RD & US-50E	11	-0.11	39	0	0	3	1	7	3	0	4	0	2	0	0	0	3	0	0	1	0
N CARSON ST & RICE ST	10	-0.05	23	0	0	1	2	7	4	0	6	0	0	0	1	0	6	0	2	1	0
S STEWART ST & LITTLE LN	10	0.26	581	1	0	0	3	6	4	1	2	1	0	0	0	0	0	0	1	1	0
US-50 & SILVER STATE ST	10	-0.13	25	0	0	0	4	6	1	0	6	1	1	0	1	0	5	1	3	1	0
N EDMONDS DR & US-50	10	-0.13	31	0	0	0	5	5	2	0	6	0	0	1	0	0	5	0	0	1	0
FAIRVIEW DR & DESATOYA DR	10	0.19	6	0	0	0	1	9	2	0	8	0	0	0	1	0	5	0	2	2	1
E COLLEGE PKWY & SHERMAN LN	10	0.19	23	0	0	1	2	7	5	0	3	1	0	0	0	0	6	0	0	2	0
E COLLEGE PKWY & I-580 SB RAMPS	10	-0.10	17	0	0	1	1	8	3	0	3	0	2	1	0	1	3	1	0	1	0
US-395 & WAREHOUSE WAY	10	-0.13	12	0	0	0	2	7	1	0	5	0	0	0	1	0	4	0	1	1	0
FRONTAGE RD & MOSES ST	9	-0.11	17	0	0	1	1	7	3	1	3	0	2	0	0	1	2	0	0	0	0
S NEVADA ST & W 5TH ST	9	0.49	6	0	0	0	1	8	7	0	0	0	0	1	0	0	3	1	1	2	0
S CARSON ST & COLORADO ST	9	-0.12	18	0	0	0	3	6	6	0	2	0	1	0	0	0	1	0	0	0	0
S CARSON ST & W 10TH ST	9	0.04	12	0	0	0	2	7	2	1	4	0	0	0	0	0	4	1	0	1	0
N CARSON ST & W TELEGRAPH ST	9	-0.04	23	0	0	1	2	6	1	0	2	0	1	0	0	0	2	0	0	1	0
HOT SPRINGS RD & HOT SPRINGS RD	9	0.56	170	0	2	1	1	5	6	0	1	0	2	0	3	0	2	0	0	3	0
WOODSIDE DR & STANTON DR	9	1.25	11	0	0	1	0	8	4	0	2	0	0	0	0	0	3	1	2	2	0
RED ROCK RD & US-50E	9	-0.18	36	0	0	1	4	4	3	0	3	0	1	0	0	0	2	0	1	3	0
US-50 & FORT CHURCHILL RD	9	-0.14	36	0	0	1	4	4	6	0	3	0	0	0	1	0	1	1	1	2	0
E COLLEGE PKWY & I-580 NB RAMPS	9	-0.13	110	0	1	2	2	4	3	0	3	0	2	2	0	0	3	0	0	2	0
US-395 & PLYMOUTH DR	8	-0.21	33	0	0	3	0	5	3	0	2	1	2	0	0	0	4	1	0	2	0
S CARSON ST & W 4TH ST	8	-0.01	23	0	0	1	2	5	0	1	6	1	0	0	0	0	2	0	0	0	0
N CARSON ST & W ADAMS ST	8	-0.11	17	0	0	1	1	6	1	0	4	0	2	0	2	0	5	0	1	2	0

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1. Local Critical Crash Rate
2. Equivalent Property Damage Only



Intersection	Crashes	Local CCR Differential <sup>1</sup>	EPDO <sup>2</sup>	K	A	B	C	O	Angle	Sideswipe	Rear End	Head On	Hit Object	Overtuned	Pedestrian	Bicycle	Aggressive	Impaired	Distracted	Dark	Wet
N CARSON ST & ADALINE ST	8	-0.12	6	0	0	0	1	7	3	0	5	0	0	0	0	0	6	1	1	1	0
N CARSON ST & BATH ST	8	-0.11	17	0	0	1	1	6	2	0	4	0	2	0	1	0	4	0	0	2	0
MARKET DR & E COLLEGE PKWY	8	-0.17	12	0	0	0	2	6	1	0	0	0	3	0	0	0	1	0	1	1	0
S EDMONDS DR & CLEARVIEW DR	8	1.10	104	0	1	2	1	4	5	0	2	0	0	0	0	0	3	0	0	4	1
DORI WAY & N LOMPA LN	8	0.98	11	0	0	1	0	7	2	0	0	0	6	2	0	0	1	1	2	1	0
AIRPORT RD & SHERMAN LN	8	0.40	0	0	0	0	0	8	3	0	3	1	0	0	0	0	3	0	1	0	0
ASPHALT DR & US-50E	8	-0.18	12	0	0	0	2	6	1	0	5	0	2	0	0	0	0	2	0	4	0
S CURRY ST & RHODES ST	7	0.23	12	0	0	0	2	5	5	0	1	0	1	0	0	0	3	0	0	0	0
S DIVISION ST & W 5TH ST	7	0.02	17	0	0	1	1	5	5	0	2	0	0	0	0	0	1	0	0	2	0
N CARSON ST & W SPEAR ST	7	-0.15	11	0	0	1	0	6	0	0	5	0	0	1	0	0	5	1	1	0	0
SILVER SAGE DR & CLEARVIEW DR	7	0.29	76	0	1	0	0	6	1	0	3	1	0	0	0	0	3	1	0	1	0
ANDERSON ST & E WILLIAM ST	7	-0.11	12	0	0	0	2	5	6	0	1	0	0	0	0	0	1	0	1	0	1
E COLLEGE PKWY & AIRPORT RD	7	-0.13	6	0	0	0	1	6	5	0	1	0	0	0	0	0	1	0	0	2	0
AIRPORT RD & E NYE LN	7	0.24	34	0	0	2	2	3	4	0	1	0	1	0	0	0	3	0	1	2	0
VISTA GRANDE BLVD & OLD CLEAR CREEK RD	6	-0.12	33	0	0	3	0	3	3	0	1	0	0	0	0	0	1	0	0	0	0
S DIVISION ST & W KING ST	6	0.07	6	0	0	0	1	5	3	0	1	0	1	0	0	0	2	0	1	0	0
N DIVISION ST & W WASHINGTON ST	6	0.03	0	0	0	0	0	6	5	0	0	0	0	0	0	0	1	0	0	0	0
US-395 & RHODES ST	6	-0.21	22	0	0	2	0	4	4	0	0	0	1	1	0	0	0	0	0	1	0
N CARSON ST & W ANN ST	6	-0.19	36	0	0	1	4	1	0	0	5	0	0	1	0	0	5	0	0	0	0
N CARSON ST & HOT SPRINGS RD	6	0.18	0	0	0	0	0	6	5	0	0	0	0	0	0	0	1	0	0	0	0
NORTHGATE LN & HOT SPRINGS RD	6	0.18	0	0	0	0	0	6	3	0	2	0	0	0	1	0	2	0	0	1	0
S STEWART ST & WRIGHT WAY	6	-0.01	159	0	2	0	1	3	2	0	0	0	0	0	1	0	0	0	0	0	0
N STEWART ST & E JOHN ST	6	-0.08	17	0	0	1	1	4	1	0	3	0	0	0	0	0	2	0	0	2	0
IDAHO ST & FAIRVIEW DR	6	0.00	6	0	0	0	1	5	4	0	0	0	0	0	0	0	0	0	0	0	0
SILVER SAGE DR & SONOMA ST	6	0.06	11	0	0	1	0	5	2	0	2	0	0	0	0	0	3	0	1	0	0
DIAMOND AVE & E COLLEGE PKWY	6	-0.16	12	0	0	0	2	4	0	0	6	0	0	0	0	0	5	1	1	1	0
N HARBIN AVE & E MUSSER ST	6	2.19	0	0	0	0	0	6	2	0	1	0	0	0	0	0	0	1	0	1	0
S SALIMAN RD & LITTLE LN	6	0.02	17	0	0	1	1	4	4	0	1	0	0	0	0	0	0	0	0	0	0
WENDY LN & E LONG ST	6	0.00	11	0	0	1	0	5	3	0	1	1	1	0	0	1	1	0	0	0	0

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1. Local Critical Crash Rate
2. Equivalent Property Damage Only



Intersection	Crashes	Local CCR Differential <sup>1</sup>	EPDO <sup>2</sup>	K	A	B	C	O	Angle	Sideswipe	Rear End	Head On	Hit Object	Overturned	Pedestrian	Bicycle	Aggressive	Impaired	Distracted	Dark	Wet
DORI WAY & CARMINE ST	6	0.22	17	0	0	1	1	4	1	0	4	0	0	1	0	0	3	0	2	1	0
US-50 & SHERMAN LN	6	-0.23	28	0	0	2	1	3	1	0	1	0	3	0	0	0	3	1	1	1	0
HIGHLANDS DR & US-50	6	-0.24	1131	2	0	0	1	3	2	0	0	0	1	0	1	0	1	0	0	4	0
AFFONSO DR & US-50	6	-0.24	23	0	0	1	2	3	5	0	0	0	0	0	0	0	0	0	0	1	0
ROSE PEAK RD & FLOWERY AVE	6	-0.23	11	0	0	1	0	5	2	0	1	0	1	0	0	0	0	0	0	3	0
SAM CLEMENS AVE & SIX MILE CANYON RD	6	0.49	0	0	0	0	0	6	1	0	2	0	3	0	0	0	1	1	1	2	1
OCCIDENTAL DR & US-50	6	-0.21	11	0	0	1	0	5	1	0	1	0	4	0	0	0	0	1	0	3	1
OCCIDENTAL DR & US-50	6	-0.21	51	0	0	3	3	0	2	1	2	0	1	0	0	0	1	0	1	1	0
S CURRY ST & S CURRY ST	5	0.15	6	0	0	0	1	4	3	0	0	1	0	0	0	0	2	0	1	1	0
N NEVADA ST & W WILLIAM ST	5	-0.16	11	0	0	1	0	4	4	0	0	0	0	0	0	0	1	0	0	0	0
N FALL ST & E LONG ST	5	1.64	76	0	1	0	0	4	2	0	0	1	0	0	0	0	1	0	0	0	0
N VALLEY ST & E WILLIAM ST	5	-0.20	76	0	1	0	0	4	3	0	0	0	0	0	1	0	0	1	0	1	0
LONE MOUNTAIN DR & E WINNIE LN	5	-0.01	22	0	0	2	0	3	3	0	0	0	1	0	1	0	0	1	0	1	1
S EDMONDS DR & KOONTZ LN	5	0.04	0	0	0	0	0	5	2	0	1	0	1	0	0	0	2	1	0	0	0
N LOMPA LN & MENLO DR	5	0.32	0	0	0	0	0	5	1	0	0	0	2	0	0	1	0	2	0	1	0
FAIRVIEW DR & E TELEGRAPH ST	5	-0.19	17	0	0	1	1	3	1	0	0	1	1	1	0	0	2	0	0	3	0
BROWN ST & N EDMONDS DR	5	2.37	6	0	0	0	1	4	2	0	1	1	0	0	0	0	1	1	0	0	0
MERRIMAC WAY & US-50	5	-0.25	12	0	0	0	2	3	1	0	2	0	0	0	0	0	2	0	0	0	0
CENTENNIAL PARK DR & US-50	5	-0.25	17	0	0	1	1	3	0	0	5	0	0	0	0	0	3	2	1	1	0
NEWMAN LN & US-50	5	-0.26	563	1	0	0	0	4	1	0	1	0	1	0	1	0	0	0	0	2	0
US-50 & WINTERS PKWY	5	-0.25	22	0	0	2	0	3	0	1	1	0	2	0	0	0	1	0	1	2	1
RIVER ST & DOUGLAS ST	5	-0.26	6	0	0	0	1	4	1	0	1	0	2	0	0	0	1	0	0	1	0
TRADITIONS PKWY & SEGALE RD	5	-0.25	87	0	1	1	0	3	1	0	1	0	3	1	0	0	1	1	1	3	0
AMBROSE LN & US-50E	5	-0.24	574	1	0	1	0	3	1	0	2	1	1	0	0	0	2	1	0	2	0
US-50 & GOLF CLUB DR	4	-0.26	0	0	0	0	0	4	1	0	0	0	3	0	0	0	0	0	0	2	0
HOMANN WAY & N ORMSBY BLVD	4	0.22	6	0	0	0	1	3	1	0	1	0	2	0	0	0	1	0	0	0	0
TAMARA CT & STEPHANIE WAY	4	-0.16	17	0	0	1	1	2	0	0	2	0	0	0	0	0	3	0	1	0	0
MOUNTAIN ST & W WASHINGTON ST	4	-0.02	0	0	0	0	0	4	2	0	0	0	1	0	0	0	1	0	0	0	0
N MINNESOTA ST & W SOPHIA ST	4	-0.02	6	0	0	0	1	3	1	1	1	0	0	0	0	1	1	0	1	0	0

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1. Local Critical Crash Rate
2. Equivalent Property Damage Only



Intersection	Crashes	Local CCR Differential <sup>1</sup>	EPDO <sup>2</sup>	K	A	B	C	O	Angle	Sideswipe	Rear End	Head On	Hit Object	Overturned	Pedestrian	Bicycle	Aggressive	Impaired	Distracted	Dark	Wet
N NEVADA ST & W WASHINGTON ST	4	0.11	17	0	0	1	1	2	3	0	0	0	1	0	1	0	0	0	2	0	1
S CURRY ST & W 8TH ST	4	-0.02	11	0	0	1	0	3	4	0	0	0	0	0	0	0	0	0	0	1	0
S CARSON ST & W 2ND ST	4	-0.23	6	0	0	0	1	3	0	0	2	0	0	0	0	0	1	2	0	0	0
N CURRY ST & W PROCTOR ST	4	-0.23	6	0	0	0	1	3	1	0	2	0	0	0	0	0	1	1	1	0	1
N VALLEY ST & E WASHINGTON ST	4	0.11	82	0	1	0	1	2	2	0	1	0	1	0	0	1	0	0	0	0	0
S ROOP ST & RANDELL DR	4	-0.09	6	0	0	0	1	3	3	0	0	0	0	0	0	0	0	0	1	1	0
S ROOP ST & E 2ND ST	4	-0.17	12	0	0	0	2	2	3	0	1	0	0	0	1	0	1	0	0	0	0
HEYBOURNE RD & JOHNSON LN	4	-0.15	0	0	0	0	0	4	1	0	1	0	2	0	0	0	3	1	0	0	0
EMERSON DR & ARROWHEAD DR	4	-0.23	82	0	1	0	1	2	2	0	1	0	1	1	0	0	3	1	0	0	0
STATE ST & HANDELIN RD	4	-0.27	11	0	0	1	0	3	1	0	1	0	0	0	0	0	0	0	1	0	0
GONI RD & ARROWHEAD DR	4	-0.18	11	0	0	1	0	3	3	0	1	0	0	0	0	0	1	0	0	1	0
VICKY LN & JOHNSON LN	4	-0.07	17	0	0	1	1	2	2	0	0	1	0	0	0	0	1	0	1	0	0
S LOMPA LN & FAIRVIEW DR	4	-0.20	0	0	0	0	0	4	3	0	1	0	0	0	0	0	1	1	0	0	0
S EDMONDS DR & FAIRVIEW DR	4	-0.22	0	0	0	0	0	4	2	0	0	0	0	0	0	0	1	0	0	1	0
AIRPORT RD & WOODSIDE DR	4	-0.07	0	0	0	0	0	4	0	1	1	0	1	0	0	0	0	2	0	1	0
E NYE LN & US-50	4	-0.28	0	0	0	0	0	4	1	1	1	0	0	1	0	0	2	0	0	0	0
HILLSIDE DR & US-50	4	-0.28	0	0	0	0	0	4	0	0	0	0	4	0	0	0	0	0	0	2	0
YHVONA DR & US-50	4	-0.28	12	0	0	0	2	2	1	0	1	0	1	0	0	0	0	1	0	0	0
PRADERE RD & US-50	4	-0.28	11	0	0	1	0	3	2	0	0	0	1	0	0	0	0	0	0	1	0
US-50 & HALL ST	4	-0.28	0	0	0	0	0	4	1	0	3	0	0	0	0	0	2	0	1	1	0
US-50 & PINE CONE RD	4	-0.28	0	0	0	0	0	4	2	0	0	0	1	0	0	0	0	0	0	1	0
SILVER OAK DR & MEDICAL PKWY	3	-0.26	6	0	0	0	1	2	1	0	0	0	1	0	0	0	2	0	0	0	0
VISTA GRANDE BLVD & JACKS VALLEY RD	3	-0.29	6	0	0	0	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0
US-395 & MONK CT	3	-0.29	6	0	0	0	1	2	1	1	1	0	0	0	0	0	0	1	0	0	0
MICHAEL LN & JOHNSON LN	3	-0.26	0	0	0	0	0	3	2	0	1	0	0	0	0	0	1	0	0	1	0
S CARSON ST & E ROVENTINI WAY	3	-0.30	0	0	0	0	0	3	2	0	1	0	0	0	0	0	0	0	0	0	0
IMPERIAL WAY & W APPLGATE WAY	3	0.91	6	0	0	0	1	2	0	1	1	0	0	0	0	0	1	0	0	0	0
N DIVISION ST & FLEISCHMANN WAY	3	-0.19	6	0	0	0	1	2	2	0	0	0	0	0	0	0	0	1	0	0	0
OAK ST & CLEARVIEW DR	3	-0.16	11	0	0	1	0	2	1	0	1	0	1	1	0	0	1	0	0	0	1

3/27/2024

1. Local Critical Crash Rate
2. Equivalent Property Damage Only



Intersection	Crashes	Local CCR Differential <sup>1</sup>	EPDO <sup>2</sup>	K	A	B	C	O	Angle	Sideswipe	Rear End	Head On	Hit Object	Overturned	Pedestrian	Bicycle	Aggressive	Impaired	Distracted	Dark	Wet
FRONTAGE RD & US-395	3	-0.30	12	0	0	0	2	1	1	0	0	0	0	0	0	0	1	1	0	1	0
S CARSON ST & W 7TH ST	3	-0.29	0	0	0	0	0	3	0	0	2	0	0	0	0	0	2	0	1	0	0
S CARSON ST & W 8TH ST	3	-0.29	0	0	0	0	0	3	2	0	1	0	0	0	0	0	1	0	0	1	0
S CARSON ST & E 6TH ST	3	-0.28	6	0	0	0	1	2	0	0	2	0	0	0	0	0	3	0	0	0	0
N CARSON ST & E CAROLINE ST	3	-0.30	12	0	0	0	2	1	1	0	1	0	0	0	0	0	2	0	0	1	0
N CARSON ST & CORBETT ST	3	-0.30	0	0	0	0	0	3	0	0	1	0	0	0	0	0	1	0	0	0	0
GRANITE WAY & CASTLE WAY	3	0.91	0	0	0	0	0	3	0	1	1	0	0	0	0	0	0	0	0	0	0
S PLAZA ST & E 5TH ST	3	-0.24	6	0	0	0	1	2	0	0	3	0	0	0	0	0	2	0	0	0	0
BILLY'S RD & JOHNSON LN	3	-0.24	11	0	0	1	0	2	1	0	1	0	0	0	0	0	3	1	0	0	0
SILVER SAGE DR & SNYDER AVE	3	0.18	11	0	0	1	0	2	3	0	0	0	0	0	0	0	1	0	0	0	0
S ROOP ST & EVALYN DR	3	-0.21	12	0	0	0	2	1	3	0	0	0	0	0	0	0	0	0	0	0	0
N WALSH ST & E ROBINSON ST	3	0.54	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0
CENTER DR & RACE TRACK RD	3	0.24	6	0	0	0	1	2	1	0	0	1	1	1	0	0	2	0	1	1	0
N ROOP ST & E WASHINGTON ST	3	-0.27	11	0	0	1	0	2	1	0	1	0	0	1	0	0	1	0	0	0	0
HEYBOURNE RD & STEPHANIE WAY	3	-0.18	17	0	0	1	1	1	1	0	1	0	0	0	0	0	0	0	1	0	0
N ROOP ST & BASQUE WAY	3	-0.27	28	0	0	2	1	0	1	0	0	0	1	0	0	1	0	0	0	0	0
KANSAS ST & FAIRVIEW DR	3	-0.27	6	0	0	0	1	2	1	0	1	0	0	0	0	0	1	0	0	0	0
WILMA WAY & NORTHRIDGE DR	3	0.04	0	0	0	0	0	3	1	0	1	0	0	0	0	0	0	0	1	1	0
E LONG ST & MOLLY DR	3	-0.19	0	0	0	0	0	3	1	0	1	1	0	0	0	0	1	0	0	0	0
STATE ST & E LONG ST	3	-0.18	0	0	0	0	0	3	0	0	1	1	0	0	0	0	0	1	0	0	0
BUSINESS PKWY & JOHNSON LN	3	-0.19	0	0	0	0	0	3	1	0	0	1	1	0	0	0	1	0	1	0	0
S SALIMAN RD & COLORADO ST	3	-0.25	0	0	0	0	0	3	2	0	0	1	0	0	0	0	1	1	0	0	0
RAND AVE & E LONG ST	3	-0.19	11	0	0	1	0	2	1	0	0	0	1	0	1	0	1	0	0	1	0
HUMBOLDT LN & E LONG ST	3	-0.19	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	1	1	2	0
CHALLENGER WAY & E COLLEGE PKWY	3	-0.30	6	0	0	0	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0
VICKY LN & STEPHANIE WAY	3	-0.10	17	0	0	1	1	1	1	0	0	1	1	0	0	0	0	1	0	1	0
SILVER LN & E COLLEGE PKWY	3	-0.29	11	0	0	1	0	2	2	0	1	0	0	0	0	0	1	0	0	0	0
AIRPORT RD & CHAMPION ST	3	-0.22	11	0	0	1	0	2	1	0	0	0	0	0	0	0	0	0	0	0	1
OTHA ST & E COLLEGE PKWY	3	-0.28	639	1	1	0	0	1	0	0	0	0	0	0	0	0	0	2	0	1	0

3/27/2024

1. Local Critical Crash Rate

2. Equivalent Property Damage Only

Intersection	Crashes	Local CCR Differential <sup>1</sup>	EPDO <sup>2</sup>	K	A	B	C	O	Angle	Sideswipe	Rear End	Head On	Hit Object	Overtaken	Pedestrian	Bicycle	Aggressive	Impaired	Distracted	Dark	Wet	
STANFORD DR & WOODSIDE DR	3	0.19	6	0	0	0	1	2	2	0	1	0	0	0	0	0	0	0	0	0	0	0
FAIRVIEW DR & STANTON DR	3	-0.28	0	0	0	0	0	3	2	0	1	0	0	0	0	0	1	1	0	1	0	0
FAIRVIEW DR & LEPIRE DR	3	-0.28	0	0	0	0	0	3	2	0	1	0	0	0	0	0	0	0	0	0	0	0
FAIRVIEW DR & SWEETWATER DR	3	-0.28	0	0	0	0	0	3	1	0	2	0	0	0	0	0	1	0	0	0	0	0
FREMONT AVE & JOHNSON LN	3	-0.24	6	0	0	0	1	2	2	0	0	0	0	0	0	0	1	1	0	0	0	0
AKRON WAY & US-50	3	-0.30	82	0	1	0	1	1	0	1	1	1	0	0	0	0	2	1	1	0	0	0
DRAKO WAY & US-50	3	-0.30	11	0	0	1	0	2	2	0	0	1	0	0	0	0	1	0	0	2	0	0
HARBOR RD & US-50	3	-0.30	6	0	0	0	1	2	0	0	0	0	3	0	0	0	0	0	0	2	0	0
US-50 & FOURTH AVE	3	-0.30	6	0	0	0	1	2	0	0	2	0	0	0	0	0	1	0	0	0	0	0
US-50 & TOWNSEND ST	3	-0.30	0	0	0	0	0	3	1	0	0	0	0	0	0	0	1	0	0	0	0	0
US-50 & HART ST	3	-0.30	6	0	0	0	1	2	0	0	1	0	2	0	0	0	0	0	0	3	0	0
US-50 & ENTERPRISE WAY	3	-0.30	17	0	0	1	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	1

Note: Only crash types that typically contribute to fatal and serious injury crashes are shown here.



# ATTACHMENT C

## SEGMENT NETWORK SCREENING RESULTS



Facility	Cross Street 1	Cross Street 2	Crashes	Local CCR Differential <sup>1</sup>	EPD <sub>2</sub>	K	A	B	C	O	Angle	Sidewipe	Rear End	Head On	Hit Object	Overturned	Pedestrian	Bicycle	Aggressive	Distracted	Impaired	Dark	Wet	
																								1
US-50	GOLF LINKS DR	S CARSON ST/J-580/US 395	91	0.27	836	1	2	2	16	70	4	1	12	1	48	5	0	0	0	36	3	3	24	1
US-50	CAMPO BOUNDARY	GOLF CLUB DR	68	0.37	210	0	1	6	11	50	11	1	2	1	34	6	0	0	30	1	1	21	0	
US-50	WINTERS PKWY	BALDWIN LN	35	-0.02	77	0	0	2	9	24	5	0	14	0	11	1	0	0	16	3	3	12	1	
US-395	JACKS VALLEY RD	MICA DR	33	0.35	103	0	0	6	6	21	2	1	24	0	2	0	0	1	19	0	0	5	0	
US-395	JACKS VALLEY RD	TOPSY LN	32	0.21	99	0	0	4	9	19	15	1	8	1	2	1	0	0	8	2	2	7	0	
US-395	TOPSY LN	CLEAR CREEK RD	30	0.35	65	0	0	2	7	21	3	0	23	0	1	2	0	0	17	1	1	5	0	
US-395	STEPHANIE WAY	S SUNRIDGE DR	25	-0.22	11	0	0	1	0	24	2	1	4	0	12	0	0	0	9	0	0	7	1	
US-395	US-50	CLEAR CREEK RD	23	0.49	57	0	0	3	4	16	1	0	16	0	1	0	0	0	9	0	0	5	0	
US-395	S SUNRIDGE DR	MICA DR	22	-0.13	47	0	0	2	4	16	2	0	12	0	5	0	0	1	10	2	2	9	0	
US-50	AIRPORT RD	SILVER STATE ST	20	1.47	31	0	0	0	5	15	6	0	6	0	2	1	0	0	7	3	3	6	1	
US-395	STEPHANIE WAY	HITE CT	17	0.11	51	0	0	3	3	11	0	0	12	0	3	0	0	0	10	2	2	3	1	
US-50	FLINT DR	LINEHAN RD	13	-0.18	45	0	0	3	2	8	1	0	2	2	6	1	0	0	2	0	0	3	1	
US-50	FLINT DR	DRAKO WAY	9	-0.21	22	0	0	2	0	7	0	0	1	0	4	0	0	0	1	0	0	2	1	
US-395	JOHNSON LN	CAMPO BOUNDARY	9	-0.17	598	1	0	1	4	3	0	0	6	0	0	1	0	0	5	1	1	1	0	
US-50	ARROWHEAD DR	ASPHALT DR	8	0.03	12	0	0	0	2	6	0	1	5	0	2	0	0	0	3	0	0	2	0	
US-50	E NYE LN	EMPIRE RANCH RD	7	0.01	45	0	0	3	2	2	3	0	3	0	0	0	0	0	5	1	1	1	0	
US-50	N RAINBOW DR	DAYTON STATE PK	7	-0.11	0	0	0	0	0	7	0	0	1	0	6	0	0	0	3	0	0	4	0	
US-50	MERCURY WAY	NICHOLS LN	6	0.16	17	0	0	1	1	4	1	1	3	0	0	0	0	0	0	0	0	2	0	
US-50	SEGATE RD	FORTUNE DR	6	-0.31	575	1	0	0	2	3	1	0	1	0	3	2	0	0	2	2	2	3	0	
US-50	KIT KAT DR	NEWMAN LN	6	-0.18	28	0	0	2	1	3	0	0	3	0	3	0	0	0	1	0	0	3	0	
US-395	JOHNSON LN	HITE CT	5	-0.34	11	0	0	1	0	4	0	0	1	0	1	0	0	0	3	0	0	1	0	
US-50	SHERMAN LN	FAIRVIEW DR	5	-0.21	6	0	0	0	1	4	2	0	1	0	0	0	0	0	0	0	0	0	0	
US-50	4TH AVE	TOWNSEND ST	5	-0.09	6	0	0	0	1	4	3	0	0	0	2	0	0	0	0	0	3	3	4	
US-50	FORTUNE DR	RETAIL RD	5	-0.28	6	0	0	0	1	4	1	0	0	1	1	0	0	0	1	0	0	2	0	
US-50	SILVER STATE ST	BROWN ST	4	-0.22	17	0	0	1	1	2	1	0	3	0	0	0	0	0	3	0	0	0	0	
US-50	OCCIDENTAL DR	RIVERBOAT RD	4	-0.24	569	1	0	0	1	2	0	0	1	1	2	0	0	0	1	1	1	3	0	
US-50	FLOWERY AVE	PINE CONE RD	4	-0.37	0	0	0	0	0	4	0	1	1	0	0	0	0	0	1	0	0	2	0	
US-50	HART ST	DAYTON STATE PARK	4	-0.34	6	0	0	0	1	3	0	0	2	0	2	0	0	0	2	0	0	1	0	
US-50	RIVER RD	PINE CONE RD	4	-0.27	0	0	0	0	0	4	2	0	0	0	2	0	0	0	0	0	1	1	0	
US-50	S PINENUT DR	N RAINBOW DR	4	-0.34	6	0	0	0	1	3	0	0	1	0	3	1	0	0	1	0	0	2	0	
US-50	N DEER RUN RD	AKRON WAY	3	-0.33	0	0	0	0	0	3	0	0	2	0	0	0	0	0	1	0	0	2	0	
US-50	FORT CHURCHILL RD	LA FOND AVE	3	-0.39	0	0	0	0	0	3	1	0	0	0	2	0	0	0	0	0	0	2	0	
US-50	HILLSIDE DR	ALFONSO DR	3	-0.41	6	0	0	0	1	2	0	0	3	0	0	0	0	0	1	1	1	1	0	

3/27/2024

1. Local Critical Crash Rate

2. Equivalent Property Damage Only



Facility	Cross Street 1	Cross Street 2	Crashes	Local CCR Differential <sup>1</sup>	EPD <sub>2</sub>	K	A	B	C	O	Angle	Sidewalk	Rear End	Head On	Hit Object	Overturned	Pedestrian	Bicycle	Aggressive	Distracted	Impaired	Dark	Wet	
US-50	JEANETTE DR	STATE ROUTE 341	3	-0.34	0	0	0	0	0	3	0	0	0	0	2	0	0	0	0	0	0	0	1	0
<b>Minor Arterial</b>																								
US-395N/S CARSON ST	W APPIAN WAY	US-50/I-580	18	0.89	18	0	0	0	3	15	1	0	14	0	1	0	0	0	0	10	0	0	2	1
N CARSON ST	HOT SPRINGS RD	W NYE LN	12	0.30	121	0	1	3	2	6	3	0	6	0	2	0	1	1	4	0	0	1	0	0
FAIRVIEW DR	S EDMONDS DR	E 5TH ST	7	-0.08	6	0	0	0	1	6	1	0	3	2	1	0	0	0	2	1	1	2	0	0
E WILLIAM ST	HUMBOLDT LN	RAND ST	7	0.28	76	0	1	0	0	6	3	1	0	0	0	0	0	0	1	0	0	0	0	0
S CARSON ST	SONOMA ST	MOSES ST	7	-0.11	23	0	0	1	2	4	5	1	1	0	0	0	0	0	2	0	0	0	0	0
E COLLEGE PKWY	E NYE LN	LUKENS LN	7	0.24	98	0	1	2	0	4	2	1	1	0	1	2	0	1	4	3	3	2	1	1
E COLLEGE PKWY	US-50	SHERMAN LN	7	1.93	11	0	0	1	0	6	5	0	0	1	0	0	0	0	1	0	0	0	0	0
N CARSON ST	BATH ST	WHINNIE LN	6	0.14	6	0	0	0	1	5	1	0	5	0	0	0	1	0	4	0	0	1	0	0
S CARSON ST	W 10TH ST	S STEWART ST	6	0.26	152	0	2	0	0	4	2	0	2	1	1	0	0	0	3	0	0	0	0	0
FAIRVIEW DR	5TH ST	BUTTI WAY	5	-0.03	11	0	0	1	0	4	1	0	4	0	0	0	0	0	2	0	0	0	0	0
E WILLIAM ST	N STATE ST	OXOBY LOOP	4	-0.29	563	1	0	0	0	3	1	0	0	0	2	0	0	1	0	0	0	2	0	0
N SALIMAN RD	SEELY LOOP	US-50	4	0.74	23	0	0	1	2	1	0	0	1	0	0	0	0	0	2	0	0	0	0	0
FAIRVIEW DR	I-580 NB RAMP	I-580 SB RAMP	3	0.15	0	0	0	0	0	3	0	0	1	0	2	0	0	0	2	0	0	2	0	0
FAIRVIEW DR	S ROOP ST	KANSAS ST	3	0.03	6	0	0	0	1	2	0	1	2	0	0	0	0	0	1	0	0	0	0	0
FAIRVIEW DR	S SALIMAN RD	I-580 SB RAMPS	3	-0.32	6	0	0	0	1	2	0	0	1	0	1	0	0	0	2	0	0	1	0	0
N CARSON ST	W COLLEGE PKWY	W NYE LN	3	-0.37	0	0	0	0	0	3	1	0	2	0	0	0	0	0	2	0	0	1	0	0
N CARSON ST	MEDICAL PKWY	SILVER OAK DR	3	-0.31	0	0	0	0	0	3	1	0	2	0	0	0	0	0	3	0	0	0	1	0
S CARSON ST	FAIRVIEW DR	S STEWART ST	3	-0.29	76	0	1	0	0	2	1	0	2	0	0	0	0	0	2	0	0	1	0	0
E COLLEGE PKWY	N ROOP ST	RETAIL DR	3	-0.09	6	0	0	0	1	2	1	0	1	0	0	0	0	0	1	0	0	0	0	0
E COLLEGE PKWY	RESEARCH WAY	GONI RD	3	-0.30	12	0	0	0	2	1	1	0	2	0	0	0	0	0	1	1	1	1	1	0
N ROOP ST	NORTHBRIDGE DR	E WINNIE LN	3	-0.29	0	0	0	0	0	3	0	0	1	0	1	1	0	0	2	0	0	0	0	0
E 5TH ST	PASTURE DR	BUTTI WAY	3	-0.37	23	0	0	1	2	0	0	0	1	0	2	0	0	0	3	1	1	1	1	0
<b>Major Collector</b>																								
SR 341	MAIN ST	INDUSTRIAL PKWY	6	-0.01	104	0	1	2	1	2	0	0	0	0	6	2	0	0	0	2	2	3	0	0
JOHNSON LN	US 395	MICHAEL LN	4	0.96	0	0	0	0	0	4	0	0	2	0	1	1	0	0	1	1	1	0	0	0
JOHNSON LN	BILLY'S RD	MICHAEL LN	4	-0.06	0	0	0	0	0	4	1	0	1	0	2	0	0	0	1	1	1	0	0	0
STEPHANIE WAY	TAMARA CT	HEYBOURNE RD	3	-0.23	11	0	0	1	0	2	2	0	1	0	0	0	0	0	1	1	1	0	0	0
<b>Minor Collector</b>																								
S CURRY ST	CURRY CIR	LAKE GLEN DR	7	0.82	34	0	0	2	2	3	1	0	0	0	5	2	0	0	2	2	2	1	0	0
S CURRY ST	W CLEARVIEW DR	KOONTZ LN	6	1.76	87	0	1	1	0	4	5	0	0	0	0	1	0	0	1	1	1	0	0	0
W COLLEGE PKWY	GS RICHARDS BLVD	US-395	5	1.99	18	0	0	0	3	2	2	0	1	0	0	0	0	0	3	0	0	0	0	0
S ROOP ST	LITTLE LN	E 5TH ST	4	0.45	6	0	0	0	1	3	0	0	0	0	1	0	0	0	1	0	0	0	0	0

3/27/2024

1. Local Critical Crash Rate
2. Equivalent Property Damage Only



Facility	Cross Street 1	Cross Street 2	Crashes	Local CCR Differential <sup>1</sup>	EPDO <sup>2</sup>	K	A	B	C	O	Angle	Sideswipe	Rear End	Head On	Hit Object	Overturned	Pedestrian	Bicycle	Aggressive	Distracted	Impaired	Dark	Wet	
TOPSY LN	LYLA LN	CENTER DR	4	0.75	163	0	2	1	0	1	1	0	0	0	3	2	0	0	0	2	1	1	1	0
OLD CLEAR CREEK RD	VISTA GRANDE BLVD	RV COMSTOCK ST	3	-0.14	6	0	0	0	1	2	1	0	1	0	0	0	0	0	0	2	1	1	0	0
<b>Local Roads</b>																								
WOODSIDE DR	STANTON DR	DESTOYA DR	6	5.82	28	0	0	2	1	3	3	1	0	0	0	0	0	0	0	0	0	0	3	0
SIERRA VISTA LN	PINION HILLS DR	MEXICAN DAM RD	5	1.78	76	0	1	0	0	4	0	1	0	1	3	1	0	0	2	1	1	2	0	0
RESEARCH WAY	GONI RD	E COLLEGE PKWY	3	10.69	580	1	0	1	1	0	1	0	0	1	0	0	0	0	1	1	1	0	0	0
WOODSIDE DR	SISKIYOU DR	MONTE ROSA DR	3	3.72	22	0	0	2	0	1	2	0	1	0	0	0	0	0	0	1	1	2	0	0

Note: Only crash types that typically contribute to fatal and serious injury crashes are shown here.



## **APPENDIX B**

### **CAMPO LRSP POLICIES, PLANS, AND STUDIES MEMORANDUM**



## MEMORANDUM

RE: **CAMPO Local Road Safety Plan Document Review and Research**

From: **Lindsay Saner, P.E., PTOE, RSP<sub>2</sub>, Kimley-Horn**

Date: **September 25, 2023**

## Summary of Policies, Plans, and Studies

The first step in the Local Road Safety Plan (LRSP) is to conduct a review of existing policies, plans, and studies. This memorandum provides a summary of known studies and documents related to the Local Road Safety Plan (LRSP) for the Carson Area Metropolitan Planning Organization (CAMPO). The documents reviewed and responsible agencies are listed below.

- Strategic Highway Safety Plan (SHSP) (NDOT)
- Highway Safety Improvement Program (HSIP), Local Public Agencies (LPA) Process (NDOT)
- CAMPO Mission, Vision, and Goals (CAMPO)
- Highway Safety Manual (AASHTO)
- Proven Safety Countermeasures (FHWA)
- Countermeasures that Work (NHSTA)
- CAMPO program budgets (CAMPO)
- Existing safety related policies and practices (CAMPO)
- CAMPO proposed projects (CAMPO)
- Complete Streets Plan (CAMPO)
- Safe Routes to School (SRTS) Carson City
- SRTS Douglas County
- Capital Improvements Plan (CAMPO)
- 2020 Carson City ADA Transition Plan

The following sections summarize the studies reviewed and are organized by responsible agency.

### **American Association of State Highway and Transportation Officials (AASHTO):**

**Study Name:** Highway Safety Manual

#### **Summary:**

The AASHTO Highway Safety Manual (HSM), published in 2010, presents a variety of methods for quantitatively estimating crash frequency or severity at a variety of locations. This four-part manual is divided into Parts: A) Introduction, Human Factors, and Fundamentals; B) Roadway Safety Management Process; C) Predictive Method; D) Crash Modification Factors.

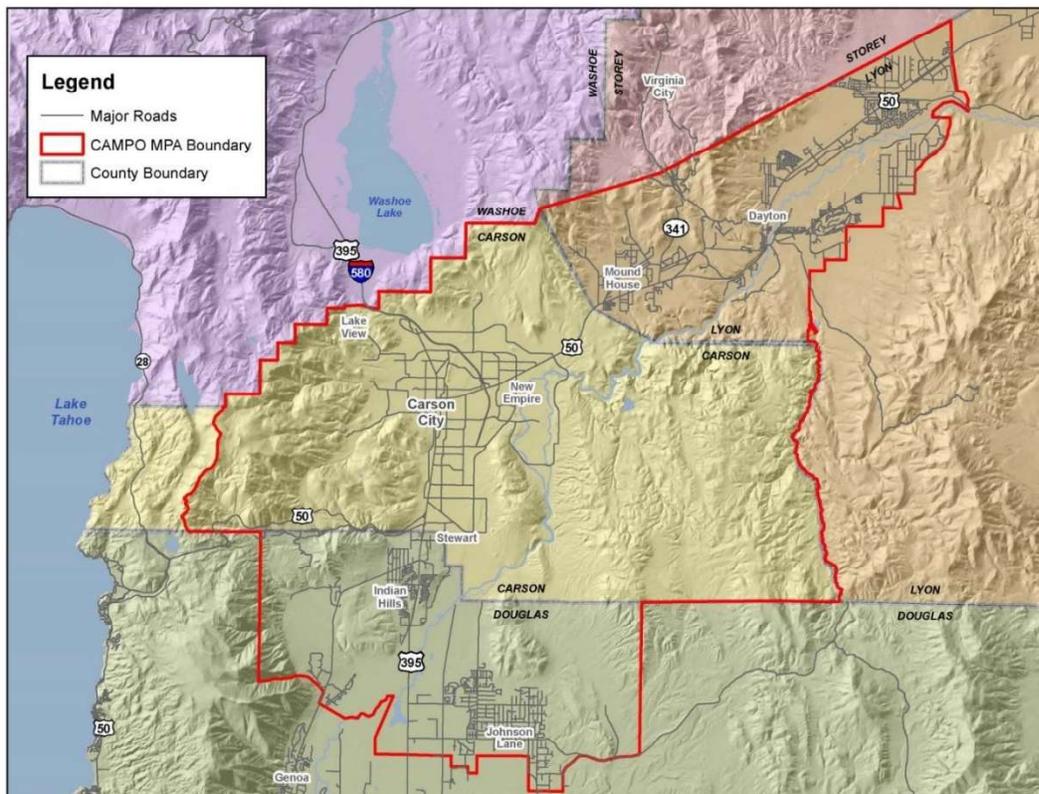
Chapter 4 of Part B of the HSM discusses the Network Screening process. The Network Screening Process is a tool for an agency to analyze their entire network and identify/rank locations that, based on the implementation of a countermeasure, are most likely to least likely realize a reduction in the frequency of crashes.

The HSM identifies five steps in this process:

1. Establish Focus: Identify the purpose or intended outcome of the network screening analysis. This decision will influence data needs, the selection of performance measures, and the screening method that can be applied.
2. Identify Network and Establish Reference Populations: Specify the types of sites or facilities being screened (i.e., segments, intersections, geometrics) and identify groupings of similar sites or facilities.
3. Select Performance Measures: There are a variety of performance measures available to evaluate the potential to reduce crash frequency at a site. In this step, the performance measure is selected as a function of the screening focus and the data and analytical tools available.
4. Select Screening Method: There are three principal screening methods described in this chapter (i.e., ranking, sliding window, peak searching). Each method has advantages and disadvantages; the most appropriate method for a given situation should be selected.
5. Screen and Evaluate Results: The final step in the process is to conduct the screening and analysis and evaluate the results.

The HSM provides several statistical methods for screening roadway networks to identify high-risk locations based on overall crash histories. In addition to identifying the total number of crashes, this LRSP uses a method referred to as Critical Crash Rate (CCR) to analyze the data.

### Carson Area Metropolitan Planning Organization (CAMPO):



Source: CAMPO

**Figure 1: CAMPO Jurisdiction Boundary**

**Name:** CAMPO Mission, Vision, and Goals

**Summary:**

CAMPO is the metropolitan planning organization (MPO) for the Carson City, western Lyon County, and northern Douglas County. The mission, vision, and goals for CAMPO that are included within the 2050 Regional Transportation Plan identify current and future needs to maintain safety, while promoting sustainability, mobility, and reliability on an integrated, multimodal transportation system. Carson City has their own vision, mission and values which include: “To be a leader among cities as an inviting, prosperous community where people live, work, and play,” and “to preserve and enhance the quality of life and heritage of Carson City for present and future generations of residents, workers, and visitors.” CAMPO uses a performance-based planning lens to establish goals, targets, and performance measures, which are reviewed annually within the CAMPO Network Monitoring Report. Some procedures in place for CAMPO include updating the Regional Transportation Plan every five years and updating the Transportation Improvement Plan every four years. The LRSP shall incorporate the mission, vision, and goals into any future proposed projects or improvements based upon findings in the LRSP.

**Name:** 2024 Unified Planning Work Program (UPWP)

**Completed:** May, 2022

**Summary:**

CAMPO has approved their 2024 UPWP which identified objectives for the 2023 and 2024 fiscal years. CAMPO conducts its efforts in two-year cycles to allow for greater flexibility in completing significant work tasks within a funding cycle. CAMPO has five work elements with budgets. The total funding amount is divided between the Unified Planning Work Program (UPWP) consolidated planning grant (CPG) with a local match and includes other federal or local funding included. The total amount budgeted for FY2023 is \$564,505. The total amount budgeted for FY2024 is \$730,570. Over the two-year period there is \$1,295,075 in total budgeted with \$1,128,980 accounted to come from UPWP CPG/local and \$166,095 to come from other federal and local funding.

It will be important for the LRSP to keep in mind that funding is allocated on this two-year cycle so any plans for implementation of recommendations from the LRSP would be budgeted for on the two-year cycle depending on the timing of the project.

**Name:** Carson City Safety-Related Policies and Practices (CAMPO)

**Summary:**

CAMPO is intended to work in conjunction with other governmental agencies but still operates under its own set of policies and procedures. All policies must be approved by CAMPO majority vote. The CAMPO governing body is comprised of seven voting members, which includes five members of the Regional Transportation Commission of Carson City and two appointees from the surrounding counties (Douglas, and Lyon), as well as one non-voting ex-officio member from NDOT. Each member serves a two-year term. The board also includes on non-voting ex-officio member. A key part of safety related practices and policies is to prioritize safety within the Regional Transportation Plan (RTP) 2021-2050, Transportation Improvement Program (TIP), and Public Participation Plan (PPP). The RTP 2021-2050 identifies safety performance measures that are based off of the FHWA HSIP and Safety Performance Management measures. They use number of fatalities, rate of fatalities, number of serious injuries, rate of serious injuries, and number of non-motorized fatalities and non-motorized serious injuries to measure performance.

**Name:** CAMPO Regional Transportation Plan 2021-2050 and Transportation Improvement Program (CAMPO)

**Summary:**

CAMPO’s RTP 2021-2050 and TIP for federal fiscal year 2023 through 2026 include proposed future projects. There are two groups of proposed projects, near-term (2020-2030) and long-range (2031-2050) and they anticipate inflation of project costs. In the near term, there are 21 funded (fiscally-constrained) projects, which include rehabilitation and safety improvement projects in various areas within Carson City, ADA improvements in Lyon County, Jump Around Carson (JAC) Operations and Ambassador Program,

and construction of a new road in Douglas County. The RTP incorporates plans, such as the Carson City Safe Routes to School Master Plan, to allow for additional funding sources to accomplish safety projects. There are 13 near-term projects that are unfunded, although some of these cost estimates were not developed at the time of the RTP. Near-term unfunded projects in the RTP include additional pavement rehabilitation projects, congestion mitigation improvements, Jump Around Carson (JAC) expansions, new intersection construction, new roadway construction, congestion mitigations, traffic control devices, and a new bridge.

There are three fiscally constrained projects that are long-range with a total cost of \$119.4 million which include pavement preservation projects within Carson City, safety improvements based off the SHSP plan, and funding for the continued operation of JAC bus service for 20 years. There are 14 long-range projects planned with an estimated cost of \$111.3 million, with some cost estimates not developed at the time of the RTP. These projects include the construction of new roads and interchanges, roadway lane expansions, new traffic control devices, establishment of new park and ride lots, and bus services throughout Carson City, Douglas County, and the Tahoe Regional Planning Area (TRPA) jurisdiction area.

The Transportation Improvement Plan (TIP) prioritizes this list of projects for the future four years. The TIP works in conjunction with the Statewide Transportation Improvement Program (STIP) and the Regional Transportation Plan (RTP). The TIP also includes various funding sources for transportation projects that are available through the FHWA, United States Department of Housing and Urban Development (HUD), and Federal Transit Administration (FTA). There is also the planned state match that would be required for various funding sources. Any planned implementation for projects recommended by the LRSP should take the funding cycles within the TIP into consideration as they will likely be near-term improvements and their funding sources and required matches should be included in the TIP and any future updates to the RTP.

**Study Name:** Carson City Public Works Complete Streets Policy (CAMPO)

**Summary:**

The Complete Streets Policy for CAMPO is a program ensuring that streets are safe, accessible, and comfortable for users of all ages and abilities without limitation. The Complete Streets Policy also includes safety for people using all types of transportation. The Complete Streets Policy applies to all projects regardless of their funding sources. Complete Street elements should be an aspect of all future projects and phases moving forward, so any proposed changes in the LRSP should take this into consideration. CAMPO has created a Complete Streets Performance Monitoring guide that can be used alongside the policy document to guide compliance with Complete Streets. CAMPO has previously invested funds into pedestrian and bicycle monitoring within four primary corridors, Carson Street Downtown, South Carson Street, William Street, and North Carson Street, which have been reviewed annually. These corridors were the first in which Complete Streets projects were created to add pedestrian and bicycle improvements, lane reductions, on street parking, and continuous center turn lanes. Each proposed corridor requires a Complete Streets Feasibility Study to ensure that Complete Streets will work. Public participation is an important part of this process as well, including engagement and visioning. While those aspects are not typically part of an LRSP, it is still important to consider Complete Streets ideas into any LRSP proposals. While the LRSP will be focused on roadway implementations, it still involves bicycle and pedestrian users who can be included in serious injury and fatal crashes. Complete Streets design ideas should be considered in any intersection that is used by bicyclists, pedestrians, transit users, and vulnerable road users.

**Carson City:**

**Study Name:** Carson City 2020 Americans with Disabilities Act (ADA) Transition Plan for Pedestrian Facilities in the Public Right-of-Way (CAMPO)

**Completion Date:** 2020

**Summary:**

This plan provides a framework for Carson City to meet equal access requirements as identified in the ADA. It largely relates to pedestrian facilities in the public right-of-way and ensuring those facilities are provided and always maintained. This is an updated plan from the previous 2015 plan which originally inventoried some of the available pedestrian facilities. The updated inventory includes 269 linear miles of sidewalk, 3,099 existing curb ramps, and 825 missing curb ramps. Additional inventory is planned. To meet the ADA accessibility guidelines, Carson City is relying on the TIP, development permits, and street maintenance for the planned updates and funding. Funding is a pressure point to achieving accessibility as there is limited funding for sidewalk improvements each year compared to the funds required to make all sidewalks within Carson City accessible. Any roadway improvements undertaken as part of the LRSP must meet ADA specification for pedestrian facilities as identified within the ADA Transition Plan.

**Study Name:** Safe Routes to School (SRTS) Carson City Master Plan (CAMPO)

**Completion Date:** 2020; Updated 2022

**Consultant:** Headway Transportation, Alta Planning and Design, CFA

**Project Extent:** Carson City

**Summary:**

The Carson City Safe Routes to School (SRTS) Master Plan focuses on encouraging walking and biking to school and improving the safety of students within one mile of the schools. The plan considered the six E's of SRTS Planning, Engineering, Education, Encouragement, Engagement, Equity, and Evaluation to come up with recommendations in three categories: Quick Win Projects, SRTS Core Projects, and Aspirational Projects. Most of the safety improvements can be completed in the Quick Win Project stage and the Core Projects stage and are able to be completed in the near or medium term. Changes proposed in SRTS planning are likely implementations that will benefit future users in areas that could be considered under the LRSP analysis.

The main considerations for the SRTS plan include a focus on bus stop connectivity, sidewalk connectivity, and bicycle network connectivity as well as safety in school zones. It is certainly possible that some of the corridor crash history identified in SRTS may be segments or intersections identified for improvements in the LRSP. Any crossover in recommendations between SRTS and the LRSP would be geared toward any fatal or serious injury crashes that involve a pedestrian or a cyclist and a driver.

**Douglas County:**

**Study Name:** Safe Routes to School (SRTS) Douglas County

**Completion Date:** Fall 2023

**Summary:**

The Douglas County Safe Routes to School Action Plan focuses on increasing walking and biking while improving safety in the areas surrounding the county's 11 schools. The plan was developed with input from stakeholders who identified valuable insights about each of the school campuses. The plan identifies infrastructure that would allow students to have safer mobility options, as well as providing alternative transportation options to support improving health outcomes, reduce traffic congestion, and improve academic performance. Engagement with community members and agency partners was a critical component of the development of this Action Plan.

## Federal Highway Administration (FHWA):

**Study Name:** Proven Safety Countermeasures (PSC) (FHWA)

**Completion Date:** 2021

### Summary:

The FHWA has identified and is promoting use of 28 PSCs which offer significant and measurable impacts to improving safety. More information from FHWA can be found here: [Proven Safety Countermeasures | FHWA \(dot.gov\)](https://www.fhwa.dot.gov/proven-safety-countermeasures/). The 28 PSCs are shown in Figure 4.

## Proven Safety Countermeasures

### SPEED MANAGEMENT



Speed Safety Cameras



Variable Speed Limits



Appropriate Speed Limits for All Road Users

### ROADWAY DEPARTURE



Wider Edge Lines



Enhanced Delineation for Horizontal Curves



Longitudinal Rumble Strips and Stripes on Two-Lane Roads



SafetyEdge<sup>SM</sup>



Roadside Design Improvements at Curves



Median Barriers

### INTERSECTIONS



Backplates with Retroreflective Borders



Corridor Access Management



Dedicated Left- and Right-Turn Lanes at Intersections



Reduced Left-Turn Conflict Intersections



Roundabouts



Systemic Application of Multiple Low-Cost Countermeasures at Stop-Controlled Intersections



Yellow Change Intervals

### PEDESTRIANS/BICYCLES



Crosswalk Visibility Enhancements



Bicycle Lanes



Rectangular Rapid Flashing Beacons (RRFB)



Leading Pedestrian Interval



Medians and Pedestrian Refuge Islands in Urban and Suburban Areas



Pedestrian Hybrid Beacons



Road Diets (Roadway Reconfiguration)



Walkways

### CROSSCUTTING



Pavement Friction Management



Lighting



Local Road Safety Plans



Road Safety Audit

Source: FHWA

Figure 2: Proven Safety Countermeasures

PSCs are a basis for agency consideration for highway safety projects and agencies are encouraged to implement them to accelerate the achievement of safety goals at all levels. While the LRSP itself is a PSC, other PSCs can be included as solutions within the LRSP. The FHWA acknowledges that while most rural roads are owned by local agencies, they see a higher number of fatal and serious injury crashes than State highways. LRSPs support goals of a state’s SHSP. The FHWA also supports and acknowledges that collaboration between various agencies is important for a successful LRSP.

**Nevada Department of Transportation (NDOT):**



Source: NDOT

**Figure 3: Nevada SHSP Goals**

**Study Name:** 2021-2025 Nevada Strategic Highway Safety Plan

**Completion Date:** 2021

**Project Extent:** Statewide Nevada

**Summary:**

The Nevada Strategic Highway Safety Plan (SHSP) has identified Critical Emphasis Areas (CEAs) to help guide efforts to increase road user safety on Nevada’s streets and highways. The plan is updated every five years with the most recent crash data and helps provide information to planning organizations and agencies. The SHSP seeks to incorporate equity, prioritize safe speeds, double down on strategies that work, and to accelerate implementation of advanced technology to help reduce fatalities on Nevada’s roadways. The SHSP identifies strategies and actions for the following CEAS:

- Bicyclists
- Impaired Driving
- Intersections
- Lane Departures
- Motorcyclists
- Occupant Protection
- Older Drivers
- Pedestrians
- Safe Speeds
- Young Drivers
- Work Zones

These CEAs will be considered in the analysis of the LRSP for CAMPO. The goals, strategies, and actions of the SHSP should be considered when developing recommendations for the LRSP.

**Study Name:** Highway Safety Improvement Program (HSIP), Local Public Agencies (LPA) Process

**Completion Date:** October 2021

**Summary:**

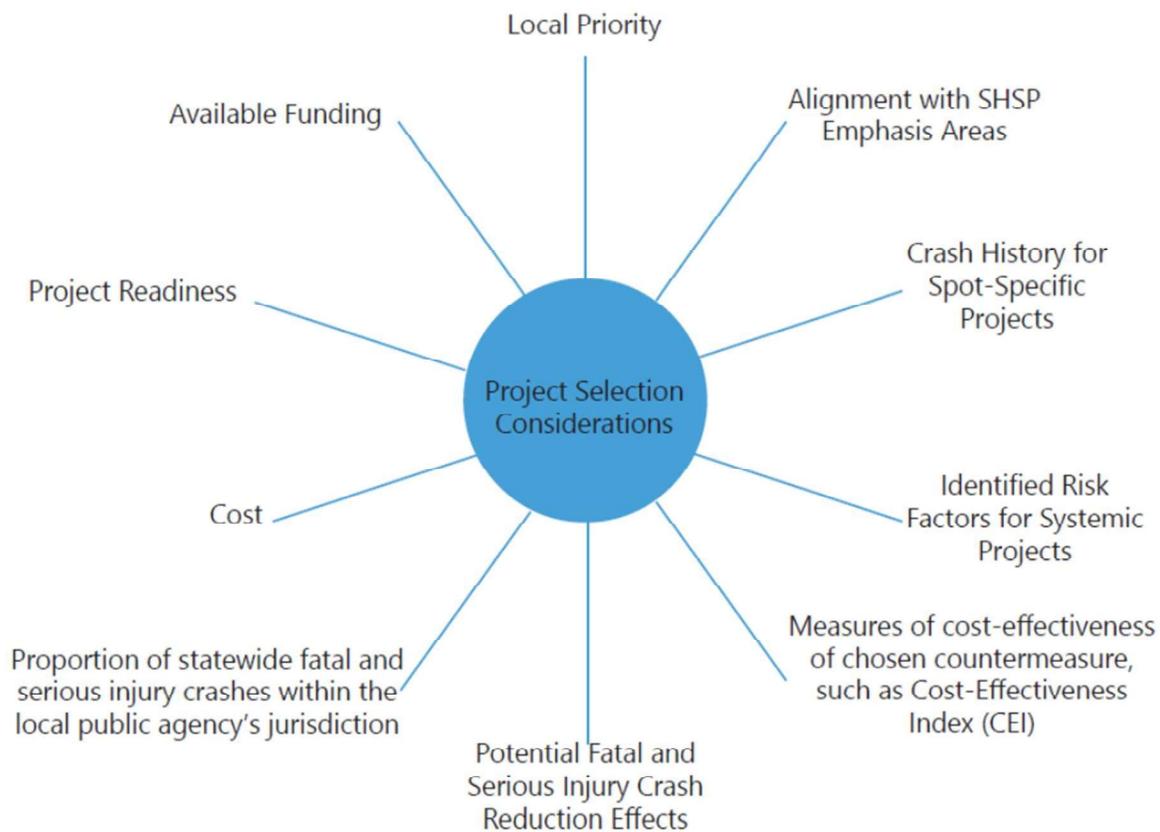
The HSIP LPA Process supports efforts to assist agencies with applying for HSIP funding. HSIP is a federal program using a data driven approach and the preparation of an LRSP, such as the one being completed for CAMPO is a requirement for this funding source. Each project submitted for funding is required to support at least one emphasis area in the Nevada SHSP as summarized above. This LPA process defines the steps to completing an LRSP, which includes the identification of stakeholders, use of safety data, selection of proven solutions, and the implementation of those solutions. The document provides guidance on important components of an LRSP, including types of data to use other than crash data, such as roadway characteristics, traffic volumes, maintenance logs, and traffic citations is also important in determining safety of roadways. The systemic process for the LRSP process is shown in **Figure 4**.



Source: NDOT

**Figure 4: LRSP Systemic Process**

Once the LRSP had been prepared based on the criteria mentioned in the document, NDOT will review for several project selection considerations shown below in **Figure 5**. It is important that the CAMPO LRSP take these selection considerations and incorporate them into the report.



Source: NDOT

**Figure 5: LRSP Process Project Selection**

The LPA Process requires project sponsors receiving funds to execute a legal agreement with NDOT. The project sponsors are required to have the capacity to administer funding and contracts as specified by NDOT's LPA Manual. Close work with NDOT throughout the LRSP process is essential for meeting project funding goals.

## **National Highway Traffic Safety Administration (NHTSA)**

**Study Name:** Countermeasures that Work, 10<sup>th</sup> Edition

### **Summary:**

The National Highway Traffic Safety Administration's (NHTSA) Countermeasures that Work are behavior-related countermeasures intended to be applicable for State Highway Safety Offices (SHSO) as a guideline for effectiveness. These countermeasures are grouped into ten different problem areas. It is important to note that some countermeasure areas have been longer researched than others. The areas of focus for the guide include:

- Alcohol and Drug Impaired Driving
- Seatbelts and Child Restraints
- Speeding and Speed Management
- Distracted Driving
- Motorcycle Safety
- Young Drivers
- Older Drivers
- Pedestrian Safety
- Bicycle Safety
- Drowsy Driving

Any of these areas could be crash factors for the LRSP but primarily impaired driving, speed management, and distracted driving are factors that could impact crash rates analyzed within the LRSP. Each countermeasure area features specific countermeasures in a table with a ranked effectiveness out of five stars, as well as the cost on a scale from low to high, the frequency of use of the countermeasure, and the time required to implement. Time to implement is ranked by "long" being more than one year, "medium" more than 3 months but less than one year, and "short" being 3 months or less. The effectiveness to cost ratio is an important consideration for recommendations that are to come out of the LRSP. The countermeasures outlined in this guide are aimed toward shifting the behaviors of drivers through different types of implementations. Physical changes like those in the FHWA PSCs must be considered in conjunction with behavioral implementations to make roads safer.

### **Summary**

The documents listed above have provided substantial background that will be used to support findings within the CAMPO LRSP. It is important to understand what improvement projects are already being considered within the CAMPO boundaries. The LRSP may identify priority locations with high local CCR, along segments, or at signalized or unsignalized intersections, that already have planned improvements or implemented countermeasures to reduce fatal and serious injury crashes. The safety documents provide a useful background for metrics that we can use to analyze the study area.

**ATTACHMENT A**  
**PLANNING STUDIES MATRIX**

Manual	2010	<p>The Network Screening Process in the HSM is a tool for an agency to analyze their entire network and identify/rank locations that, based on the implementation of a countermeasure, are most likely to least likely realize a reduction in the frequency of crashes. The HSM identifies five steps in this process: Establish Focus, Identify Network and Establish Reference Populations, Select Performance Measures, Select Screening Method, Screen and Evaluate Results</p> <p>The HSM provides several statistical methods for screening roadway networks to identify high risk locations based on overall crash histories. In addition to identifying the total number of crashes, this LRSP uses a method referred to as Critical Crash Rate (CCR) to analyze the data.</p>	<a href="#">Highway Safety</a>
Mission, Vision, and Goals		<p>CAMPO's mission, vision, and goals identify current and future needs to maintain a safe, efficient, and sustainable transportation system. Carson City has their own vision, mission and values which include: "To be a leader among cities as an inviting, prosperous community where people live, work, and play," and "to preserve and enhance the quality of life and heritage of Carson City for present and future generations of residents, workers, and visitors."</p>	<a href="#">Carson City Organization</a>
Planning (UPWP)	2022	<p>CAMPO has approved their 2024 UPWP which identified objectives for the 2023 and 2024 fiscal years. CAMPO has five work elements with budgets. The total funding amount is divided between the Unified Planning Work Program (UPWP) consolidated planning grant (CPG) with a local match and includes other federal or local funding included.</p> <p>It will be important for the LRSP to keep in mind that funding is allocated on this two-year cycle so any plans for implementation of recommendations from the LRSP would be budgeted for on the two-year cycle depending on the timing of the project.</p>	<a href="#">2024 Unified</a>
Safety Measures and Goals	2021	<p>The CAMPO governing body is comprised of seven members which includes five members of the Regional Transportation Commission of Carson City including appointees from the surrounding counties (Carson City, Douglas, and Lyon) and each member serves a two-year term. A key part of safety related practices and policies is to maintain the Regional Transportation Plan, Regional Transportation Plan, Transportation Improvement Program, and Public Participation Plan. The 2050 Regional Transportation Plan identifies safety performance measures that are based off of the FHWA HSIP and Safety Performance Management measures. They use number of fatalities, rate of fatalities, number of serious injuries, rate of serious injuries, and number of non-motorized fatalities and non-motorized serious injuries to measure performance.</p>	<a href="#">2050 Regional</a>
Regional Transportation Plan 2050	2020	<p>CAMPO's 2050 Regional Transportation Plan 2021-2050 (RTP), and Transportation Improvement Program for Federal Fiscal Year 2023 through 2026 include proposed future projects. There are two groups of proposed projects, near-term (2020-2030) and long-range (2031-2050) and they anticipate inflation of project costs. In the near term, there are 21 funded (fiscally-constrained) projects, which include rehabilitation and safety improvement projects in various areas within Carson City, ADA improvements in Lyon County, Safe Routes to School (SRTS) Master Plan for Carson City, Jump Around Carson (JAC) Operations and Ambassador Program, and construction of a new road in Douglas County. Near-term unfunded projects in the RTP include additional pavement rehabilitation projects, congestion mitigation improvements, Jump Around Carson (JAC) expansions, new intersection construction, new roadway construction, congestion mitigations, traffic control devices, and a new bridge.</p>	<a href="#">2050 Regional</a>

<p>2021</p>	<p>The Transportation Improvement Plan (TIP) prioritizes this list of projects for the future four years. There is also the planned state match that would be required for various funding sources. Any planned implementation for projects recommended by the LRSP should take the funding cycles within the TIP into consideration as they will likely be near-term improvements and their funding sources and required matches should be included in the TIP and any future updates to the RTP.</p>	<p><a href="#">Transpo</a></p>
<p>2014, updated 2022</p>	<p>The Complete Streets Policy for CAMPO is a program ensuring that streets are safe, accessible, and comfortable for users of all ages and abilities without limitation. The Complete Streets Policy also includes safety for people using all types of transportation. Complete Street elements should be an aspect of all future projects and phases moving forward, so any proposed changes in the LRSP should take this into consideration. CAMPO has created a Complete Streets Performance Monitoring guide that can be used alongside the policy document to guide compliance with Complete Streets. Public participation is an important part of this process as well, including engagement and visioning. While those aspects are not typically part of an LRSP, it is still important to consider Complete Streets ideas into any LRSP proposals. While the LRSP will be focused on roadway implementations, it still involves bicycle and pedestrian users who can be included in serious injury and fatal crashes. Complete Streets design ideas should be considered in any intersection involving pedestrians or cyclists.</p>	<p><a href="#">East Willia</a></p>
<p>2020</p>	<p>This plan provides a framework for Carson City to meet equal access requirements as identified in the ADA. It largely relates to pedestrian facilities in the public right-of-way and ensuring those facilities are provided and always maintained. To meet the ADA accessibility guidelines, Carson City is relying on the TIP, development permits, and street maintenance for the planned updates and funding. Funding is a pressure point to achieving accessibility as there is limited funding for sidewalk improvements each year compared to the funds required to make all sidewalks within Carson City accessible. Any roadway improvements undertaken as part of the LRSP must meet ADA specification for pedestrian facilities as identified within the ADA Transition Plan.</p>	<p><a href="#">Carson City (ADA) Transit</a></p>

	<p>School Safety Plan</p> <p>2020, updated 2022</p>	<p>The Carson City Safe Routes to School (SRTS) Master Plan focuses on encouraging walking and biking to school and improving the safety of students within one mile of the schools. The plan considered the six E's of SRTS Planning, Engineering, Education, Encouragement, Engagement, Equity, and Evaluation to come up with recommendations in three categories: Quick Win Projects, SRTS Core Projects, and Aspirational Projects. Most of the safety improvements can be completed in the Quick Win Project stage and the Core Projects stage and are able to be completed in the near or medium term. Changes proposed in SRTS planning are likely implementations that will benefit future users in areas that could be considered under the LRSP analysis.</p> <p>The main considerations for the SRTS plan include a focus on bus stop connectivity, sidewalk connectivity, and bicycle network connectivity as well as safety in school zones. It is certainly possible that some of the corridor crash history identified in SRTS may be segments or intersections identified for improvements in the LRSP. Any crossover in recommendations between SRTS and the LRSP would be geared toward any fatal or serious injury crashes that involve a pedestrian or a cyclist and a driver.</p>	<p><a href="#">SRTS</a></p>
<p>School County</p>	<p>Fall 2023</p>	<p>The Douglas County Safe Routes to School Action Plan focuses on increasing walking and biking while improving safety in the areas surrounding the county's 11 schools. The plan was developed with input from stakeholders who identified valuable insights about each of the school campuses. The plan identifies infrastructure that would allow students to have safer mobility options, as well as providing alternative transportation options to support improving health outcomes, reduce traffic congestion, and improve academic performance. Engagement with community members and agency partners was a critical component of the development of this Action Plan.</p>	<p><a href="#">Douglas County</a></p>
<p>Safety Plans (PSC)</p>	<p>2021</p>	<p>The FHWA has identified and is promoting use of 28 PSCs which offer significant and measurable impacts to improving safety. PSCs are a basis for agency consideration for highway safety projects and agencies are encouraged to implement them to accelerate the achievement of safety goals at all levels. While the LRSP itself is a PSC, other PSCs can be included as solutions within the LRSP. LRSPs support goals of a state's SHSP. The FHWA also supports and acknowledges that collaboration between various agencies is important for a successful LRSP.</p>	<p><a href="#">Proven Safety Plans</a></p>
<p>Nevada Highway Safety Plan</p>	<p>2021</p>	<p>The Nevada Strategic Highway Safety Plan (SHSP) has identified Critical Emphasis Areas (CEAs) to help guide efforts to increase road user safety on Nevada's streets and highways. The plan is updated every five years with the most recent crash data and helps provide information to planning organizations and agencies. The SHSP seeks to incorporate equity, prioritize safe speeds, double down on strategies that work, and to accelerate implementation of advanced technology to help reduce fatalities on Nevada's roadways. The goals, strategies, and actions of the SHSP should be considered when developing recommendations for the LRSP.</p>	<p><a href="#">Nevada Strategic Highway Safety Plan</a></p>

	<p>The HSIP LPA Process supports efforts to assist agencies with applying for HSIP funding. HSIP is a federal program using a data driven approach and the preparation of an LRSP, such as the one being completed for CAMPO is a requirement for this funding source. Each project submitted for funding is required to support at least one emphasis area in the Nevada SHSP. This LPA process defines the steps to completing an LRSP, which includes the identification of stakeholders, use of safety data, selection of proven solutions, and the implementation of those solutions. The document provides guidance on important components of an LRSP, including types of data to use other than crash data, roadway characteristics, traffic volumes, maintenance logs, and traffic citations is also important in determining safety of roadways. Close work with NDOT throughout the LRSP process is essential for meeting project funding goals.</p>	<p>The National Highway Traffic Safety Administration's (NHTSA) Countermeasures that Work are behavior-related countermeasures intended to be applicable for State Highway Safety Offices (SHSO) as a guideline for effectiveness. These countermeasures are grouped into ten different problem areas. It is important to note that some countermeasure areas have been longer researched than others. The areas of focus for the guide include:</p> <ul style="list-style-type: none"> <li>•Alcohol and Drug Impaired Driving</li> <li>•Seatbelts and Child Restraints</li> <li>•Speeding and Speed Management</li> <li>•Distracted Driving</li> <li>•Motorcycle Safety</li> <li>•Young Drivers</li> <li>•Older Drivers</li> <li>•Pedestrian Safety</li> <li>•Bicycle Safety</li> <li>•Drowsy Driving</li> </ul> <p>Any of these areas could be crash factors for the LRSP but primarily impaired driving, speed management, and distracted driving are factors that could impact crash rates analyzed within the LRSP.</p>	<p>2021</p>	<p>Countermeasures that Work Safety Countermeasures Highway</p>
	<p>safety program Public (LPA)</p>	<p>2020</p>	<p>2020</p>	<p>Countermeasures that Work Safety Countermeasures Highway</p>

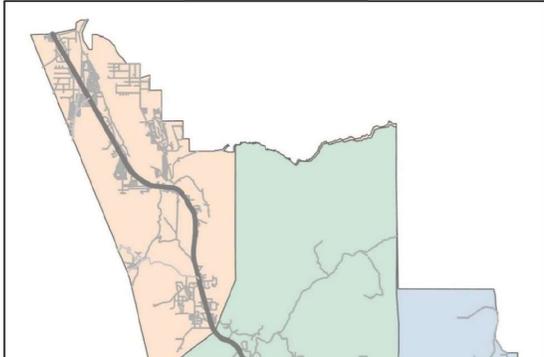


## **APPENDIX C**

### **PRIORITY LOCATION FIELD REVIEW SHEETS**



**Route 395 Business) from I-580 to W Long Street**



files

between Winnie Ln and Hot Springs Rd; 45 mph between Hot Springs Rd and Arrowhead Dr; 55 mph between Arrowhead Dr and I-580.

to 150 feet

to 120 feet

as in each direction with a two-way left turn lane (TWLTL)

ions of the segment have sidewalks, including buffered sidewalks. Most of the segment contains a shoulder but no dedicated bike lane.

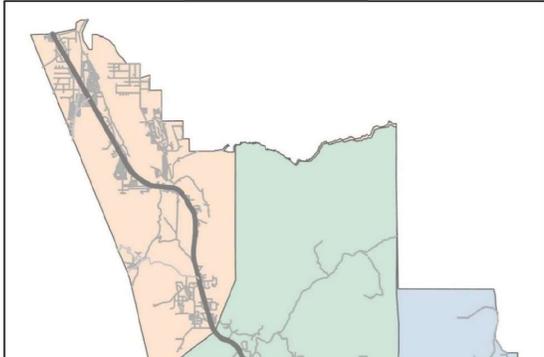
Commercial

		Issue/Comment	Recommendation
		Future Complete Streets Project will begin with Feasibility Study in January 2025. Study will take about 6 months to complete then begin looking at other grants to pay for improvements	None.
		Inconsistent sidewalks, curb ramps, and shoulders present pedestrian connectivity issues.	Provide PROWAG compliant pedestrian facilities.
		Vehicles exceed the speed limit in the southbound lanes.	Install speed feedback signs, oversized speed limit signs, reduced speed limit.
		There are no dedicated bike lanes along the segment.	Reconfigure the roadway cross section to install bike lanes. Consider green paint at bicycle conflict zones.
		Medians north of Silver Oak Drive are limited to decomposed granite and curbs.	Install vegetation with irrigation on existing medians.
		Lighting is dim along the segment.	Install lighting with LED bulbs along the segment.

<b>Crash S</b>	<b>Crash S</b>
Fatal (K)	
Serious Injury (A)	
Non-Incapacitating Injury (B)	
Possible Injury (C)	
PDO (O)	
<b>Total Crashes</b>	<b>Total Crashes</b>
<b>Crash Angle</b>	<b>Crash Angle</b>
Sideswipe	
Rear End	
Head-On	
Hit Object	
Overturned	
Other	
<b>Non-Motorist</b>	<b>Non-Motorist</b>
Pedestrian	
Bicycle	
<b>Contributor</b>	<b>Contributor</b>
Aggressive	
Distracted	
Impaired	
<b>Crash CC</b>	<b>Crash CC</b>
Dark	
Wet	

Source: NCATS Crash Data (last updated 12/31/2022), provided by NDOT FARS (last updated 12/31/2021), provided by NDOT FARS (last updated 12/31/2021), provided by NDOT FARS (last updated 12/31/2021).

**Route 395 Business) from I-580 to W Long Street**



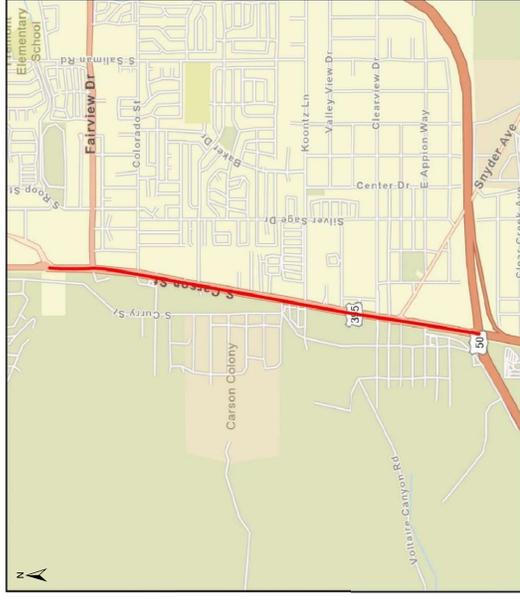
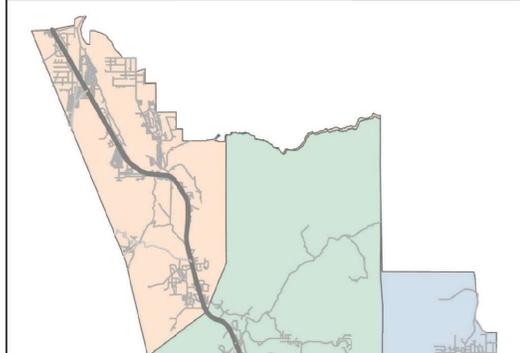
<b>Crash S</b>
Fatal (K)
Serious Injury (A)
Non-Incapacitating Injury (B)
Possible Injury (C)
PDO (O)
<b>Total Crashes</b>
<b>Crash</b>
Angle
Sideswipe
Rear End
Head-On
Hit Object
Overturned
Other
<b>Non-Moto</b>
Pedestrian
Bicycle
<b>Contributors</b>
Aggressive
Distracted
Impaired
<b>Crash Cc</b>
Dark
Wet

Source: NCATS Crash Data (last updated 12/31/2022), provided by NDOT FARS (last updated December 31, 2021), provided

...iles  
 ...h between Winnie Ln and Hot Springs Rd; 45 mph between Hot Springs Rd and Arrowhead Dr; 55 mph between Arrowhead Dr and I-580.  
 ...p 150 feet  
 ...p 120 feet  
 ...s in each direction with a two-way left turn lane (TWLTL)  
 ...ons of the segment have sidewalks, including buffered sidewalks. Most of the segment contains a shoulder but no dedicated bike lane.  
 Commercial

	Issue/Comment	Recommendation
	Vehicles travel at high speeds through unsignalized intersections.	Consider replacing unsignalized intersection with roundabout.
...head Road, ...t Springs ...ons	Pedestrian pushbuttons do not comply with current standards.	Replace all pushbuttons with Accessible Pedestrian Signals (APS).
...head Road, ...t Springs ...ons	Crosswalks at unsignalized intersections do not have pedestrian activated flashers.	Install pedestrian refuge area and evaluate appropriate enhanced pedestrian treatment (PHB, etc.) at these locations. Improve lighting at pedestrian crossings.
...head Road, ...t Springs ...ons	Non-compliant curb ramps at the intersection.	Install new pedestrian ramps compliant with PROWAG standards.
...ersection	Lighting is dim at the intersection.	Install dual mast-arm (LED) lighting.

**S. Route Business 395) from Stewart Street to US-50/I-580**



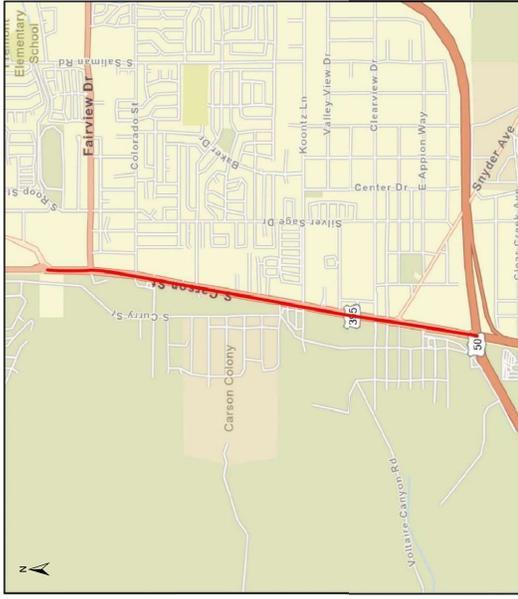
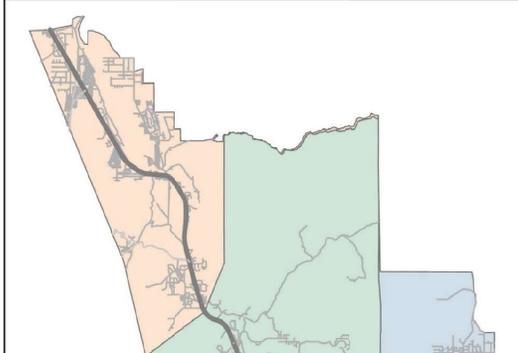
0.9 miles  
 mph from Stewart St to Clearview Dr; 50 mph from Clearview Dr to US-50/I-580  
 5-220 feet  
 to 150 feet  
 lanes in each direction  
 me access points between intersections have TWLTL, while other access points have dedicated left turn lanes. Continuous sidewalks are present on the west side of the roadway, while sidewalks, a multi-use path or combination of sidewalks and multi-use path is present on the east side of the roadway.  
 neral Commercial, Public, and Retail Commercial

<b>Crash Severity</b>
Fatal (K)
Serious Injury (A)
Non-Incapacitating Injury (B)
Possible Injury (C)
PDO (O)
<b>Total Crashes</b>
<b>Crash Type</b>
Angle
Sideswipe
Rear End
Head-On
Hit Object
Overtaken
Other
<b>Non-Motorists</b>
Pedestrian
Bicycle
<b>Contributing</b>
Aggressive
Distracted
Impaired
<b>Crash Conditions</b>
Dark
Wet

**Source:** NCATS Crash Data (January 2022), provided by NIDOT FARS Data (December 31, 2021), provided by

Item	Issue/Comment	Recommendation
	Speeding is an issue. Speed limit increases to 50 mph south of Clearview Dr near the intersection with I-580/US 50.	Install speed feedback signs and oversized speed limit signs.
	Angle crashes are an issue along this segment.	Limit left turns from side streets with raised median islands and access management. Recommend replate gore lines with median island to manage speeds north of Clearview Drive.
	Visibility of speed limit signs is blocked by overgrown vegetation.	Trim and maintain landscaping.
	Narrow sidewalk widths (5 ft or less) on the west side of the road.	Widen pedestrian walkways.
	Minimal street lighting along the segment.	Install lighting along the segment.
	Pedestrian pushbuttons do not comply with current standards.	Replace all pushbuttons with Accessible Pedestrian Signals (APS).
	Pedestrian crossing time is too short.	Analyze crossing time of pedestrian phase and adjust signal timing. Communicate that travel times and will improve if following the speed.
	Low visibility of street light signs at the signalized intersections.	Install advanced street name signs.

**S. Route Business 395) from Stewart Street to US-50/I-580**



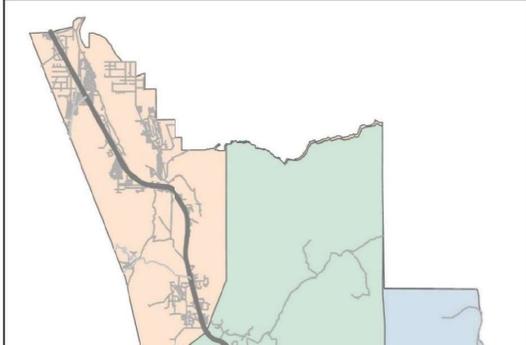
0.9 miles  
 mph from Stewart St to Clearview Dr; 50 mph from Clearview Dr to US-50/I-580  
 5-220 feet  
 to 150 feet  
 lanes in each direction  
 same access points between intersections have TWLTL, while other access points have dedicated left turn lanes. Continuous sidewalks are present on the west side of the roadway, while sidewalks, a multi-use path or combination of sidewalks and multi-use path is present on the east side of the roadway.  
 neral Commercial, Public, and Retail Commercial

<b>Crash Severity</b>
Fatal (K)
Serious Injury (A)
Non-Incapacitating Injury (B)
Possible Injury (C)
PDO (O)
<b>Total Crashes</b>
<b>Crash Type</b>
Angle
Sideswipe
Rear End
Head-On
Hit Object
Overtaken
Other
<b>Non-Motorists</b>
Pedestrian
Bicycle
<b>Contributing</b>
Aggressive
Distracted
Impaired
<b>Crash Conditions</b>
Dark
Wet

**Source:** NCATS Crash Data (January 2022), provided by NIDOT FARS Data (December 31, 2021), provided by

Item	Issue/Comment	Recommendation
Intersection	There is a drainage issue causing ponding and debris to remain at the northeast corner curb ramp.	Install new pedestrian ramp that complies with PROWAG and allows for proper drainage.
Intersection	Vehicles making eastbound to northbound left turns or westbound to northbound right turns go straight through the multi-use path.	Reinforce with signage and install bollards to prohibit vehicles from entering the multi-use path.
Intersection	The north/south left turns have a flashing yellow arrow (FYA).	Change from FYA to protected phasing.
Intersection	Crosswalk striping is faded and deteriorated.	Restripe crosswalk markings at intersection.
Intersection	Streetlights are located on the other leg of the intersection across from the RRFB and not illuminating the crosswalk.	Install streetlighting at the RRFB crossing with breakaway poles.
Intersection	High number of crashes at the intersection.	Install S-island to prevent eastbound lefts or evaluate for future traffic signal.
Intersection	There is a potential for a new signal at this intersection with future development.	Evaluate the need for a signal based on traffic impact study for the new development. Install traffic signal if warranted.
Intersection	Three-legged intersection is the future site of a signalized intersection.	Evaluate the need for a signal. Install traffic signal if warranted.

**Lake Glen Drive to Curry Circle**



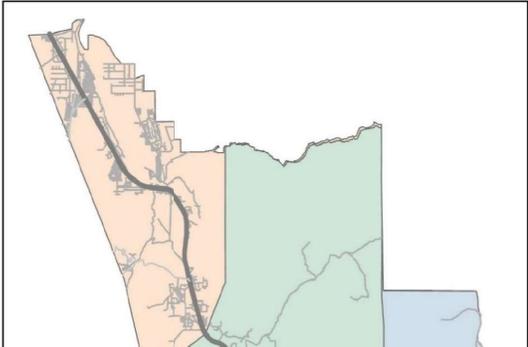
files  
 mph  
 210 feet  
 25 feet  
 e in each direction  
 not have sidewalk or dedicated bike lane  
 c and Retail Commercial

	Issue/Comment	Recommendation
	<b>Positive:</b> Chevron signs are present at the curve.	None.
	There is a creek, and potentially aquifers, that run along the west side of Curry St that is believed to flow water to the duck pond.	Assess environmental concerns with future improvement project within the corridor.
	The speed limit along the segment is 35 mph.	Change posted speed to 25 mph.
	Curb ramps at driveways are not PROWAG compliant.	Improve driveways and curb ramps to comply with PROWAG.
	There is no "No Parking" signage within the limits of this segment.	Install "No Parking" signage.
	Narrow roadway with non-recoverable slopes.	Improvement project to widen roadway. Right-of-way and extensive grading needed.
	No streetlighting is present along the segment.	Conduct lighting study and install appropriate streetlight along the segment. Right-of-way an

Crash S	
Fatal (K)	
Serious Injury (A)	
Non-Incapacitating Injury (B)	
Possible Injury (C)	
PDO (O)	
Total Crashes	
Crash	
Angle	
Sideswipe	
Rear End	
Head-On	
Hit Object	
Overturned	
Other	
Non-Moto	
Pedestrian	
Bicycle	
Contribut	
Aggressive	
Distracted	
Impaired	
Crash Cc	
Dark	
Wet	

Source: NCATS Crash Data (last updated 12/31/2022), provided by NDOT FARS' data. Data for this report is for the period from December 31, 2021, provided

**Lake Glen Drive to Curry Circle**



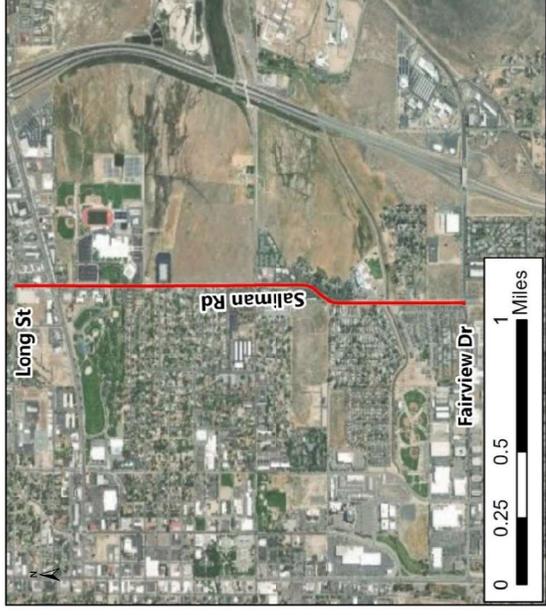
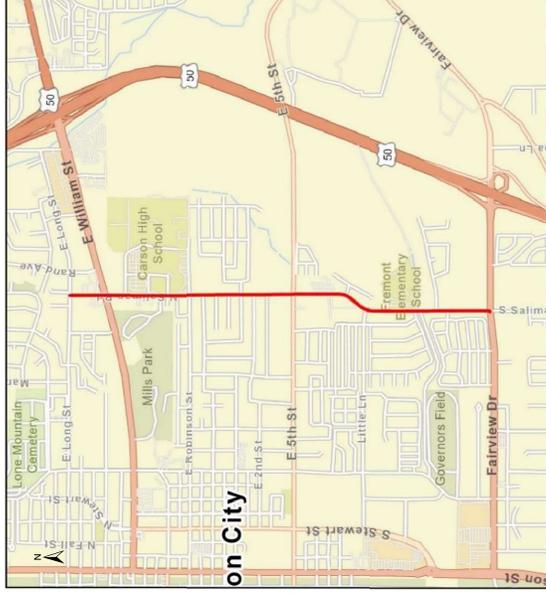
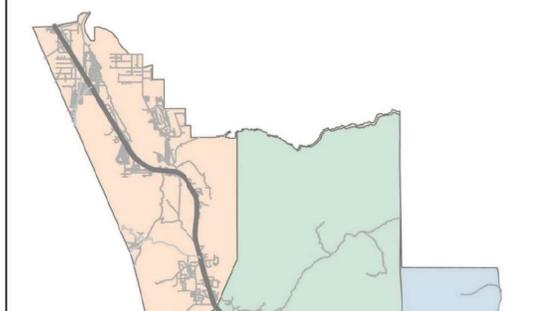
files  
 ph  
 210 feet  
 25 feet  
 e in each direction  
 not have sidewalk or dedicated bike lane  
 c and Retail Commercial

Crash S	
Fatal (K)	
Serious Injury (A)	
Non-Incapacitating Injury (B)	
Possible Injury (C)	
PDO (O)	
Total Crashes	
Crash	
Angle	
Sideswipe	
Rear End	
Head-On	
Hit Object	
Overturned	
Other	
Non-Moto	
Pedestrian	
Bicycle	
Contributor	
Aggressive	
Distracted	
Impaired	
Crash CC	
Dark	
Wet	

Source: NCATS Crash Data (January 2022), provided by NDOT FARS December 31, 2021), provided

	Issue/Comment	Recommendation
	There is no space to accommodate bicycles.	Consider using sharrows, bike lanes, striping, or enhanced "Share the Road" signage for vehicle aware and look out for bikes.
	Pedestrians and bicyclists use Curry St in areas without a sidewalk to get to Carson Middle School.	Install advanced signage to direct bicyclists and pedestrians to multi-use path on S Carson St use Curry St).
	During summer months, chevron signs at the curve are covered by overgrown vegetation.	Consider raising chevron signage so it is above the foliage.
ment	Poles create obstruction in the sidewalk at the north end of the segment.	Relocate or underground utility poles or widen sidewalk.
ment	Unofficial trailhead for C Hill. Vehicles parked along roadway.	Grade an area off the roadway for trail users. Right-of-way and extensive grading needed.
ment	Guardrail on east side does not extend far enough to the north.	Extend guardrail. Extensive grading and potential environmental impacts.

**Long Street to Fairview Drive**



0.5 miles

15 mph in front of Carson High School (15 mph in school zones when children are present)

at

65 feet

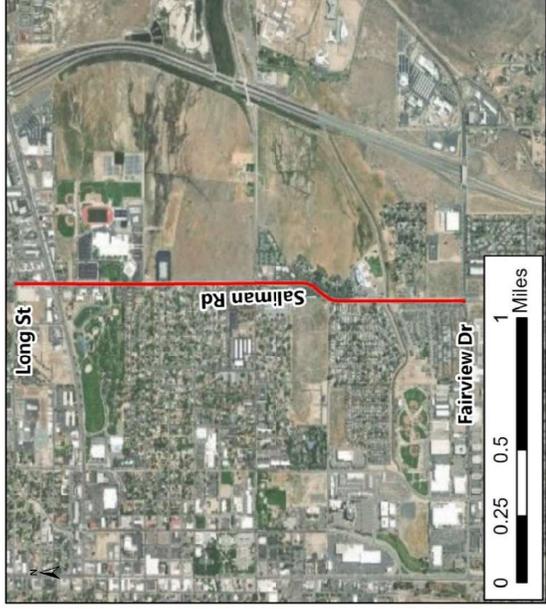
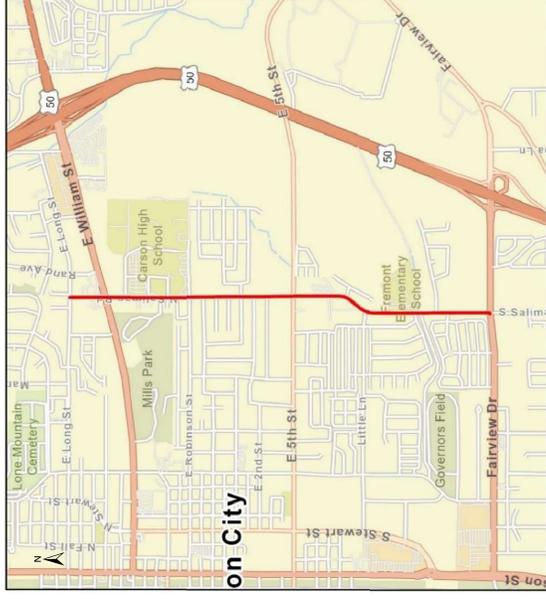
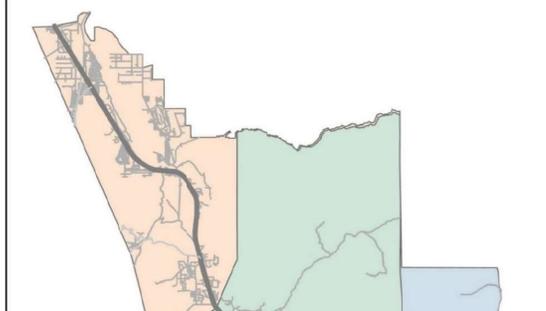
General purpose travel lanes in each direction, one center located two-way left turn lane (TWLTL), and one curb adjacent bike lane in each direction  
 Fremont Elementary School, Carson High School; Danish Offset crossings outside of Fremont Elementary School and Carson High School  
 Retail Commercial, Retail Commercial, Public, Single Family, and Multi-Family

<b>Crash Severity</b>	
Fatal (K)	
Serious Injury (A)	
Non-Incapacitating Injury (B)	
Possible Injury (C)	
PDO (O)	
<b>Total Crashes</b>	
<b>Crash Type</b>	
Angle	
Sideswipe	
Rear End	
Head-On	
Hit Object	
Overturned	
<b>Non-Motorist</b>	
Pedestrian	
Bicycle	
<b>Contributor</b>	
Aggressive	
Distracted	
Impaired	
<b>Crash Conditions</b>	
Dark	
Wet	

Source: NCATS Crash Data (January 2022), provided by NDOT FARS, December 31, 2021), provided

	Issue/Comment	Recommendation
	<b>Positive:</b> Continuous sidewalk along the segment.	None.
road Drive	<b>Positive:</b> Multi-use path crossing utilizes crossing guard before/after school.	None.
ble Lane	<b>Positive:</b> School zone flashers with speed feedback signs are present near Fremont Elementary School.	None.
	There are three school zones within the segment. The posted speed limit of 35 mph reduces to 25 mph between US-50 and Pinto Ct (15 mph when children are present).	Reduce the speed limit to 25 mph based on the Roadway Environment of "RE5 - Urban /Small Center" per the NDOT Speed Management Action Plan. Consider painting the speed limit on
	The outside lane is used as parking by parents during school pick up at the schools. Drivers make U-turns in front of the schools during pick-up.	Install "No Parking" and "No U-Turn" signage in front of the schools.
	The segment has two lanes each direction with a two-way left turn lane (TWLTL).	Remove the TWLTL and install raised medians as part of access management.

**Long Street to Fairview Drive**



miles

25 mph in front of Carson High School (15 mph in school zones when children are present)

at

65 feet

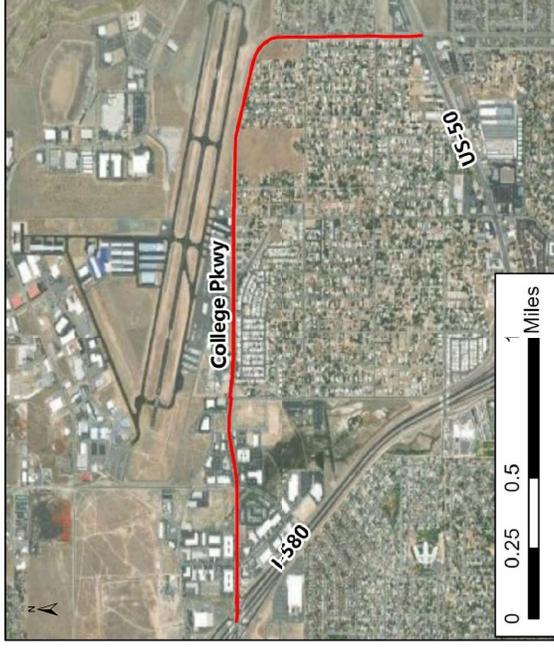
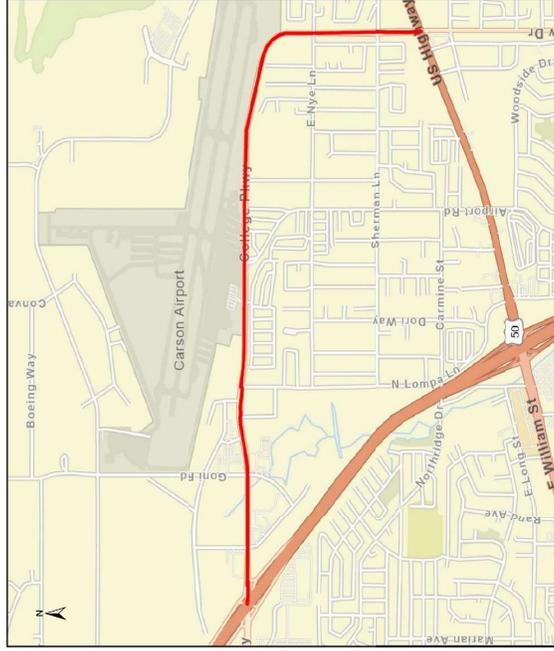
general purpose travel lanes in each direction, one center located two-way left turn lane (TWLTL), and one curb adjacent bike lane in each direction  
 Fremont Elementary School, Carson High School; Danish Offset crossings outside of Fremont Elementary School and Carson High School  
 Retail Commercial, Retail Commercial, Public, Single Family, and Multi-Family

<b>Crash S</b>
Fatal (K)
Serious Injury (A)
Non-Incapacitating Injury (B)
Possible Injury (C)
PDO (O)
<b>Total Crashes</b>
<b>Crash</b>
Angle
Sideswipe
Rear End
Head-On
Hit Object
Overturned
<b>Non-Moto</b>
Pedestrian
Bicycle
<b>Contributor</b>
Aggressive
Distracted
Impaired
<b>Crash Cc</b>
Dark
Wet

**Source:** NCATS Crash Data (last updated 2022), provided by NDOT FARS (last updated December 31, 2021), provided

	<b>Issue/Comment</b>	<b>Recommendation</b>
	Lighting is dim along the segment.	Install lighting with LED bulbs along the segment.
	Existing bike lanes are narrow and do not provide a buffer between the travel lanes.	Restripe roadway to provide wider bike lane or buffered bike lane. Consider green paint at bicyclist conflict zones.
Carson Street	The four-way stop experiences 40-50 buses daily.	Evaluate the need for a signal. Install signal if warranted.
Little Lane	Vehicles observed speeding through the curve.	Install signage or flashers to reduce the speed through the curve.
Little Lane	New development on Little Lane will use Saliman Road and Roop Street creating additional vehicle trips on Little Lane and Saliman Road.	Evaluate the need for a signal based on the traffic impact study for the new residential development. Install signal if warranted.
sidewalks	Pedestrian pushbuttons are not PROWAG compliant.	Replace all push buttons with accessible pedestrian signals (APS).
school	There are no Rectangular Rapid Flashing Beacons (RRFBs) and pedestrian fencing is	Install RRFBs and repair damaged pedestrian fencing in the median

from I-580 to US-50



files

between Winnie Ln and Hot Springs Rd; 45 mph between Hot Springs Rd and Arrowhead Dr; 55 mph between Arrowhead Dr and I-580.

to 150 feet

to 120 feet

in each direction with a two-way left turn lane (TWLTL)

segment contains TWLTL from I-580 to west of Silver Lane and a center median from west of Silver Lane to US-50

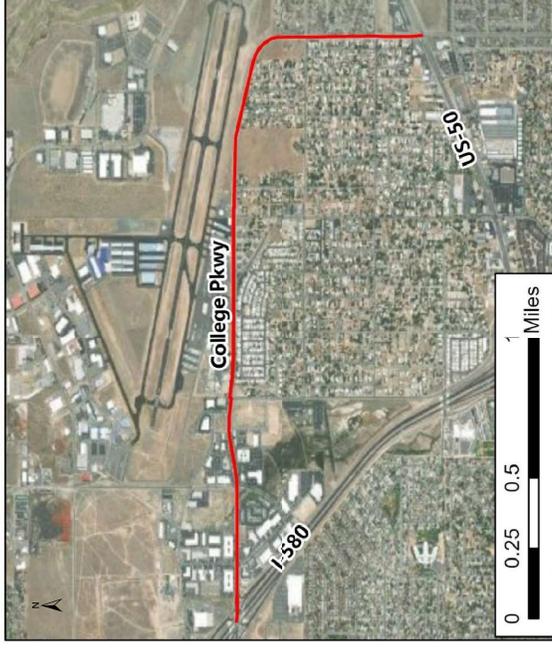
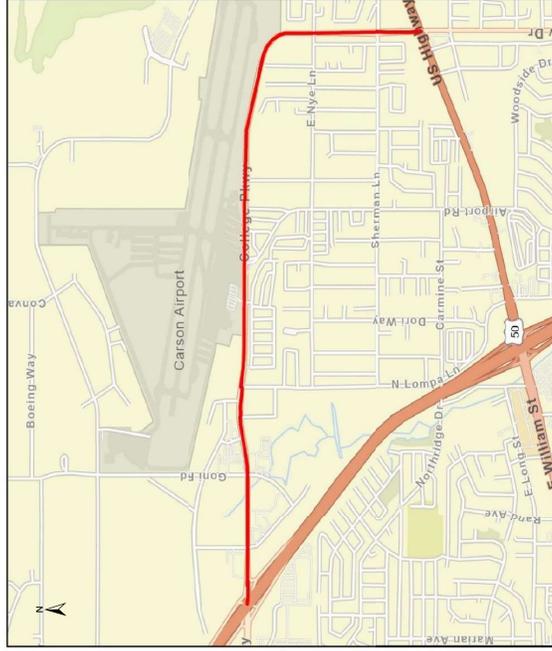
Commercial

Crash S	
Fatal (K)	
Serious Injury (A)	
Non-Incapacitating Injury (B)	
Possible Injury (C)	
PDO (O)	
Total Crashes	
Crash Angle	
Sideswipe	
Rear End	
Head-On	
Hit Object	
Overturned	
Other	
Non-Moto	
Pedestrian	
Bicycle	
Contributors	
Aggressive	
Distracted	
Impaired	
Crash CC	
Dark	
Wet	

Source: NCATS Crash Data (last updated 12/31/2022), provided by NDOT FARS' data, provided December 31, 2021), provided

	Issue/Comment	Recommendation
	<b>Positive:</b> Bike lanes are present east of Lompa Lane along the corridor.	None.
	There is low visibility at the curve from Nye Lane to Otha Street.	Install additional oversized chevrons at curve.
	The segment varies between a raised median and TWLTL.	Reconfigure roadway to accommodate for improved pedestrian or bicycle facilities throughout the corridor.
	There are inconsistent bike lanes along the segment.	Restripe roadway and shift lanes by narrowing median to add bicycle facilities. Consider green bicycle conflict zones.
	Pavement and striping along the segment is deteriorated.	Rehabilitate pavement along segment and repaint striping.
	Streetlights with high-pressure sodium (HPS) bulbs.	Replace HPS bulbs with light emitting diode (LED) bulbs.
	Minimal lighting along the segment.	Conduct a lighting study to verify illuminance and streetlight pole spacing.

**Segment from I-580 to US-50**



**Issues**

Pedestrian ramps at intersections and driveways in numerous locations along the segment do not comply with PROWAG.  
 There is a Jump Around Carson stop with no bus turnout.  
 There is a property wall adjacent to the sidewalk (south side) that limits the physical space for pedestrians on the sidewalk and sight distance for vehicles turning on to College Pkwy.  
 There is a fire hydrant without a red-painted curb.  
 WB to NB and NB to EB right turns are too wide due to skew.  
 There are permissive N/S left turn movements at the intersection and vehicles were observed not yielding to pedestrians.

**Issue/Comment**

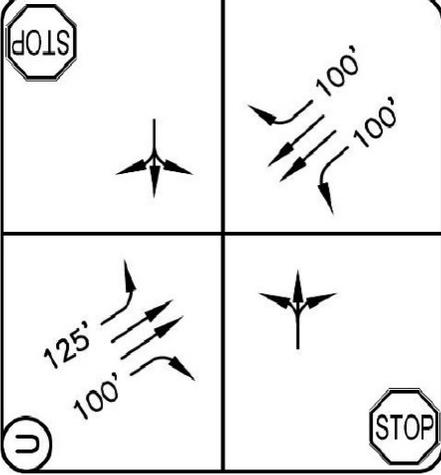
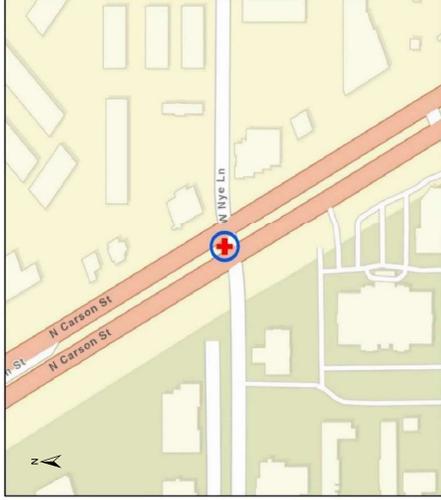
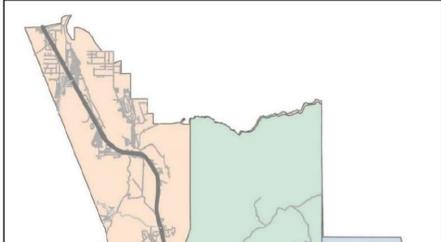
**Recommendation**

Provide PROWAG compliant pedestrian facilities.  
 Obtain right-of-way and construct bus turnout.  
 Evaluate the option to acquire right-of-way (ROW) to widen sidewalk.  
 Stripe the curb to be red within the vicinity of the fire hydrant to be compliant with local standards.  
 Reduce curb radii at the intersection.  
 Evaluate signal phasing to consider protected N/S left turns, lead pedestrian intervals (LPI), or pedestrian phase.

Crash Statistics	
Fatal (K)	0
Serious Injury (A)	0
Non-Incapacitating Injury (B)	0
Possible Injury (C)	0
PDO (O)	0
Total Crashes	0
Crash Types	
Angle	0
Sideswipe	0
Rear End	0
Head-On	0
Hit Object	0
Overturned	0
Other	0
Non-Motorist	
Pedestrian	0
Bicycle	0
Contributors	
Aggressive	0
Distracted	0
Impaired	0
Crash Conditions	
Dark	0
Wet	0

**Source:** NCATS Crash Data (last updated 12/31/2022), provided by NDOT FARS (last updated December 31, 2021), provided by NDOT.

**W Nye Ln**



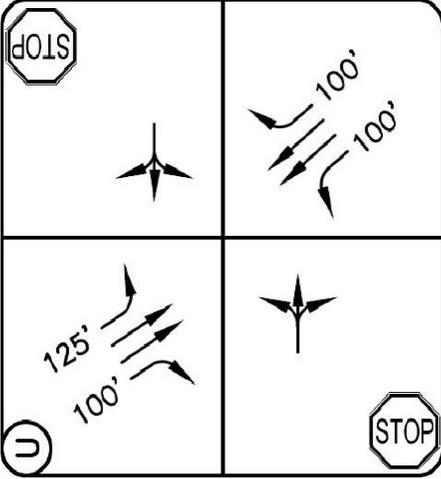
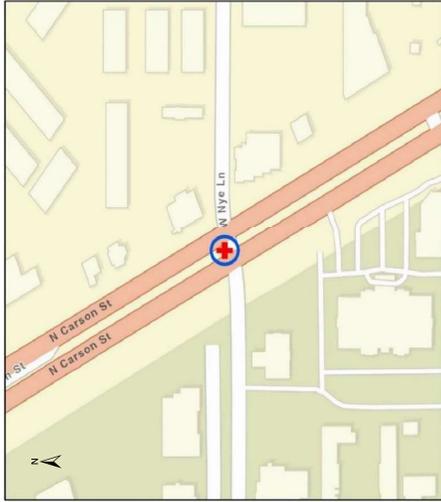
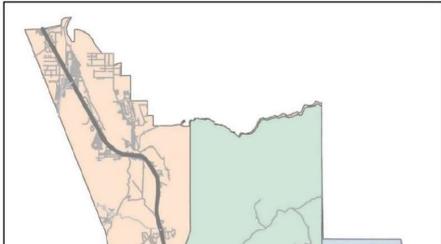
Signalized; Two-way stop with "STOP" sign on east and west legs  
 Use Commercial, Community/Regional Commercial

Crash Severity	
Fatal (K)	
Serious Injury (A)	
Non-Incapacitating Injury	
Possible Injury (C)	
PDO (O)	
Total Crashes	
Crash Type	
Angle	
Sideswipe	
Rear End	
Head-On	
Hit Object	
Overturned	
Other	
Non-Motorist	
Pedestrian	
Bicycle	
Contributing Factors	
Aggressive	
Distracted	
Impaired	
Crash Conditions	
Dark	
Wet	

Source: NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NHTSA

Issue/Comment		Recommendation	
Note: There was a recent fatal crash at this location involving a pedestrian. The pedestrian was struck while crossing N Carson Street in a marked crosswalk.		Install, construct, implement safety countermeasures.	
Distance to cross in the crosswalk on north leg is long.		Realign the intersection, realign the curb ramps and restripe crosswalk, and provide pedestrian refuge islands.	
Curb ramps are missing truncated domes.		Install truncated domes on all curb ramps.	
Pavement and striping at the intersection is deteriorated.		Rehabilitate pavement and restripe crosswalks and lane lines.	
Large, unsignalized intersection is difficult for pedestrians to cross and is more than 0.25 miles from the nearest signalized intersection.		Install pedestrian refuge area and enhanced pedestrian crossing (PHB, RRFB, etc.). Improve lighting at pedestrian crossing. Education and enforcement are critical components about enhanced pedestrian crossings.	
High number of angle crashes occur at this intersection.		Limit left turns from side streets with raised median islands and access management.	

**W Nye Ln**



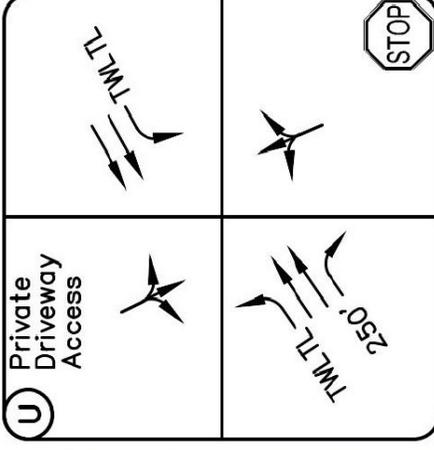
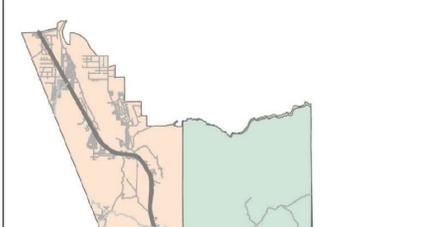
Unsignalized; Two-way stop with "STOP" sign on east and west legs  
 Land Use Commercial, Community/Regional Commercial

Crash Severity	
Fatal (K)	
Serious Injury (A)	
Non-Incapacitating Injury	
Possible Injury (C)	
PDO (O)	
<b>Total Crashes</b>	
Crash Type	
Angle	
Sideswipe	
Rear End	
Head-On	
Hit Object	
Overturned	
Other	
Non-Motorist	
Pedestrian	
Bicycle	
Contributing Factors	
Aggressive	
Distracted	
Impaired	
Crash Conditions	
Dark	
Wet	

**Source:** NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NHTSA

Issue/Comment		Recommendation	
Streetlights at the intersection have high pressure sodium (HPS) bulbs.		Replace HPS bulbs with light emitting diode (LED) bulbs.	
Lighting is dim at the intersection.		Install lighting within the center median (dual mast arms) to light the crosswalk.	
Utility poles and other debris obstruct pedestrian path of travel providing less than 48" clear width.		Clear debris and maintain walkways. Work with utility companies to determine need. Relocate or remove utility poles and other debris obstructing sidewalks.	

Highlands Drive



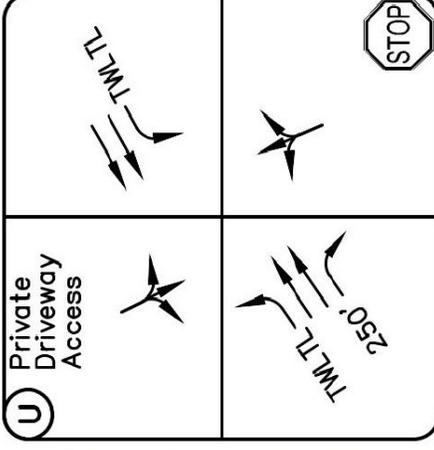
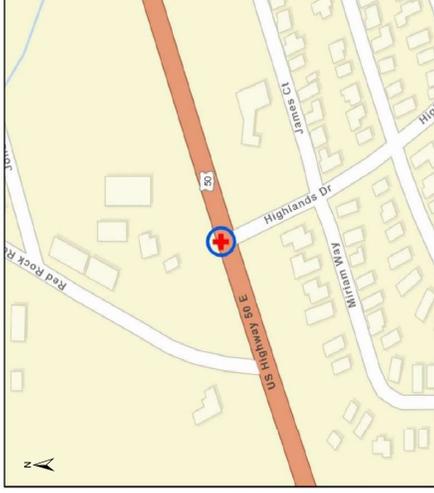
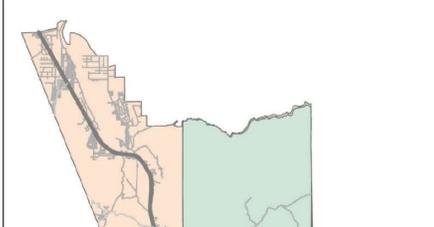
Unsignalized; T-intersection with Private Driveway Access on North Leg  
 neighborhood Residential, Heavy Industrial, Community Commercial

Crash Severity	
Fatal (K)	
Serious Injury (A)	
Non-Incapacitating Injury	
Possible Injury (C)	
PDO (O)	
Total Crashes	
Crash Type	
Angle	
Sideswipe	
Rear End	
Head-On	
Hit Object	
Overturned	
Other	
Non-Motorist	
Pedestrian	
Bicycle	
Contributing Factors	
Aggressive	
Distracted	
Impaired	
Crash Conditions	
Dark	
Wet	

Source: NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NHTSA

	Issue/Comment	Recommendation
	There was a recent fatal crash at this location where a pedestrian was struck while crossing US-50 in an unmarked crosswalk.	Evaluate enhanced pedestrian facility (i.e., PHB, RRFB) with advance warning signs.
	There are heavy traffic volumes on US-50 from 6:00-8:00 am and 3:00-5:00 pm.	None.
	Lighting is dim at the intersection.	Install intersection lighting with LED bulbs.
	Pavement and shoulder are deteriorated at the intersection.	Rehabilitate pavement and shoulder area.
	Vehicles observed speeding through the intersection.	Conduct speed study and enhance speed reduction zones signs. Install advanced street signs and oversized speed limit signs.
	Limited sight visibility for vehicles making a left from Highlands Drive.	Consider acceleration lane in the median for northbound to westbound left turns.

Highlands Drive



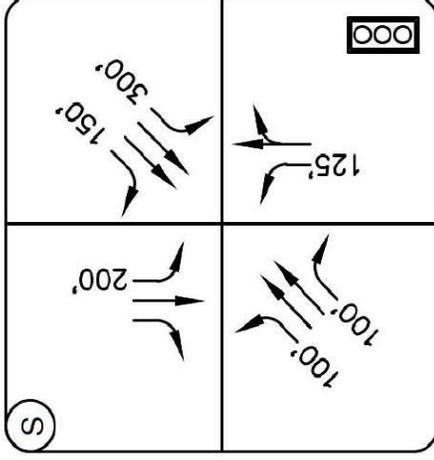
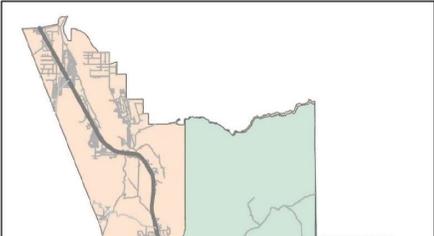
Crash Severity	
Fatal (K)	
Serious Injury (A)	
Non-Incapacitating Injury	
Possible Injury (C)	
PDO (O)	
Total Crashes	
Crash Type	
Angle	
Sideswipe	
Rear End	
Head-On	
Hit Object	
Overturned	
Other	
Non-Motorist	
Pedestrian	
Bicycle	
Contributing Factors	
Aggressive	
Distracted	
Impaired	
Crash Conditions	
Dark	
Wet	

Source: NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NHTSA

Unsignalized; T-intersection with Private Driveway Access on North Leg  
 Neighborhood Residential, Heavy Industrial, Community Commercial

	Issue/Comment	Recommendation
Highlands	There is an off-set T-intersection with Red Rock Road and US-50.	Consider roundabout in this location or realign Red Rock Rd and Highlands Dr for a full (signalized) intersection.
Highlands	School buses turn left from Red Rock Road toward Dayton.	Add acceleration lane for left turns out of Red Rock Road.
Highlands	Linehan Road has a high number of heavy vehicles that turn left onto US-50.	Study segment of US 50 from Linehan Road to Highlands Drive to limit lefts out of the side street with median islands and reroute truck and bus traffic.
Highlands	US-50 has a five-lane cross-section with two-way left turn lane (TWLTL) and no access control.	Study segment of US 50 from Linehan Road to Highlands Drive to limit lefts out of the side street with median islands and reroute truck and bus traffic.
Highlands	There are no marked (designated) pedestrian crossings in Mound House on US 50 (residents that live on Highlands Drive walk across US 50 to the Red Rock convenience store).	Evaluate location(s) for enhanced pedestrian facilities (i.e., PHB, RRFB) with advance warning signage. Education and enforcement are critical components.

**Port Road**



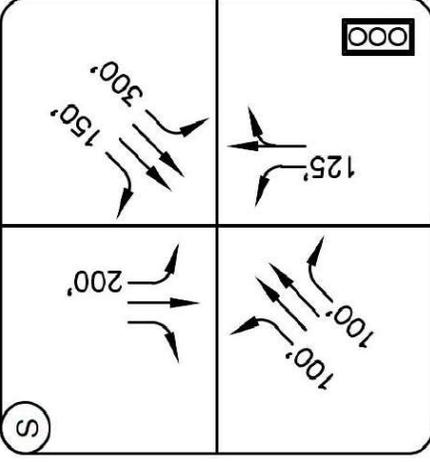
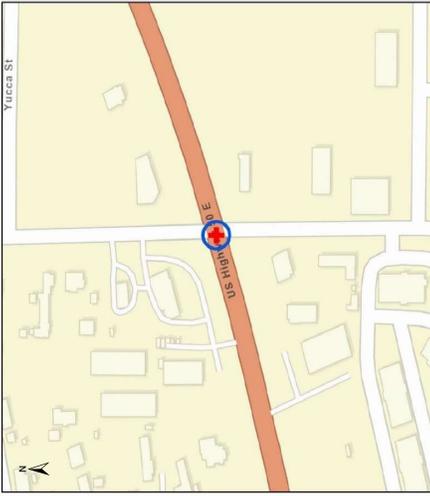
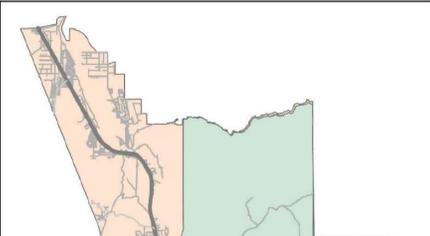
Crash Severity	
Fatal (K)	
Serious Injury (A)	
Non-Incapacitating Injury	
Possible Injury (C)	
PDO (O)	
Total Crashes	
Crash Type	
Angle	
Sideswipe	
Rear End	
Head-On	
Hit Object	
Overturned	
Other	
Non-Motorist	
Pedestrian	
Bicycle	
Contributing Factors	
Aggressive	
Distracted	
Impaired	
Crash Conditions	
Dark	
Wet	

**Source:** NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NHTSA

alized; NB/SB Permissive Left Turns (Flashing Yellow Arrow), EB/WB Protected Left Turns and Use Commercial

Issue/Comment		Recommendation	
<b>Positive:</b> LED streetlights are present at the intersection.		None.	
<b>Positive:</b> All signal heads have retroreflective backplates.		None.	
<b>Positive:</b> Wide sidewalks are present at the northeast corner of the intersection.		None.	
Bike lanes are present but do not connect through the intersection.		Consider improving bike lane connectivity at intersection: Green paint, white dashed lines to extension, blend in (westbound), and/or exclusive (eastbound).	
NDOT has a 3R Project from I-580 to College Parkway.		Implement safety countermeasures with US-50 3R Project.	
High number of angle crashes occur at this intersection.		Adjust all-red clearance time for signal phasing.	
Pavement and striping at the intersection is deteriorated.		Rehabilitate pavement and restripe crosswalks and lane lines.	

**Airport Road**



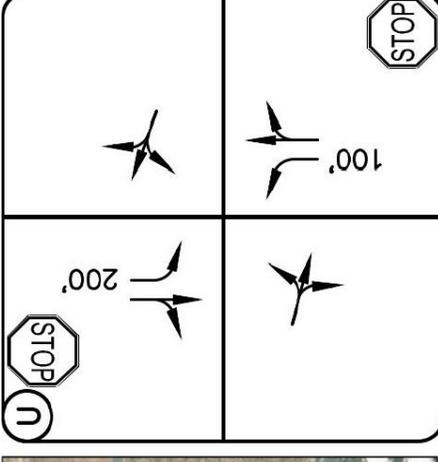
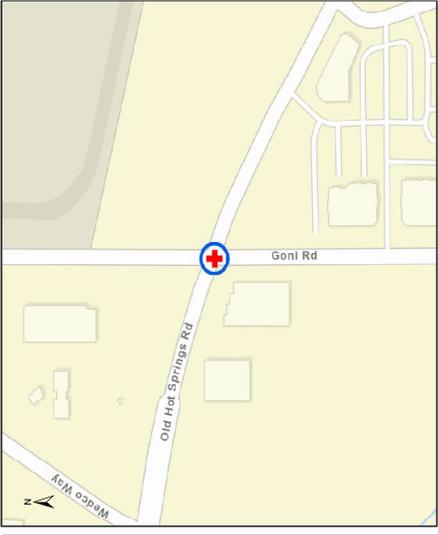
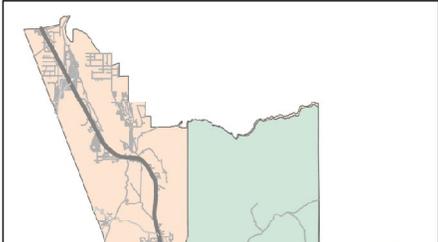
alized; NB/SB Permissive Left Turns (Flashing Yellow Arrow), EB/WB Protected Left Turns  
d Use Commercial

Crash Severity	
Fatal (K)	
Serious Injury (A)	
Non-Incapacitating Injury	
Possible Injury (C)	
PDO (O)	
Total Crashes	
Crash Type	
Angle	
Sideswipe	
Rear End	
Head-On	
Hit Object	
Overtaken	
Other	
Non-Motorist	
Pedestrian	
Bicycle	
Contributing Factors	
Aggressive	
Distracted	
Impaired	
Crash Conditions	
Dark	
Wet	

**Source:** NCATS Crash Data (January 1, 2018 to December 31, 2022), provided by NHTSA

Issue/Comment		Recommendation	
Existing intersection streetlights are single mast arm light poles.		Install dual-mast arm light poles on all corners.	
Pedestrian pushbuttons do not comply with current standards.		Replace all pushbuttons with Accessible Pedestrian Signals (APS).	
The pedestrian signal head at the southwest corner is difficult to see from the opposite corner and crosswalk.		Install 1A/1B signal pole for pedestrian signal head for improved visibility. Consider a porkchop island on the NWC and SWC to realign crosswalk. Consider bulbouts to shorten pedestrian crossing distance.	
This intersection is part of a project to realign the north leg of Airport Road with the changed truck route.		Adjust angle of Airport Rd on north leg realignment.	
Multi-use path along US-50 is deteriorated and covered in debris.		Develop maintenance agreement between owners of multi-use path.	
NB through lane has two signal heads but one through lane.		Evaluate need for extra signal head. Center signal heads with each travel lane.	

**Old Hot Springs Road**



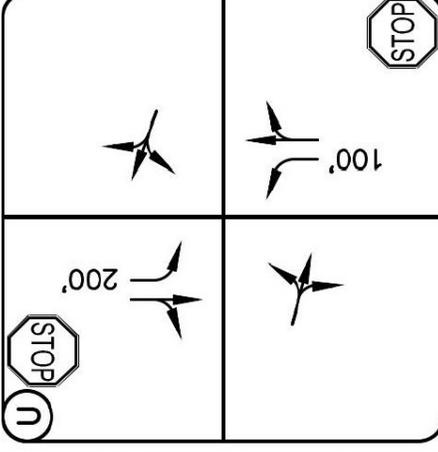
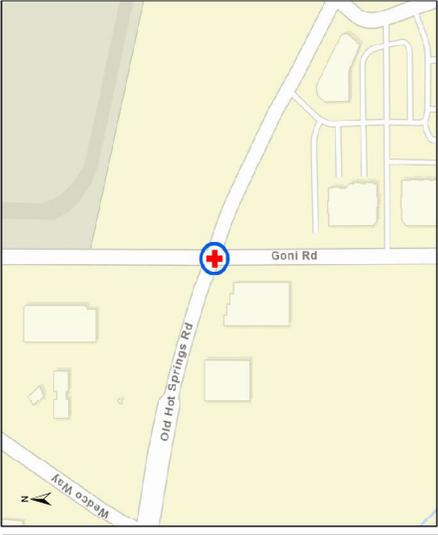
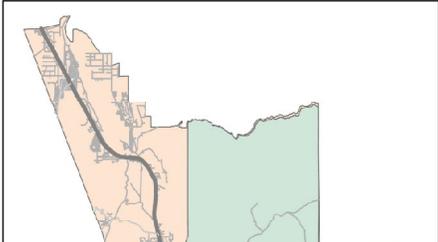
Realized; Two-way stop with "STOP" sign on north and south legs.

Crash Severity	
Fatal (K)	
Serious Injury (A)	
Non-Incapacitating Injury	
Possible Injury (C)	
PDO (O)	
Total Crashes	
Crash Type	
Angle	
Sideswipe	
Rear End	
Head-On	
Hit Object	
Overturned	
Other	
Non-Motorist	
Pedestrian	
Bicycle	
Contributing Factors	
Aggressive	
Distracted	
Impaired	
Crash Conditions	
Dark	
Wet	

Source: NCATS Crash Data (January 31, 2022), provided by NDOT FARS to December 31, 2021), provided b

Issue/Comment		Recommendation	
	Positive: Sidewalks are present at this location.		None.
	There is a high number of angle crashes due to the skewed nature of the intersection.		Realign the intersection to improve sight distance.
	There is a new medical facility in development on the NE corner that is anticipated to increase AADT, and may warrant more pedestrian facilities and on-street parking facilities.		Evaluate the need for a signal, pedestrian facilities, and on-street parking based on the traffic impact study for the new medical development. Install signal if warranted.
	Pavement and striping at the intersection is deteriorated.		Assess need for pedestrian crossings at east and north legs with pedestrian facilities. Rehabilitate pavement and restripe crosswalks and other pavement markings.
	There are no streetlights at the intersection.		Install streetlights at the intersection with LED bulbs in coordination with adjacent development intersection improvements.
	Curb ramps are missing truncated domes.		Install PROWAG compliant curb ramps and crosswalk markings.

**Old Hot Springs Road**



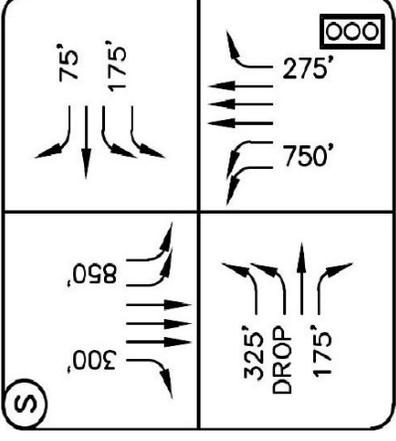
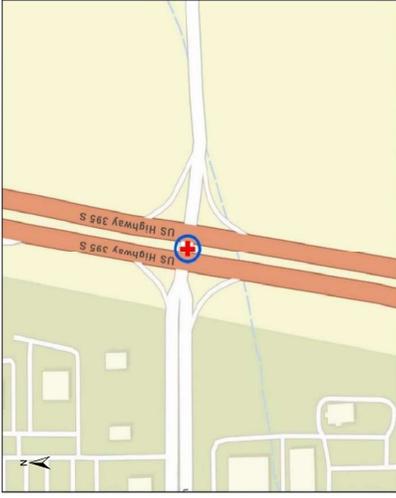
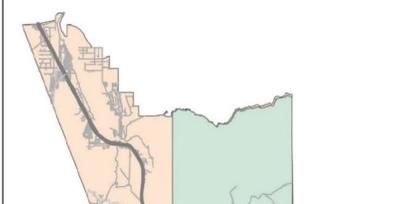
Realized; Two-way stop with "STOP" sign on north and south legs.

Crash Severity	
Fatal (K)	
Serious Injury (A)	
Non-Incapacitating Injury	
Possible Injury (C)	
PDO (O)	
Total Crashes	
Crash Type	
Angle	
Sideswipe	
Rear End	
Head-On	
Hit Object	
Overturned	
Other	
Non-Motorist	
Pedestrian	
Bicycle	
Contributing Factors	
Aggressive	
Distracted	
Impaired	
Crash Conditions	
Dark	
Wet	

Source: NCATS Crash Data (January 31, 2022), provided by NDOT FARS to December 31, 2021), provided b

	Issue/Comment	Recommendation
Issue	Poor sight distance for eastbound turns (both left and right). Vehicles were observed speeding. There are no speed limit signs near the intersection on Goni Road.	Add signage for limited sight distance, install advanced warning signs, and relocate stop bars on Hot Springs Road to improve sight distance. Review existing speed limit sign locations and add new locations using oversized speed limit sign
Issue	High percentage of heavy vehicle traffic on Goni Road.	Install signage for heavy vehicles.
Issue	No bike lane striping, buffer, or separation present.	Reconfigure the roadway cross section to install bike lanes. Consider green paint at bicycle conflict zones.

**Topsy Lane**



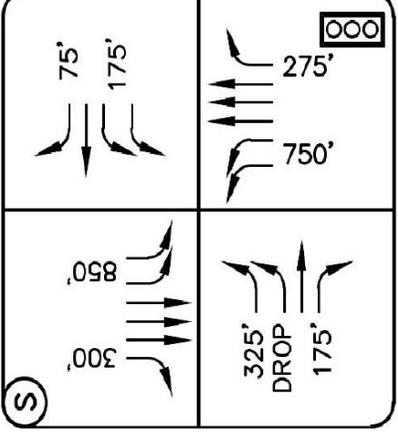
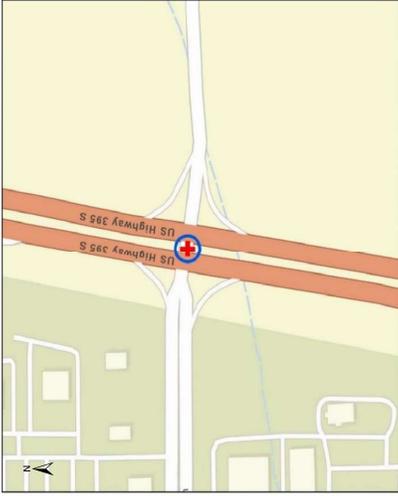
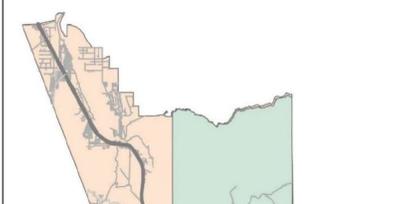
Crash Severity	
Fatal (K)	
Serious Injury (A)	
Non-Incapacitating Injury	
Possible Injury (C)	
PDO (O)	
Total Crashes	
Crash Type	
Angle	
Sideswipe	
Rear End	
Head-On	
Hit Object	
Overturned	
Other	
Non-Motorist	
Pedestrian	
Bicycle	
Non-Motorist	
Aggressive	
Distracted	
Impaired	
Crash Condition	
Dark	
Wet	

Source: NCATS Crash Data (January 31, 2022), provided by NDOT FARS to December 31, 2021), provided by

zed; Protected Left Turns, Channelized Right Turns  
al Commercial, Tourism Commercial

Issue/Comment		Recommendation	
<b>Positive:</b> LED lighting is present.		None.	
<b>Positive:</b> Advance yield line with "sharks teeth" yield markings on all right turns.		None.	
No retroreflective backplates on the signal heads.		Install retroreflective backplates on each signal head.	
High PM peak hour volumes create backup on the northbound		Coordinate signal timing with Jacks Valley/Clear Creek intersection.	
Debris is present on the detectable warnings at curb ramps.		Clear debris from curb ramps. Evaluate curb ramps per PROWAG guidelines.	
Sweeping right turns on all legs of the intersection.		Redesign right turn lanes to improve sight visibility, reduce speeds for right turning vehicles, and shorten the pedestrian crossing distance.	

**Topsy Lane**



zed; Protected Left Turns, Channelized Right Turns  
al Commercial, Tourism Commercial

Crash Severity	
Fatal (K)	
Serious Injury (A)	
Non-Incapacitating Injury	
Possible Injury (C)	
PDO (O)	
Total Crashes	
Crash Type	
Angle	
Sideswipe	
Rear End	
Head-On	
Hit Object	
Overturned	
Other	
Non-Motorist	
Pedestrian	
Bicycle	
Non-Motorist	
Aggressive	
Distracted	
Impaired	
Crash Conditions	
Dark	
Wet	

Source: NCATS Crash Data (January 31, 2022), provided by NDOT FARS to December 31, 2021), provided b

Issue/Comment		Recommendation	
Low visibility of street light signs at the signalized intersections.		Install advanced street name signs.	
Many crashes with multiple conflict points at the driveway for Best Buy south of Topsy Lane.		Evaluate intersection design and modify medians to prevent vehicles from making a left out of the driveway.	
There is a short acceleration distance for westbound to northbound right turns.		Design compliant taper on northbound US 395 to allow for vehicles to merge.	
Bike lanes on Topsy Lane east of US 395 have no signage.		Install bike lane signage on Topsy Lane.	
Signal heads are not aligned.		Align signal heads with one centered over each lane.	
The 2:1 taper on eastbound Topsy Lane, east of US-395, taper is too short.		Design compliant taper on Topsy lane to allow for vehicles to merge.	
Drop inlet located within bike lane.		Reconfigure bike lane to avoid drop inlet or relocate drop inlet. Consider a more bike traversable	



## **APPENDIX D**

### **CMF CLEARINGHOUSE AND FHWA PROVEN SAFETY COUNTERMEASURES DETAIL SHEETS**



## CMF / CRF Details

**CMF ID:** 153

**CMF Name:** Prohibit on-street parking

**Description:**

**Prior Condition:** No Prior Condition(s)

**Category:** On-street parking

**Study ID:** [Handbook of Road Safety Measures, Elvik, R. and Vaa, T. 2004](#)

Star Quality Rating	
Star Quality Rating:	4 Stars

Crash Modification Factor (CMF)	
Value:	0.8
Adjusted Standard Error:	0.05
Unadjusted Standard Error:	0.03

Crash Reduction Factor	
Value:	20
Adjusted Standard Error:	5
Unadjusted Standard Error:	3

## Applicability

<b>Crash Type:</b>	All
<b>Crash Severity:</b>	A (serious injury),B (minor injury),C (possible injury)
<b>Roadway Types:</b>	Minor Arterial
<b>Minimum Number of Lanes:</b>	
<b>Maximum Number of Lanes:</b>	
<b>Number of Lanes Direction:</b>	
<b>Number of Lanes Comment:</b>	
<b>Road Division Type:</b>	
<b>Minimum Speed Limit:</b>	
<b>Maximum Speed Limit:</b>	
<b>Speed Unit:</b>	
<b>Speed Limit Comment:</b>	
<b>Area Type:</b>	Urban
<b>Traffic Volume:</b>	
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	
<i>If countermeasure is intersection-based.</i>	
<b>Intersection Type:</b>	
<b>Intersection Geometry:</b>	
<b>Traffic Control:</b>	
<b>Major Road Traffic Volume:</b>	
<b>Minor Road Traffic Volume:</b>	

<b>Average Major Road Volume:</b>	
<b>Average Minor Road Volume:</b>	

<b>Development Details</b>	
<b>Date Range of Data Used:</b>	
<b>Municipality:</b>	
<b>State:</b>	
<b>Country:</b>	
<b>Type of Methodology Used:</b>	Meta-analysis

<b>Other Details</b>	
<b>Included in HSM:</b>	No
<b>Date Added to Clearinghouse:</b>	Dec 01, 2009
<b>Comments:</b>	

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CRASH MODIFICATION FACTORS CLEARINGHOUSE

## CMF / CRF Details

**CMF ID:** 175

**CMF Name:** Install raised median with marked crosswalk (uncontrolled)

**Description:**

**Prior Condition:** Marked crosswalk with no raised median at an uncontrolled pedestrian crossing.

**Category:** Pedestrians

**Study ID:** [Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations: Executive Summary and Recommended Guidelines](#), Zegeer et al. 2002

### Star Quality Rating

Star Quality Rating:	4 Stars
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### Crash Modification Factor (CMF)

Value:	0.54
Adjusted Standard Error:	
Unadjusted Standard Error:	0.1

### Crash Reduction Factor

Value:	46
Adjusted Standard Error:	
Unadjusted Standard Error:	10

## Applicability

<b>Crash Type:</b>	Vehicle/pedestrian
<b>Crash Severity:</b>	All
<b>Roadway Types:</b>	Principal Arterial Other
<b>Minimum Number of Lanes:</b>	3
<b>Maximum Number of Lanes:</b>	8
<b>Number of Lanes Direction:</b>	
<b>Number of Lanes Comment:</b>	
<b>Road Division Type:</b>	
<b>Minimum Speed Limit:</b>	
<b>Maximum Speed Limit:</b>	
<b>Speed Unit:</b>	
<b>Speed Limit Comment:</b>	
<b>Area Type:</b>	Urban and Suburban
<b>Traffic Volume:</b>	Minimum of 15000 Average Daily Traffic (ADT)
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	All
<i>If countermeasure is intersection-based.</i>	
<b>Intersection Type:</b>	
<b>Intersection Geometry:</b>	
<b>Traffic Control:</b>	
<b>Major Road Traffic Volume:</b>	
<b>Minor Road Traffic Volume:</b>	

<b>Average Major Road Volume:</b>	
<b>Average Minor Road Volume:</b>	

<b>Development Details</b>	
<b>Date Range of Data Used:</b>	1994 to 1998
<b>Municipality:</b>	
<b>State:</b>	AZ,CA,FL,KS,LA,MD,MA,MO,NC,OH,OR,PA,TX,UT,WA,WI
<b>Country:</b>	USA
<b>Type of Methodology Used:</b>	Non-regression cross-section
<b>Sample Size (crashes):</b>	111 crashes

<b>Other Details</b>	
<b>Included in HSM:</b>	No
<b>Date Added to Clearinghouse:</b>	Dec 01, 2009
<b>Comments:</b>	The study design was a simple comparison of crash rates, controlling for pedestrian and traffic volume.

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## CMF / CRF Details

**CMF ID: 333**

**CMF Name: Change from permitted or permitted-protected to protected**

**Description:**

**Prior Condition: No Prior Condition(s)**

**Category: Intersection traffic control**

**Study ID:** [Accident Modification Factors for Traffic Engineering and ITS Improvements, Harkey et al. 2008](#)

### Star Quality Rating

Star Quality Rating:	4 Stars
----------------------	---------

### Crash Modification Factor (CMF)

Value:	0.01
Adjusted Standard Error:	0.03
Unadjusted Standard Error:	0.01

### Crash Reduction Factor

Value:	99
Adjusted Standard Error:	3
Unadjusted Standard Error:	1

## Applicability

<b>Crash Type:</b>	Angle
<b>Crash Severity:</b>	All
<b>Roadway Types:</b>	Not specified
<b>Minimum Number of Lanes:</b>	
<b>Maximum Number of Lanes:</b>	
<b>Number of Lanes Direction:</b>	
<b>Number of Lanes Comment:</b>	
<b>Road Division Type:</b>	
<b>Minimum Speed Limit:</b>	
<b>Maximum Speed Limit:</b>	
<b>Speed Unit:</b>	
<b>Speed Limit Comment:</b>	
<b>Area Type:</b>	Urban
<b>Traffic Volume:</b>	
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	
<i>If countermeasure is intersection-based.</i>	
<b>Intersection Type:</b>	Roadway/roadway (not interchange related)
<b>Intersection Geometry:</b>	Not specified
<b>Traffic Control:</b>	Signalized
<b>Major Road Traffic Volume:</b>	
<b>Minor Road Traffic Volume:</b>	

<b>Average Major Road Volume:</b>	
<b>Average Minor Road Volume:</b>	

<b>Development Details</b>	
<b>Date Range of Data Used:</b>	
<b>Municipality:</b>	
<b>State:</b>	
<b>Country:</b>	
<b>Type of Methodology Used:</b>	Before/after using empirical Bayes or full Bayes

<b>Other Details</b>	
<b>Included in HSM:</b>	No
<b>Date Added to Clearinghouse:</b>	Dec 01, 2009
<b>Comments:</b>	The number of crashes in the after period were not reported in this study, however, they have been recorded as 300 to give 10 points as a benefit of doubt for one or more of the following: (1) number of miles/sites in the reference/treatment group, (2) number of crashes in the references/treatment group, (3) reporting AADTs for the aggregate dataset but not for the disaggregate dataset used for CMF development.

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## CMF / CRF Details

**CMF ID: 446**

**CMF Name: Provide flashing beacons at stop controlled intersections**

**Description:**

**Prior Condition: No Prior Condition(s)**

**Category: Intersection traffic control**

**Study ID:** [Safety Evaluation of Flashing Beacons at Stop Controlled Intersections, Srinivasan et al. 2008](#)

Star Quality Rating	
Star Quality Rating:	4 Stars

Crash Modification Factor (CMF)	
Value:	0.95
Adjusted Standard Error:	0.04
Unadjusted Standard Error:	0.04

Crash Reduction Factor	
Value:	5
Adjusted Standard Error:	4
Unadjusted Standard Error:	4

## Applicability

<b>Crash Type:</b>	All
<b>Crash Severity:</b>	All
<b>Roadway Types:</b>	Not Specified
<b>Minimum Number of Lanes:</b>	2
<b>Maximum Number of Lanes:</b>	2
<b>Number of Lanes Direction:</b>	
<b>Number of Lanes Comment:</b>	
<b>Road Division Type:</b>	
<b>Minimum Speed Limit:</b>	
<b>Maximum Speed Limit:</b>	
<b>Speed Unit:</b>	
<b>Speed Limit Comment:</b>	
<b>Area Type:</b>	All
<b>Traffic Volume:</b>	
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	
<i>If countermeasure is intersection-based.</i>	
<b>Intersection Type:</b>	Roadway/roadway (not interchange related)
<b>Intersection Geometry:</b>	4-leg
<b>Traffic Control:</b>	Stop-controlled
<b>Major Road Traffic Volume:</b>	Minimum of 250 to Maximum of 42520 Average Daily Traffic (ADT)
<b>Minor Road Traffic Volume:</b>	Minimum of 90 to Maximum of 13270 Average Daily Traffic (ADT)

<b>Average Major Road Volume:</b>	
<b>Average Minor Road Volume:</b>	

<b>Development Details</b>	
<b>Date Range of Data Used:</b>	
<b>Municipality:</b>	
<b>State:</b>	
<b>Country:</b>	
<b>Type of Methodology Used:</b>	Before/after using empirical Bayes or full Bayes

<b>Other Details</b>	
<b>Included in HSM:</b>	Yes. HSM lists this CMF in bold font to indicate that it has the highest reliability since it
<b>Date Added to Clearinghouse:</b>	Dec 01, 2009
<b>Comments:</b>	Countermeasure name changed from

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## CMF / CRF Details

**CMF ID: 447**

**CMF Name: Provide flashing beacons at stop controlled intersections**

**Description:**

**Prior Condition: No Prior Condition(s)**

**Category: Intersection traffic control**

**Study ID:** [Safety Evaluation of Flashing Beacons at Stop Controlled Intersections, Srinivasan et al. 2008](#)

Star Quality Rating	
Star Quality Rating:	4 Stars

Crash Modification Factor (CMF)	
Value:	0.9
Adjusted Standard Error:	0.06
Unadjusted Standard Error:	0.05

Crash Reduction Factor	
Value:	10
Adjusted Standard Error:	6
Unadjusted Standard Error:	5

## Applicability

<b>Crash Type:</b>	All
<b>Crash Severity:</b>	A (serious injury),B (minor injury),C (possible injury)
<b>Roadway Types:</b>	Not Specified
<b>Minimum Number of Lanes:</b>	2
<b>Maximum Number of Lanes:</b>	2
<b>Number of Lanes Direction:</b>	
<b>Number of Lanes Comment:</b>	
<b>Road Division Type:</b>	
<b>Minimum Speed Limit:</b>	
<b>Maximum Speed Limit:</b>	
<b>Speed Unit:</b>	
<b>Speed Limit Comment:</b>	
<b>Area Type:</b>	All
<b>Traffic Volume:</b>	
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	
<i>If countermeasure is intersection-based.</i>	
<b>Intersection Type:</b>	Roadway/roadway (not interchange related)
<b>Intersection Geometry:</b>	4-leg
<b>Traffic Control:</b>	Stop-controlled
<b>Major Road Traffic Volume:</b>	Minimum of 250 to Maximum of 42520 Average Daily Traffic (ADT)
<b>Minor Road Traffic Volume:</b>	Minimum of 90 to Maximum of 13270 Average Daily Traffic (ADT)

<b>Average Major Road Volume:</b>	
<b>Average Minor Road Volume:</b>	

<b>Development Details</b>	
<b>Date Range of Data Used:</b>	
<b>Municipality:</b>	
<b>State:</b>	
<b>Country:</b>	
<b>Type of Methodology Used:</b>	Before/after using empirical Bayes or full Bayes

<b>Other Details</b>	
<b>Included in HSM:</b>	Yes. HSM lists this CMF in bold font to indicate that it has the highest reliability since it
<b>Date Added to Clearinghouse:</b>	Dec 01, 2009
<b>Comments:</b>	Countermeasure name changed from

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CRASH MODIFICATION FACTORS CLEARINGHOUSE

## CMF / CRF Details

**CMF ID:** 1914

**CMF Name:** Install chevron signs, curve warning signs, and sequential flashing beacons

**Description:** Along a curve with a small radius, large deflection angle, available sight distance smaller than stopping sight distance, and superelevation smaller than demanded at design and operating speed

**Prior Condition:** No curve delineation treatment

**Category:** Signs

**Study ID:** [Safety Evaluation of Curve Delineation Improvements An Empirical Bayes Observational Before-After Study, Montella 2009](#)

### Star Quality Rating

Star Quality Rating:	4 Stars
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### Crash Modification Factor (CMF)

Value:	0.524
Adjusted Standard Error:	
Unadjusted Standard Error:	0.09

### Crash Reduction Factor

Value:	47.6
Adjusted Standard Error:	
Unadjusted Standard Error:	9

## Applicability

<b>Crash Type:</b>	All
<b>Crash Severity:</b>	All
<b>Roadway Types:</b>	Principal Arterial Other Freeways and Expressways
<b>Minimum Number of Lanes:</b>	4
<b>Maximum Number of Lanes:</b>	4
<b>Number of Lanes Direction:</b>	
<b>Number of Lanes Comment:</b>	
<b>Road Division Type:</b>	
<b>Minimum Speed Limit:</b>	
<b>Maximum Speed Limit:</b>	
<b>Speed Unit:</b>	
<b>Speed Limit Comment:</b>	
<b>Area Type:</b>	Not specified
<b>Traffic Volume:</b>	Minimum of 7400 to Maximum of 13975
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	All
<i>If countermeasure is intersection-based.</i>	
<b>Intersection Type:</b>	
<b>Intersection Geometry:</b>	
<b>Traffic Control:</b>	
<b>Major Road Traffic Volume:</b>	
<b>Minor Road Traffic Volume:</b>	

<b>Average Major Road Volume:</b>	
<b>Average Minor Road Volume:</b>	

<b>Development Details</b>	
<b>Date Range of Data Used:</b>	2001 to 2005
<b>Municipality:</b>	Trans European Road Network, Italy
<b>State:</b>	notusa
<b>Country:</b>	
<b>Type of Methodology Used:</b>	Before/after using empirical Bayes or full Bayes
<b>Sample Size (sites):</b>	4 sites after

<b>Other Details</b>	
<b>Included in HSM:</b>	No
<b>Date Added to Clearinghouse:</b>	Dec 01, 2009
<b>Comments:</b>	

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## CMF / CRF Details

**CMF ID: 2514**

**CMF Name: Replace TWLTL with raised median**

**Description:**

**Prior Condition: Two way left turn lane (TWLTL)**

**Category: Access management**

**Study ID:** [Modeling and Evaluating the Safety Impacts of Access Management \(AM\) Features in the Las Vegas Valley, Mauga and Kaseko 2010](#)

Star Quality Rating	
Star Quality Rating:	4 Stars

Crash Modification Factor (CMF)	
Value:	0.77
Adjusted Standard Error:	
Unadjusted Standard Error:	0.0616

Crash Reduction Factor	
Value:	23
Adjusted Standard Error:	
Unadjusted Standard Error:	6.16

## Applicability

<b>Crash Type:</b>	Angle,Fixed object,Head on,Rear end,Run off road,Sideswipe,Single vehicle
<b>Crash Severity:</b>	All
<b>Roadway Types:</b>	All
<b>Minimum Number of Lanes:</b>	
<b>Maximum Number of Lanes:</b>	
<b>Number of Lanes Direction:</b>	
<b>Number of Lanes Comment:</b>	
<b>Road Division Type:</b>	All
<b>Minimum Speed Limit:</b>	30
<b>Maximum Speed Limit:</b>	45
<b>Speed Unit:</b>	mph
<b>Speed Limit Comment:</b>	
<b>Area Type:</b>	Urban
<b>Traffic Volume:</b>	Minimum of 4883 to Maximum of 96080 Annual Average Daily Traffic (AADT)
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	Not specified
<i>If countermeasure is intersection-based.</i>	
<b>Intersection Type:</b>	
<b>Intersection Geometry:</b>	
<b>Traffic Control:</b>	
<b>Major Road Traffic Volume:</b>	
<b>Minor Road Traffic Volume:</b>	

<b>Average Major Road Volume:</b>	
<b>Average Minor Road Volume:</b>	

### Development Details

<b>Date Range of Data Used:</b>	2002 to 2006
<b>Municipality:</b>	
<b>State:</b>	NV
<b>Country:</b>	
<b>Type of Methodology Used:</b>	Regression cross-section

### Other Details

<b>Included in HSM:</b>	No
<b>Date Added to Clearinghouse:</b>	Aug 11, 2010
<b>Comments:</b>	

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## CMF / CRF Details

**CMF ID: 5244**

**CMF Name: Add exclusive pedestrian phasing**

**Description:**

**Prior Condition: Without all pedestrian phase**

**Category: Intersection traffic control**

**Study ID:** [Safety countermeasures and crash reduction in New York City - Experience and lessons learned, Chen et al. 2013](#)

Star Quality Rating	
Star Quality Rating:	4 Stars

Crash Modification Factor (CMF)	
Value:	0.65
Adjusted Standard Error:	
Unadjusted Standard Error:	0.16

Crash Reduction Factor	
Value:	35
Adjusted Standard Error:	
Unadjusted Standard Error:	16

## Applicability

<b>Crash Type:</b>	Vehicle/pedestrian
<b>Crash Severity:</b>	All
<b>Roadway Types:</b>	Not specified
<b>Minimum Number of Lanes:</b>	
<b>Maximum Number of Lanes:</b>	
<b>Number of Lanes Direction:</b>	
<b>Number of Lanes Comment:</b>	
<b>Road Division Type:</b>	
<b>Minimum Speed Limit:</b>	
<b>Maximum Speed Limit:</b>	
<b>Speed Unit:</b>	
<b>Speed Limit Comment:</b>	
<b>Area Type:</b>	Urban
<b>Traffic Volume:</b>	
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	
<i>If countermeasure is intersection-based.</i>	
<b>Intersection Type:</b>	Roadway/roadway (not interchange related)
<b>Intersection Geometry:</b>	No values chosen.
<b>Traffic Control:</b>	Signalized
<b>Major Road Traffic Volume:</b>	
<b>Minor Road Traffic Volume:</b>	

<b>Average Major Road Volume:</b>	
<b>Average Minor Road Volume:</b>	

<b>Development Details</b>	
<b>Date Range of Data Used:</b>	1989 to 2008
<b>Municipality:</b>	New York City
<b>State:</b>	NY
<b>Country:</b>	
<b>Type of Methodology Used:</b>	Other before/after

<b>Other Details</b>	
<b>Included in HSM:</b>	No
<b>Date Added to Clearinghouse:</b>	Jan 01, 1970
<b>Comments:</b>	The number of crashes in the after period were not reported in this study, however, they have been recorded as 300 to give 10 points as a benefit of doubt for one or more of the following: (1) number of miles/sites in the reference/treatment group, (2) number of crashes in the references/treatment group, (3) reporting AADTs for the aggregate dataset but not for the disaggregate dataset used for CMF development.

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## CMF / CRF Details

**CMF ID:** 5252

**CMF Name:** Increase length of signal phases to allow pedestrians more crossing time

**Description:** An increase in the length of signal phases on the main and/or cross streets so that pedestrians have more time crossing streets.

**Prior Condition:** Without increase in signal phase length

**Category:** Intersection traffic control

**Study ID:** [Safety countermeasures and crash reduction in New York City -Experience and lessons learned, Chen et al. 2013](#)

### Star Quality Rating

Star Quality Rating:	4 Stars
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### Crash Modification Factor (CMF)

Value:	0.49
Adjusted Standard Error:	
Unadjusted Standard Error:	0.1

### Crash Reduction Factor

Value:	51
Adjusted Standard Error:	
Unadjusted Standard Error:	10

## Applicability

<b>Crash Type:</b>	Vehicle/pedestrian
<b>Crash Severity:</b>	All
<b>Roadway Types:</b>	Not specified
<b>Minimum Number of Lanes:</b>	
<b>Maximum Number of Lanes:</b>	
<b>Number of Lanes Direction:</b>	
<b>Number of Lanes Comment:</b>	
<b>Road Division Type:</b>	
<b>Minimum Speed Limit:</b>	
<b>Maximum Speed Limit:</b>	
<b>Speed Unit:</b>	
<b>Speed Limit Comment:</b>	
<b>Area Type:</b>	Urban
<b>Traffic Volume:</b>	
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	
<i>If countermeasure is intersection-based.</i>	
<b>Intersection Type:</b>	Roadway/roadway (not interchange related)
<b>Intersection Geometry:</b>	No values chosen.
<b>Traffic Control:</b>	Signalized
<b>Major Road Traffic Volume:</b>	
<b>Minor Road Traffic Volume:</b>	

<b>Average Major Road Volume:</b>	
<b>Average Minor Road Volume:</b>	

### Development Details

<b>Date Range of Data Used:</b>	1989 to 2008
<b>Municipality:</b>	New York City
<b>State:</b>	NY
<b>Country:</b>	
<b>Type of Methodology Used:</b>	Other before/after

### Other Details

<b>Included in HSM:</b>	No
<b>Date Added to Clearinghouse:</b>	Jan 01, 1970
<b>Comments:</b>	The number of crashes in the after period were not reported in this study, however, they have been recorded as 300 to give 10 points as a benefit of doubt for one or more of the following: (1) number of miles/sites in the reference/treatment group, (2) number of crashes in the references/treatment group, (3) reporting AADTs for the aggregate dataset but not for the disaggregate dataset used for CMF development.

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# CMF / CRF Details

**CMF ID:** 6885

**CMF Name:** Install dynamic speed feedback sign

**Description:** System consisting of a speed measuring device and a message sign that displays feedback to those drivers who exceed a predetermined threshold.

It may be the actual speed, a message such as SLOW DOWN, or activation of a warning device, such as beacons or a c

**Prior Condition:** High-crash curve sites with identified speeding problem

**Category:** Advanced technology and ITS

**Study ID:** [Evaluation of Dynamic Speed Feedback Signs on Curves: A National Demonstration Project, Hallmark et al. 2015](#)

Star Quality Rating	
Star Quality Rating:	4 Stars

Crash Modification Factor (CMF)	
Value:	0.95
Adjusted Standard Error:	
Unadjusted Standard Error:	0.01

Crash Reduction Factor	
Value:	5
Adjusted Standard Error:	
Unadjusted Standard Error:	1

## Applicability

<b>Crash Type:</b>	All
<b>Crash Severity:</b>	All
<b>Roadway Types:</b>	Not specified
<b>Minimum Number of Lanes:</b>	2
<b>Maximum Number of Lanes:</b>	2
<b>Number of Lanes Direction:</b>	
<b>Number of Lanes Comment:</b>	
<b>Road Division Type:</b>	Undivided
<b>Minimum Speed Limit:</b>	50
<b>Maximum Speed Limit:</b>	65
<b>Speed Unit:</b>	mph
<b>Speed Limit Comment:</b>	
<b>Area Type:</b>	Rural
<b>Traffic Volume:</b>	Minimum of 400 to Maximum of 8400 Annual Average Daily Traffic (AADT)
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	All
<i>If countermeasure is intersection-based.</i>	
<b>Intersection Type:</b>	
<b>Intersection Geometry:</b>	
<b>Traffic Control:</b>	
<b>Major Road Traffic Volume:</b>	
<b>Minor Road Traffic Volume:</b>	

<b>Average Major Road Volume:</b>	
<b>Average Minor Road Volume:</b>	

<b>Development Details</b>	
<b>Date Range of Data Used:</b>	2005 to 2013
<b>Municipality:</b>	
<b>State:</b>	AZ,FL,IA,OH,OR,TX,WA
<b>Country:</b>	USA
<b>Type of Methodology Used:</b>	Before/after using empirical Bayes or full Bayes
<b>Sample Size (crashes):</b>	160 crashes before, 53 crashes after
<b>Sample Size (sites):</b>	20 sites before, 20 sites after

<b>Other Details</b>	
<b>Included in HSM:</b>	No
<b>Date Added to Clearinghouse:</b>	Nov 01, 2015
<b>Comments:</b>	This CMF applies to two-lane rural horizontal curves.

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## CMF / CRF Details

**CMF ID:** 7898

**CMF Name:** Improve pavement friction (HFS-High Friction Surfacing)

**Description:** The safety benefit of High Friction Surfacing Treatment (HFS)

**Prior Condition:** Ramp with perceived problem with friction-related crashes

**Category:** Roadway

**Study ID:** [Evaluation of Pavement Safety Performance, Merritt et al. 2015](#)

Star Quality Rating	
Star Quality Rating:	4 Stars

Crash Modification Factor (CMF)	
Value:	0.653
Adjusted Standard Error:	
Unadjusted Standard Error:	0.092

Crash Reduction Factor	
Value:	34.7
Adjusted Standard Error:	
Unadjusted Standard Error:	9.2

## Applicability

<b>Crash Type:</b>	All
<b>Crash Severity:</b>	All
<b>Roadway Types:</b>	Not specified
<b>Minimum Number of Lanes:</b>	
<b>Maximum Number of Lanes:</b>	
<b>Number of Lanes Direction:</b>	
<b>Number of Lanes Comment:</b>	
<b>Road Division Type:</b>	
<b>Minimum Speed Limit:</b>	
<b>Maximum Speed Limit:</b>	
<b>Speed Unit:</b>	
<b>Speed Limit Comment:</b>	
<b>Area Type:</b>	All
<b>Traffic Volume:</b>	
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	All
<i>If countermeasure is intersection-based.</i>	
<b>Intersection Type:</b>	
<b>Intersection Geometry:</b>	
<b>Traffic Control:</b>	
<b>Major Road Traffic Volume:</b>	
<b>Minor Road Traffic Volume:</b>	

<b>Average Major Road Volume:</b>	
<b>Average Minor Road Volume:</b>	

<b>Development Details</b>	
<b>Date Range of Data Used:</b>	
<b>Municipality:</b>	
<b>State:</b>	KS,KY,MI,MT,SC,WI
<b>Country:</b>	USA
<b>Type of Methodology Used:</b>	Before/after using comparison group
<b>Sample Size (crashes):</b>	77 crashes after
<b>Sample Size (sites):</b>	12 sites before, 12 sites after

<b>Other Details</b>	
<b>Included in HSM:</b>	No
<b>Date Added to Clearinghouse:</b>	Nov 01, 2015
<b>Comments:</b>	CMF is for HFS treatment at ramps. This CMF was adjusted by the authors to correct a likely regression-to-the-mean bias.

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# CMF / CRF Details

**CMF ID:** 8496

**CMF Name:** Change right-turn lane geometry to increase line of sight (intersection level)

**Description:** Changes made to study approaches include: sharpening the flat approach angle typical in the traditional design, reducing the radius, adjusting the stop/yield bar position, and/or modifying the corner island to improve safety by increasing the line of sight of approaching through traffic.

**Prior Condition:** Traditional right-turn lane design

**Category:** Intersection geometry

**Study ID:** [Effectiveness Evaluation of a Modified Right-Turn Lane Design at Intersections, Schattler et al. 2016](#)

Star Quality Rating	
Star Quality Rating:	4 Stars

Crash Modification Factor (CMF)	
Value:	0.558
Adjusted Standard Error:	
Unadjusted Standard Error:	0.089

Crash Reduction Factor	
Value:	44.2
Adjusted Standard Error:	
Unadjusted Standard Error:	8.95

## Applicability

<b>Crash Type:</b>	All
<b>Crash Severity:</b>	All
<b>Roadway Types:</b>	All
<b>Minimum Number of Lanes:</b>	
<b>Maximum Number of Lanes:</b>	
<b>Number of Lanes Direction:</b>	
<b>Number of Lanes Comment:</b>	
<b>Road Division Type:</b>	
<b>Minimum Speed Limit:</b>	25
<b>Maximum Speed Limit:</b>	45
<b>Speed Unit:</b>	mph
<b>Speed Limit Comment:</b>	
<b>Area Type:</b>	
<b>Traffic Volume:</b>	
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	
<i>If countermeasure is intersection-based.</i>	
<b>Intersection Type:</b>	Other
<b>Intersection Geometry:</b>	3-leg,4-leg
<b>Traffic Control:</b>	Other
<b>Major Road Traffic Volume:</b>	
<b>Minor Road Traffic Volume:</b>	

<b>Average Major Road Volume:</b>	
<b>Average Minor Road Volume:</b>	

<b>Development Details</b>	
<b>Date Range of Data Used:</b>	2003 to 2014
<b>Municipality:</b>	
<b>State:</b>	IL
<b>Country:</b>	
<b>Type of Methodology Used:</b>	Before/after using empirical Bayes or full Bayes
<b>Sample Size (crashes):</b>	274 crashes before, 161 crashes after
<b>Sample Size (sites):</b>	6 sites before, 6 sites after
<b>Sample Size (site-years):</b>	site-years before, 18 site-years after

<b>Other Details</b>	
<b>Included in HSM:</b>	No
<b>Date Added to Clearinghouse:</b>	Mar 13, 2017
<b>Comments:</b>	Authors indicate that this CMF should be used with caution, since improvements were made to other approaches. Intersection AADT ranges from 15,558 to 29,992. CMF applies to both stop-controlled and signalized intersections. Roadway/roadway both interchange and not-interchange related.

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## CMF / CRF Details

**CMF ID:** 10223

**CMF Name:** Change lane width from X to Y (in feet)

**Description:** Change lane width on rural two-lane highways from X to Y (in feet)

**Prior Condition:** Average lane width of X feet

**Category:** Roadway

**Study ID:** [Estimation of bicycle crash modification factors \(CMFs\) on urban facilities using zero inflated negative binomial models](#), Raihan et al. 2019

### Star Quality Rating

Star Quality Rating:	4 Stars
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### Crash Modification Factor (CMF)

Value:	
Adjusted Standard Error:	
Unadjusted Standard Error:	

### Crash Reduction Factor

Value:	
Adjusted Standard Error:	
Unadjusted Standard Error:	

## Applicability

<b>Crash Type:</b>	Vehicle/bicycle
<b>Crash Severity:</b>	All
<b>Roadway Types:</b>	Not specified
<b>Minimum Number of Lanes:</b>	4
<b>Maximum Number of Lanes:</b>	4
<b>Number of Lanes Direction:</b>	
<b>Number of Lanes Comment:</b>	
<b>Road Division Type:</b>	Divided by Median
<b>Minimum Speed Limit:</b>	35
<b>Maximum Speed Limit:</b>	60
<b>Speed Unit:</b>	mph
<b>Speed Limit Comment:</b>	
<b>Area Type:</b>	Urban
<b>Traffic Volume:</b>	Minimum of 2300 to Maximum of 120000 Annual Average Daily Traffic (AADT)
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	All
<i>If countermeasure is intersection-based.</i>	
<b>Intersection Type:</b>	
<b>Intersection Geometry:</b>	
<b>Traffic Control:</b>	
<b>Major Road Traffic Volume:</b>	
<b>Minor Road Traffic Volume:</b>	

<b>Average Major Road Volume:</b>	
<b>Average Minor Road Volume:</b>	

<b>Development Details</b>	
<b>Date Range of Data Used:</b>	2011 to 2014
<b>Municipality:</b>	
<b>State:</b>	FL
<b>Country:</b>	USA
<b>Type of Methodology Used:</b>	Regression cross-section
<b>Sample Size (crashes):</b>	1174 crashes
<b>Sample Size (miles):</b>	1573 miles
<b>Sample Size (miles-years):</b>	6292 mile-years

<b>Other Details</b>	
<b>Included in HSM:</b>	No
<b>Date Added to Clearinghouse:</b>	Dec 07, 2019
<b>Comments:</b>	This CMF applies to vehicle/bicycle crashes on urban four-lane divided segments with an average lane width from 10 to 12 feet.

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## CMF / CRF Details

**CMF ID: 10280**

**CMF Name: Resurface pavement**

**Description:**

**Prior Condition: No Prior Condition(s)**

**Category: Roadway**

**Study ID:** [Evaluating Safety Effectiveness of Surface Treatment at Signalised Intersections: A Before and After Study, Hussein, N.A. and R.A. Hassan. 2018](#)

Star Quality Rating	
Star Quality Rating:	5 Stars

Crash Modification Factor (CMF)	
Value:	0.787
Adjusted Standard Error:	
Unadjusted Standard Error:	0.0313

Crash Reduction Factor	
Value:	21.3
Adjusted Standard Error:	
Unadjusted Standard Error:	3.13

## Applicability

<b>Crash Type:</b>	All
<b>Crash Severity:</b>	K (fatal),A (serious injury),B (minor injury),C (possible injury)
<b>Roadway Types:</b>	All
<b>Minimum Number of Lanes:</b>	
<b>Maximum Number of Lanes:</b>	
<b>Number of Lanes Direction:</b>	
<b>Number of Lanes Comment:</b>	
<b>Road Division Type:</b>	
<b>Minimum Speed Limit:</b>	
<b>Maximum Speed Limit:</b>	
<b>Speed Unit:</b>	
<b>Speed Limit Comment:</b>	
<b>Area Type:</b>	Urban and suburban
<b>Traffic Volume:</b>	
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	All
<i>If countermeasure is intersection-based.</i>	
<b>Intersection Type:</b>	Roadway/roadway (not interchange related)
<b>Intersection Geometry:</b>	3-leg,4-leg
<b>Traffic Control:</b>	Signalized
<b>Major Road Traffic Volume:</b>	Minimum of 1600 to Maximum of 27136 Annual Average Daily Traffic (AADT)
<b>Minor Road Traffic Volume:</b>	

<b>Average Major Road Volume:</b>	12865 Annual Average Daily Traffic (AADT)
<b>Average Minor Road Volume:</b>	

### Development Details

<b>Date Range of Data Used:</b>	2005 to 2010
<b>Municipality:</b>	Melbourne
<b>State:</b>	notusa
<b>Country:</b>	Australia
<b>Type of Methodology Used:</b>	Before/after using empirical Bayes or full Bayes
<b>Sample Size (crashes):</b>	1355 crashes before, 1010 crashes after
<b>Sample Size (sites):</b>	136 sites before, 136 sites after

### Other Details

<b>Included in HSM:</b>	No
<b>Date Added to Clearinghouse:</b>	Dec 07, 2019
<b>Comments:</b>	

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## CMF / CRF Details

**CMF ID: 10737**

**CMF Name: Install bicycle lanes**

**Description:**

**Prior Condition: No Bicycle Lane**

**Category: Bicyclists**

**Study ID:** [Development of Crash Modification Factors for Bicycle Lane Additions While Reducing Lane and Shoulder Widths, 2021](#)

Star Quality Rating	
Star Quality Rating:	4 Stars

Crash Modification Factor (CMF)	
Value:	0.435
Adjusted Standard Error:	
Unadjusted Standard Error:	0.225

Crash Reduction Factor	
Value:	
Adjusted Standard Error:	
Unadjusted Standard Error:	

## Applicability

<b>Crash Type:</b>	All
<b>Crash Severity:</b>	All
<b>Roadway Types:</b>	All
<b>Minimum Number of Lanes:</b>	4
<b>Maximum Number of Lanes:</b>	4
<b>Number of Lanes Direction:</b>	
<b>Number of Lanes Comment:</b>	
<b>Road Division Type:</b>	Undivided
<b>Minimum Speed Limit:</b>	
<b>Maximum Speed Limit:</b>	
<b>Speed Unit:</b>	
<b>Speed Limit Comment:</b>	
<b>Area Type:</b>	Urban
<b>Traffic Volume:</b>	Minimum of 10 to Maximum of 92462 Annual Average Daily Traffic (AADT)
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	All
<i>If countermeasure is intersection-based.</i>	
<b>Intersection Type:</b>	
<b>Intersection Geometry:</b>	
<b>Traffic Control:</b>	
<b>Major Road Traffic Volume:</b>	
<b>Minor Road Traffic Volume:</b>	

<b>Average Major Road Volume:</b>	
<b>Average Minor Road Volume:</b>	

<b>Development Details</b>	
<b>Date Range of Data Used:</b>	2015 to 2018
<b>Municipality:</b>	
<b>State:</b>	TX
<b>Country:</b>	
<b>Type of Methodology Used:</b>	Regression cross-section
<b>Sample Size (sites):</b>	372 sites

<b>Other Details</b>	
<b>Included in HSM:</b>	No
<b>Date Added to Clearinghouse:</b>	Feb 25, 2021
<b>Comments:</b>	This CMF is for bicycle lane addition resulting in reduced shoulder or lane width and no change in average daily bicycle traffic (ADBT). The base condition was 11-ft lanes, no shoulder, no median, and four-lane urban collector or local road.

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# CMF / CRF Details

**CMF ID:** 11026

**CMF Name:** Improve street lighting illuminance and uniformity

**Description:** Add or update street lighting to change the illuminance and uniformity along a roadway segment

**Prior Condition:** Average lighting level is [0 ft, 0.5fc]

**Category:** Highway lighting

**Study ID:** [Development of crash modification factors for roadway illuminance: A matched case-control study, Li et al. 2021](#)

Star Quality Rating	
Star Quality Rating:	4 Stars

Crash Modification Factor (CMF)	
Value:	0.679
Adjusted Standard Error:	
Unadjusted Standard Error:	0.129

Crash Reduction Factor	
Value:	32.1
Adjusted Standard Error:	
Unadjusted Standard Error:	12.9

## Applicability

<b>Crash Type:</b>	All
<b>Crash Severity:</b>	All
<b>Roadway Types:</b>	Not specified
<b>Minimum Number of Lanes:</b>	
<b>Maximum Number of Lanes:</b>	
<b>Number of Lanes Direction:</b>	
<b>Number of Lanes Comment:</b>	
<b>Road Division Type:</b>	
<b>Minimum Speed Limit:</b>	
<b>Maximum Speed Limit:</b>	
<b>Speed Unit:</b>	
<b>Speed Limit Comment:</b>	
<b>Area Type:</b>	Urban and suburban
<b>Traffic Volume:</b>	
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	Night
<i>If countermeasure is intersection-based.</i>	
<b>Intersection Type:</b>	
<b>Intersection Geometry:</b>	
<b>Traffic Control:</b>	
<b>Major Road Traffic Volume:</b>	
<b>Minor Road Traffic Volume:</b>	

<b>Average Major Road Volume:</b>	
<b>Average Minor Road Volume:</b>	

<b>Development Details</b>	
<b>Date Range of Data Used:</b>	2011 to 2014
<b>Municipality:</b>	Tampa
<b>State:</b>	FL
<b>Country:</b>	USA
<b>Type of Methodology Used:</b>	

<b>Other Details</b>	
<b>Included in HSM:</b>	No
<b>Date Added to Clearinghouse:</b>	Mar 16, 2022
<b>Comments:</b>	CMF of increasing the average lighting level from [0 fc, 0.5 fc] to (0.5 fc, 1.0 fc]

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## CMF / CRF Details

**CMF ID: 11158**

**CMF Name: Install rectangular rapid flashing beacon (RRFB)**

**Description: Install rectangular rapid flashing beacon (RRFB)**

**Prior Condition: without RRFB installation**

**Category: Pedestrians**

**Study ID:** [Safety Effectiveness of Rectangular Rapid Flashing Beacons \(RRFB\) Pedestrian Enhancement, Amrita Goswamy, Mohamed Abdel-Aty, and Nada Mahmoud 2022](#)

Star Quality Rating	
Star Quality Rating:	4 Stars

Crash Modification Factor (CMF)	
Value:	0.31
Adjusted Standard Error:	
Unadjusted Standard Error:	0.03

Crash Reduction Factor	
Value:	69
Adjusted Standard Error:	
Unadjusted Standard Error:	3

## Applicability

<b>Crash Type:</b>	Vehicle/pedestrian
<b>Crash Severity:</b>	All
<b>Roadway Types:</b>	Not specified
<b>Minimum Number of Lanes:</b>	
<b>Maximum Number of Lanes:</b>	
<b>Number of Lanes Direction:</b>	
<b>Number of Lanes Comment:</b>	
<b>Road Division Type:</b>	
<b>Minimum Speed Limit:</b>	
<b>Maximum Speed Limit:</b>	
<b>Speed Unit:</b>	
<b>Speed Limit Comment:</b>	
<b>Area Type:</b>	All
<b>Traffic Volume:</b>	
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	Not specified
<i>If countermeasure is intersection-based.</i>	
<b>Intersection Type:</b>	Roadway/pedestrian crossing (eg, midblock crossing)
<b>Intersection Geometry:</b>	Not specified
<b>Traffic Control:</b>	
<b>Major Road Traffic Volume:</b>	
<b>Minor Road Traffic Volume:</b>	

<b>Average Major Road Volume:</b>	
<b>Average Minor Road Volume:</b>	

<b>Development Details</b>	
<b>Date Range of Data Used:</b>	2012 to 2019
<b>Municipality:</b>	
<b>State:</b>	FL
<b>Country:</b>	
<b>Type of Methodology Used:</b>	

<b>Other Details</b>	
<b>Included in HSM:</b>	No
<b>Date Added to Clearinghouse:</b>	Aug 25, 2022
<b>Comments:</b>	It is the CMF of total pedestrian crashes.

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## CMF / CRF Details

**CMF ID: 11288**

**CMF Name: Lower posted speed**

**Description:**

**Prior Condition: No Prior Condition(s)**

**Category: Speed management**

**Study ID:** [Evaluation of Direct and Indirect Safety Effects of Speed-Limit Reduction on Urban Networks, Seung-oh et al. 2022](#)

Star Quality Rating	
Star Quality Rating:	4 Stars

Crash Modification Factor (CMF)	
Value:	0.856
Adjusted Standard Error:	
Unadjusted Standard Error:	0.041

Crash Reduction Factor	
Value:	14.4
Adjusted Standard Error:	
Unadjusted Standard Error:	4.1

## Applicability

<b>Crash Type:</b>	All
<b>Crash Severity:</b>	K (fatal),A (serious injury),B (minor injury),C (possible injury)
<b>Roadway Types:</b>	All
<b>Minimum Number of Lanes:</b>	
<b>Maximum Number of Lanes:</b>	
<b>Number of Lanes Direction:</b>	Not Specified
<b>Number of Lanes Comment:</b>	
<b>Road Division Type:</b>	All
<b>Minimum Speed Limit:</b>	
<b>Maximum Speed Limit:</b>	
<b>Speed Unit:</b>	km/h
<b>Speed Limit Comment:</b>	
<b>Area Type:</b>	Not specified
<b>Traffic Volume:</b>	Minimum of 1156 to Maximum of 59219 Annual Average Daily Traffic (AADT)
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	All
<i>If countermeasure is intersection-based.</i>	
<b>Intersection Type:</b>	
<b>Intersection Geometry:</b>	
<b>Traffic Control:</b>	
<b>Major Road Traffic Volume:</b>	
<b>Minor Road Traffic Volume:</b>	

<b>Average Major Road Volume:</b>	
<b>Average Minor Road Volume:</b>	

### Development Details

<b>Date Range of Data Used:</b>	
<b>Municipality:</b>	
<b>State:</b>	notusa
<b>Country:</b>	South Korea
<b>Type of Methodology Used:</b>	

### Other Details

<b>Included in HSM:</b>	No
<b>Date Added to Clearinghouse:</b>	Jun 11, 2023
<b>Comments:</b>	This CMF presents the safety effects at Direct Treatment Sections.  The paper does not clearly state the posted speed limit reduction being evaluated. However, based on the material presented, it is likely a reduction in the posted speed limit by 10 km/h

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# CMF / CRF Details

**CMF ID:** 8992

**CMF Name:** Implement Systemic Signing and Visibility Improvements at Signalized Intersections

**Description:** replace all signal heads. Replace pedestrian signal heads, pushbuttons, and signs. Install backplates with retroreflective borders on all signal heads. Re-stripe stop lines. Re-stripe crosswalks. Install advance warning signs. Install overhead signs (e.g., r10 - 12, r3 - 5l, r3 - 5r in the mutcd(4)). Install curb.

**Prior Condition:** Signalized Intersection without Systemic Signing and Visibility Improvements

**Study:** [Safety Effects Of Low-Cost Systemic Safety Improvements At Signalized And Stop-Controlled Intersections, Le Et Al., 2017](#)

Star Quality Rating	
Star Quality Rating:	4 Stars

Crash Modification Factor (CMF)	
Value:	0.955
Adjusted Standard Error:	
Unadjusted Standard Error:	0.023

Crash Reduction Factor	
Value:	4.5
Adjusted Standard Error:	
Unadjusted Standard Error:	2.3

Applicability	
<b>Crash Type:</b>	All
<b>Crash Severity:</b>	All
<b>Roadway Types:</b>	All
<b>Minimum Number of Lanes:</b>	2
<b>Maximum Number of Lanes:</b>	4
<b>Number of Lanes Direction:</b>	
<b>Number of Lanes Comment:</b>	
<b>Road Division Type:</b>	
<b>Minimum Speed Limit:</b>	
<b>Maximum Speed Limit:</b>	
<b>Speed Unit:</b>	
<b>Speed Limit Comment:</b>	
<b>Area Type:</b>	All
<b>Traffic Volume:</b>	
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	All
<i>If countermeasure is intersection-based.</i>	
<b>Intersection Type:</b>	
<b>Intersection Geometry:</b>	3-leg,4-leg
<b>Traffic Control:</b>	Signalized
<b>Major Road Traffic Volume:</b>	Minimum of 4272 to Maximum of 41100 Annual Average Daily Traffic (AADT)
<b>Minor Road Traffic Volume:</b>	Minimum of 111 to Maximum of 20000 Annual Average Daily Traffic (AADT)

<b>Average Major Road Volume:</b>	20447 Annual Average Daily Traffic (AADT)
<b>Average Minor Road Volume:</b>	5864 Annual Average Daily Traffic (AADT)

### Development Details

<b>Date Range of Data Used:</b>	2005 to 2014
<b>Municipality:</b>	
<b>State:</b>	SC
<b>Country:</b>	
<b>Type of Methodology Used:</b>	Before/after using empirical Bayes or full Bayes
<b>Sample Size (crashes):</b>	5132 crashes before, 2675 crashes after
<b>Sample Size (sites):</b>	84 sites before, 84 sites after
<b>Sample Size (site-years):</b>	site-years before, 209 site-years after

### Other Details

<b>Included in HSM:</b>	No
<b>Date Added to Clearinghouse:</b>	Nov 17, 2017
<b>Comments:</b>	

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# MAKING OUR ROADS SAFER

## One Countermeasure at a Time

*28 Proven Safety Countermeasures that offer significant and measurable impacts to improving safety*



U.S. Department of Transportation  
**Federal Highway Administration**

**ZERO IS OUR GOAL**  
A SAFE SYSTEM IS HOW WE GET THERE

<https://safety.fhwa.dot.gov/>

## Technical Report Documentation Page

<b>1. REPORT NO.</b> FHWA-SA-21-071	<b>2. GOVERNMENT ACCESSION NO.</b>	<b>3. RECIPIENT'S CATALOG NO.</b>	
<b>4. TITLE AND SUBTITLE</b> Making Our Roads Safer   One Countermeasure at a Time		<b>5. REPORT DATE</b> October 2021	
		<b>6. PERFORMING ORGANIZATION CODE</b>	
<b>7. AUTHOR(S)</b> Matt Albee, Phillip Bobitz		<b>8. PERFORMING ORGANIZATION REPORT NO.</b>	
<b>9. PERFORMING ORGANIZATION NAME &amp; ADDRESS</b> VHB 940 Main Campus Dr Ste 500 Raleigh, NC 27606		<b>10. WORK UNIT NO.</b>	
		<b>11. CONTRACT OR GRANT NO.</b> DTFH6116D00040-693JJ320F000262	
<b>12. SPONSORING AGENCY NAME AND ADDRESS</b> Federal Highway Administration Office of Safety 1200 New Jersey Ave., SE Washington, DC 20590		<b>13. TYPE OF REPORT AND PERIOD</b> Final Report, July 2020 – August 2021	
		<b>14. SPONSORING AGENCY CODE</b> HSST	
<b>15. SUPPLEMENTARY NOTES</b> The Contract Manager for this report was Phillip Bobitz (FHWA Office of Safety). Matt Albee (VHB) was the Principal Investigator.  An FHWA Technical Oversight Working Group included: Dick Albin, Usman Ali, Roya Amjadi, RosemarieAnderson, Eduardo Arispe, Tori Brinkly, Joe Cheung, Becky Crowe, Mike Griffith, Ken Kochevar, MichaelMatzke, Tara McLoughlin, Laura Mero, Anyesha Mookherjee, Elliott Moore, Norah Ocel, Tamara Redmon, Jerry Roche, Cate Satterfield, Jeff Shaw, Keith Sinclair, Karen Timpone, Guan Xu, and Abdul Zineddin.			
<b>16. ABSTRACT</b> The Proven Safety Countermeasure Initiative (PSCi) is a collection of 28 countermeasures and strategies effective in reducing roadway fatalities and serious injuries on our Nation's highways. Transportation agencies are strongly encouraged to consider widespread implementation of PSCs to accelerate the achievement of local, State, and National safety goals. This booklet provides 1-page handouts for all 28 PSCs, broken into the focus areas of speed management, roadway departure, intersections, pedestrians/bicyclists, and crosscutting for countermeasures that apply across categories.			
<b>17. KEY WORDS</b> safety, countermeasures, speed management, roadway departure, intersections, pedestrian, bicyclist		<b>18. DISTRIBUTION STATEMENT</b> No restrictions.	
<b>19. SECURITY CLASSIF. (OF THIS REPORT)</b> Unclassified	<b>20. SECURITY CLASSIF. (OF THIS PAGE)</b> Unclassified	<b>21. NO. OF PAGES</b> 33	<b>22. PRICE</b>

# Proven Safety Countermeasures

## SPEED MANAGEMENT



**Speed Safety Cameras**



**Variable Speed Limits**



**Appropriate Speed Limits for All Road Users**

## ROADWAY DEPARTURE



**Wider Edge Lines**



**Enhanced Delineation for Horizontal Curves**



**Longitudinal Rumble Strips and Stripes on Two-Lane Roads**



**SafetyEdge<sup>SM</sup>**



**Roadside Design Improvements at Curves**



**Median Barriers**

## INTERSECTIONS



**Backplates with Retroreflective Borders**



**Corridor Access Management**



**Dedicated Left- and Right-Turn Lanes at Intersections**



**Reduced Left-Turn Conflict Intersections**



**Roundabouts**



**Systemic Application of Multiple Low-Cost Countermeasures at Stop-Controlled Intersections**



**Yellow Change Intervals**

## PEDESTRIANS/BICYCLES



**Crosswalk Visibility Enhancements**



**Bicycle Lanes**



**Rectangular Rapid Flashing Beacons (RRFB)**



**Leading Pedestrian Interval**



**Medians and Pedestrian Refuge Islands in Urban and Suburban Areas**



**Pedestrian Hybrid Beacons**



**Road Diets (Roadway Reconfiguration)**



**Walkways**

## Crosscutting



**Pavement Friction Management**



**Lighting**



**Local Road Safety Plans**



**Road Safety Audit**

## Introduction

Widespread use of the 28 Proven Safety Countermeasures (PSCs) identified in this booklet can offer significant, measurable impacts as part of any agency's approach to improving safety. These strategies are designed for all road users and all kinds of roads—from rural to urban, from high-volume freeways to less traveled two-lane State and county roads, from signalized crossings to horizontal curves, and everything in between. Each countermeasure addresses at least one safety focus area – speed management, intersections, roadway departures, or pedestrians/bicyclists – while others are crosscutting strategies that address multiple safety focus areas.

Between 2016 and 2020, 85 percent<sup>1</sup> of all public highway fatalities occurred on Federal-aid highways, which represent 25 percent<sup>2</sup> of the entire public highway network. FHWA's partner agencies have invested in highway safety through the Highway Safety Improvement Program (HSIP), which provides targeted safety funding that is eligible for use on all public roads. However, this dedicated funding source represents only about 6 percent of the total Federal-aid program.<sup>3</sup> Every transportation project, whether or not the specific project purpose is safety related, is a new opportunity to save lives on our roadways. The FHWA's Proven Safety Countermeasures are eligible under most Federal-aid highway funding programs, and can support state, local, and tribal agency efforts to effectively accomplish goals to reduce fatalities and serious injuries. These countermeasures should serve as the basis for what agencies consider and implement when designing any highway project to improve safety.

To assist practitioners with determining the most appropriate PSC for their location of interest, the PSC webpage includes a filter tool that allows users to obtain a tailored listing of potential PSCs. Users answer questions regarding area types, functional classification, traffic volumes, issue identified, targeted crash types, and other information to receive a list of PSCs meeting the criteria. This search function is intended to better serve practitioners, including those with limited safety background, when identifying and considering treatments and strategies that can improve safety as part of their program or project.

The PSCs can support agencies with implementation of the Safe System Approach, which seeks to build and reinforce multiple layers of protection to both prevent crashes from happening and minimize the harm caused to those involved when crashes do occur. Implementing a Safe System Approach requires collaborative engagement among a diverse group of stakeholders to increase safety for all road users. Accordingly, agencies should consider how the PSCs and National Highway Traffic Safety Administration's (NHTSA) Countermeasures That Work<sup>4</sup> can create a system with redundancies in place to protect all road users. Reaching our goal of zero deaths and serious injuries requires all of us to take ownership in safety. Together, we can consider the safety needs at every stage of the project development process, the safety impact of every investment decision, and the appropriate safety countermeasures for every Federal-aid project.

1 NHTSA Fatality Analysis Reporting System (FARS) 2016-2020 Final

2 FHWA Highway Statistics 2022 (<https://www.fhwa.dot.gov/policyinformation/statistics/2022/hm16.cfm>)

3 Federal-aid apportioned programs under the Infrastructure Investment and Jobs Act (IIJA) (<https://www.fhwa.dot.gov/bipartisan-infrastructure-law/funding.cfm>)

4 Countermeasures That Work (<https://www.nhtsa.gov/book/countermeasures/countermeasures-that-work>)



## Speed Safety Cameras

Safe Speeds is a core principle of the Safe System Approach since humans are less likely to survive high-speed crashes. Enforcing safe speeds has been challenging; however, with more information and tools communities can make progress in reducing speeds. Agencies can use speed safety cameras (SSCs) as an effective and reliable technology to supplement more traditional methods of enforcement, engineering measures, and education to alter the social norms of speeding. SSCs use speed measurement devices to detect speeding and capture photographic or video evidence of vehicles that are violating a set speed threshold.

**Safety Benefits:**  
Fixed units can reduce crashes on urban principal arterials up to:

**54%** for all crashes.<sup>4</sup>

**48%** for injury crashes.<sup>4</sup>

**P2P units can reduce crashes on urban expressways, freeways, and principal arterials up to:**

**37%**

for fatal and injury crashes.<sup>2</sup>

**Mobile units can reduce crashes on urban principal arterials up to:**

**20%**

for fatal and injury crashes.<sup>5</sup>

**In New York City, fixed units reduced speeding in school zones up to 63% during school hours.<sup>6</sup>**

**For more information on this and other FHWA Proven Safety Countermeasures, please reference the: [Speed Safety Camera Program Planning and Operations Guide.](#)**

The contents of this Fact Sheet do not have the force and effect of law and are not meant to bind the public in any way. This Fact Sheet is intended only to provide clarity regarding existing requirements under the law or agency policies.

### Applications

Agencies should conduct a network analysis of speeding-related crashes to identify locations to implement SSCs. The analysis can include scope (e.g., widespread, localized), location types (e.g., urban/suburban/rural, work zones, residential, school zones), roadway types (e.g., expressways, arterials, local streets), times of day, and road users most affected by speed-related crashes (e.g., pedestrians, bicyclists).

SSCs can be deployed as:

- **Fixed units**—a single, stationary camera targeting one location.
- **Point-to-Point (P2P) units**—multiple cameras to capture average speed over a certain distance.
- **Mobile units**—a portable camera, generally in a vehicle or trailer.

The table below describes suitable circumstances for SSC deployment.<sup>1</sup>

### Considerations

- SSCs can produce a crash reduction upstream and downstream, thus generating a spillover effect.<sup>2</sup>

- Public trust is essential for any type of enforcement. With proper controls in place, SSCs can offer fair and equitable enforcement of speeding, regardless of driver age, race, gender, or socio-economic status. SSCs should be planned with community input and equity impacts in mind.

- Using both overt (i.e., highly visible) and covert (i.e., hidden) enforcement may encourage drivers to comply with limits everywhere, not only at sites they are aware are enforced.

- Agencies should conduct evaluations regularly to determine if SSCs are accomplishing safety goals and whether changes in strategy, scheduling, communications, or public engagement are necessary.

- Agencies should conduct a legal and policy review to determine if SSCs are authorized within a jurisdiction and how the authorization and other traffic laws will affect a SSC program.

- Agencies should develop an SSC program plan with consideration of the USDOT SSC guidelines for planning, public involvement, stakeholder coordination, implementation, maintenance, evaluation, etc.<sup>3</sup>

Considerations for Selection	Fixed	P2P	Mobile
Problems are long-term and site-specific.	X	X	—
Problems are network-wide, and shift based on enforcement efforts.	—	—	X
Speeds at enforcement site vary largely from downstream sites.	—	X	X
Overt enforcement is legally required.	X	X	X
Sight distance for the enforcement unit is limited.	X	X	—
Enforcement sites are multilane facilities.	X	X	—

1 Speed Safety Camera Program Planning and Operations Guide, FHWA, (2023).

2 (CMF ID: 7718) Montella et al. "Effects on speed and safety of point-to-point speed enforcement systems". Accident Analysis and Prevention, Vol. 75, (2015). Note that this is an international study.

3 Speed Enforcement Camera Systems Operational Guidelines, NHTSA, (2008).

4 (CMF ID: 2915, 2921) Shin et al. "Evaluation of the Scottsdale Loop 101 automated speed enforcement demonstration program." Accident Analysis and Prevention, Vol. 41, (2009).

5 (CMF ID: 7582) Li et al. "A Before-and-After Empirical Bayes Evaluation of Automated Mobile Speed Enforcement on Urban Arterial Roads." Presented at the 94th Annual Meeting of the Transportation Research Board, Paper No. 15-1563, Washington, D.C., (2015).

Note that this is an international study.

6 Automated Speed Enforcement Program Report 2014-2017. New York City DOT, (2018).



### Safety Benefits:

VSLs can reduce crashes on freeways up to:

**34%**

for total crashes.<sup>1</sup>

**65%**

for rear-end crashes.<sup>1</sup>

**51%**

for fatal and injury crashes.<sup>1</sup>

Benefit/Cost Ratios range between<sup>1</sup>

**9:1 - 40:1**

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/speed-management/reference-materials>.

## Variable Speed Limits

Selecting appropriate speed limits on roadways is important in maintaining a safe and efficient transportation network. Speed limits are established with an engineering study based on inputs like traffic volumes, operating speeds, roadway characteristics, and crash history. However, conditions on the roadway are susceptible to change in a short amount of time (e.g., congestion, crashes, weather). Drivers typically determine their operating speeds under normal weather conditions on a straight roadway section with good pavement quality and adequate sight distances. If ideal conditions do not exist and the roadway does not meet the driver's expectations, there is a greater chance that a driver error could result in a crash. Providing variable speeds limits (VSLs) capable of adapting to changing circumstances could reduce crash frequency and severity.

Speed management strategies, including VSLs, are integral to the Safe Speeds element of the Safe System Approach. Because humans are unlikely to survive high-speed crashes, VSLs reduce speeds so that human injury tolerances are accommodated in three ways: improving visibility, providing additional time for drivers to stop, and reducing impact forces.

### Applications

VSLs use prevailing information on the roadway, like traffic speed, volumes, weather, and road surface conditions, to determine appropriate speeds and display them to drivers. This strategy improves safety performance and traffic flow by reducing speed variance (i.e., improving speed harmonization). VSLs may also improve driver expectation by providing information in advance of slowdowns and potential lane closures, which could reduce the probability for secondary crashes. VSLs can mitigate adverse weather conditions or to slow faster-moving traffic as it approaches a queue or bottleneck.

Agencies can implement VSLs for the following applications:



CONGESTION



INCIDENTS



WORK ZONES



INCLEMENT WEATHER

### Considerations

- Particularly effective on urban and rural freeways and high-speed arterials with posted speed limits greater than 40 mph.
- Often implemented as part of Active Traffic Management (ATM) plans or incorporated into existing Road Weather Information Systems.
- When used with ATM, VSLs can mitigate rear-end, sideswipe, and other crashes on high-speed roadways.
- May be implemented as a regulatory and/or an advisory system.
- Can be applied to an entire roadway segment or individual lanes.



Source: WSDOT

<sup>1</sup> (CMF ID: 11002,11005,11003) Avelar et al. Developing Crash Modification Factors for Variable Speed Limit. FHWA, (2020).



## Safety Benefits:

Traffic fatalities in the City of Seattle decreased 26 percent after the city implemented comprehensive, city-wide speed management strategies and countermeasures inspired by Vision Zero. This included setting speed limits on all non-arterial streets at 20 mph and 200 miles of arterial streets at 25 mph.<sup>5</sup>

One study found that on rural roads, when considering other relevant factors in the engineering study along with the speed distribution, setting a speed limit no more than 5 mph below the 85th-percentile speed may result in fewer total and fatal plus injury crashes, and lead to drivers complying closely with the posted speed limit.<sup>6</sup>

**For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/speed-management/reference-materials>.**

## Appropriate Speed Limits for All Road Users

There is broad consensus among global roadway safety experts that speed control is one of the most important methods for reducing fatalities and serious injuries. Speed is an especially important factor on non-limited access roadways where vehicles and vulnerable road users mix.

A driver may not see or be aware of the conditions within a corridor, and may drive at a speed that feels reasonable for themselves but may not be for all users of the system, especially vulnerable road users, including children and seniors. A driver traveling at 30 miles per hour who hits a pedestrian has a 45 percent chance of killing or seriously injuring them.<sup>1</sup> At 20 miles per hour, that percentage drops to 5 percent.<sup>1</sup> A number of cities across the United States, including New York, Washington, Seattle and Minneapolis, have reduced their local speed limits in recent years in an effort to reduce fatalities and serious injuries, with most having to secure State legislative authorization to do so.

States and local jurisdictions should set appropriate speed limits to reduce the significant risks drivers impose on others—especially vulnerable road users—and on themselves. Addressing speed is fundamental to the Safe System Approach to making streets safer, and a growing body of research shows that speed limit changes alone can lead to measurable declines in speeds and crashes.<sup>2</sup>

### Applications

Posted speed limits are often the same as the legislative statutory speed limit. Agencies with designated authorities to set speed limits, which include States, and sometimes local jurisdictions, can establish non-statutory speed limits or designate reduced speed zones, and a growing number are doing so. While non-statutory speed limits must be based on an engineering study, conducted in accordance with the *Manual on Uniform Traffic Control Devices (MUTCD)* involving multiple factors and engineering judgment, FHWA is also encouraging agencies to use the following:<sup>3</sup>

- Expert Systems tools.
  - [USLIMITS2](#).
  - [NCHRP 966: Posted Speed Limit Setting Procedure and Tool](#).
- Safe System approach.

Based on international experience and implementation in the United States, the use of 20 mph speed zones or speed limits in urban core areas where vulnerable users share the road environment with motorists may result in further safety benefits.<sup>4</sup>

### Considerations

When setting a speed limit, agencies should consider a range of factors such as pedestrian and bicyclist activity, crash history, land use context, intersection spacing, driveway density, roadway geometry, roadside conditions, roadway functional classification, traffic volume, and observed speeds.

To achieve desired speeds, agencies often implement other speed management strategies concurrently with setting speed limits, such as self-enforcing roadways, traffic calming, and speed safety cameras. Additional information is in the following FHWA resources:

- [FHWA Speed Management website](#).
- [Self-Enforcing Roadways: A Guidance Report](#).
- [Noteworthy Speed Management Practices](#).
- [Jurisdiction Speed Management Action Plan Development Package](#).
- [Traffic Calming ePrimer](#).

<sup>1</sup> Reducing the speed limit to 20 mph in urban areas: Child deaths and injuries would be decreased.

<sup>2</sup> Lowering the speed limit from 30 to 25 mph in Boston: effects on vehicle speeds.

<sup>3</sup> FHWA's Methods and Practices for Setting Speed Limits: An Informational Report. (2012).

<sup>4</sup> Recommendations of the Academic Expert Group for the 3rd Global Ministerial Conference on Road Safety.

<sup>5</sup> [https://safety.fhwa.dot.gov/speedmgmt/ref\\_mats/fhwasa20047/sec8.cfm#foot813](https://safety.fhwa.dot.gov/speedmgmt/ref_mats/fhwasa20047/sec8.cfm#foot813)

<sup>6</sup> Safety and Operational Impacts of Setting Speed Limits below Engineering Recommendations.



### Safety Benefits:

**Wider edge lines can reduce crashes up to:**

# 37%

for non-intersection, fatal and injury crashes on rural, two-lane roads.<sup>2</sup>

# 22%

for fatal and injury crashes on rural freeways.<sup>3</sup>

### Benefit Cost Ratio

# 25:1

for fatal and serious injury crashes on two-lane rural roads.<sup>4</sup>

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/other/visibility/pavement-markings>.

## Wider Edge Lines

Roadway departures account for over half of all traffic fatalities in the United States. If drivers cannot clearly identify the edge of the travel lanes and see the road alignment ahead, the risk of roadway departure may be greater. Wider edge lines enhance the visibility of travel lane boundaries compared to traditional edge lines. Edge lines are considered “wider” when the marking width is increased from the minimum normal line width of 4 inches to the maximum normal line width of 6 inches.<sup>1</sup>

### Applications

Wider edge lines increase drivers’ perception of the edge of the travel lane and can provide a safety benefit to all facility types (e.g., freeways, multilane divided and undivided highways, two-lane highways) in both urban and rural areas.<sup>2</sup> Wider edge lines are most effective in reducing crashes on rural two-lane highways, especially for single-vehicle crashes.<sup>3</sup> Agencies should also consider implementing a systemic approach to wider edge line installation based roadway departure crash risk factors. Potential risk factors for two-lane rural roads include:

- Pavement and shoulder widths.
- Presence of curves.
- Traffic volumes.
- History of nighttime crashes.

### Considerations

- Wider edge lines are relatively low cost.
- Wider edge lines can be implemented using existing equipment during maintenance procedures like re-striping and resurfacing, with the only cost increase being the additional material.
- Paint may have a lower initial cost, but more durable materials (e.g., thermoplastic) may result in a lower life cycle cost based on their longer service life.
- As the number of automated vehicles increases on roadways, wider edge lines may provide better guidance for these vehicles’ sensors.



Source: Texas Transportation Institute

1 Manual on Uniform Traffic Control Devices (MUTCD), Section 3A.04, FHWA, (2023).  
 2 (CMF ID: 4737) Park et al. “Safety effects of wider edge lines on rural, two-lane highways. “ Accident Analysis and Prevention Vol. 48, pp.317-325, (2012).  
 3 Potts et al. Benefit/Cost Evaluation of MoDOT’s Total Striping and Delineation Program: Phase II. Missouri Department of Transportation, (2011).  
 4 Abdel-Rahim et al. Safety Impacts of Using Wider Pavement Markings on Two-Lane Rural Highways in Idaho. Idaho Transportation Department, (2018).



### Safety Benefits:

#### Chevron Signs

**25%** reduction in nighttime crashes.<sup>1</sup>

**16%** reduction in non-intersection fatal and injury crashes.<sup>2</sup>

#### Oversized Chevron Signs

**15%** reduction in fatal and injury crashes.<sup>3</sup>

#### Sequential Dynamic Chevrons

**60%** reduction in fatal and injury crashes.<sup>4</sup>

#### In-Lane Curve Warning Pavement Markings

**35 - 38%** reduction in all crashes.<sup>5</sup>

#### New Fluorescent Curve Signs or Upgrade Existing Curve Signs to Fluorescent Sheeting

**18%** reduction in non-intersection, head-on, run-off-road, and sideswipe in rural areas.<sup>1</sup>

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/rwd/keep-vehicles-road/horizontal-curve-safety>.

## Enhanced Delineation for Horizontal Curves

Enhanced delineation at horizontal curves includes a variety of potential strategies that can be implemented in advance of or within curves, in combination, or individually.

Potential Strategies	In Advance of Curve	Within Curve
Pavement markings (standard width or wider)	✓	✓
In-lane curve warning pavement markings	✓	
Retroreflective strips on sign posts	✓	✓
Delineators		✓
Chevron signs		✓
Enhanced Conspicuity (larger, fluorescent, and/or retroreflective signs)	✓	✓
Dynamic curve warning signs (including speed radar feedback signs)	✓	
Sequential dynamic chevrons		✓

Enhanced delineation treatments can alert drivers to upcoming curves, the direction and sharpness of the curve, and appropriate operating speed.

Agencies can take the following steps to implement enhanced delineation strategies:

1. Review signing practices and policies to ensure they comply with the Manual on Uniform Traffic Control Devices (MUTCD) principles of traffic control devices. Consistent practice for similar curves sets the appropriate driver expectancy.
2. Use the [systemic approach](#) to identify and treat problem curves. For example, Minnesota uses risk factors that include curve radii between 500 and 1,200 ft, traffic volumes between 500 and 1,000 vehicles per day, intersection in the curve, and presence of a visual trap.<sup>1</sup>
3. Match the appropriate strategy to the identified problem(s), considering the full range of enhanced delineation treatments. Once the MUTCD requirements and recommendations have been met, an incremental approach is often beneficial to avoid excessive cost.



Chevron signs with retroreflective strips on sign posts installed along a curve. Source: FHWA

1 (CMF ID: 2439,2431,2432) Albin et al. Low-Cost Treatments for Horizontal Curve Safety 2016. FHWA-SA-15-084, (2016).

2 (CMF ID: 2438) Srinivasan et al. Safety Evaluation of Improved Curve Delineation. FHWA-HRT-09-045, (2009).

3 (CMF ID: 8978) Lyon et al. Safety Evaluation of Two Curve Warning Treatments: In-Lane Curve Warning Pavement Markings and Oversized Chevron Signs. Presented at the 96th TRB Annual Meeting, Paper No. 17-00432, (2017).

4 (CMF ID: 10362) Hallmark, S. Evaluation of Sequential Dynamic Chevrons on Rural Two-lane Highways. FHWA, (2017).

5 (CMF ID: 10312,9167) Donnell et al. Reducing Roadway Departure Crashes at Horizontal Curve Sections on Two-lane Rural Highways. FHWA-SA-19-005, (2019).



### Safety Benefits:

#### Center Line Rumble Strips

# 44-64%

reduction in head-on fatal and injury crashes on two-lane rural roads.<sup>4</sup>

#### Shoulder Rumble Strips

# 13-51%

reduction in single vehicle, run-off-road fatal and injury crashes on two-lane rural roads.<sup>4</sup>

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/rwd/keep-vehicles-road/rumble-strips>.

## Longitudinal Rumble Strips and Stripes

**Longitudinal rumble strips** are milled or raised elements on the pavement intended to alert drivers through vibration and sound that their vehicle has left the travel lane. They can be installed on the shoulder, edge line, or at or near the center line of an undivided roadway.

**Rumble stripes** are edge line or center line rumble strips where the pavement marking is placed over the rumble strip. This can increase the visibility and durability of the pavement marking during wet, nighttime conditions, and can improve the durability of the marking on roads with snowplowing operations.

With roadway departure crashes accounting for more than half of the fatal roadway crashes annually in the United States, rumble strips and stripes are designed to address these crashes by alerting distracted, drowsy, or otherwise inattentive drivers who drift from their lane. They are most effective when deployed systemically.

Transportation agencies should consider milled center line rumble strips (including in passing zone areas) and milled edge line or shoulder rumble strips with bicycle gaps for systemic safety projects, location-specific corridor safety improvements, as well as reconstruction or resurfacing projects.

### Considerations

- Rumble strips are relatively low-cost, and economic analyses have indicated benefit/cost ratios that exceed 100.<sup>1</sup>
- Where rumble strips cannot be placed due to noise concerns, agencies may consider a design using an oscillating sine wave pattern (also known as “mumble strips”) that reduces noise outside of the vehicle. However, the safety benefits of this design need more study.<sup>2</sup>

### Maintenance concerns:

- Where rumble strips are placed along a pavement joint, there are typically no issues with joint stability if the pavement structure and joint was already in good condition.
- Studies have shown no evidence of issues related to snow, ice, or rain build-up in the rumble strip.<sup>3</sup>



Shoulder rumble strips and center line rumble stripes are installed on this roadway. Source: FHWA



Example of an edge line rumble stripe. Source: Missouri DOT

<sup>1</sup> Himes, S., and McGee, H. Decision Support Guide for the Installation of Shoulder and Center Line Rumble Strips on Non-Freeways. Federal Highway Administration Report No. FHWA-SA-16-115. (August 2016).  
<sup>2</sup> Bedsole et al. *Did You Hear That?* Public Roads Magazine, Volume 80, No. 4. FHWA Publication No. FHWA-HRT-17-002. (2017).  
<sup>3</sup> NCHRP Synthesis 339: Centerline Rumble Strips – A Synthesis of Highway Practices, (2005)  
<sup>4</sup> (CMF ID: 3358, 3356, 3425, 3648) NCHRP Report 641: Guidance for the Design and Application of Shoulder and Centerline Rumble Strips, (2009).



### Safety Benefits:

# 11%

reduction in fatal and injury crashes.<sup>2</sup>

# 21%

reduction in run-off-road crashes.<sup>2</sup>

# 19%

reduction in head-on crashes.<sup>2</sup>

### Benefit-Cost Ratio Range<sup>3</sup>

# 700:1 to 1,500:1

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/rwd/provide-safe-recovery/safetyedge>.

## SafetyEdge<sup>SM</sup>

The SafetyEdge<sup>SM</sup> technology shapes the edge of the pavement at approximately 30 degrees from the pavement cross slope during the paving process. This safety practice eliminates the potential for vertical drop-off at the pavement edge, has minimal effect on project cost, and can improve pavement durability by reducing edge raveling of asphalt.

Rural road crashes involving edge drop-offs are 2-4 times more likely to include a fatality than other crashes on similar roads.<sup>1</sup> Vehicles may leave the roadway for various reasons ranging from distracted driver errors to low visibility, or to the presence of an animal on the road. Exposed vertical pavement edges can cause vehicles to become unstable and prevent their safe return to the roadway. The SafetyEdge<sup>SM</sup> gives drivers the opportunity to return to their travel lane while maintaining control of their vehicle.

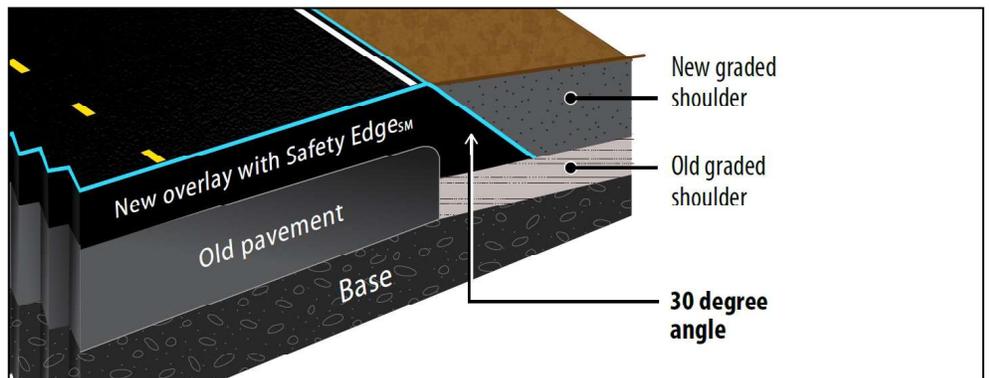
The SafetyEdge<sup>SM</sup> technology only requires adding one of several commercially available devices to the screed or endgate when placing hot-mix asphalt. Forms for shaping the edge of concrete pavement are simpler and can be made on site by the contractor. Some agencies allow the SafetyEdge<sup>SM</sup> to remain exposed while a segment is under construction, unlike conventional pavement edges. However, before construction ends, agencies should bring the adjacent roadside flush with the top of the pavement

for both the SafetyEdge<sup>SM</sup> and traditional pavement edge. Over time, regardless of the edge type, the edge may become exposed due to settling, erosion, and tire wear. When this occurs, the gentle slope provided by the SafetyEdge<sup>SM</sup> is preferred versus the traditional vertical pavement edge.

Transportation agencies should develop standards for implementing the SafetyEdge<sup>SM</sup> systemwide on all new asphalt paving and resurfacing projects where curbs and/or guardrail are not present, while also encouraging standard application for concrete pavements.



Example of the SafetyEdge<sup>SM</sup> after backfill material settles or erodes. Source: FHWA



Cross-section view of an overlay with the SafetyEdge<sup>SM</sup>. Source: FHWA-SA-17-044

1 Hallmark et al. Safety Impacts of Pavement Edge Drop-offs, (Washington, DC: AAA Foundation for Traffic Safety; 2006), p 93.

2 (CMF ID: 9205, 9211, 9217) Donnell et al. Development of Crash Modification Factors for the Application of the SafetyEdge<sup>SM</sup> on Two-Lane Rural Roads. FHWA-HRT-17-081, (2017).

3 Safety Effects of the SafetyEdge<sup>SM</sup>, FHWA-SA-17-044, (2017).



## Safety Benefits:

Flatten sideslope from  
1V:3H to 1V:4H:

# 8%

reduction for  
single-vehicle crashes.<sup>2</sup>

Flatten sideslope from  
1V:4H to 1V:6H:

# 12%

reduction for  
single-vehicle crashes.<sup>2</sup>

Increase the distance to  
roadside features from  
3.3 ft to 16.7 ft:

# 22%

reduction for all crashes.<sup>3</sup>

Increase the distance to  
roadside features from  
16.7 ft to 30 ft:

# 44%

reduction for all crashes.<sup>3</sup>

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/rwd/provide-safe-recovery/clear-zones/clear-zones>.

## Roadside Design Improvements at Curves

Horizontal curves account for 27 percent of all fatal crashes and 80 percent of all fatal crashes at curves are roadway departure crashes.<sup>1</sup> Roadside design improvements at curves is a strategy encompassing several treatments that target the high-risk roadside environment along the outside of horizontal curves. These treatments can reduce roadway departure fatalities and serious injuries by giving vehicles the opportunity to recover safely and by reducing crash severity.

Roadside design improvements can be implemented alone or in combination, and are particularly recommended at horizontal curves—where data indicates a higher risk for roadway departure fatalities and serious injuries.

### Roadside Design Improvements to Provide for a Safe Recovery

In cases where a vehicle leaves the roadway, having strategic roadside design elements, including an added or widened shoulder, flattened sideslopes, or a widened clear zone can provide drivers with an opportunity to regain control and re-enter the roadway in their lane or come to a safe stop before rolling over or encountering a fixed object.

- A **clear zone** is an unobstructed, traversable roadside area that allows a driver to stop safely or regain control of a vehicle that has left the roadway. Agencies should avoid adding new fixed objects such as trees and utility cabinets or poles in the clear zone. AASHTO's *Roadside Design Guide* details the clear zone width adjustment factors to be applied at horizontal curves.
- **Slope flattening** reduces the steepness of the sideslope to increase drivers' ability to keep the vehicle stable, regain control of the vehicle, and avoid obstacles. Slopes of 1V:4H or flatter are considered recoverable (i.e., drivers can retain control of a vehicle by slowing or stopping). Slopes between 1V:3H and 1V:4H are generally considered traversable, but non-recoverable (i.e., errant vehicle will continue to the bottom of the slope).

### • Adding or widening shoulders

gives drivers more recovery area to regain control in the event of a roadway departure.

### Roadside Design Improvements to Reduce Crash Severity

Since not all roadside hazards can be removed, relocated, or redesigned at curves, installing roadside barriers to shield unmovable objects or steep embankments may be an appropriate treatment. Three common types of roadside barriers are:

- **Cable barrier** is a flexible barrier made from steel cables mounted on weak steel posts. Flexible barriers are more forgiving and have the most deflection.
- **Metal-beam guardrail** is a semi-rigid barrier where a W-beam or box-beam is mounted on steel or timber posts. These deflect less than cable barriers, so they can be located closer to objects where space is limited.
- **Concrete barrier** is a rigid barrier that has little to no deflection.



Clear zone provided on the outside of the curve. Source: FHWA.

1 Fatality Analysis Reporting System.

2 (CMF ID: 4627,4632) NCHRP Report 617: Accident Modification Factors for Traffic Engineering and ITS Improvements, (2008).

3 (CMF ID: 35,36) Elvik, R., and Vaa, T. Handbook of Road Safety Measures, (2004).



**8%**

of all fatalities on divided highways are due to head-on crashes.<sup>1</sup>

**Safety Benefits:**  
**Median Barriers Installed on Rural Four-Lane Freeways**

**97%**

reduction in cross-median crashes.<sup>2</sup>

**For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/rwd/reduce-crash-severity>.**

## Median Barriers

Median barriers are longitudinal barriers that separate opposing traffic on a divided highway and are designed to redirect vehicles striking either side of the barrier. Median barriers significantly reduce the number of cross-median crashes, which are attributed to the relatively high speeds that are typical on divided highways. AASHTO's *Roadside Design Guide* (RDG) recommends guidelines for the use of median barriers on high-speed, fully controlled-access roadways for locations where the median is 30 ft in width or less and the average daily traffic (ADT) is greater than 20,000 vehicles per day (vpd). For locations with median widths greater than 50 ft and where the ADT is less than 20,000 vpd, a median barrier is optional. For locations where the median is between 30 and 50 feet, the RDG suggests an analysis to determine the cost effectiveness of median barrier installation. Median barriers can be cable, metal-beam, or concrete.

- **Cable barriers** are flexible barriers, made from steel cables mounted on weak steel posts, resulting in less occupant impact force as it absorbs energy from the crash, capturing or redirecting the vehicle. Due to larger deflection, median width is an important consideration. These barriers are more adaptable to slopes typically found in medians. Cable barriers tend to require more frequent maintenance and repair than other barrier types.
- **Metal-beam guardrails** are considered semi-rigid barriers, where the W-beam or box-beam is mounted to steel or timber posts. When impacted, they are designed to deform and deflect, absorbing some of the crash energy and redirecting the vehicle. Metal-beam guardrails often do not require maintenance after minor impacts. They deflect less than cable barriers, so they can be located closer to objects where space is limited.
- **Concrete barriers** are usually rigid and result in little to no deflection. They redirect rather than absorb energy from the impact. Rigid concrete barriers seldom require repair or maintenance. Some agencies have used portable concrete barriers as median barriers. These barriers require

repositioning after an impact but are typically less maintenance than a post mounted barrier.

To reduce cross-median crashes, transportation agencies should review their head-on crash history on divided highways to identify hot spots. Agencies should also consider implementing a systemic approach to median barrier placement based on cross-median crash risk factors. Potential risk factors include:

- Traffic volumes.
- Vehicle classifications.
- Median crossover history.
- Crash incidents.
- Vertical and horizontal alignment.
- Median terrain configurations.



Median cable barrier prevents a potential head-on crash.  
Source: Washington State DOT

<sup>1</sup> Fatality Analysis Reporting System.

<sup>2</sup> (CMF ID: 7040) NCHRP Report 794: Median Cross-Section Design for Rural Divided Highways, (2011).



### Safety Benefits:

# 15%

reduction in total crashes.<sup>1</sup>

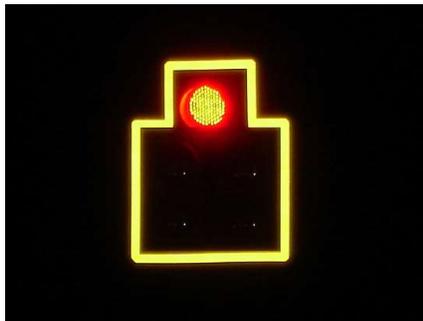
## Backplates with Retroreflective Borders

Backplates added to a traffic signal head improve the visibility of the illuminated face of the signal by introducing a controlled-contrast background. The improved visibility of a signal head with a backplate is made even more conspicuous by framing it with a 1- to 3-inch yellow retroreflective border. Signal heads that have backplates equipped with retroreflective borders are more visible and conspicuous in both daytime and nighttime conditions.

This treatment is recognized as a human factors enhancement of traffic signal visibility, conspicuity, and orientation for both older and color vision deficient drivers. This countermeasure is also advantageous during periods of power outages when the signals would otherwise be dark, providing a visible cue for motorists to stop at the intersection ahead.

safety countermeasure is to adopt it as a standard treatment for signalized intersections across a jurisdiction or State.

Implementation challenges include minimizing installation time, accessing existing signal heads, and structural limitations due to added wind load in instances where an entire backplate is added. Agencies should consider the design of the existing signal support structure to determine if the design is sufficient to support the added wind load.



Retroreflective borders are highly visible during the night. Source: South Carolina DOT

### Considerations

Transportation agencies should consider backplates with retroreflective borders as part of their efforts to systematically improve safety performance at signalized intersections. Adding a retroreflective border to an existing signal backplate is a very low-cost safety treatment. This can be done by either adding retroreflective tape to an existing backplate or purchasing a new backplate with a retroreflective border already incorporated. The most efficient means of implementing this proven



Signal backplate framed with a retroreflective border. Source: FHWA

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://rosap.ntl.bts.gov/view/dot/42807>.

<sup>1</sup> (CMF ID: 1410) Sayed, T., Leur, P., and Pump, J., "Safety Impact of Increased Traffic Signal Backboards Conspicuity," 2005 TRB 84th Annual Meeting: Compendium of Papers CD-ROM, Vol. TRB#05-16, Washington, D.C., (2005).



## Safety Benefits:

Reducing driveway density

# 5-23%

reduction in total crashes along 2-lane rural roads.<sup>3</sup>

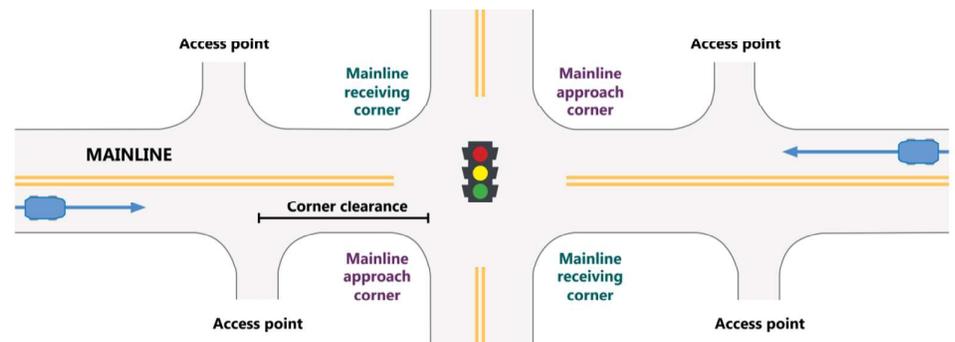
# 25-31%

reduction in fatal and injury crashes along urban/suburban arterials.<sup>4</sup>

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/intersection-safety/cam>.

## Corridor Access Management

Access management refers to the design, application, and control of entry and exit points along a roadway. This includes intersections with other roads and driveways that serve adjacent properties. Thoughtful access management along a corridor can simultaneously enhance safety for all modes, facilitate walking and biking, and reduce trip delay and congestion.



Schematic of an intersection and adjacent access points. Source: FHWA

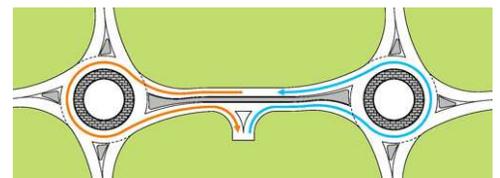
Every intersection, from a signalized intersection to an unpaved driveway, has the potential for conflicts between vehicles, pedestrians, and bicyclists. The number and types of conflict points—locations where the travel paths of two users intersect— influence the safety performance of the intersection or driveway. FHWA developed corridor-level crash prediction models to estimate and analyze the safety effects of selected access management techniques for different area types, land uses, roadway variables, and traffic volumes.<sup>1</sup>

The following access management strategies can be used individually or in combination with one another:

- Reduce density through driveway closure, consolidation, or relocation.
- Manage spacing of intersection and access points.
- Limit allowable movements at driveways (such as right-in/right-out only).

- Place driveways on an intersection approach corner rather than a receiving corner, which is expected to have fewer total crashes.<sup>2</sup>
- Implement raised medians that preclude across-roadway movements.
- Utilize designs such as roundabouts or reduced left-turn conflicts (such as restricted crossing U-turn, median U-turns, etc.).
- Provide turn lanes (i.e., left-only, right-only, or interior two-way left).
- Use lower speed one-way or two-way off-arterial circulation roads.

Successful corridor access management involves balancing overall safety and mobility for all users along with the needs of adjacent land uses.



Tandem roundabouts with a continuous raised median eliminates left-turn and across-roadway conflicts. Source: FHWA

1 Gross et al. Safety Evaluation of Access Management Policies and Techniques. FHWA-HRT-14-057, (2018).

2 Le et al. Safety Evaluation of Corner Clearance at Signalized Intersections. FHWA-HRT-17-084, (2018).

3 Harwood et al. Prediction of the Expected Safety Performance of Rural Two-Lane Highways. FHWA-RD-99-207, (2000).

4 (CMF ID: 179,178) Elvik, R. and Vaa, T., Handbook of Road Safety Measures. Oxford, United Kingdom, Elsevier, (2004).



## Safety Benefits:

### Left-Turn Lanes

# 28-48%

reduction in total crashes.<sup>1</sup>

### Positive Offset Left-Turn Lanes

# 36%

reduction in fatal and injury crashes.<sup>2</sup>

### Right-Turn Lanes

# 14-26%

reduction in total crashes.<sup>1</sup>



Left- and right-turn lanes at a two-way stop-controlled intersection. Source: City of Greeley, CO

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://www.fhwa.dot.gov/publications/research/safety/02103/02103techbrief.pdf>.

## Dedicated Left- and Right-Turn Lanes at Intersections

Auxiliary turn lanes—either for left turns or right turns—provide physical separation between turning traffic that is slowing or stopped and adjacent through traffic at approaches to intersections. Turn lanes can be designed to provide for deceleration prior to a turn, as well as for storage of vehicles that are stopped and waiting for the opportunity to complete a turn.

While turn lanes provide measurable safety and operational benefits at many types of intersections, they are particularly helpful at two-way stop-controlled intersections. Crashes occurring at these intersections are often related to turning maneuvers. Since the major route traffic is free flowing and typically travels at higher speeds, crashes that do occur are often severe. The main crash types include collisions of vehicles turning left across opposing through traffic and rear-end collisions of vehicles turning left or right with other vehicles following closely behind. Turn lanes reduce the potential for these types of crashes.

Installing left-turn lanes and/or right-turn lanes should be considered for the major road approaches for improving safety at both three- and four-leg intersections with stop control on the minor road, where significant turning volumes exist, or where there is a history of turn-related crashes. Pedestrian and bicyclist safety and convenience should also be considered when adding turn lanes at an intersection. Specifically, offset left- and right-turn

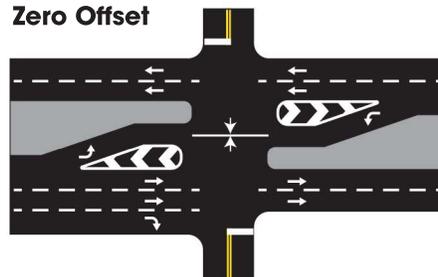
lanes will lengthen crossing distances for pedestrians.

### Offset Turn Lanes

Providing offset of left- and right-turn lanes to increase visibility can provide added safety benefits, and is preferable in many situations, particularly at locations with higher speeds, or where free-flow or permissive movements are possible.

At turn lanes with zero or negative offset, turning vehicles can block sightlines. For left-turn lanes, this usually involves opposing left-turning vehicles occupying the turn lanes at the same time. For right-turn lanes, this typically involves right-turning vehicles from the major road and vehicles entering the intersection from the minor road. In both scenarios, adding positive offset to turn lanes enhances the sight distance to approaching vehicles that conflict with the turning movement. Offset turn lanes should be considered when there is a high frequency of these types of conflicts in order to reduce the likelihood of a severe crash.

### Zero Offset



### Positive Offset

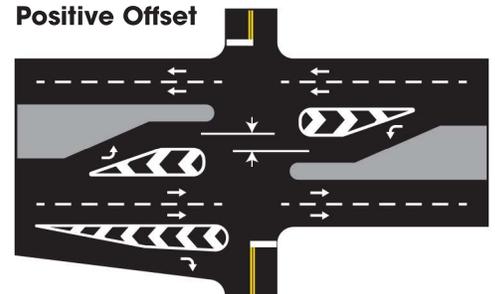


Illustration comparing zero offset to positive offset of left- and right-turn lanes. Source: FHWA

<sup>1</sup> (CMF ID: 260, 268, 285, 289) Harwood et al. Safety Effectiveness of Intersection Left- and Right-Turn Lanes. FHWA-HRD-02-089, (2002).

<sup>2</sup> (CMF ID: 6096) Persaud et al. Safety Evaluation of Offset Improvements for Left-Turn Lanes. FHWA-HRT-09-035, (2009).



## Safety Benefits:

### RCUT

Two-Way  
Stop-Controlled to RCUT:

# 54%

reduction in fatal  
and injury crashes.<sup>2</sup>

Signalized Intersection  
to Signalized RCUT:

# 22%

reduction in fatal  
and injury crashes.<sup>3</sup>

Unsignalized Intersection  
to Unsignalized RCUT:

# 63%

reduction in fatal and  
injury crashes.<sup>4</sup>

### MUT

# 30%

reduction in intersection-  
related injury crash rate.<sup>5</sup>

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/intersection-safety/intersection-types/reduced-left-turn-conflict-intersections>.

## Reduced Left-Turn Conflict Intersections

Reduced left-turn conflict intersections are geometric designs that alter how left-turn movements occur. These intersections simplify decision-making for drivers and minimize the potential for higher severity crash types, such as head-on and angle. Two highly effective designs that rely on U-turns to complete certain left-turn movements are known as the Restricted Crossing U-turn (RCUT) and the Median U-turn (MUT).

### Restricted Crossing U-turn

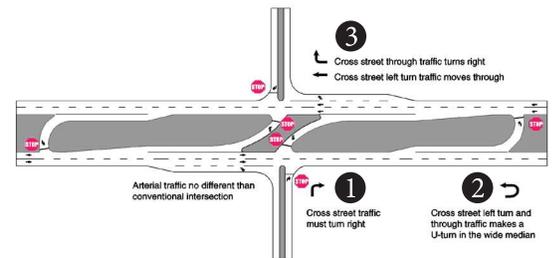
The RCUT intersection, also known as a J-Turn, Superstreet, or Reduced Conflict Intersection, modifies the direct left-turn and through movements from cross-street approaches. Minor road traffic makes a right turn followed by a U-turn at a designated location—either signalized or unsignalized—to continue in the desired direction. The RCUT is suitable for and adaptable to a wide variety of circumstances, ranging from isolated rural, high-speed locations to urban and suburban high-volume, multimodal corridors. It is a competitive and less costly alternative to constructing an interchange. RCUTs work well when consistently used along a corridor, but also can be used effectively at individual intersections. Studies have shown that installing an RCUT can result in a 30-percent increase in throughput and a 40-percent reduction in network intersection travel time.<sup>1</sup>

### Median U-turn

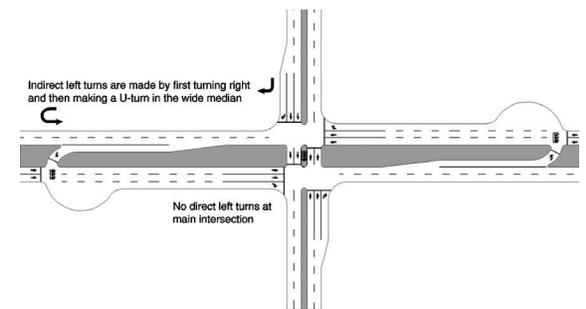
The MUT intersection modifies direct left turns from the major approaches. Vehicles proceed through the main intersection, make a U-turn a short distance downstream, followed by a right turn at the main intersection. The U-turns can also be used for

modifying the cross-street left turns, similar to the RCUT.

The MUT is an excellent choice for intersections with heavy through traffic and moderate left-turn volumes. Studies have shown a 20- to 50-percent improvement in intersection throughput for various lane configurations as a result of implementing the MUT design. When implemented at multiple intersections along a corridor, the efficient two-phase signal operation of the MUT can reduce delay, improve travel times, and create more crossing opportunities for pedestrians and bicyclists.



Example of an unsignalized RCUT intersection. Source: FHWA



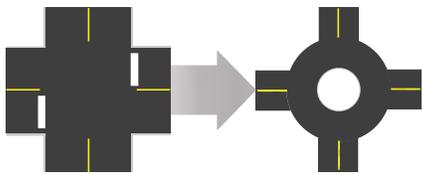
Example of a MUT intersection. Source: FHWA

1 Hugher and Jagannathan. Restricted Crossing U-Turn Intersection. FHWA-HRT-09-059, (2009).  
2 (CMF ID: 5556) Edara et al. Evaluation of J-turn Intersection Design Performance in Missouri. MoDOT, (2013).  
3 (CMF ID: 9985) Hummer and Rao. Safety Evaluation of a Signalized Restricted Crossing U-Turn. FHWA-HRT-17-082, (2017).  
4 (CMF ID: 4884) Hummer et al. Superstreet Benefits and Capacities. FHWA/NC/2009-06. NC State University, (2010).  
5 (CMF ID: 10867) Synthesis of the Median U-Turn Treatment, Safety, and Operational Benefits. FHWA-HRT-07-033, (2007).



## Safety Benefits:

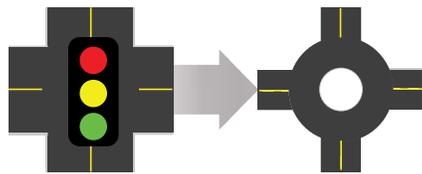
### Two-Way Stop-Controlled Intersection to a Roundabout



# 82%

reduction in fatal and injury crashes.<sup>1</sup>

### Signalized Intersection to a Roundabout



# 78%

reduction in fatal and injury crashes.<sup>1</sup>

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/intersection-safety/intersection-types/roundabouts>.

## Roundabouts

The modern roundabout is an intersection with a circular configuration that safely and efficiently moves traffic. Roundabouts feature channelized, curved approaches that reduce vehicle speed, entry yield control that gives right-of-way to circulating traffic, and counterclockwise flow around a central island that minimizes conflict points. The net result of lower speeds and reduced conflicts at roundabouts is an environment where crashes that cause injury or fatality are substantially reduced.

Roundabouts are not only a safer type of intersection; they are also efficient in terms of keeping people moving. Even while calming traffic, they can reduce delay and queuing when compared to other intersection alternatives. Furthermore, the lower vehicular speeds and reduced conflict environment can create a more suitable environment for walking and bicycling.

Roundabouts can be implemented in both urban and rural areas under a wide range of traffic conditions. They can replace signals, two-way stop controls, and all-way stop controls. Roundabouts are an effective option for managing speed and transitioning traffic from high-speed to low-speed environments, such as freeway interchange ramp terminals, and rural intersections along high-speed roads.

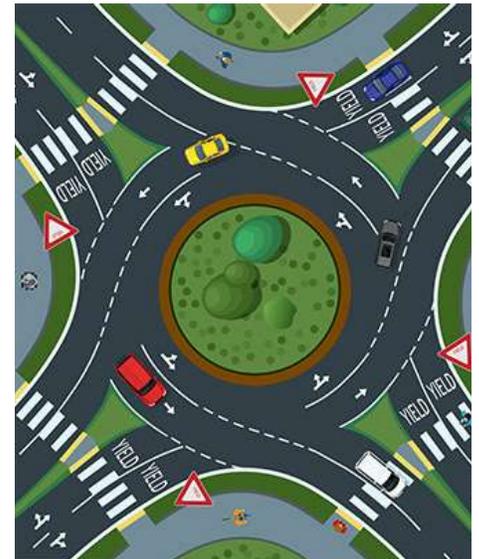
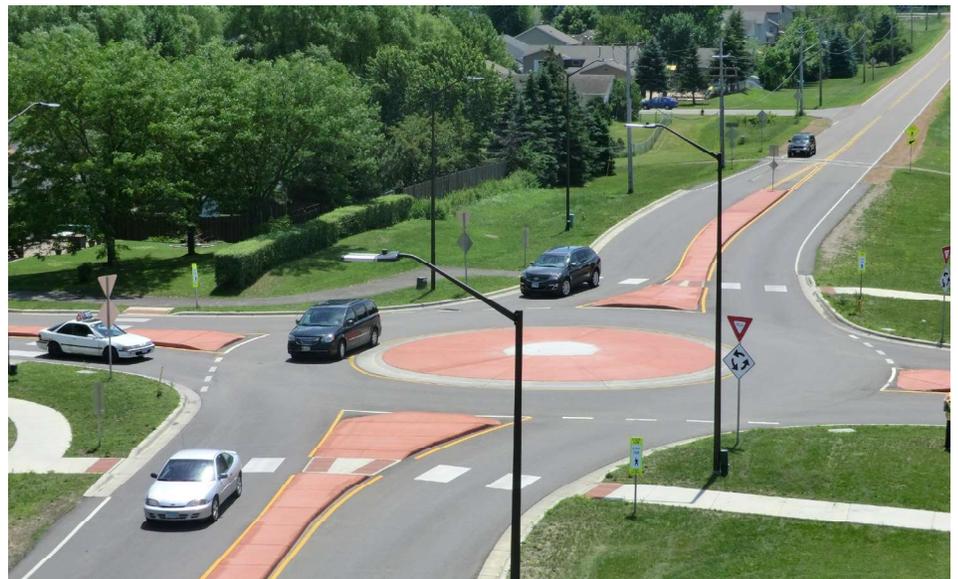


Illustration of a multilane roundabout. Source: FHWA



Example of a single-lane roundabout. Source: FHWA

<sup>1</sup> (CMF ID: 211.226) AASHTO, The Highway Safety Manual, American Association of State Highway Transportation Professionals, Washington, D.C., (2010).



### Safety Benefits:

# 10%

reduction of fatal and injury crashes at all locations/types/areas.

# 15%

reduction of nighttime crashes at all locations/types/areas.

# 27%

reduction of fatal and injury crashes at rural intersections.

# 19%

reduction of fatal and injury crashes at 2-lane by 2-lane intersections.

### Average Benefit-Cost Ratio

# 12:1

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/fhwasa18047.pdf>.

## Systemic Application of Multiple Low-Cost Countermeasures at Stop-Controlled Intersections

This systemic approach to intersection safety involves deploying a package of multiple low-cost countermeasures, including enhanced signing and pavement markings, at a large number of stop-controlled intersections within a jurisdiction. These countermeasures increase driver awareness and recognition of the intersections and potential conflicts.

There are several benefits to systemically applying multiple low-cost countermeasures at stop-controlled intersections, including,

- Resources are maximized because the treatments are low cost.
- A high number of intersections can receive treatment.
- Improvements are highly cost-effective, with an average benefit-cost ratio of 12:1, even assuming a conservative 3-year service life.

The low-cost countermeasures for stop-controlled intersections generally consist of the following treatments:

### On the Through Approach

- Doubled-up (left and right), oversized advance intersection warning signs, with supplemental street name plaques (can also include flashing beacon).
- Retroreflective sheeting on sign posts.
- Enhanced pavement markings that delineate through lane edge lines.

### On the Stop Approach

- Doubled-up (left and right), oversized advance "Stop Ahead" intersection warning signs (can also include flashing beacon).
- Doubled-up (left and right), oversized Stop signs.
- Retroreflective sheeting on sign posts.
- Properly placed stop bar.
- Removal of vegetation, parking, or obstructions that limit sight distance.
- Double arrow warning sign at stem of T-intersections.



Example of countermeasures on the through approach.  
Source: South Carolina DOT



Example of countermeasures on the stop approach.  
Source: South Carolina DOT



### Safety Benefits:

**36-50%**  
reduction in  
red light running.<sup>3</sup>

**8-14%**  
reduction in  
total crashes.<sup>3</sup>

**12%**  
reduction in  
injury crashes.<sup>3</sup>

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/fhwas13027.pdf>.

## Yellow Change Intervals

At a signalized intersection, the yellow change interval is the length of time that the yellow signal indication is displayed following a green signal indication. The yellow signal confirms to motorists that the green has ended and that a red will soon follow.

Since red-light running is a leading cause of severe crashes at signalized intersections, it is imperative that the yellow change interval be appropriately timed. Too brief an interval may result in drivers being unable to stop safely and cause unintentional red-light running. Too long of an interval may result in drivers treating the yellow as an extension of the green phase and invite intentional red-light running. Factors such as the speed of approaching and turning vehicles, driver perception-reaction time, vehicle deceleration, and intersection geometry should all be considered in the timing calculation.

Transportation agencies can improve signalized intersection safety and reduce red-light running by reviewing and updating their traffic signal timing policies and procedures concerning the yellow change interval. Agencies should institute regular evaluation and adjustment protocols for existing traffic signal timing. Refer to the *Manual on Uniform Traffic Control Devices* for basic requirements and further recommendations about yellow change interval timing.<sup>1</sup> As part of strategic signal system modernization and updates, incorporating automated traffic signal performance measures (ATSPMs) is a proven approach to improve on traditional retiming processes. ATSPMs provide continuous performance monitoring capability and the ability to modify timing based on actual performance, without requiring expensive modeling or data collection.<sup>2</sup>



Appropriately timed yellow change intervals can reduce red-light running and improve overall intersection safety. Source: FHWA

<sup>1</sup> Manual on Uniform Traffic Control Devices (MUTCD), Section 4F.17, FHWA, (2023).  
<sup>2</sup> Federal Highway Administration, "Automated Traffic Signal Performance," (2020).  
<sup>3</sup> (CMF ID: 380,384) NCHRP Report 731: Guidelines for Timing Yellow and All-Red Intervals at Signalized Intersections, (2011).



### Safety Benefits:

**High-visibility crosswalks can reduce pedestrian injury crashes up to:**

**40%<sup>1</sup>**

**Intersection lighting can reduce pedestrian crashes up to:**

**42%<sup>2</sup>**

**Advance yield or stop markings and signs can reduce pedestrian crashes up to:**

**25%<sup>3</sup>**

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/techSheetVizEnhancement2018.pdf>.

## Crosswalk Visibility Enhancements

Poor lighting conditions, obstructions such as parked cars, and horizontal or vertical roadway curvature can reduce visibility at crosswalks, contributing to safety issues. For multilane roadway crossings where vehicle volumes are in excess of 10,000 Average Annual Daily Traffic (AADT), a marked crosswalk alone is typically not sufficient. Under such conditions, more substantial crossing improvements could prevent an increase in pedestrian crash potential.

Three main crosswalk visibility enhancements help make crosswalks and the pedestrians, bicyclists, wheelchair and other mobility device users, and transit users using them more visible to drivers. These include high-visibility crosswalks, lighting, and signing and pavement markings. These enhancements can also assist users in deciding where to cross. Agencies can implement these features as standalone or combination enhancements to indicate the preferred location for users to cross.

### High-visibility crosswalks

High-visibility crosswalks use patterns (i.e., bar pairs, continental, ladder) that are visible to both the driver and pedestrian from farther away compared to traditional transverse line crosswalks. They should be considered at all midblock pedestrian crossings and uncontrolled intersections. Agencies should use materials such as inlay or thermoplastic tape, instead of paint or brick, for highly reflective crosswalk markings.

### Improved Lighting

The goal of crosswalk lighting should be to illuminate with positive contrast to make it easier for a driver to visually identify the pedestrian. This involves carefully placing the luminaires in forward locations to avoid a silhouette effect of the pedestrian.

### Enhanced Signing and Pavement Markings

On multilane roadways, agencies can use "YIELD Here to Pedestrians" or "STOP Here for Pedestrians" signs 20 to 50 feet in advance of

a marked crosswalk to indicate where a driver should stop or yield to pedestrians, depending on State law. To supplement the signing, agencies can also install a STOP or YIELD bar (commonly referred to as "shark's teeth") pavement markings.

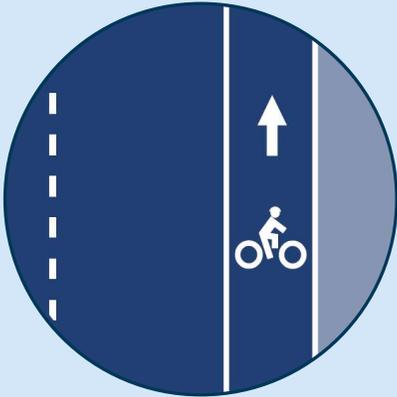
In-street signing, such as "STOP Here for Pedestrians" or "YIELD Here to Pedestrians" may be appropriate on roads with two- or three-lane roads where speed limits are 30 miles per hour or less.



Source: FHWA

1 (CMF ID: 4123) Chen, L., C. Chen, and R. Ewing, The Relative Effectiveness of Pedestrian Safety Countermeasures at Urban Intersections - Lessons from a New York City Experience. (2012).  
2 (CMF ID: 436) Elvik, R. and Vaa, T. Handbook of Road Safety Measures. Oxford, United Kingdom, Elsevier, (2004).  
3 (CMF ID: 9017) Zeeger et al. Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments, FHWA, (2017).

Transportation agencies should refer to the Manual on Uniform Traffic Control Devices (MUTCD) for information on crosswalk markings (Chapter 3C) and in-street signing (Sections 2B.19 and 2B.20).



## Safety Benefits:

**Converting traditional or flush buffered bicycle lanes to a separated bicycle lane with flexible delineator posts can reduce crashes up to:**

**53%**

for bicycle/vehicle crashes.<sup>3</sup>

**Bicycle Lane Additions can reduce crashes up to:**

**49%**

for total crashes on urban 4-lane undivided collectors and local roads.<sup>7</sup>

**30%**

for total crashes on urban 2-lane undivided collectors and local roads.<sup>7</sup>



Bicycle lane in Washington, DC.  
Source: Alex Baca, Washington Area Bicyclist Association.

**For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-07/fhwsa18077.pdf>.**

## Bicycle Lanes

Most fatal and serious injury bicyclist crashes occur at non-intersection locations. Nearly one-third of these crashes occur when motorists are overtaking bicyclists<sup>1</sup> because the speed and size differential between vehicles and bicycles can lead to severe injury. Many people are not comfortable riding a bicycle because of their fear that this type of crash may occur. To make bicycling safer and more comfortable for most types of bicyclists, State and local agencies should consider installing bicycle lanes. Providing bicycle facilities can mitigate or prevent interactions, conflicts, and crashes between bicyclists and motor vehicles, and create a network of safer roadways for bicycling. Bicycle Lanes align with the Safe System Approach principle of recognizing human vulnerability—where separating users in space can enhance safety for all road users.

### Applications

The FHWA's [Bikeway Selection Guide](#) and [Incorporating On-Road Bicycle Networks into Resurfacing Projects](#) assist agencies in determining which facilities provide the most benefit in various contexts. Bicycle lanes can be included on new roadways or created on existing roads by reallocating space in the right-of-way through [Road Diets](#). Separated bicycle lanes, which use vertical elements—such as flexible delineator posts, curbs, or vegetation—between the bicycle lane and motorized traffic lanes provide additional safety benefits.<sup>2,3</sup> For a marked bike lane without vertical elements, a lateral offset with marked buffer can help to further separate bicyclists from vehicle traffic.

### Considerations

- In order to maximize a roadway's suitability for riders of all ages and abilities, bicycle lane design should vary according to roadway characteristics (number of lanes, motor vehicle and truck volumes, speed, presence of transit), user needs (current and forecasted ridership, types of bicycles and micromobility devices in use within the community, role within the bicycling network), and land-use context (adjacent land uses, types and intensity of conflicting uses, demands from other users for curbside access). Separated bicycle lanes are recommended on roadways with higher vehicle volumes and speeds, such as arterials.
- City and State policies may require minimum bicycle lane widths, although desirable bicycle lane widths

can differ by agency and functional classification of the road, current and forecasted bicycle volumes, and contextual attributes such as topography.

- Studies have found that roadways did not experience an increase in crashes or congestion when travel lane widths were decreased to add a bicycle lane.<sup>4</sup>
- Studies and experience in U.S. cities show that bicycle lanes increase ridership and may help jurisdictions better manage roadway capacity.
- In rural areas, rumble strips can negatively impact bicyclists' ability to ride if not properly installed. Agencies should consider the dimensions, placement, and offset of rumble strips when adding a bicycle lane.<sup>5</sup>
- Bicycle lanes should be considered on roadways where adjacent land use suggests that trips could be served by varied modes, particularly to meet the safety and travel needs of low-income populations likely to use bicycles to reach essential destinations.<sup>6</sup>

<sup>1</sup> Thomas et al. *Bicyclist Crash Types on National, State, and Local Levels: A New Look*. Transportation Research Record 673(6), 664-676, (2019).

<sup>2</sup> [Separated Bike Lane Planning and Design Guide](#). FHWA-HEP-15-025, (2015).

<sup>3</sup> (CMF ID: [11296](#)) [Developing CMFs for Separated Bicycle Lanes](#). FHWA-HRT-23-025, (2023).

<sup>4</sup> Park and Abdel-Aty. *Evaluation of safety effectiveness of multiple cross sectional features on urban arterials*. Accident Analysis and Prevention, Vol. 92, pp. 245-255, (2016).

<sup>5</sup> FHWA Tech Advisory [Shoulder and Edge Line Rumble Strips](#), (2011).

<sup>6</sup> Sandt et al. [Pursuing Equity in Pedestrian and Bicycle Planning](#). FHWA, (2016).

<sup>7</sup> (CMF ID: [10738](#), [10742](#)) [Development of Crash Modification Factors for Bicycle Lane Additions While Reducing Lane and Shoulder Widths](#). FHWA-HRT-21-012, (2021).



### Safety Benefits:

RRFBs can reduce crashes up to:

**47%**

for pedestrian crashes.<sup>4</sup>

RRFBs can increase motorist yielding rates up to:

**98%**

(varies by speed limit, number of lanes, crossing distance, and time of day).<sup>3</sup>



RRFBs used at a trail crossing.  
Source: LJB

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and [https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/techSheet\\_RRFB\\_2018.pdf](https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/techSheet_RRFB_2018.pdf).

## Rectangular Rapid Flashing Beacons (RRFB)

A marked crosswalk or pedestrian warning sign can improve safety for pedestrians crossing the road, but at times may not be sufficient for drivers to visibly locate crossing locations and yield to pedestrians. To enhance pedestrian conspicuity and increase driver awareness at uncontrolled, marked crosswalks, transportation agencies can install a pedestrian actuated Rectangular Rapid Flashing Beacon (RRFB) to accompany a pedestrian warning sign. RRFBs consist of two, rectangular-shaped yellow indications, each with a light-emitting diode (LED)-array-based light source.<sup>1</sup> RRFBs flash with an alternating high frequency when activated to enhance conspicuity of pedestrians at the crossing to drivers.

Transportation agencies should refer to the *Manual on Uniform Traffic Control Devices (MUTCD)* for information on the application of RRFBs.<sup>1</sup>

### Applications

The RRFB is applicable to many types of pedestrian crossings but is particularly effective at multilane crossings with speed limits less than 40 miles per hour.<sup>2</sup> Research suggests RRFBs can result in motorist yielding rates as high as 98 percent at marked crosswalks, but varies depending on the location, posted speed limit, pedestrian crossing distance, one- versus two-way road, and the number of travel lanes.<sup>3</sup> RRFBs can also accompany school or trail crossing warning signs.

RRFBs are placed on both sides of a crosswalk below the pedestrian crossing sign and above the diagonal downward arrow plaque pointing at the crossing.<sup>1</sup> The flashing pattern can be activated with pushbuttons or passive (e.g., video or infrared) pedestrian detection, and should be unlit when not activated.

### Considerations

#### Agencies should:<sup>2</sup>

- Install RRFBs in the median rather than the far-side of the roadway if there is a pedestrian refuge or other type of median.
- Use solar-power panels to eliminate the need for a power source.
- Reserve the use of RRFBs for locations with significant pedestrian safety issues, as over-use of RRFB treatments may diminish their effectiveness.

#### Agencies shall not:<sup>2</sup>

- Use RRFBs without the presence of a pedestrian, school or trail crossing warning sign.
- Use RRFBs for crosswalks across approaches controlled by YIELD signs, STOP signs, traffic control signals, or pedestrian hybrid beacons, except for the approach or egress from a roundabout.

<sup>1</sup> Manual on Uniform Traffic Control Devices (MUTCD), Chapter 4L, FHWA, (2023).

<sup>2</sup> "Rectangular Rapid Flash Beacon" in PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System. FHWA, (2013).

<sup>3</sup> Fitzpatrick et al. "Will You Stop for Me? Roadway Design and Traffic Control Device Influences on Drivers Yielding to Pedestrians in a Crosswalk with a Rectangular Rapid-Flashing Beacon." Report No. TTI-CTS-0010. Texas A&M Transportation Institute, (2016).

<sup>4</sup> (CMF ID: 9024) NCHRP Research Report 841 Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments, (2017).



## Safety Benefits:

# 13%

reduction in pedestrian-vehicle crashes at intersections.<sup>2</sup>

## Leading Pedestrian Interval

A leading pedestrian interval (LPI) gives pedestrians the opportunity to enter the crosswalk at an intersection 3-7 seconds before vehicles are given a green indication. Pedestrians can better establish their presence in the crosswalk before vehicles have priority to turn right or left.

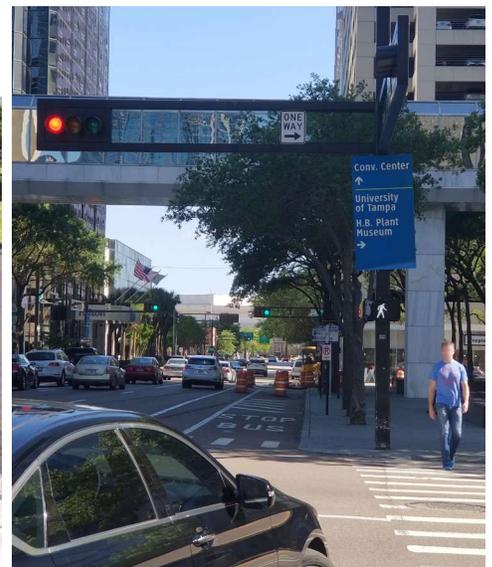
### LPIs provide the following benefits:

- Increased visibility of crossing pedestrians.
- Reduced conflicts between pedestrians and vehicles.
- Increased likelihood of motorists yielding to pedestrians.
- Enhanced safety for pedestrians who may be slower to start into the intersection.

FHWA's Handbook for *Designing Roadways for the Aging Population* recommends the use of the LPI at intersections with high turning vehicle volumes. Transportation agencies should refer to the *Manual on Uniform Traffic Control Devices* for guidance on LPI timing and ensure that pedestrian signals are accessible for all users.<sup>1</sup> Costs for implementing LPIs are very low when only signal timing alteration is required.



An LPI allows a pedestrian to establish a presence in the crosswalk before vehicles are given a green indication. Source: FHWA



LPIs reduce potential conflicts between pedestrians and turning vehicles. Source: FHWA

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/fhwasa19040.pdf>.

<sup>1</sup> Manual on Uniform Traffic Control Devices (MUTCD), Section 4I.06. FHWA, (2023).  
<sup>2</sup> (CMF ID: 9918) Goughnour, E., D. Carter, C. Lyon, B. Persaud, B. Lan, P. Chun, I. Hamilton, and K. Signor. "Safety Evaluation of Protected Left-Turn Phasing and Leading Pedestrian Intervals on Pedestrian Safety." Report No. FHWA-HRT-18-044. Federal Highway Administration. (October 2018)



### Safety Benefits:

Median with  
Marked Crosswalk

# 46%

reduction in  
pedestrian crashes.<sup>2</sup>

Pedestrian Refuge  
Island

# 56%

reduction in  
pedestrian crashes.<sup>2</sup>

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-08/techSheetPedRefugeIsland2018.pdf>.

## Medians and Pedestrian Refuge Islands in Urban and Suburban Areas

A **median** is the area between opposing lanes of traffic, excluding turn lanes. Medians in urban and suburban areas can be defined by pavement markings, raised medians, or islands to separate motorized and non-motorized road users.

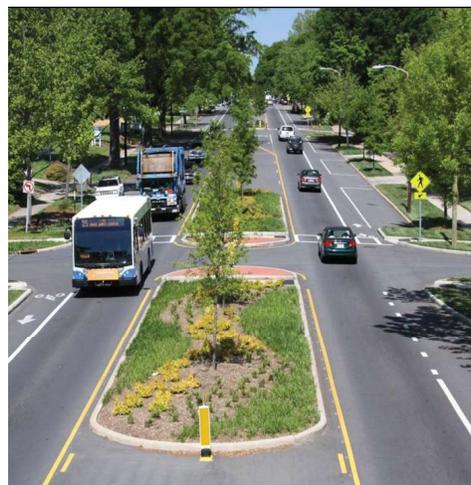
A **pedestrian refuge island** (or crossing area) is a median with a refuge area that is intended to help protect pedestrians who are crossing a road.

Pedestrian crashes account for approximately 17 percent of all traffic fatalities annually, and 74 percent of these occur at non-intersection locations.<sup>1</sup> For pedestrians to safely cross a roadway, they must estimate vehicle speeds, determine acceptable gaps in traffic based on their walking speed, and predict vehicle paths. Installing a median or pedestrian refuge island can help improve safety by allowing pedestrians to cross one direction of traffic at a time.

Transportation agencies should consider medians or pedestrian refuge islands in curbed sections of urban and suburban multilane

roadways, particularly in areas with a significant mix of pedestrian and vehicle traffic, traffic volumes over 9,000 vehicles per day, and travel speeds 35 mph or greater. Medians/refuge islands should be at least 4-ft wide, but preferably 8 ft for pedestrian comfort. Some example locations that may benefit from medians or pedestrian refuge islands include:

- Mid-block crossings.
- Approaches to multilane intersections.
- Areas near transit stops or other pedestrian-focused sites.



Example of a road with a median and pedestrian refuge islands. Source: City of Charlotte, NC



Median and pedestrian refuge island near a roundabout. Source: [www.pedbikeimages.org](http://www.pedbikeimages.org) / Dan Burden

<sup>1</sup> National Center for Statistics and Analysis. (2020, March). Pedestrians: 2018 data (Traffic Safety Facts, Report No. DOT HS 812 850), National Highway Traffic Safety Administration  
<sup>2</sup> (CMF ID: 175) Desktop Reference for Crash Reduction Factors, FHWA-SA-08-011, September 2008, Table 11.



### Safety Benefits:

# 55%

reduction in pedestrian crashes.<sup>3</sup>

# 29%

reduction in total crashes.<sup>4</sup>

# 15%

reduction in fatal and serious injury crashes.<sup>4</sup>

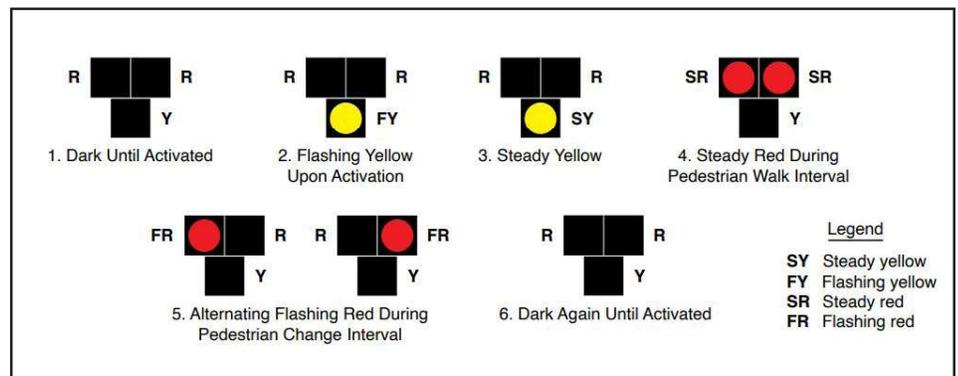


Example of PHBs mounted on a mast arm. Source: FHWA

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/fhwasat18064.pdf>.

## Pedestrian Hybrid Beacons

The pedestrian hybrid beacon (PHB) is a traffic control device designed to help pedestrians safely cross higher-speed roadways at midblock crossings and uncontrolled intersections. The beacon head consists of two red lenses above a single yellow lens. The lenses remain “dark” until a pedestrian desiring to cross the street pushes the call button to activate the beacon, which then initiates a yellow to red lighting sequence consisting of flashing and steady lights that directs motorists to slow and come to a stop, and provides the right-of-way to the pedestrian to safely cross the roadway before going dark again.



Sequence for a PHB. Source: MUTCD 2023 Edition, Chapter 4J, FHWA

Nearly 74 percent of pedestrian fatalities occur at non-intersection locations, and vehicle speeds are often a major contributing factor.<sup>1</sup> As a safety strategy to address this pedestrian crash risk, the PHB is an intermediate option between a flashing beacon and a full pedestrian signal because it assigns right of way and provides positive stop control. It also allows motorists to proceed once the pedestrian has cleared their side of the travel lane(s), reducing vehicle delay.

Transportation agencies should refer to the *Manual on Uniform Traffic Control Devices* (MUTCD) for information on the application of PHBs.<sup>2</sup> Transportation agencies should locate pedestrian signals to be accessible for all users.

In general, PHBs are used where it is difficult for pedestrians to cross a roadway, such as when gaps in traffic are not sufficient or speed limits exceed 35 miles per hour. They are very effective at locations where three or more lanes will be crossed or traffic volumes are above 9,000 annual average daily traffic. Installation of a PHB must also include a marked crosswalk and pedestrian countdown signal. If PHBs are not already familiar to a community, agencies should conduct appropriate education and outreach as part of implementation.

<sup>1</sup> National Center for Statistics and Analysis. (2020, March). Pedestrians: 2018 data (Traffic Safety Facts, Report No. DOT HS 812 850). National Highway Traffic Safety Administration

<sup>2</sup> Manual on Uniform Traffic Control Devices, Chapter 4J, FHWA, (2023).

<sup>3</sup> (CMF ID: 9020) Zegeer et al. NCHRP Report 841: Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments. TRB, (2017).

<sup>4</sup> (CMF ID: 2911, 2917) Fitzpatrick, K. and Park, E.S. Safety Effectiveness of the HAWK Pedestrian Crossing Treatment, FHWA-HRT-10-042, (2010).



### Safety Benefits:

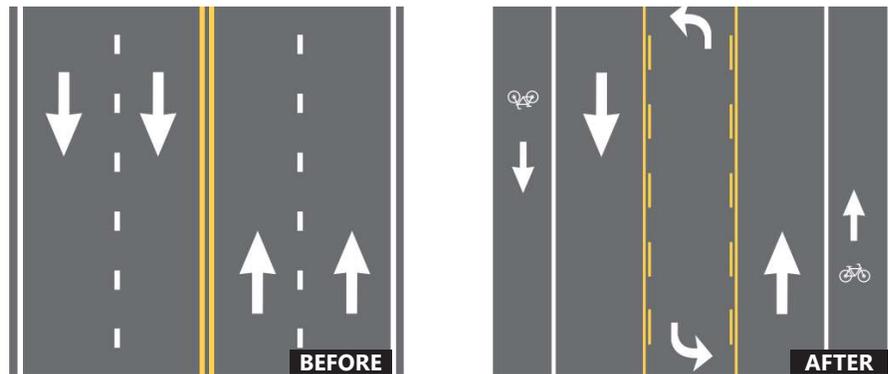
4-Lane to 3-Lane  
Road Diet Conversions

# 19-47%

reduction in total crashes.<sup>1</sup>

## Road Diets (Roadway Reconfiguration)

A Road Diet, or roadway reconfiguration, can improve safety, calm traffic, provide better mobility and access for all road users, and enhance overall quality of life. A Road Diet typically involves converting an existing four-lane undivided roadway to a three-lane roadway consisting of two through lanes and a center two-way left-turn lane (TWLTL).



Before and after example of a Road Diet. Source: FHWA

### Benefits of Road Diet installations may include:

- Reduction of rear-end and left-turn crashes due to the dedicated left-turn lane.
- Reduced right-angle crashes as side street motorists cross three versus four travel lanes.
- Fewer lanes for pedestrians to cross.
- Opportunity to install pedestrian refuge islands, bicycle lanes, on-street parking, or transit stops.
- Traffic calming and more consistent speeds.
- A more community-focused, Complete Streets environment that better accommodates the needs of all road users.



Road Diet project in Honolulu, Hawaii.  
Source: Leidos

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/other/road-diets>.

A Road Diet can be a low-cost safety solution when planned in conjunction with a simple pavement overlay, and the reconfiguration can be accomplished at no additional cost. Typically, a Road Diet is implemented on a roadway with a current and future average daily traffic of 25,000 or less.

<sup>1</sup> (CMF ID: 5554.2841) Evaluation of Lane Reduction "Road Diet" Measures on Crashes, FHWA-HRT-10-053, (2010).



## Safety Benefits:

### Sidewalks

# 65-89%

reduction in crashes involving pedestrians walking along roadways.<sup>3</sup>

### Paved Shoulders

# 71%

reduction in crashes involving pedestrians walking along roadways.<sup>3</sup>

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and [http://www.pedbikesafe.org/PEDSAFE/countermeasures\\_detail.cfm?CM\\_NUM=1](http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=1).

## Walkways

A walkway is any type of defined space or pathway for use by a person traveling by foot or using a wheelchair. These may be pedestrian walkways, shared use paths, sidewalks, or roadway shoulders.

With more than 6,200 pedestrian fatalities and 75,000 pedestrian injuries occurring in roadway crashes annually,<sup>1</sup> it is important for transportation agencies to improve conditions and safety for pedestrians and to integrate walkways more fully into the transportation system. Research shows people living in low-income communities are less likely to encounter walkways and other pedestrian-friendly features.<sup>2</sup>

Well-designed pedestrian walkways, shared use paths, and sidewalks improve the safety and mobility of pedestrians. Pedestrians should have direct and connected network of walking routes to desired destinations without gaps or abrupt changes. In some rural or suburban areas, where these types of walkways are not feasible, roadway shoulders provide an area for pedestrians to walk next to the roadway, although these are not preferable.

Transportation agencies should work towards incorporating pedestrian facilities into all roadway projects

unless exceptional circumstances exist. It is important to provide and maintain accessible walkways along both sides of the road in urban areas, particularly near school zones and transit locations, and where there is a large amount of pedestrian activity. Walkable shoulders should also be considered along both sides of rural highways when routinely used by pedestrians.



Example of a sidewalk in a residential area. Source: [pedbikeimages.org](http://pedbikeimages.org) / Burden

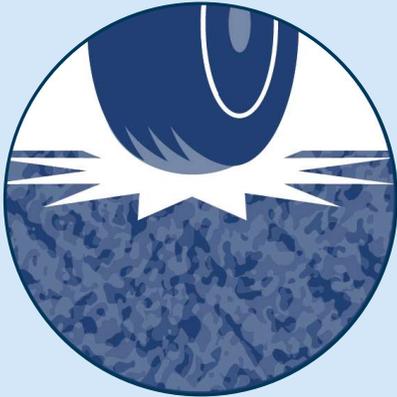


Paved shoulder used as a walkway. Source: [pedbikeimages.org](http://pedbikeimages.org) / Burden

1 National Center for Statistics and Analysis. (2020, March). Pedestrians: 2018 data (Traffic Safety Facts, Report No. DOT HS 812 850), National Highway Traffic Safety Administration.

2 Gibbs, et al. Income Disparities in Street Features that Encourage Walking. Bridging the Gap. (2012, March).

3 Gan et al. Update of Florida Crash Reduction Factors and Countermeasures to Improve the Development of District Safety Improvement Projects. Florida DOT, (2005).



## Safety Benefits:

HFST can reduce crashes up to:

**63%**

for injury crashes at ramps.<sup>2</sup>

**48%**

for injury crashes at horizontal curves.<sup>2</sup>

**20%**

for total crashes at intersections.<sup>3</sup>



Automated application of HFST.  
Source: FHWA

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/rwd/keep-vehicles-road/pavement-friction/hfst>.

## Pavement Friction Management

Friction is a critical characteristic of a pavement that affects how vehicles interact with the roadway, including the frequency of crashes. Measuring, monitoring, and maintaining pavement friction—especially at locations where vehicles are frequently turning, slowing, and stopping—can prevent many roadway departure, intersection, and pedestrian-related crashes.

Pavement friction treatments, such as High Friction Surface Treatment (HFST), can be better targeted and result in more efficient and effective installations when using continuous pavement friction data along with crash and roadway data.

### Continuous Pavement Friction Measurement

Friction data for safety performance is best measured with Continuous Pavement Friction Measurement (CPFM) equipment. Spot friction measurement devices, like locked-wheel skid trailers, cannot safely and accurately collect friction data in curves or intersections, where the pavement polishes more quickly and adequate friction is so much more critical. Without CPFM equipment, agencies will assume the same friction over a mile or more.

CPFM technology measures friction continuously at highway speeds and provides both network and segment level data. Practitioners can analyze the friction, crash, and roadway data to better understand and predict where friction-related crashes will occur to better target locations and more effectively install treatments.<sup>1</sup>

### High Friction Surface Treatment

HFST consists of a layer of durable, anti-abrasion, and polish-resistant aggregate over a thermosetting polymer resin binder that locks the aggregate in place to restore or enhance friction and skid resistance. Calcined bauxite is the aggregate shown to yield the best results and should be used with HFST applications.

### Applications

HFST should be applied in locations with increased friction demand, including:

- Horizontal curves.
- Interchange ramps.
- Intersection approaches.
  - Higher-speed signalized and stop-controlled intersections.
  - Steep downward grades.
- Locations with a history of rear-end, failure to yield, wet-weather, or red-light-running crashes.
- Crosswalk approaches.

### Considerations

- HFST is applied on existing pavement, so no new pavement is added.
- If the underlying pavement structure is unstable, then the HFST life cycle may be shortened, resulting in pre-mature failure.
- The automated installation method is preferred as it minimizes issues often associated with manual installation: human error due to fatigue, inadequate binder mixing, improper and uneven binder thickness, delayed aggregate placement, and inadequate aggregate coverage.
- The cost can be reduced when bundling installations at multiple locations.

<sup>1</sup> Izeppi et al. Continuous Friction Measurement Equipment as a Tool for Improving Crash Rate Prediction: A Pilot Study. Virginia Department of Transportation, (2016).

<sup>2</sup> (CMF ID: [10342\\_10333](#)) Merritt et al. Development of Crash Modification Factors for High Friction Surface Treatments. FHWA, (2020).

<sup>3</sup> (CMF ID: [2259](#)) NCHRP Report 617: Accident Modification Factors for Traffic Engineering and ITS Improvements, (2008).



**Safety Benefits:**  
Lighting can reduce crashes up to:

## 42%

for nighttime injury pedestrian crashes at intersections.<sup>1</sup>

## 33-38%

for nighttime crashes at rural and urban intersections.<sup>2,1</sup>

## 28%

for nighttime injury crashes on rural and urban highways.<sup>1</sup>



Source: FHWA

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/other/visibility/roadway-lighting-resources>.

## Lighting

The number of fatal crashes occurring in daylight is about the same as those that occur in darkness. However, the nighttime fatality rate is three times the daytime rate because only 25 percent of vehicle miles traveled (VMT) occur at night. At nighttime, vehicles traveling at higher speeds may not have the ability to stop once a hazard or change in the road ahead becomes visible by the headlights. Therefore, lighting can be applied continuously along segments and at spot locations such as intersections and pedestrian crossings in order to reduce the chances of a crash.

Adequate lighting (i.e., at or above minimum acceptable standards) is based on research recommending horizontal and vertical illuminance levels to provide safety benefits to all users of the roadway environment. Adequate lighting can also provide benefits in terms of personal security for pedestrians, wheelchair and other mobility device users, bicyclists, and transit users as they travel along and across roadways.

### Applications

#### Roadway Segments

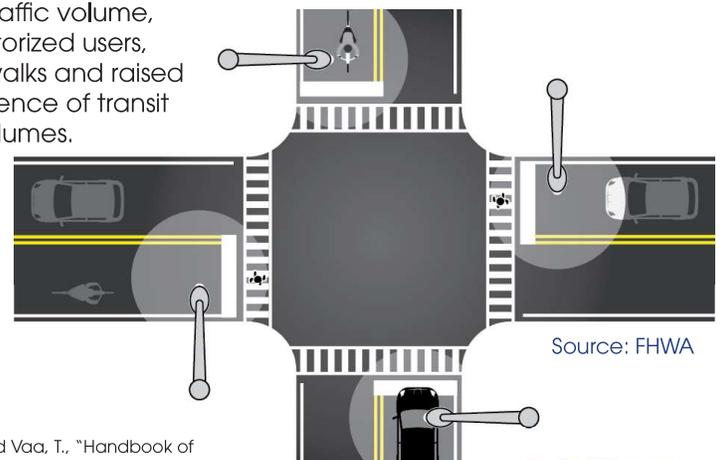
Research indicates that continuous lighting on both rural and urban highways (including freeways) has an established safety benefit for motorized vehicles.<sup>1</sup> Agencies can provide adequate visibility of the roadway and its users through the uniform application of lighting that provides full coverage along the roadway and the strategic placement of lighting where it is needed the most.

#### Intersections and Pedestrian Crossings

Increased visibility at intersections at nighttime is important since various modes of travel cross paths at these locations. Agencies should consider providing lighting to intersections based on factors such as a history of crashes at nighttime, traffic volume, the volume of non-motorized users, the presence of crosswalks and raised medians, and the presence of transit stops and boarding volumes.

### Considerations

Most new lighting installations are made with breakaway features, shielded, or placed far enough from the roadway to reduce the probability and/or severity of fixed-object crashes. Modern lighting technology gives precise control with minimal excessive light affecting the nighttime sky or spilling over to adjacent properties. Agencies can equitably engage with underserved communities to determine where and how new and improved lighting can most benefit the community by considering their priorities, including eliminating crash disparities, connecting to essential neighborhood services, improving active transportation routes, and promoting personal safety.



Source: FHWA

<sup>1</sup> (CMF ID: 436,433,192) Elvik, R. and Vaa, T., "Handbook of Road Safety Measures." Oxford, United Kingdom, Elsevier, (2004).

<sup>2</sup> (CMF ID: 2376) Ye et al. A Simultaneous Equations Model of Crash Frequency By Collision Type for Rural Intersections, 87th Annual Meeting of the Transportation Research Board, (2008).



### Safety Benefits:

Agencies have experienced the following benefits after LRSP implementation:

## 25%

reduction in county road fatalities in Minnesota.

## 17%

reduction in fatal and serious injury crashes on county-owned roads in Washington State.

## 35%

reduction in severe curve crashes in Thurston County, WA.

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/local-rural/local-road-safety-plans>.

## Local Road Safety Plans

A local road safety plan (LRSP) provides a framework for identifying, analyzing, and prioritizing roadway safety improvements on local roads. The LRSP development process and content are tailored to local issues and needs. The process results in a prioritized list of issues, risks, actions, and improvements that can be used to reduce fatalities and serious injuries on local roads. FHWA has developed several resources including an LRSP Do-It-Yourself website which further explains the process and includes resources local agencies and their partners need to create and implement an LRSP.<sup>1</sup>

Approximately 75 percent of rural roads are owned by local agencies.<sup>2</sup> While local roads are less traveled than State highways, they have a much higher rate of fatal and serious injury crashes.<sup>2</sup> Developing an LRSP is an effective strategy to improve local road safety for all road users and support the goals of a State's overall Strategic Highway Safety Plan (SHSP).

Although the development process and resulting plan can vary depending on the local agency's needs, available resources, and targeted crash types, aspects common to LRSPs include:

- Stakeholder engagement representing the 4E's: engineering, enforcement, education, and emergency medical services.
- Collaboration among municipal, county, Tribal, State, and/or Federal entities to leverage expertise and resources.

- Identification of target crash types and crash risk with corresponding recommended proven safety countermeasures.
- Timeline and goals for implementation and evaluation.

Local road agencies should consider developing an LRSP to be used as a tool for reducing roadway fatalities, injuries, and crashes.<sup>3</sup> LRSPs can help agencies create a prioritized list of improvements. LRSPs are also a proactive risk management technique to demonstrate an agency's responsiveness. The plan should be viewed as a living document that can be updated to reflect changing local needs and priorities.



Infographic showing the LRSP process. Source: FHWA

<sup>1</sup> <https://highways.dot.gov/safety/local-rural/local-road-safety-plans>

<sup>2</sup> Anderson et al. Noteworthy Practices: Addressing Safety on Locally-Owned and Maintained Roads A Domestic Scan, FHWA-SA-09-019, (2010).

<sup>3</sup> Developing Safety Plans: A Manual for Local Rural Road Owners, FHWA-SA-12-017, provides guidance on developing an LRSP.



### Safety Benefits:

**10-60%**  
reduction in total crashes.<sup>1</sup>

For more information on this and other FHWA Proven Safety Countermeasures, please visit <https://highways.dot.gov/safety/proven-safety-countermeasures> and <https://highways.dot.gov/safety/data-analysis-tools/systemic/road-safety-audits-rsa>.

## Road Safety Audit

While most transportation agencies have established traditional safety review procedures, a road safety audit (RSA) or assessment is unique. RSAs are performed by a multidisciplinary team independent of the project. RSAs consider all road users, account for human factors and road user capabilities, are documented in a formal report, and require a formal response from the road owner. (See the eight steps for conducting an RSA below.)

### Responsibilities



**RSA Team**



**Design Team/Project Owner**



Source: FHWA

### RSAs provide the following benefits:

- Reduced number and severity of crashes due to safer designs.
- Reduced costs resulting from early identification and mitigation of safety issues before projects are built.
- Increased opportunities to integrate multimodal safety strategies and proven safety countermeasures.
- Expanded ability to consider human factors in all facets of design.
- Increased communication and collaboration among safety stakeholders.
- Objective review by independent multidisciplinary team.

RSAs can be performed in any phase of project development, from planning through construction. Agencies may focus RSAs specifically on motorized vehicles, pedestrians, bicyclists, motorcyclists, or a combination of these roadway users. Agencies are encouraged to conduct an RSA at the earliest stage possible, as all roadway design options and alternatives are being explored.



Multidisciplinary team performs field review during an RSA. Source: FHWA

<sup>1</sup> Road Safety Audits: An Evaluation of RSA Programs and Projects, FHWA-SA-12-037; and FHWA Road Safety Audit Guidelines, FHWA-SA-06-06.

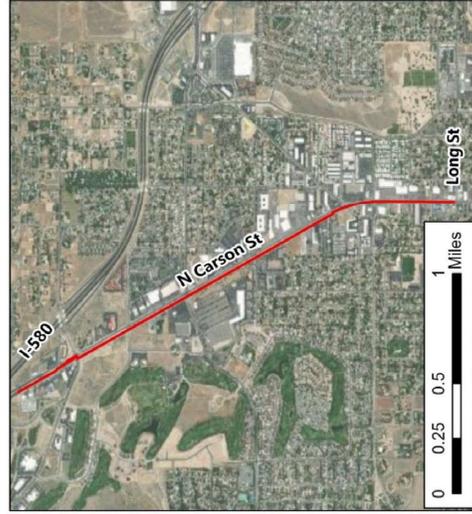
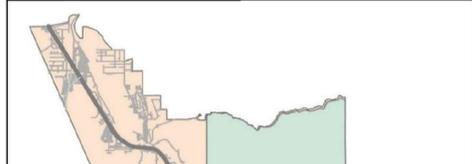




## **APPENDIX E**

### **PRIORITY LOCATION PROJECT SHEETS, COST ESTIMATES, AND NDOT BCR SHEETS**





2.29 miles

35 mph from Stewart St to Clearview Dr; 50 mph from Clearview Dr to US-50/I-580

115-220 feet

60 to 150 feet

2 lanes in each direction

Corridor has TWLTL with some defined left turn lanes. Continuous sidewalks are present on the west side of the roadway, while sidewalks, a multi-use path or combination of sidewalks and multi-use path is present on the east side of the roadway.

General Commercial, Public, and Retail Commercial

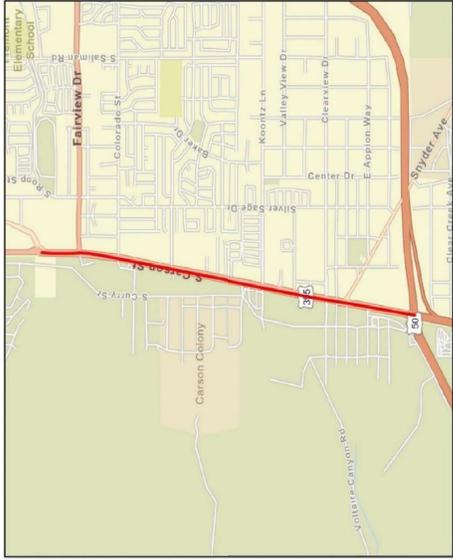
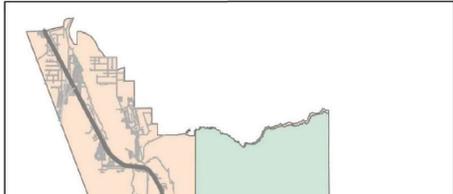
Fatal	
Serious Injury	
Other Visible Injury	
Complaint	
PDC	
<b>Total Crashes</b>	
<b>Contribution</b>	
Aggressive	
Distraction	
Impaired	
<b>Crash Type</b>	
Dart	
We	

Source: NCATS Crash Data 2022, provided by NLD

Foundation	Countermeasure	CMF	Associated Crash Type/Severity	Associated Crashes (2018-2022)		Crashes Saved Annually	Crash Societal Cost (2023 \$)	Societal Benefit (2023 \$)	Annual Benefit (w/ 2% Growth)	Annual Cost	Irrigation Cost (\$)
				K - Fatal	A - Serious Injury						
AG compliant facilities.	N/A	N/A	Pedestrian/All	K - Fatal		N/A	\$7,286,652	N/A		N/A	\$
				A - Serious Injury		N/A	\$387,209	N/A			
				B - Non-incapacitating Injury		N/A	\$141,477	N/A			
				C - Possible Injury		N/A	\$79,850	N/A			
				O - PDO		N/A	\$12,951	N/A			
Feedback and speed limit	Install Dynamic Speed Feedback Sign CMF ID: 6885	0.95	All/All	K - Fatal		0.01	\$7,286,652	\$72,867			
				A - Serious Injury		0.06	\$387,209	\$23,233			
				B - Non-incapacitating Injury		0.17	\$141,477	\$24,051		\$ 157,974	\$ 8,219
				C - Possible Injury		0.25	\$79,850	\$19,963			
				O - PDO		1.14	\$12,951	\$14,764			
The roadway to install bike green paint at conflict zones.	Install On-Street Bike Facility (NDOT CMF # BP-01)	0.40	Bicycle/All	K - Fatal		0.00	\$7,286,652	\$-			
				A - Serious Injury		0.00	\$387,209	\$-			
				B - Non-incapacitating Injury		0.12	\$141,477	\$16,977		\$ 18,902	\$ 29,953
				C - Possible Injury		0.00	\$79,850	\$-			
				O - PDO		0.12	\$12,951	\$1,554			



From Stewart Street to I-580/US-50



- 2.0 miles
- 25 mph between Winnie Ln and Hot Springs Rd; 45 mph between Hot Springs Rd and Arrowhead Dr; 55 mph between Arrowhead Dr and I-580.
- 115 to 150 feet
- 110 to 120 feet
- 2 lanes in each direction with a two-way left turn lane (TWLTL)
- Portions of the segment have sidewalks, including buffered sidewalks. Most of the segment contains a shoulder but no dedicated bike lane.
- Retail Commercial

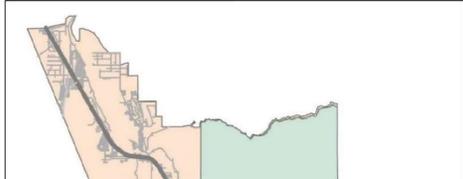
Countermeasure	CMF	Associated Crash Type/Severity	Associated Crashes (2018-2022)	Crashes Saved Annually	Crash Societal Cost (2023 \$)	Societal Benefit (2023 \$)	Annual Benefit (w/ 2% Growth)	Annual Cost																																
Lower Posted Speed Limit (CMF ID: 11288)	0.856	All/K,A,B,C	<table border="1"> <tr><td>K - Fatal</td><td>1</td></tr> <tr><td>A - Serious Injury</td><td>6</td></tr> <tr><td>B - Non-incapacitating Injury</td><td>22</td></tr> <tr><td>C - Possible Injury</td><td>30</td></tr> <tr><td>O - PDO</td><td>149</td></tr> </table>	K - Fatal	1	A - Serious Injury	6	B - Non-incapacitating Injury	22	C - Possible Injury	30	O - PDO	149	<table border="1"> <tr><td>0.03</td></tr> <tr><td>0.17</td></tr> <tr><td>0.63</td></tr> <tr><td>0.86</td></tr> <tr><td>0.00</td></tr> </table>	0.03	0.17	0.63	0.86	0.00	<table border="1"> <tr><td>\$7,286,652</td></tr> <tr><td>\$387,209</td></tr> <tr><td>\$141,477</td></tr> <tr><td>\$79,850</td></tr> <tr><td>\$12,951</td></tr> </table>	\$7,286,652	\$387,209	\$141,477	\$79,850	\$12,951	<table border="1"> <tr><td>\$209,856</td></tr> <tr><td>\$66,910</td></tr> <tr><td>\$89,640</td></tr> <tr><td>\$68,990</td></tr> <tr><td>\$-</td></tr> <tr><td>\$335,186</td></tr> <tr><td>\$106,870</td></tr> <tr><td>\$143,175</td></tr> <tr><td>\$110,193</td></tr> <tr><td>\$88,766</td></tr> </table>	\$209,856	\$66,910	\$89,640	\$68,990	\$-	\$335,186	\$106,870	\$143,175	\$110,193	\$88,766	<table border="1"> <tr><td>\$431,768</td></tr> <tr><td>\$7,119</td></tr> </table>	\$431,768	\$7,119	
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Replace TWLTL with Raised Median (CMF ID: 2514)	0.77	All/All	<table border="1"> <tr><td>K - Fatal</td><td>1</td></tr> <tr><td>A - Serious Injury</td><td>6</td></tr> <tr><td>B - Non-incapacitating Injury</td><td>22</td></tr> <tr><td>C - Possible Injury</td><td>30</td></tr> <tr><td>O - PDO</td><td>149</td></tr> </table>	K - Fatal	1	A - Serious Injury	6	B - Non-incapacitating Injury	22	C - Possible Injury	30	O - PDO	149	<table border="1"> <tr><td>0.05</td></tr> <tr><td>0.28</td></tr> <tr><td>1.01</td></tr> <tr><td>1.38</td></tr> <tr><td>6.85</td></tr> </table>	0.05	0.28	1.01	1.38	6.85	<table border="1"> <tr><td>\$7,286,652</td></tr> <tr><td>\$387,209</td></tr> <tr><td>\$141,477</td></tr> <tr><td>\$79,850</td></tr> <tr><td>\$12,951</td></tr> </table>	\$7,286,652	\$387,209	\$141,477	\$79,850	\$12,951	<table border="1"> <tr><td>\$335,186</td></tr> <tr><td>\$106,870</td></tr> <tr><td>\$143,175</td></tr> <tr><td>\$110,193</td></tr> <tr><td>\$88,766</td></tr> </table>	\$335,186	\$106,870	\$143,175	\$110,193	\$88,766	<table border="1"> <tr><td>\$799,873</td></tr> <tr><td>\$340,318</td></tr> </table>	\$799,873	\$340,318						
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Resurface Pavement (CMF ID: 10280)	N/A	Pedestrian/All	<table border="1"> <tr><td>K - Fatal</td><td>0</td></tr> <tr><td>A - Serious Injury</td><td>0</td></tr> <tr><td>B - Non-incapacitating Injury</td><td>0</td></tr> <tr><td>C - Possible Injury</td><td>0</td></tr> <tr><td>O - PDO</td><td>0</td></tr> </table>	K - Fatal	0	A - Serious Injury	0	B - Non-incapacitating Injury	0	C - Possible Injury	0	O - PDO	0	<table border="1"> <tr><td>N/A</td></tr> <tr><td>N/A</td></tr> <tr><td>N/A</td></tr> <tr><td>N/A</td></tr> <tr><td>N/A</td></tr> </table>	N/A	N/A	N/A	N/A	N/A	<table border="1"> <tr><td>\$7,286,652</td></tr> <tr><td>\$387,209</td></tr> <tr><td>\$141,477</td></tr> <tr><td>\$79,850</td></tr> <tr><td>\$12,951</td></tr> </table>	\$7,286,652	\$387,209	\$141,477	\$79,850	\$12,951	<table border="1"> <tr><td>N/A</td></tr> <tr><td>N/A</td></tr> <tr><td>N/A</td></tr> <tr><td>N/A</td></tr> <tr><td>N/A</td></tr> </table>	N/A	N/A	N/A	N/A	N/A	<table border="1"> <tr><td>N/A</td></tr> <tr><td>N/A</td></tr> </table>	N/A	N/A	<table border="1"> <tr><td>N/A</td></tr> <tr><td>N/A</td></tr> </table>	N/A	N/A			
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Source: NCATS Crashes (2022), provided by



Markings at the intersection.	Implement Systemic Signing and Visibility Improvements at Signalized Intersection (NDOT Planning Level CMF SI-14)	0.96	Pedestrian/All	K - Fatal A - Serious Injury B - Non-incapacitating Injury C - Possible Injury O - PDO	0	0.00	\$7,286,652	\$ -	\$ -	\$ 130,164
					0	0.00	\$387,209	\$ -		
Signage at the intersection with potholes.	Install Intersection Lighting (NDOT Planning Level CMF US-10)	0.67	Nighttime/All	K - Fatal A - Serious Injury B - Non-incapacitating Injury C - Possible Injury O - PDO	2	0.13	\$387,209	\$ 51,112	\$ 122,923	\$ 2,270
					4	0.26	\$141,477	\$ 37,350		
Signage to prevent crashes and evaluate the need for a signal.	Install Reduced Conflict Intersection (S-Island, J-Turn, or RCUT) (NDOT Planning Level CMF US- 03)	0.81	All/All	K - Fatal A - Serious Injury B - Non-incapacitating Injury C - Possible Injury O - PDO	3	0.20	\$79,850	\$ 15,810	\$ 660,764	\$ 314,595
					19	1.25	\$12,951	\$ 16,241		
Signage for a signal at the intersection to be included in a signal plan study development. Signal if needed.	N/A	N/A	All/All	K - Fatal A - Serious Injury B - Non-incapacitating Injury C - Possible Injury O - PDO	1	N/A	\$7,286,652	N/A	N/A	N/A
					6	N/A	\$387,209	N/A		
Signage for a signal at the intersection to be included in a signal plan study development. Signal if needed.	N/A	N/A	All/All	K - Fatal A - Serious Injury B - Non-incapacitating Injury C - Possible Injury O - PDO	22	N/A	\$141,477	N/A	N/A	N/A
					30	N/A	\$79,850	N/A		
Signage for a signal at the intersection to be included in a signal plan study development. Signal if needed.	N/A	N/A	All/All	K - Fatal A - Serious Injury B - Non-incapacitating Injury C - Possible Injury O - PDO	149	N/A	\$12,951	N/A	N/A	N/A
					1	N/A	\$7,286,652	N/A		
Signage for a signal at the intersection to be included in a signal plan study development. Signal if needed.	N/A	N/A	All/All	K - Fatal A - Serious Injury B - Non-incapacitating Injury C - Possible Injury O - PDO	6	N/A	\$387,209	N/A	N/A	N/A
					22	N/A	\$141,477	N/A		
Signage for a signal at the intersection to be included in a signal plan study development. Signal if needed.	N/A	N/A	All/All	K - Fatal A - Serious Injury B - Non-incapacitating Injury C - Possible Injury O - PDO	30	N/A	\$79,850	N/A	N/A	N/A
					149	N/A	\$12,951	N/A		
Signage for a signal at the intersection to be included in a signal plan study development. Signal if needed.	Install Advanced Street Name Signs (NDOT Planning Level CMF SI-13)	0.98	Bicyclist/All	K - Fatal A - Serious Injury B - Non-incapacitating Injury C - Possible Injury O - PDO	0	0.00	\$7,286,652	\$ -	\$ 577	\$ 1,823
					0	0.00	\$387,209	\$ -		
Signage for a signal at the intersection to be included in a signal plan study development. Signal if needed.	N/A	N/A	All/All	K - Fatal A - Serious Injury B - Non-incapacitating Injury C - Possible Injury O - PDO	1	0.00	\$141,477	\$ 566	\$ 577	\$ 1,823
					0	0.00	\$79,850	\$ -		
Signage for a signal at the intersection to be included in a signal plan study development. Signal if needed.	N/A	N/A	All/All	K - Fatal A - Serious Injury B - Non-incapacitating Injury C - Possible Injury O - PDO	0	0.00	\$12,951	\$ -	\$ 577	\$ 1,823
					0	0.00	\$12,951	\$ -		

from Lake Glen Drive to Curry Circle



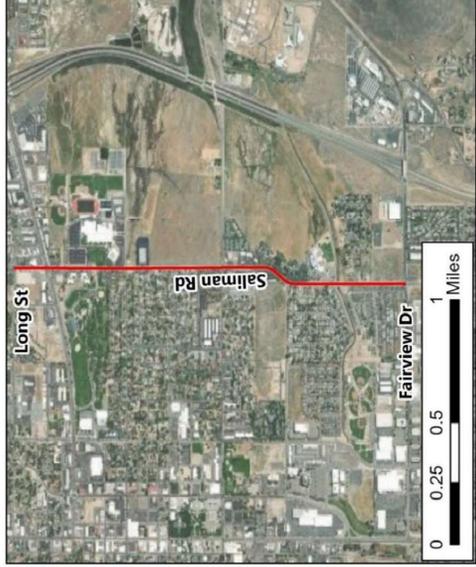
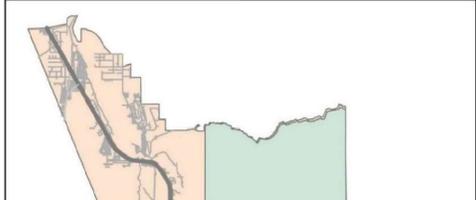
- 0.7 miles
- 25 mph
- 90 to 210 feet
- 20 to 25 feet
- 1 lane in each direction
- Does not have sidewalk or dedicated bike lane
- Public and Retail Commercial

Source: NCATS C  
31, 2022), provide

Location	Countermeasure	CMF	Associated Crash Type/Severity	Associated Crashes (2018-2022)	Crashes Saved Annually	Crash Societal Cost (2023 \$)	Societal Benefit (2023 \$)	Annual Benefit (w/ 2% Growth)	Annual Cost
Environmental in future project within corridor.	N/A	N/A	N/A	K - Fatal	0	N/A	\$7,286,652	N/A	N/A
				A - Serious Injury	0	N/A	\$387,209	N/A	
				B - Non-incapacitating Injury	0	N/A	\$141,477	N/A	
				C - Possible Injury	0	N/A	\$79,850	N/A	
				O - PDO	0	N/A	\$12,951	N/A	
				K - Fatal	0	0.00	\$7,286,652	\$ -	
Lower Posted Speed Limit (CMF ID: 11288)	0.86	All/All	A - Serious Injury	0	0.00	\$387,209	\$ -	N/A	
			B - Non-incapacitating Injury	2	0.06	\$141,477	\$ 7,923		
			C - Possible Injury	2	0.06	\$79,850	\$ 4,472		
Resurface Pavement (CMF ID: 10280)	N/A	Pedestrian/All	O - PDO	3	0.09	\$12,951	\$ 1,088	\$ 13,752	\$ 1,410
			K - Fatal	0	N/A	\$7,286,652	N/A		
			A - Serious Injury	0	N/A	\$387,209	N/A		
Streets and curbs to be replaced with permeable pavement (CMF ID: 10280)	N/A	Pedestrian/All	B - Non-incapacitating Injury	0	N/A	\$141,477	N/A	N/A	N/A
			C - Possible Injury	0	N/A	\$79,850	N/A		
			O - PDO	0	N/A	\$12,951	N/A		



from Long Street to Fairview Drive



1.66 miles

35 mph; 25 mph in front of Carson High School (15 mph in school zones when children are present)

80 feet

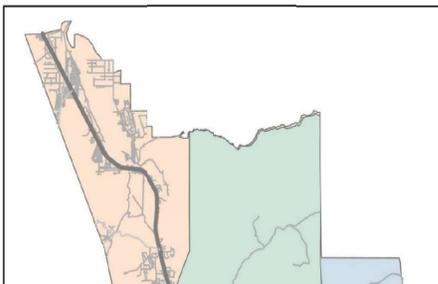
60 to 65 feet

Two general purpose travel lanes in each direction, one center located two-way left turn lane (TWLTL), and one curb adjacent bike lane in each direction  
 Fremont Elementary School, Carson High School; Danish Offset crossings outside of Fremont Elementary School and Carson High School  
 General Commercial, Retail Commercial, Public, Single Family, and Multi-Family

Source: NCATS C  
 31, 2022), provided

Justification	Countermeasure	CMF	Associated Crash Type/Severity	Associated Crashes (2018-2022)	Crashes Saved Annually	Crash Societal Cost (2023 \$)	Societal Benefit (2023 \$)	Annual Benefit (w/ 2% Growth)	Annual Cost	
30 to 25 mph based on the implementation of "RES - 25 mph" per the NDOT Strategic Plan. Consider additional signage on the road, such as speed feedback signs.	Lower Posted Speed Limit (CMF ID: 11288)	0.86	All/K,A,B,C	K - Fatal	0	0.00	\$7,286,652	\$ -	\$ 160,815	\$ 8,355
				A - Serious Injury	4	0.12	\$387,209	\$ 43,367		
				B - Non-incapacitating Injury	17	0.49	\$141,477	\$ 67,343		
				C - Possible Injury	21	0.60	\$79,850	\$ 46,952		
				O - PDO	82	0.00	\$12,951	\$ -		
				K - Fatal	0	0.00	\$7,286,652	\$ -		
"No On-Street Parking" and "No Staggered Signage in School Zones"	Prohibit On-Street Parking (CMF ID: 153)	0.80	All/A,B,C	A - Serious Injury	4	0.16	\$387,209	\$ 61,953	\$ 229,737	\$ 3,788
				B - Non-incapacitating Injury	17	0.68	\$141,477	\$ 96,204		
				C - Possible Injury	21	0.84	\$79,850	\$ 67,074		
				O - PDO	82	0.00	\$12,951	\$ -		
				K - Fatal	0	0.00	\$7,286,652	\$ -		
				A - Serious Injury	4	0.18	\$387,209	\$ 71,246		
MLTL and Median as part of traffic management.	Resurface Pavement (CMF ID: 10280)	0.77	All/All	B - Non-incapacitating Injury	17	0.78	\$141,477	\$ 110,635	\$ 314,025	\$ 258,609
				C - Possible Injury	21	0.97	\$79,850	\$ 77,135		
				O - PDO	82	3.77	\$12,951	\$ 48,851		
				K - Fatal	0	0.00	\$7,286,652	\$ -		
				A - Serious Injury	4	0.18	\$387,209	\$ 71,246		
				B - Non-incapacitating Injury	17	0.78	\$141,477	\$ 110,635		

Project Description	Type/severity	0.68	N/A	Improve Street Lighting Illuminance and Uniformity (CMF ID: 11026)	Nighttime/All	Annually		(2025 \$)		2% Growth	\$ 83,478	\$ 2,062,000
						Count	Rate	Cost	Benefit			
Replace streetlights with LED bulbs with dimming capability in the downtown segment.	Nighttime/All	0.68	N/A	Improve Street Lighting Illuminance and Uniformity (CMF ID: 11026)	Nighttime/All	0	0.00	\$7,286,652	\$ -	N/A	\$ 83,478	\$ 2,062,000
						1	0.06	\$387,209	\$ 24,781			
						2	0.13	\$141,477	\$ 18,109			
						6	0.38	\$79,850	\$ 30,662			
						10	0.64	\$12,951	\$ 8,289			
						0	0.00	\$7,286,652	\$ -			
						1	0.06	\$387,209	\$ 21,684			
						2	0.11	\$141,477	\$ 15,845			
						6	0.34	\$79,850	\$ 26,830			
						10	0.56	\$12,951	\$ 7,253			
Install a new traffic light to provide visibility for bicyclists and buffered pedestrian crossings to reduce conflict.	Bicycle/All	0.40	N/A	Install On-Street Bike Facility (BP-01)	Bicycle/All	0	0.00	\$7,286,652	\$ -	N/A	\$ 61,724	\$ 198,944,000
						0	0.00	\$387,209	\$ -			
						3	0.36	\$141,477	\$ 50,932			
						1	0.12	\$79,850	\$ 9,582			
						0	0.00	\$12,951	\$ -			
						0	N/A	\$7,286,652	N/A			
						4	N/A	\$387,209	N/A			
						17	N/A	\$141,477	N/A			
						21	N/A	\$79,850	N/A			
						82	N/A	\$12,951	N/A			
Install a new traffic light to provide visibility for bicyclists and buffered pedestrian crossings to reduce conflict.	All/All	0.52	N/A	Install Chevron Signs, Curve Warning Signs, and Subsequent Flashing Beacons (CMF ID: 1914)	All/All	0	0.00	\$7,286,652	\$ -	N/A	\$ 655,357	\$ 1,133,000
						4	0.38	\$387,209	\$ 148,688			
						17	1.63	\$141,477	\$ 230,890			
						21	2.02	\$79,850	\$ 160,978			
						82	7.87	\$12,951	\$ 101,950			
						0	N/A	\$7,286,652	N/A			
						4	N/A	\$387,209	N/A			
						17	N/A	\$141,477	N/A			
						21	N/A	\$79,850	N/A			
						82	N/A	\$12,951	N/A			
Install a new traffic light to provide visibility for bicyclists and buffered pedestrian crossings to reduce conflict.	Pedestrian/All	N/A	N/A	Rectangular Rapid Flashing Beacon (RRFB) (NDOT Planning Level CMF BP-03)	Pedestrian/All	0	N/A	\$7,286,652	\$ -	N/A	\$ 8,998	\$ 15,510,000
						0	0.00	\$7,286,652	\$ -			
						0	0.00	\$387,209	\$ -			
						0	0.00	\$141,477	\$ -			
						1	0.09	\$79,850	\$ 7,506			
						1	N/A	\$12,951	N/A			
						0	0.00	\$7,286,652	\$ -			
						0	0.00	\$387,209	\$ -			
						0	0.00	\$141,477	\$ -			
						1	0.09	\$79,850	\$ 7,506			



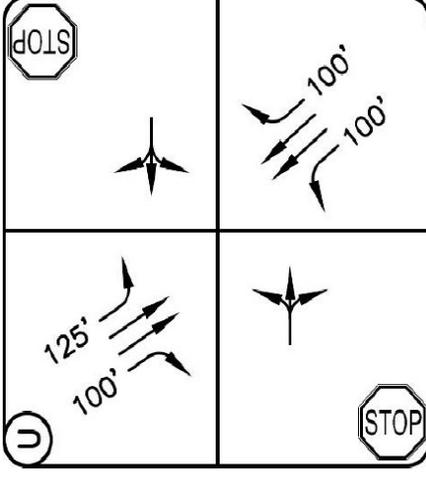
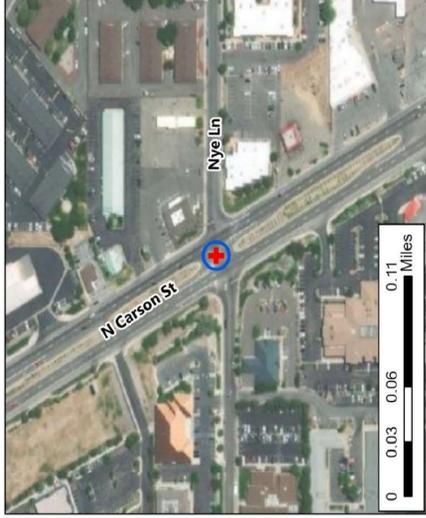
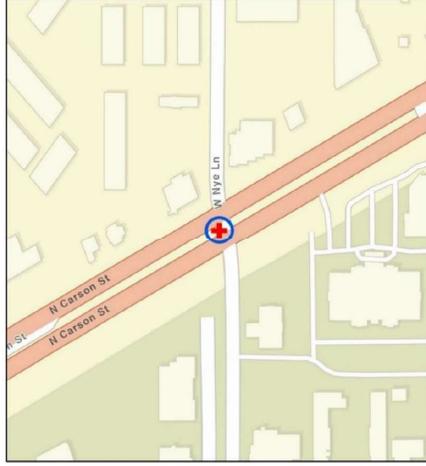
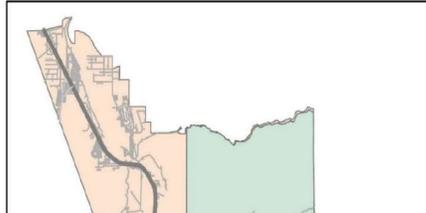
2.2 miles  
 25 mph between Winnie Ln and Hot Springs Rd; 45 mph between Hot Springs Rd and Arrowhead Dr; 55 mph between Arrowhead Dr and I-580.  
 115 to 150 feet  
 110 to 120 feet  
 2 lanes in each direction with a two-way left turn lane (TWLTL)  
 Segment contains TWLTL from I-580 to west of Silver Lane and a center median from west of Silver Lane to US-50  
 Retail Commercial

Fatal
Serious Injury
Other Visible Inj
Complaint of F
PDO
<b>Total Crashes</b>
<b>Crashes</b>
Angle
Sideswipe
Rear End
Head-On
Hit Object
Overturned
Other
<b>Non-Moto</b>
Pedestrian
Bicycle
<b>Contributor</b>
Aggressive
Distracted
Impaired
<b>Crash C</b>
Dark
Wet

Source: NCATS Crash Data (2022), provided by NDOT F December

Recommendation	Countermeasure	CMF	Associated Crash Type/Severity	Associated Crashes (2018-2022)	Crashes Saved Annually	Crash Societal Cost (2023 \$)	Societal Benefit (2023 \$)	Annual Benefit (w/ 2% Growth)	Annual Cost	Implement Cost
Additional oversized signs at curve.  roadway and shift narrowing median to facilities. Consider at bicycle conflict zones.	Install Chevron Signs, Curve Warning Signs, an Subsequent Flashing Beacons (CMF ID: 1914)	0.52	All/All	K - Fatal	1	0.10	\$7,286,652	\$ 699,519		
				A - Serious Injury	3	0.29	\$387,209	\$ 111,516		
				B - Non-incapacitating Injury	12	1.15	\$141,477	\$ 162,982	\$ 1,326,350	\$ 1,823
				C - Possible Injury	27	2.59	\$79,850	\$ 206,971		
				O - PDO	96	9.22	\$12,951	\$ 119,356		
Install On-Street Bike Facility (BP-01)	Install On-Street Bike Facility (BP-01)	0.40	Bicycle/All	K - Fatal	0	0.00	\$7,286,652	\$ -		
				A - Serious Injury	0	0.00	\$387,209	\$ -		
				B - Non-incapacitating Injury	1	0.12	\$141,477	\$ 16,977	\$ 17,317	\$ 239,694
				C - Possible Injury	0	0.00	\$79,850	\$ -		
				O - PDO	0	0.00	\$12,951	\$ -		
Resurface pavement (CMF ID: 10280)	Resurface Pavement (CMF ID: 10280)	0.79	All/K,A,B,C	K - Fatal	1	0.04	\$7,286,652	\$ 306,039		
				A - Serious Injury	3	0.13	\$387,209	\$ 48,788		
				B - Non-incapacitating Injury	12	0.50	\$141,477	\$ 71,304	\$ 527,016	\$ 1,150,464
				C - Possible Injury	27	1.13	\$79,850	\$ 90,550		
				O - PDO	96	0.00	\$12,951	\$ -		
HPS bulbs with lighting diode (LED) bulbs.	Improve Street Lighting Illuminance and Uniformity (CMF ID: 11026)	0.68	Nighttime/All	K - Fatal	1	0.06	\$7,286,652	\$ 466,346		
				A - Serious Injury	1	0.06	\$387,209	\$ 24,781		
				B - Non-incapacitating Injury	1	0.06	\$141,477	\$ 9,055	\$ 553,437	\$ 1,376
				C - Possible Injury	7	0.45	\$79,850	\$ 35,773		
				O - PDO	8	0.51	\$12,951	\$ 6,631		

Lighting study to determine luminaire and pole spacing.	N/A	Nighttime/All	N/A	1	N/A	\$7,286,652	N/A	RC estim obtain desir	
				A - Serious Injury	1	N/A	\$387,209		N/A
				B - Non-incapacitating Injury	1	N/A	\$141,477		N/A
				C - Possible Injury	7	N/A	\$79,850		N/A
				O - PDO	8	N/A	\$12,951		N/A
				K - Fatal	0	N/A	\$7,286,652		N/A
				A - Serious Injury	0	N/A	\$387,209		N/A
				B - Non-incapacitating Injury	0	N/A	\$141,477		N/A
				C - Possible Injury	1	N/A	\$79,850		N/A
				O - PDO	1	N/A	\$12,951		N/A
CROWAG compliant pedestrian facilities.	N/A	Pedestrian/All	N/A	1	N/A	\$7,286,652	N/A	RC estim obtain desir	
				A - Serious Injury	3	N/A	\$387,209		N/A
				B - Non-incapacitating Injury	12	N/A	\$141,477		N/A
				C - Possible Injury	27	N/A	\$79,850		N/A
				O - PDO	96	N/A	\$12,951		N/A
				K - Fatal	0	0.00	\$7,286,652		\$ -
				A - Serious Injury	0	0.00	\$387,209		\$ -
				B - Non-incapacitating Injury	0	0.00	\$141,477		\$ -
				C - Possible Injury	0	0.00	\$79,850		\$ -
				O - PDO	2	0.04	\$12,951		\$ 570
Light-of-way and curb turnouts.	N/A	All/All	N/A	0	N/A	\$7,286,652	N/A	RC estim obtain desir	
				A - Serious Injury	0	N/A	\$387,209		N/A
				B - Non-incapacitating Injury	0	N/A	\$141,477		N/A
				C - Possible Injury	1	N/A	\$79,850		N/A
				O - PDO	1	N/A	\$12,951		N/A
				K - Fatal	0	N/A	\$7,286,652		N/A
				A - Serious Injury	0	N/A	\$387,209		N/A
				B - Non-incapacitating Injury	0	N/A	\$141,477		N/A
				C - Possible Injury	1	N/A	\$79,850		N/A
				O - PDO	1	N/A	\$12,951		N/A
Install edgelines at curve.	Install Edgelines (CMF ID: 1945)	Lane Departure/All	0.89	0	N/A	\$7,286,652	N/A	RC estim obtain desir	
				A - Serious Injury	0	N/A	\$387,209		N/A
				B - Non-incapacitating Injury	0	N/A	\$141,477		N/A
				C - Possible Injury	1	N/A	\$79,850		N/A
				O - PDO	1	N/A	\$12,951		N/A
				K - Fatal	0	N/A	\$7,286,652		N/A
				A - Serious Injury	0	N/A	\$387,209		N/A
				B - Non-incapacitating Injury	0	N/A	\$141,477		N/A
				C - Possible Injury	1	N/A	\$79,850		N/A
				O - PDO	1	N/A	\$12,951		N/A
Consider the option to provide light-of-way (ROW) on sidewalk.	N/A	Pedestrian/All	N/A	0	N/A	\$7,286,652	N/A	RC estim obtain desir	
				A - Serious Injury	0	N/A	\$387,209		N/A
				B - Non-incapacitating Injury	0	N/A	\$141,477		N/A
				C - Possible Injury	1	N/A	\$79,850		N/A
				O - PDO	1	N/A	\$12,951		N/A
				K - Fatal	0	N/A	\$7,286,652		N/A
				A - Serious Injury	0	N/A	\$387,209		N/A
				B - Non-incapacitating Injury	0	N/A	\$141,477		N/A
				C - Possible Injury	1	N/A	\$79,850		N/A
				O - PDO	1	N/A	\$12,951		N/A
Consider curb to be red in vicinity of the fire hydrant to be compliant with standards.	N/A	All/All	N/A	0	N/A	\$7,286,652	N/A	RC estim obtain desir	
				A - Serious Injury	3	N/A	\$387,209		N/A
				B - Non-incapacitating Injury	12	N/A	\$141,477		N/A
				C - Possible Injury	27	N/A	\$79,850		N/A
				O - PDO	96	N/A	\$12,951		N/A
				K - Fatal	0	N/A	\$7,286,652		N/A
				A - Serious Injury	0	N/A	\$387,209		N/A
				B - Non-incapacitating Injury	0	N/A	\$141,477		N/A
				C - Possible Injury	1	N/A	\$79,850		N/A
				O - PDO	1	N/A	\$12,951		N/A
Consider curb radii at the intersection.	N/A	All/All	N/A	0	N/A	\$7,286,652	N/A	RC estim obtain desir	
				A - Serious Injury	3	N/A	\$387,209		N/A
				B - Non-incapacitating Injury	12	N/A	\$141,477		N/A
				C - Possible Injury	27	N/A	\$79,850		N/A
				O - PDO	96	N/A	\$12,951		N/A
				K - Fatal	0	N/A	\$7,286,652		N/A
				A - Serious Injury	0	N/A	\$387,209		N/A
				B - Non-incapacitating Injury	0	N/A	\$141,477		N/A
				C - Possible Injury	1	N/A	\$79,850		N/A
				O - PDO	1	N/A	\$12,951		N/A
Signal phasing to protect N/S left turn and pedestrian (LPL), or exclusive pedestrian phase.	Implement Leading Pedestrian Interval (NDOT Planning Level CMF BP-05)	Pedestrian/All	0.64	0	N/A	\$7,286,652	\$ -	RC estim obtain desir	
				A - Serious Injury	0	N/A	\$387,209		\$ -
				B - Non-incapacitating Injury	0	0.00	\$141,477		\$ -
				C - Possible Injury	1	0.07	\$79,850		\$ 5,749
				O - PDO	1	0.07	\$12,951		\$ 932
				K - Fatal	0	N/A	\$7,286,652		N/A
				A - Serious Injury	0	N/A	\$387,209		N/A
				B - Non-incapacitating Injury	0	N/A	\$141,477		N/A
				C - Possible Injury	1	N/A	\$79,850		N/A
				O - PDO	1	N/A	\$12,951		N/A
Consider all pushbuttons and possible Pedestrian Signals (APS).	N/A	Pedestrian/All	N/A	0	N/A	\$7,286,652	N/A	RC estim obtain desir	
				A - Serious Injury	0	N/A	\$387,209		N/A
				B - Non-incapacitating Injury	0	N/A	\$141,477		N/A
				C - Possible Injury	1	N/A	\$79,850		N/A
				O - PDO	1	N/A	\$12,951		N/A
				K - Fatal	0	N/A	\$7,286,652		N/A
				A - Serious Injury	0	N/A	\$387,209		N/A
				B - Non-incapacitating Injury	0	N/A	\$141,477		N/A
				C - Possible Injury	1	N/A	\$79,850		N/A
				O - PDO	1	N/A	\$12,951		N/A



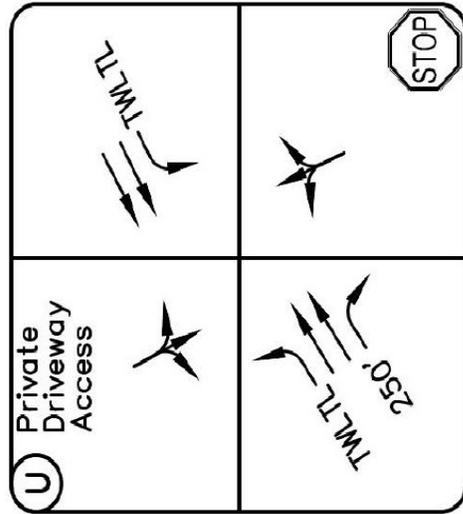
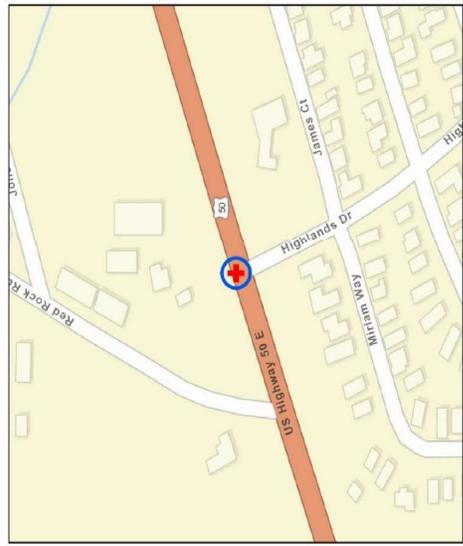
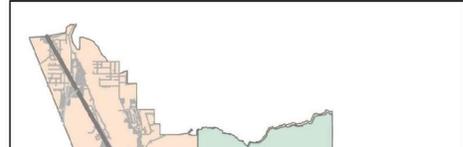
Unsignalized; Two-way stop. "STOP" sign on east and west legs  
Mixed Use Commercial, Community/Regional Commercial

Fat
Serious
Other Visi
Complain
PD
<b>Total C</b>
Non-M
Pedest
Bicy
<b>Contri</b>
Aggre
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Impa
<b>Cras</b>
Da
W

Source: NCATS Crash 31, 2022), provided by to De

Recommendation	Countermeasure	CMF	Associated Crash Type/Severity	Associated Crashes (2018-2022)	Crashes Saved Annually	Crash Societal Cost (2023 \$)	Societal Benefit (2023 \$)	Annual Benefit (w/ 2% Growth)	Annual Cost
Intersection, realign curbs and restripe to provide pedestrian islands.	Install Raised Median with Marked Crosswalk (Uncontrolled) (CMF ID: 175)	0.54	Pedestrian/All	K - Fatal	0	\$7,286,652	\$ -	\$ -	\$ 1,134,852
				A - Serious Injury	0	\$387,209	\$ -	\$ -	
				B - Non-incapacitating Injury	0	\$141,477	\$ -	\$ -	
				C - Possible Injury	0	\$79,850	\$ -	\$ -	
				O - PDO	0	\$12,951	\$ -	\$ -	
Unsignalized intersections on ramps.	N/A	N/A	Pedestrian/All	K - Fatal	0	\$7,286,652	N/A	N/A	N/A
				A - Serious Injury	0	\$387,209	N/A	N/A	
				B - Non-incapacitating Injury	0	\$141,477	N/A	N/A	
				C - Possible Injury	0	\$79,850	N/A	N/A	
				O - PDO	0	\$12,951	N/A	N/A	
Resurface pavement and lane markings.	Resurface Pavement (CMF ID: 10280)	0.79	All/All	K - Fatal	1	\$7,286,652	\$ 306,039	\$ 372,583	\$ 37,209
				A - Serious Injury	1	\$387,209	\$ 16,263	\$ -	
				B - Non-incapacitating Injury	2	\$141,477	\$ 11,884	\$ -	
				C - Possible Injury	7	\$79,850	\$ 23,476	\$ -	
				O - PDO	14	\$12,951	\$ 7,615	\$ -	

in refuge area and in crossing (PHB, RREF).	Rectangular Rapid Flashing Beacon (RRFB) (NDOT Planning Level CMF BP-03)	0.53	Pedestrian/All	K - Fatal	0	0.00	\$7,286,652	\$-	\$-	\$38,000
					A - Serious Injury	0	0.00	\$387,209		
. Improve lighting at critical components pedestrian crossings.	Install Reduced Conflict Intersection (S-Island, J-Turn, or RCUT) (NDOT Planning Level CMF US-03)	0.81	All/All	A - Serious Injury	1	0.04	\$7,286,652	\$276,893	\$337,099	\$3,405
					B - Non-incapacitating Injury	2	0.08	\$141,477		
rns from side raised median and access ment.	Improve Street Lighting Illuminance and Uniformity (CMF ID: 11026)	0.68	Nighttime/All	C - Possible Injury	7	0.27	\$79,850	\$21,240	\$1,691	\$103
					O - PDO	14	0.53	\$12,951		
S bulbs with g diode (LED) lls.	Install Intersection Lighting (NDOT Planning Level CMF US-10)	0.90	Nighttime/All	K - Fatal	0	0.00	\$7,286,652	\$-	\$528	\$2,029
					A - Serious Injury	0	0.00	\$387,209		
ighting within median (dual ) to light the swalk.	N/A	N/A	Pedestrian/All	B - Non-incapacitating Injury	0	0.00	\$141,477	\$-	N/A	N/A
					C - Possible Injury	0	0.00	\$79,850		
and maintain ork with utility determine need. eground utility or sidewalks.	N/A	N/A	Pedestrian/All	O - PDO	2	0.04	\$12,951	\$518	N/A	N/A
					K - Fatal	0	N/A	\$7,286,652		
	N/A	N/A	Pedestrian/All	A - Serious Injury	0	N/A	\$387,209	N/A	N/A	N/A
					B - Non-incapacitating Injury	0	N/A	\$141,477		
	N/A	N/A	Pedestrian/All	C - Possible Injury	0	N/A	\$79,850	N/A	N/A	N/A
					O - PDO	0	N/A	\$12,951		



Unsignalized; Two-way stop. "STOP" sign on east and west legs  
Mixed Use Commercial, Community/Regional Commercial

Fatal
Serious Inj
Other Visible
Complaint of
PDO
<b>Total Crashes</b>
<b>C</b>
Angle
Sideswipe
Rear Enc
Head-On
Hit Object
Overturn
Other
<b>Non-M</b>
Pedestrian
Bicycle
<b>Contr</b>
Aggressiv
Distracte
Impaired
<b>Crash</b>
Dark
Wet

Source: NCATS Crash Data provided by NDOT FARS

Countermeasure	CMF	Associated Crash Type/Severity	Associated Crashes (2018-2022)	Crashes Saved Annually	Crash Societal Cost (2023 \$)	Societal Benefit (2023 \$)	Annual Benefit (w/ 2% Growth)	Annual Cost	Impl Co
Install a Pedestrian Hybrid Beacon (PHB or HAWK) (NDOT Planning Level CMF BP-02)	0.40	Pedestrian/All	K - Fatal	1	\$7,286,652	\$ 874,398			
			A - Serious Injury	0	\$387,209	\$ -	\$ 891,886	\$ 150,935	\$
			B - Non-incapacitating Injury	0	\$141,477	\$ -			
			C - Possible Injury	0	\$79,850	\$ -			
			O - PDO	0	\$12,951	\$ -			
Install Intersection Lighting (NDOT Planning Level CMF US-10)	0.90	Nighttime/All	K - Fatal	1	\$7,286,652	\$ 145,733			
			A - Serious Injury	0	\$387,209	\$ -	\$ 151,069	\$ 1,479	\$
			B - Non-incapacitating Injury	0	\$141,477	\$ -			
			C - Possible Injury	1	\$79,850	\$ 1,597			
			O - PDO	3	\$12,951	\$ 777			

Project/Activity	Priority	Type/Severity	Location	Frequency	2023		2024		Total Growth	
					Count	Cost (\$)	Count	Cost (\$)		
Resurface Pavement (CMF ID: 10280)	0.79	All/K,A,B,C		K - Fatal	2	\$7,286,652	2	\$7,286,652	\$ 631,162	\$ 116,546
				A - Serious Injury	0	\$387,209	0	\$387,209	\$ -	\$ -
				B - Non-incapacitating Injury	0	\$141,477	0	\$141,477	\$ -	\$ -
				C - Possible Injury	2	\$79,850	2	\$79,850	\$ 6,707	\$ 6,707
				O - PDO	5	\$12,951	5	\$12,951	\$ -	\$ -
				K - Fatal	2	\$7,286,652	2	\$7,286,652	\$ 46,635	\$ 46,635
Install Advanced Street Name Signs (CMF ID: 2449)	0.98	All/All		A - Serious Injury	0	\$387,209	0	\$387,209	\$ -	\$ -
				B - Non-incapacitating Injury	0	\$141,477	0	\$141,477	\$ -	\$ -
				C - Possible Injury	2	\$79,850	2	\$79,850	\$ 511	\$ 511
				O - PDO	5	\$12,951	5	\$12,951	\$ 207	\$ 207
				K - Fatal	2	\$7,286,652	2	\$7,286,652	\$ 1,486,477	\$ 1,486,477
				A - Serious Injury	0	\$387,209	0	\$387,209	\$ -	\$ -
Install Reduced Conflict Intersection (S-Island, J-Turn, or RCUT) (NDOT Planning Level CMF US-03)	0.49	All/K,A,B,C		B - Non-incapacitating Injury	0	\$141,477	0	\$141,477	\$ -	\$ -
				C - Possible Injury	2	\$79,850	2	\$79,850	\$ 16,289	\$ 16,289
				O - PDO	5	\$12,951	5	\$12,951	\$ -	\$ -
				K - Fatal	2	\$7,286,652	2	\$7,286,652	\$ 2,069,409	\$ 2,069,409
				A - Serious Injury	0	\$387,209	0	\$387,209	\$ -	\$ -
				B - Non-incapacitating Injury	0	\$141,477	0	\$141,477	\$ -	\$ -
Convert Non-Signalized Urban Intersection To Roundabout (NDOT Planning Level CMF US-14)	0.29	All/All		C - Possible Injury	2	\$79,850	2	\$79,850	\$ 22,677	\$ 22,677
				O - PDO	5	\$12,951	5	\$12,951	\$ 9,195	\$ 9,195
				K - Fatal	2	\$7,286,652	2	\$7,286,652	N/A	N/A
				A - Serious Injury	0	\$387,209	0	\$387,209	N/A	N/A
				B - Non-incapacitating Injury	0	\$141,477	0	\$141,477	N/A	N/A
				C - Possible Injury	2	\$79,850	2	\$79,850	N/A	N/A
Install Reduced Conflict Intersection (S-Island, J-Turn, or RCUT) (NDOT Planning Level CMF US-02)	0.49	All/K,A,B,C		O - PDO	5	\$12,951	5	\$12,951	N/A	N/A
				K - Fatal	2	\$7,286,652	2	\$7,286,652	\$ 1,486,477	\$ 1,486,477
				A - Serious Injury	0	\$387,209	0	\$387,209	\$ -	\$ -
				B - Non-incapacitating Injury	0	\$141,477	0	\$141,477	\$ -	\$ -
				C - Possible Injury	2	\$79,850	2	\$79,850	\$ 16,289	\$ 16,289
				O - PDO	5	\$12,951	5	\$12,951	\$ -	\$ -



Pavement and lane markings and lane	Resurface Pavement (CMF ID: 10280)	0.79	All/K,A,B,C	K - Fatal A - Serious Injury B - Non-incapacitating Injury C - Possible Injury O - PDO	2 1 3 8 43	0.08 0.04 0.13 0.34 0.00	\$7,286,652 \$387,209 \$141,477 \$79,850 \$12,951	\$612,079 \$16,263 \$17,826 \$26,830 -	\$686,457	\$90,272	\$
Movements compliant pedestrian signs.	N/A	N/A	Pedestrian/All	K - Fatal A - Serious Injury B - Non-incapacitating Injury C - Possible Injury O - PDO	1 0 0 0 0	N/A N/A N/A N/A N/A	\$7,286,652 \$387,209 \$141,477 \$79,850 \$12,951	N/A N/A N/A N/A N/A	N/A	N/A	\$
Two-arm light at each corner.	Improve Street Lighting Illuminance and Uniformity (CMF ID: 11026)	0.68	Nighttime/All	K - Fatal A - Serious Injury B - Non-incapacitating Injury C - Possible Injury O - PDO	1 0 1 1 6	0.06 0.00 0.06 0.06 0.38	\$7,286,652 \$387,209 \$141,477 \$79,850 \$12,951	\$466,346 -\$ \$9,055 \$5,110 \$4,973	\$495,194	\$5,915	\$
Light buttons Pedestrian (PS).	N/A	N/A	Pedestrian/All	K - Fatal A - Serious Injury B - Non-incapacitating Injury C - Possible Injury O - PDO	1 0 0 0 0	N/A N/A N/A N/A N/A	\$7,286,652 \$387,209 \$141,477 \$79,850 \$12,951	N/A N/A N/A N/A N/A	N/A	N/A	\$
Signal pole for all head for visibility.	N/A	N/A	Pedestrian/All	K - Fatal A - Serious Injury B - Non-incapacitating Injury C - Possible Injury O - PDO	1 0 0 0 0	N/A N/A N/A N/A N/A	\$7,286,652 \$387,209 \$141,477 \$79,850 \$12,951	N/A N/A N/A N/A N/A	N/A	N/A	\$
Support Rd on segment. Realign at NWC and are 15 to 25 ft.	Change Right-Turn Lane Geometry to Increase Line Of Sight (Intersection Level) (CMF ID: 8496)	0.56	All/All	K - Fatal A - Serious Injury B - Non-incapacitating Injury C - Possible Injury O - PDO	2 1 3 8 43	0.18 0.09 0.27 0.71 3.80	\$7,286,652 \$387,209 \$141,477 \$79,850 \$12,951	\$1,288,280 \$34,229 \$37,520 -\$ \$49,229	\$1,488,277	\$32,464	\$
Maintenance between owners path.	N/A	N/A	Pedestrian/All	K - Fatal A - Serious Injury B - Non-incapacitating Injury C - Possible Injury O - PDO	1 0 0 0 0	N/A N/A N/A N/A N/A	\$7,286,652 \$387,209 \$141,477 \$79,850 \$12,951	N/A N/A N/A N/A N/A	N/A	N/A	C dep ag
for extra meter signal travel lane.	N/A	N/A	All/All	K - Fatal A - Serious Injury B - Non-incapacitating Injury C - Possible Injury O - PDO	2 1 3 8 43	N/A N/A N/A N/A N/A	\$7,286,652 \$387,209 \$141,477 \$79,850 \$12,951	N/A N/A N/A N/A N/A	N/A	N/A	\$









**CAMPO LRSP N Carson St Cost Estimate Details**

<b>Recommendation: Provide PROWAG compliant pedestrian facilities</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Sidewalk	13,200	SF	\$5	\$66,000
Remove Concrete Ramps	12	EA	\$784	\$9,408
Install Sidewalk	21,120	SF	\$20	\$422,400
Install Sidewalk Ramp (includes Detectable Warnings)	12	EA	\$7,080	\$84,960
<b>Subtotal</b>				<b>\$582,768</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$233,107</b>
<b>Preliminary Engineering (15%)</b>				<b>\$87,415</b>
<b>Construction Engineering (10%)</b>				<b>\$58,277</b>
<b>Total Site Improvement Cost</b>				<b>\$961,500</b>
<b>Assumptions:</b>				
Based on 0.25 miles between College Parkway and Nye Lane				

<b>Recommendation: Install speed feedback signs, oversized speed limit signs, reduced speed limit.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement</b>
Speed Study	1	EA	\$10,000	\$10,000
Remove Sign and Pole	32	EA	\$100	\$3,200
Sign and Pole (with Installation)	32	EA	\$600	\$19,200
Speed Feedback Sign (with Installation)	4	EA	\$10,000	\$40,000
<b>Subtotal</b>				<b>\$72,400</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$28,960</b>
<b>Preliminary Engineering (15%)</b>				<b>\$10,860</b>
<b>Construction Engineering (10%)</b>				<b>\$7,240</b>
<b>Total Site Improvement Cost</b>				<b>\$119,500</b>
<b>Assumptions:</b>				
Based on 0.25 miles between College Parkway and Nye Lane				

<b>Recommendation: Install on-street bicycle facility</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
On Street Bike Facility	13,200	SF	\$20	\$264,000
<b>Subtotal</b>				<b>\$264,000</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$105,600</b>
<b>Preliminary Engineering (15%)</b>				<b>\$39,600</b>
<b>Construction Engineering (10%)</b>				<b>\$26,400</b>
<b>Total Site Improvement Cost</b>				<b>\$435,500</b>
<b>Assumptions:</b>				
Based on 0.25 miles between College Parkway and Nye Lane				

**CAMPO LRSP N Carson St Cost Estimate Details**

<b>Recommendation: Install vegetation with irrigation on existing medians.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement</b>
<b>Site Improvement Costs</b>				
Install Vegetation	23,850	SF	\$25	\$596,250
<b>Subtotal</b>				\$596,250
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$238,500</b>
<b>Preliminary Engineering (15%)</b>				<b>\$89,438</b>
<b>Construction Engineering (10%)</b>				<b>\$59,625</b>
<b>Total Site Improvement Cost</b>				<b>\$984,000</b>
<b>Assumptions:</b>				
Based on existing medians between I-580 and Long Street with no vegetation installed.				

<b>Recommendation: Install lighting with LED bulbs along the segment.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Install Single Mast-Arm Lighting with LED	32	EA	\$10,000	\$320,000
<b>Subtotal</b>				\$320,000
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$128,000</b>
<b>Preliminary Engineering (15%)</b>				<b>\$48,000</b>
<b>Construction Engineering (10%)</b>				<b>\$32,000</b>
<b>Total Site Improvement Cost</b>				<b>\$528,000</b>
<b>Assumptions:</b>				
Based on 0.25 miles between College Parkway and Nye Lane				

<b>Recommendation: Consider replacing unsignalized intersection with roundabout.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Install Roundabout	3	EA	\$1,718,705	\$5,156,115
Install Single Mast-Arm Lighting with LED	24	EA	\$10,000	\$240,000
<b>Subtotal</b>				\$5,396,115
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$2,158,446</b>
<b>Preliminary Engineering (15%)</b>				<b>\$809,417</b>
<b>Construction Engineering (10%)</b>				<b>\$539,612</b>
<b>Total Site Improvement Cost</b>				<b>\$8,903,500</b>
<b>Assumptions:</b>				
Assumed three roundabouts along the segment				

**CAMPO LRSP N Carson St Cost Estimate Details**

<b>Recommendation: Improve pavement friction in front of crosswalks.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
1" Cold Mill	8,001	SF	\$10	\$80,010
Friction Surface Treatment	2,667	SY	\$50	\$133,333
<b>Subtotal</b>				<b>\$213,343</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$85,337</b>
<b>Preliminary Engineering (15%)</b>				<b>\$32,002</b>
<b>Construction Engineering (10%)</b>				<b>\$21,334</b>
<b>Total Site Improvement Cost</b>				<b>\$352,000</b>
<b>Assumptions:</b>				
Assumed at all non-signalized intersections				

<b>Recommendation: Replace all pushbuttons with Accessible Pedestrian Signals (APS).</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Pedestrian Pushbutton	32	EA	\$50	\$1,600
Accessible Pedestrian Signal (APS)	32	EA	\$500	\$16,000
<b>Subtotal</b>				<b>\$17,600</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$7,040</b>
<b>Preliminary Engineering (15%)</b>				<b>\$2,640</b>
<b>Construction Engineering (10%)</b>				<b>\$1,760</b>
<b>Total Site Improvement Cost</b>				<b>\$29,000</b>
<b>Assumptions:</b>				
Four signalized intersections with two signals on each corner				

<b>Recommendation: Install pedestrian refuge area and evaluate appropriate enhanced pedestrian treatment (RRFB) at these locations. Improve lighting at pedestrian crossings.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Install RRFB	12	EA	\$54,070	\$648,840
Install Single Mast-Arm Lighting with LED	18	EA	\$10,000	\$180,000
<b>Subtotal</b>				<b>\$648,840</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$259,536</b>
<b>Preliminary Engineering (15%)</b>				<b>\$97,326</b>
<b>Construction Engineering (10%)</b>				<b>\$64,884</b>
<b>Total Site Improvement Cost</b>				<b>\$1,070,500</b>
<b>Assumptions:</b>				
Assume four RRFB per location at three locations				
Assume two street lights at existing (six) and new (two) pedestrian crossings.				

**CAMPO LRSP N Carson St Cost Estimate Details**

<b>Recommendation: Install new pedestrian ramps compliant with PROWAG standards.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement</b>
<b>Site Improvement Costs</b>				
Remove Concrete Ramps	12	EA	\$784	\$9,408
Install Sidewalk Ramp (includes Detectable Warnings)	24	EA	\$7,080	\$169,920
<b>Subtotal</b>				<b>\$169,920</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$67,968</b>
<b>Preliminary Engineering (15%)</b>				<b>\$25,488</b>
<b>Construction Engineering (10%)</b>				<b>\$16,992</b>
<b>Total Site Improvement Cost</b>				<b>\$280,500</b>
<b>Assumptions:</b>				
Assumed four streetlights per major intersection (Medical, College, Hot Springs)				
Assumed replaced one perpendicular ramp with parallel ramps.				

<b>Recommendation: Install dual mast-arm (LED) lighting.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Install Dual Mast-Arm Lighting with LED Bulbs	24	EA	\$13,000	\$312,000
<b>Subtotal</b>				<b>\$312,000</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$124,800</b>
<b>Preliminary Engineering (15%)</b>				<b>\$46,800</b>
<b>Construction Engineering (10%)</b>				<b>\$31,200</b>
<b>Total Site Improvement Cost</b>				<b>\$515,000</b>
<b>Assumptions:</b>				
Assumed four streetlights per major intersection				

**CAMPO LRSP S Carson St Cost Estimate Details**

<b>Recommendation: Install speed feedback signs, oversized speed limit signs, reduced speed limit.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Speed Study	1	EA	\$10,000	\$10,000
Remove Sign and Pole	18	EA	\$100	\$1,800
Sign and Pole (with Installation)	18	EA	\$600	\$10,800
Speed Feedback Sign (with Installation)	4	EA	\$10,000	\$40,000
Subtotal				\$62,600
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$25,040</b>
<b>Preliminary Engineering (15%)</b>				<b>\$9,390</b>
<b>Construction Engineering (10%)</b>				<b>\$6,260</b>
<b>Total Site Improvement Cost</b>				<b>\$103,500</b>
<b>Assumptions:</b>				
Based on 0.25 miles between Koontz Lane and Ross Private Driveway				

<b>Recommendation: Limit left turns from side streets with raised median islands and access management. Recommend replacing gore lines with median island to manage speeds north of Clearview Drive.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Pavement	84,480	SF	\$10	\$844,800
Install S-Island or Raised Median	84,480	SF	\$20	\$1,689,600
Install 6" White Edge Line	10,560	LF	\$3	\$31,680
Crosswalk Striping	18	SF	\$10	\$180
Install RRFB	8	EA	\$54,070	\$432,560
Subtotal				\$2,998,820
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$1,199,528</b>
<b>Preliminary Engineering (15%)</b>				<b>\$449,823</b>
<b>Construction Engineering (10%)</b>				<b>\$299,882</b>
<b>Total Site Improvement Cost</b>				<b>\$4,948,000</b>
<b>Assumptions:</b>				
Based on 0.25 miles between Koontz Lane and Ross Private Driveway				

<b>Recommendation: Trim and maintain landscaping.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Trim/remove vegetation	66,453	SF	\$5	\$332,265
Subtotal				\$332,265
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$132,906</b>
<b>Total Site Improvement Cost</b>				<b>\$465,000</b>
<b>Assumptions:</b>				
Assumed vegetation will be trimmed 3 feet back for 10% of corridor on each side				

**CAMPO LRSP S Carson St Cost Estimate Details**

<b>Recommendation: Widen pedestrian walkways.</b>				
Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Install Sidewalk	21,120	SF	\$20	\$422,400
Subtotal				\$422,400
<b>Project Cost Summary</b>				
Contingency (40%)				\$168,960
Preliminary Engineering (15%)				\$63,360
Construction Engineering (10%)				\$42,240
<b>Total Site Improvement Cost</b>				<b>\$697,000</b>
<b>Assumptions:</b>				
Assumed two feet of added width along entire corridor on each side				

<b>Recommendation: Install streetlighting along the segment.</b>				
Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Install Single Mast-Arm Lighting with LED	46	EA	\$10,000	\$460,000
Subtotal				\$460,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$184,000
Preliminary Engineering (15%)				\$69,000
Construction Engineering (10%)				\$46,000
<b>Total Site Improvement Cost</b>				<b>\$759,000</b>
<b>Assumptions:</b>				
Based on 0.25 miles between Koontz Lane and Ross Private Driveway. Assumed lighting is needed along 25% of the corridor.				

<b>Recommendation: Replace all pushbuttons with Accessible Pedestrian Signals (APS).</b>				
Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Remove Pedestrian Pushbutton	147	EA	\$50	\$7,350
Accessible Pedestrian Signal (APS)	147	EA	\$500	\$73,500
Subtotal				\$80,850
<b>Project Cost Summary</b>				
Contingency (40%)				\$32,340
Preliminary Engineering (15%)				\$12,128
Construction Engineering (10%)				\$8,085
<b>Total Site Improvement Cost</b>				<b>\$133,500</b>
<b>Assumptions:</b>				
Based on 0.25 miles between Koontz Lane and Ross Private Driveway Assumed two push buttons at each corner of each signalized intersection				

<b>Recommendation: Analyze crossing time of pedestrian phase and adjust signal timing. Communicate that travel times and safety will improve if following the speed limit.</b>				
Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Signal Retiming	1	INT	\$3,000	\$3,000
Subtotal				\$3,000

**CAMPO LRSP S Carson St Cost Estimate Details**

<b>Project Cost Summary</b>	
<b>Contingency (40%)</b>	<b>\$1,200</b>
<b>Preliminary Engineering (15%)</b>	<b>\$450</b>
<b>Construction Engineering (10%)</b>	<b>\$300</b>
<b>Total Site Improvement Cost</b>	<b>\$5,000</b>

**Assumptions:**  
Based on 0.25 miles between Koontz Lane and Ross Private Driveway  
Assumed two push buttons at each corner of each signalized intersection

**CAMPO LRSP S Carson St Cost Estimate Details**

<b>Recommendation: Install advanced signage for street name signs and bike crossings.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement</b>
<b>Site Improvement Costs</b>				
Sign and Pole (with Installation)	25	EA	\$600	\$15,000
Custom Advisory or Destination Sign and Pole	5	EA	\$200	\$1,000
			Subtotal	\$16,000
<b>Project Cost Summary</b>				
			<b>Contingency (40%)</b>	<b>\$6,400</b>
			<b>Preliminary Engineering (15%)</b>	<b>\$2,400</b>
			<b>Construction Engineering (10%)</b>	<b>\$1,600</b>
			<b>Total Site Improvement Cost</b>	<b>\$26,500</b>
<b>Assumptions:</b>				
Assumed as many as five custom signs needed				

<b>Recommendation: Install new pedestrian ramps to allow for crosswalk to be perpendicular to travel lanes.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Concrete Ramps	4	EA	\$784	\$3,136
Install Sidewalk Ramp (includes Detectable)	8	EA	\$7,080	\$56,640
			Subtotal	\$59,776
<b>Project Cost Summary</b>				
			<b>Contingency (40%)</b>	<b>\$23,910</b>
			<b>Preliminary Engineering (15%)</b>	<b>\$8,966</b>
			<b>Construction Engineering (10%)</b>	<b>\$5,978</b>
			<b>Total Site Improvement Cost</b>	<b>\$98,500</b>
<b>Assumptions:</b>				
Assumed remove one perpendicular for two parallel curb ramps.				

<b>Recommendation: Restripe crosswalk markings at the intersections.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
1" Cold Mill	32,976	SF	\$10	\$329,760
1" UTACS Paving	32,976	SF	\$11	\$362,736
Crosswalk Striping	32,976	SF	\$10	\$329,760
High Friction Surface Treatment	3,664	SY	\$34	\$124,580
			Subtotal	\$1,146,836
<b>Project Cost Summary</b>				
			<b>Contingency (40%)</b>	<b>\$458,734</b>
			<b>Preliminary Engineering (15%)</b>	<b>\$172,025</b>
			<b>Construction Engineering (10%)</b>	<b>\$114,684</b>
			<b>Total Site Improvement Cost</b>	<b>\$1,892,500</b>
<b>Assumptions:</b>				
Based on 0.25 miles between Koontz Lane and Ross Private Driveway				
Assumed 6 foot wide crosswalks				

**CAMPO LRSP S Carson St Cost Estimate Details**

<b>Recommendation: Reinforce with signage and install bollards to prohibit vehicles from entering the multi-use path</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Custom Advisory or Destination Sign and Pole	2	EA	\$200	\$400
Sign and Pole (with Installation)	2	EA	\$600	\$1,200
Install Bollards (Includes Bollards)	14	EA	\$10,000	\$140,000
Subtotal				\$141,600
<b>Project Cost Summary</b>				
Contingency (40%)				\$56,640
Preliminary Engineering (15%)				\$21,240
Construction Engineering (10%)				\$14,160
<b>Total Site Improvement Cost</b>				<b>\$233,500</b>
<b>Assumptions:</b>				
Assume bollards every 7 feet for 100 feet				

<b>Recommendation: Limit left turns from side streets with raised median islands and access management.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Pavement	92,400	SF	\$10	\$924,000
Install S-Island or Raised Median	92,400	SF	\$20	\$1,848,000
Subtotal				\$2,772,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$1,108,800
Preliminary Engineering (15%)				\$415,800
Construction Engineering (10%)				\$277,200
<b>Total Site Improvement Cost</b>				<b>\$4,574,000</b>
<b>Assumptions:</b>				
Assumed one light for each side of street				

<b>Recommendation: Install streetlighting at the RRFB crossing with breakaway poles.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Install Single Mast-Arm Lighting with LED Bulbs	2	EA	\$10,000	\$20,000
Subtotal				\$20,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$8,000
Preliminary Engineering (15%)				\$3,000
Construction Engineering (10%)				\$2,000
<b>Total Site Improvement Cost</b>				<b>\$33,000</b>
<b>Assumptions:</b>				
Assumed one light for each side of street				

**CAMPO LRSP S Carson St Cost Estimate Details**

<b>Recommendation: Change from FYA to protected phasing at Clearview Drive</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Traffic Signal Head	4	EA	\$1,120	\$4,480
Traffic Signal Head with Installation	4	EA	\$3,985	\$15,940
Signal Retiming	1	INT	\$3,000	\$3,000
Subtotal				\$23,420
<b>Project Cost Summary</b>				
Contingency (40%)				\$9,368
Preliminary Engineering (15%)				\$3,513
Construction Engineering (10%)				\$2,342
<b>Total Site Improvement Cost</b>				<b>\$38,500</b>
<b>Assumptions:</b>				
Assumed S-islands in front of all car dealerships				

<b>Recommendation: Evaluate the need for a signal based on traffic impact study for the new development. Install traffic signal if warranted.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Traffic Impact Study	1	EA	\$10,000	\$10,000
Subtotal				\$10,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$4,000
Preliminary Engineering (15%)				\$1,500
Construction Engineering (10%)				\$1,000
<b>Total Site Improvement Cost</b>				<b>\$16,500</b>
<b>Assumptions:</b>				
Assumed S-islands in front of all car dealerships				

<b>Recommendation: Restripe crosswalk markings at intersections</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Milling and Overlay	11,625	SF	\$5	\$58,125
Crosswalk Striping	11,625	SF	\$10	\$116,250
Sign and Pole (with Installation)	20	EA	\$600	\$12,000
Custom Flashing Advisory Sign (with Installation)	6	EA	\$5,000	\$30,000
Subtotal				\$216,375
<b>Project Cost Summary</b>				
Contingency (40%)				\$86,550
Preliminary Engineering (15%)				\$32,456
Construction Engineering (10%)				\$21,638
<b>Total Site Improvement Cost</b>				<b>\$357,000</b>
<b>Assumptions:</b>				
Assumed S-islands in front of all car dealerships				

**CAMPO LRSP S Curry St Cost Estimate Details**

**Recommendation: Assess environmental concerns with future improvement project within the corridor.**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
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**Site Improvement Costs**

Environmental Impact Study	1	EA	\$100,000	\$100,000
Subtotal				\$100,000

**Project Cost Summary**

			<b>Contingency (40%)</b>	<b>\$40,000</b>
			<b>Preliminary Engineering (15%)</b>	<b>\$15,000</b>
			<b>Construction Engineering (10%)</b>	<b>\$10,000</b>
			<b>Total Site Improvement Cost</b>	<b>\$165,000</b>

**Assumptions:**  
One sign entering the segment from each direction

**Recommendation: Change posted speed to 25 mph.**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
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**Site Improvement Costs**

Speed Study	1	EA	\$10,000	\$10,000
Sign and Pole (with Installation)	4	EA	\$600	\$2,400
Subtotal				\$12,400

**Project Cost Summary**

			<b>Contingency (40%)</b>	<b>\$4,960</b>
			<b>Preliminary Engineering (15%)</b>	<b>\$1,860</b>
			<b>Construction Engineering (10%)</b>	<b>\$1,240</b>
			<b>Total Site Improvement Cost</b>	<b>\$20,500</b>

**Assumptions:**  
One sign entering the segment from each direction

**Recommendation: Improve curb ramps at driveways to comply with PROWAG.**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
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**Site Improvement Costs**

Remove Concrete Ramps	10	EA	\$784	\$7,840
Install Sidewalk Ramp (includes Detectable Warnings)	20	EA	\$7,080	\$141,600
Subtotal				\$149,440

**Project Cost Summary**

			<b>Contingency (40%)</b>	<b>\$59,776</b>
			<b>Preliminary Engineering (15%)</b>	<b>\$22,416</b>
			<b>Construction Engineering (10%)</b>	<b>\$14,944</b>
			<b>Total Site Improvement Cost</b>	<b>\$246,500</b>

**Assumptions:**  
Improvements along entire 0.7 mile segment

**CAMPO LRSP S Curry St Cost Estimate Details**

<b>Recommendation: Install "No Parking" signage.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Sign and Pole (with Installation)	14	EA	\$600	\$8,400
Subtotal				\$8,400
<b>Project Cost Summary</b>				
Contingency (40%)				\$3,360
Preliminary Engineering (15%)				\$1,260
Construction Engineering (10%)				\$840
<b>Total Site Improvement Cost</b>				<b>\$14,000</b>
<b>Assumptions:</b>				
Assumed five signs every 0.25 miles each direction				

<b>Recommendation: Improvement project to widen roadway.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Site Grading	3,080	CY	\$45	\$138,600
Remove Pavement	221,760	SF	\$10	\$2,217,600
Aggregate Base (10")	258,720	SF	\$11	\$2,845,920
1" UTACS Paving	258,720	SF	\$11	\$2,845,920
Curb & Gutter	7,392	LF	\$40	\$295,680
Subtotal				\$8,343,720
<b>Project Cost Summary</b>				
Contingency (40%)				\$3,337,488
Preliminary Engineering (15%)				\$1,251,558
Construction Engineering (10%)				\$834,372
<b>Total Site Improvement Cost</b>				<b>\$13,767,000</b>
<b>Assumptions:</b>				
Assumed improvements to entire 0.7 mile segment				
Assumed added 10 feet of width to entire segment				

<b>Recommendation: Conduct lighting study and install appropriate streetlighting.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Lighting Study	1	EA	\$5,000	\$5,000
Install Single Mast-Arm Lighting with LED Bulbs	14	EA	\$10,000	\$140,000
Subtotal				\$145,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$58,000
Preliminary Engineering (15%)				\$21,750
Construction Engineering (10%)				\$14,500
<b>Total Site Improvement Cost</b>				<b>\$239,500</b>
<b>Assumptions:</b>				
Based on 0.25 miles of S Curry Street from Rhodes Street to Honda Dealership				

**CAMPO LRSP S Curry St Cost Estimate Details**

**Recommendation: Consider using sharrows, bike lanes, striping, or enhanced "Share the Road" signage for vehicles to be aware and look out for bikes.**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Sharrows	10	EA	\$22	\$220
Bike Lane Striping	7,392	LF	\$4	\$29,568
Sign and Pole (with Installation)	6	EA	\$600	\$3,600
Subtotal				\$33,388
<b>Project Cost Summary</b>				
Contingency (40%)				\$13,355
Preliminary Engineering (15%)				\$5,008
Construction Engineering (10%)				\$3,339
<b>Total Site Improvement Cost</b>				<b>\$55,000</b>

**Assumptions:**

Assumed five sharrows in each direction  
 Assumed bike lane striping for entire corridor  
 Assumed three signs in each direction

**Recommendation: Install advanced signage to direct bicyclists and pedestrians to multi-use path on S Carson Street (not use Curry St).**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Sign and Pole (with Installation)	6	EA	\$600	\$3,600
Subtotal				\$3,600
<b>Project Cost Summary</b>				
Contingency (40%)				\$1,440
Preliminary Engineering (15%)				\$540
Construction Engineering (10%)				\$360
<b>Total Site Improvement Cost</b>				<b>\$6,000</b>

**Assumptions:**

Assumed five sharrows in each direction  
 Assumed bike lane striping for entire corridor  
 Assumed three signs in each direction

**CAMPO LRSP S Curry St Cost Estimate Details**

<b>Recommendation: Consider rasing chevron signage so it is above foliage.</b>				
Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Sign and Pole (with Installation)	3	EA	\$600	\$1,800
Subtotal				\$1,800
<b>Project Cost Summary</b>				
Contingency (40%)				\$720
Preliminary Engineering (15%)				\$270
Construction Engineering (10%)				\$180
<b>Total Site Improvement Cost</b>				<b>\$3,000</b>
<b>Assumptions:</b>				
Assumed five sharrows in each direction				
Assumed bike lane striping for entire corridor				
Assumed three signs in each direction				

<b>Recommendation: Relocate or underground utility poles or widen sidewalk.</b>				
Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Bury Utilities	3,696	LF	\$15	\$55,440
Subtotal				\$55,440
<b>Project Cost Summary</b>				
Contingency (40%)				\$22,176
Preliminary Engineering (15%)				\$8,316
Construction Engineering (10%)				\$5,544
<b>Total Site Improvement Cost</b>				<b>\$91,500</b>
<b>Assumptions:</b>				
Assumed entire length of segment.				

<b>Recommendation: Extend guardrail. Extensive grading and potential environmental impacts.</b>				
Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Install Barrier (Guardrail)	100	LF	\$70	\$7,000
Subtotal				\$7,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$2,800
Preliminary Engineering (15%)				\$1,050
Construction Engineering (10%)				\$700
<b>Total Site Improvement Cost</b>				<b>\$11,500</b>
<b>Assumptions:</b>				
None.				

**CAMPO LRSP Saliman Rd Cost Estimate Details**

**Recommendation: Reduce the speed limit to 25 mph based on the Roadway Environment of "RE5 - Urban /Small Town Center" per the NDOT Speed Management Action Plan. Consider painting the speed limit on the road. Install dynamic speed feedback signs.**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Improvements	Quantity	Units	Unit Cost	Improvement
Speed Study	1	EA	\$10,000	\$10,000
Sign and Pole (with Installation)	6	EA	\$600	\$3,600
Speed Feedback Sign (with Installation)	6	EA	\$10,000	\$60,000
<b>Subtotal</b>				<b>\$73,600</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$29,440</b>
<b>Preliminary Engineering (15%)</b>				<b>\$11,040</b>
<b>Construction Engineering (10%)</b>				<b>\$7,360</b>
<b>Total Site Improvement Cost</b>				<b>\$121,500</b>
<b>Assumptions:</b>				
Assume one speed limit sign every 0.5 miles in each direction				
Assume one speed feedback sign every 0.5 miles in each direction				

**Recommendation: Install "No Parking" and "No U-Turn" signage in front of the schools.**

Improvements	Quantity	Units	Unit Cost	Improvement
<b>Site Improvement Costs</b>				
Improvements	Quantity	Units	Unit Cost	Improvement
Sign and Pole (with Installation)	48	EA	\$600	\$28,800
Curb Painting (Yellow or Red)	4,600	LF	\$1	\$4,600
<b>Subtotal</b>				<b>\$33,400</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$13,360</b>
<b>Preliminary Engineering (15%)</b>				<b>\$5,010</b>
<b>Construction Engineering (10%)</b>				<b>\$3,340</b>
<b>Total Site Improvement Cost</b>				<b>\$55,000</b>
<b>Assumptions:</b>				
Assumes one sign every 100 feet in front of both schools on each side of the street				

**Recommendation: Remove the TWLTL and install raised medians as part of access management.**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Remove Pavement	87,648	SF	\$10	\$876,480
Install S-Island or Raised Median	70,118	SF	\$20	\$1,402,360
<b>Subtotal</b>				<b>\$2,278,840</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$911,536</b>
<b>Preliminary Engineering (15%)</b>				<b>\$341,826</b>
<b>Construction Engineering (10%)</b>				<b>\$227,884</b>
<b>Total Site Improvement Cost</b>				<b>\$3,760,000</b>
<b>Assumptions:</b>				
Assumes 10 foot TWLTL and 8 foot raised median				

**CAMPO LRSP Saliman Rd Cost Estimate Details**

<b>Recommendation: Replace HPS bulbs with LED bulbs.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement</b>
<b>Site Improvement Costs</b>				
Replace HPS Bulbs with LED	24	EA	\$896	\$21,504
			Subtotal	\$21,504
<b>Project Cost Summary</b>				
			<b>Contingency (40%)</b>	<b>\$8,602</b>
			<b>Total Site Improvement Cost</b>	<b>\$30,000</b>
<b>Assumptions:</b>				
Based on the number of streetlights between 0.25 miles of segment between US-50 and south entrance to Carson High School				

<b>Recommendation: Install streetlighting along the segment.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement</b>
<b>Site Improvement Costs</b>				
Install Single Mast-Arm Lighting with LED Bulbs	24	EA	\$10,000	\$240,000
			Subtotal	\$240,000
<b>Project Cost Summary</b>				
			<b>Contingency (40%)</b>	<b>\$96,000</b>
			<b>Preliminary Engineering (15%)</b>	<b>\$36,000</b>
			<b>Construction Engineering (10%)</b>	<b>\$24,000</b>
			<b>Total Site Improvement Cost</b>	<b>\$396,000</b>
<b>Assumptions:</b>				
Assumes that project doubles existing streetlight inventory in segment				

<b>Recommendation: Install On-Street Bicycle Facility</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement</b>
<b>Site Improvement Costs</b>				
On Street Bike Facility	87,648	SF	\$20	\$1,752,960
			Subtotal	\$1,752,960
<b>Project Cost Summary</b>				
			<b>Contingency (40%)</b>	<b>\$701,184</b>
			<b>Preliminary Engineering (15%)</b>	<b>\$262,944</b>
			<b>Construction Engineering (10%)</b>	<b>\$175,296</b>
			<b>Total Site Improvement Cost</b>	<b>\$2,892,500</b>
<b>Assumptions:</b>				
Assume bike facilities for entire 1.66 mile segment.				
On-street bike facilities include added width, raised buffer, and striping				

**CAMPO LRSP Saliman Rd Cost Estimate Details**

<b>Recommendation: Evaluate the need for a signal. Install signal if warranted.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement</b>
<b>Site Improvement Costs</b>				
Traffic Impact Study	1	EA	\$10,000	\$10,000
Traffic Signal Head with Installation	1	EA	\$3,985	\$3,985
Subtotal				\$13,985
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$5,594</b>
<b>Preliminary Engineering (15%)</b>				<b>\$2,098</b>
<b>Construction Engineering (10%)</b>				<b>\$1,399</b>
<b>Total Site Improvement Cost</b>				<b>\$23,000</b>
<b>Assumptions:</b>				
Assumed one flashing sign at curve in each direction.				

<b>Recommendation: Install signage or flashers to reduce the speed through the curve.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement</b>
<b>Site Improvement Costs</b>				
Custom Flashing Advisory Sign (with Installation)	2	EA	\$5,000	\$10,000
Subtotal				\$10,000
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$4,000</b>
<b>Preliminary Engineering (15%)</b>				<b>\$1,500</b>
<b>Construction Engineering (10%)</b>				<b>\$1,000</b>
<b>Total Site Improvement Cost</b>				<b>\$16,500</b>
<b>Assumptions:</b>				
Assumed one flashing sign at curve in each direction.				

**CAMPO LRSP Saliman Rd Cost Estimate Details**

<b>Recommendation: Replace all pushbuttons with Accessible Pedestrian Signals (APS).</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Pedestrian Pushbutton	32	EA	\$50	\$1,600
Accessible Pedestrian Signal (APS)	32	EA	\$500	\$16,000
Subtotal				\$17,600
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$7,040</b>
<b>Preliminary Engineering (15%)</b>				<b>\$2,640</b>
<b>Construction Engineering (10%)</b>				<b>\$1,760</b>
<b>Total Site Improvement Cost</b>				<b>\$29,000</b>
<b>Assumptions:</b>				
Assumed two APS at each corner of each signalized intersection				

<b>Recommendation: Install RRFBs and repair damaged pedestrian fencing in the median.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Pedestrian Fence	3	EA	\$2,500	\$7,500
Pedestrian Fence (with Installation)	70	LF	\$300	\$21,000
Install RRFB	2	EA	\$54,070	\$108,140
Subtotal				\$136,640
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$54,656</b>
<b>Preliminary Engineering (15%)</b>				<b>\$20,496</b>
<b>Construction Engineering (10%)</b>				<b>\$13,664</b>
<b>Total Site Improvement Cost</b>				<b>\$225,500</b>
<b>Assumptions:</b>				
Assume one RRFB on each side of street				

**CAMPO LRSP E College Parkway Cost Estimate Details**

<b>Recommendation: Install additional oversized chevrons at curve.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
Sign and Pole (with Installation)	10	EA	\$600	\$6,000
Custom Flashing Advisory Sign (with Installation)	2	EA	\$5,000	\$10,000
<b>Subtotal</b>				<b>\$16,000</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$6,400</b>
<b>Preliminary Engineering (15%)</b>				<b>\$2,400</b>
<b>Construction Engineering (10%)</b>				<b>\$1,600</b>
<b>Total Site Improvement Cost</b>				<b>\$26,500</b>
<b>Assumptions:</b>				
Assumed five chevron signs through curve in each direction				
Assumed one flashing sign at curve in each direction.				

<b>Reconfigure roadway to accommodate for improved pedestrian or bicycle facilities throughout corridor. Restripe roadway and shift lanes by narrowing median to add bicycle facilities. Consider green paint at bicycle conflict zones.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
On Street Bike Facility	105,600	SF	\$20	\$2,112,000
<b>Subtotal</b>				<b>\$2,112,000</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$844,800</b>
<b>Preliminary Engineering (15%)</b>				<b>\$316,800</b>
<b>Construction Engineering (10%)</b>				<b>\$211,200</b>
<b>Total Site Improvement Cost</b>				<b>\$3,485,000</b>
<b>Assumptions:</b>				
Assume bike facilities for entire 2.0 mile segment.				
On-street bike facilities include added width, raised buffer, and striping				

<b>Recommendation: Rehabilitate pavement along segment and repaint striping.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Pavement	316,800	SF	\$10	\$3,168,000
Aggregate Base (10")	316,800	SF	\$11	\$3,484,800
1" UTACS Paving	316,800	SF	\$11	\$3,484,800
<b>Subtotal</b>				<b>\$10,137,600</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$4,055,040</b>
<b>Preliminary Engineering (15%)</b>				<b>\$1,520,640</b>
<b>Construction Engineering (10%)</b>				<b>\$1,013,760</b>
<b>Total Site Improvement Cost</b>				<b>\$16,727,000</b>
<b>Assumptions:</b>				
Assumed affected pavement is entire 2.0 mile segment				

**CAMPO LRSP E College Parkway Cost Estimate Details**

<b>Recommendation: Replace HPS bulbs with LED bulbs.</b>				
Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Replace HPS Bulbs with LED	16	EA	\$896	\$14,336
Subtotal				\$14,336
<b>Project Cost Summary</b>				
Contingency (40%)				\$5,734
Total Site Improvement Cost				\$20,000
<b>Assumptions:</b> Based on number of existing street lights within 0.25 segment from N Lompa Lane to Silver Lane				

<b>Recommendation: Conduct a lighting study to verify illuminance and streetlight pole spacing. Install streetlighting if necessary.</b>				
Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Lighting Study	1	EA	\$5,000	\$5,000
Install Single Mast-Arm Lighting with LED Bulbs	48	EA	\$10,000	\$480,000
Subtotal				\$485,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$194,000
Preliminary Engineering (15%)				\$72,750
Construction Engineering (10%)				\$48,500
Total Site Improvement Cost				\$800,500
<b>Assumptions:</b> Assume three streetlights every 0.25 miles in each direction.				

<b>Recommendation: Provide PROWAG compliant pedestrian facilities</b>				
Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Remove Sidewalk	13,200	SF	\$5	\$66,000
Remove Concrete Ramps	30	EA	\$784	\$23,520
Install Sidewalk	13,200	SF	\$20	\$264,000
Install Sidewalk Ramp (includes Detectable Warnings)	30	EA	\$7,080	\$212,400
Subtotal				\$565,920
<b>Project Cost Summary</b>				
Contingency (40%)				\$226,368
Preliminary Engineering (15%)				\$84,888
Construction Engineering (10%)				\$56,592
Total Site Improvement Cost				\$934,000
<b>Assumptions:</b> Assumed 25% of sidewalk non-compliant				

**CAMPO LRSP E College Parkway Cost Estimate Details**

<b>Recommendation: Stripe the curb to be red within the vicinity of the fire hydrant to be compliant with local standards.</b>				
Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Curb Painting (Yellow or Red)	30	LF	\$1	\$30
Subtotal				\$30
<b>Project Cost Summary</b>				
Contingency (40%)				\$12
Preliminary Engineering (15%)				\$5
Construction Engineering (10%)				\$3
<b>Total Site Improvement Cost</b>				<b>\$50</b>
<b>Assumptions:</b>				

<b>Recommendation: Reduce curb radii at the intersection.</b>				
Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Intersection Realignment	1	INT	\$10,000,000	\$10,000,000
Subtotal				\$10,000,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$4,000,000
Preliminary Engineering (15%)				\$1,500,000
Construction Engineering (10%)				\$1,000,000
<b>Total Site Improvement Cost</b>				<b>\$16,500,000</b>
<b>Assumptions:</b>				
Intersection realignment assumes civil work, pedestrian facilities, and hardware components.				

<b>Recommendation: Evaluate signal phasing to consider protected N/S left turns, lead pedestrian intervals (LPI), or exclusive pedestrian phase.</b>				
Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Signal Retiming	1	INT	\$3,000	\$3,000
Subtotal				\$3,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$1,200
Preliminary Engineering (15%)				\$450
Construction Engineering (10%)				\$300
<b>Total Site Improvement Cost</b>				<b>\$5,000</b>
<b>Assumptions:</b>				
Assumed two APS at each corner of each signalized intersection				

# DRAFT

## CAMPO LRSP E College Parkway Cost Estimate Details

<b>Recommendation: Replace all pushbuttons with Accessible Pedestrian Signals (APS).</b>				
Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Remove Pedestrian Pushbutton	50	EA	\$50	\$2,500
Accessible Pedestrian Signal (APS)	50	EA	\$500	\$25,000
			Subtotal	\$27,500
<b>Project Cost Summary</b>				
			<b>Contingency (40%)</b>	<b>\$11,000</b>
			Preliminary Engineering (15%)	\$4,125
			Construction Engineering (10%)	\$2,750
			<b>Total Site Improvement Cost</b>	<b>\$45,500</b>
<b>Assumptions:</b>				
Assumed two APS at each corner of each signalized intersection				

<b>Recommendation: Install 6-inch edgelines at the curve.</b>				
Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Install 6" White Edge Line	3,200	LF	\$3	\$9,600
			Subtotal	\$9,600
<b>Project Cost Summary</b>				
			<b>Contingency (40%)</b>	<b>\$3,840</b>
			Preliminary Engineering (15%)	\$1,440
			Construction Engineering (10%)	\$960
			<b>Total Site Improvement Cost</b>	<b>\$16,000</b>
<b>Assumptions:</b>				
Curve length and tangent is 3100 linear feet.				

**CAMPO LRSP N Carson St and W Nye Ln Cost Estimate Details**

<b>Recommendation: Realign the intersection, realign the curb ramps and restripe crosswalk, and provide pedestrian</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
Intersection Realignment	1	INT	\$10,000,000	\$10,000,000
<b>Subtotal</b>				<b>\$10,000,000</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$4,000,000</b>
<b>Preliminary Engineering (15%)</b>				<b>\$1,500,000</b>
<b>Construction Engineering (10%)</b>				<b>\$1,000,000</b>
<b>Total Site Improvement Cost</b>				<b>\$16,500,000</b>
<b>Assumptions:</b>				
Intersection realignment assumes civil work, pedestrian facilities, and hardware components.				

<b>Recommendation: Realign the intersection, realign the curb ramps and restripe crosswalk, and provide pedestrian</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
Remove Concrete Ramps	4	EA	\$784	\$3,136
Install Sidewalk Ramp (includes Detectable Warnings)	8	EA	\$7,080	\$56,640
<b>Subtotal</b>				<b>\$59,776</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$23,910</b>
<b>Preliminary Engineering (15%)</b>				<b>\$8,966</b>
<b>Construction Engineering (10%)</b>				<b>\$5,978</b>
<b>Total Site Improvement Cost</b>				<b>\$98,500</b>
<b>Assumptions:</b>				
Assumed one curb perpendicular curb ramp becomes parallel curb ramps				

<b>Recommendation: Rehabilitate pavement at intersection and repaint striping.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
Remove Pavement	15,625	SF	\$10	\$156,250
Aggregate Base (10")	15,625	SF	\$11	\$171,875
Crosswalk Markings	1,920	SF	\$15	\$28,800
Shark's Teeth Yield Markings	400	SF	\$15	\$6,000
<b>Subtotal</b>				<b>\$328,125</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$131,250</b>
<b>Preliminary Engineering (15%)</b>				<b>\$49,219</b>
<b>Construction Engineering (10%)</b>				<b>\$32,813</b>
<b>Total Site Improvement Cost</b>				<b>\$541,500</b>
<b>Assumptions:</b>				
Uses intersection area of 15,625 SF				

**CAMPO LRSP N Carson St and W Nye Ln Cost Estimate Details**

**Recommendation: Install pedestrian refuge area and enhanced pedestrian crossing (PHB, RRFB, etc.) with bulbouts. Improve lighting at pedestrian crossing. Education and enforcement are critical components about enhanced pedestrian crossings.**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Remove Pavement	625	SF	\$10	\$6,250
Install S-Island or Raised Median	625	SF	\$20	\$12,500
Install RRFB	4	EA	\$54,070	\$216,280
Install Single Mast-Arm Lighting with LED Bulbs	2	EA	\$10,000	\$20,000
Install Dual Mast-Arm Lighting with LED Bulbs	1	EA	\$13,000	\$13,000
Curb & Gutter	160	LF	\$40	\$6,400
Install Sidewalk	1,600	SF	\$20	\$32,000
Install Sidewalk Ramp (includes Detectable Warnings)	4	EA	\$7,080	\$28,320
Subtotal				\$334,750
<b>Project Cost Summary</b>				
Contingency (40%)				\$133,900
Preliminary Engineering (15%)				\$50,213
Construction Engineering (10%)				\$33,475
<b>Total Site Improvement Cost</b>				<b>\$552,500</b>
<b>Assumptions:</b>				
Assumes four RRFB at each location				
Assumes that north raised median is extended to reach existing crosswalk				

**Recommendation: Limit left turns from side streets with raised median islands and access management.**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Remove Pavement	1,000	SF	\$10	\$10,000
Install S-Island or Raised Median	1,000	SF	\$20	\$20,000
Subtotal				\$30,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$12,000
Preliminary Engineering (15%)				\$4,500
Construction Engineering (10%)				\$3,000
<b>Total Site Improvement Cost</b>				<b>\$49,500</b>
<b>Assumptions:</b>				
Assumes s-island extend 100 feet to connect center median				

**CAMPO LRSP N Carson St and W Nye Ln Cost Estimate Details**

<b>Recommendation: Replace HPS bulbs with LED bulbs.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Replace HPS Bulbs with LED	1	EA	\$896	\$896
Subtotal				\$896
<b>Project Cost Summary</b>				
Contingency (40%)				\$358
Total Site Improvement Cost				\$1,500
<b>Assumptions:</b> Only one light existing at intersection				

<b>Recommendation: Install lighting within the center median (dual mast arms) to light the crosswalk.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Lighting Study	1	EA	\$5,000	\$5,000
Install Dual Mast-Arm Lighting with LED Bulbs	1	EA	\$13,000	\$13,000
Subtotal				\$18,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$7,200
Preliminary Engineering (15%)				\$2,700
Construction Engineering (10%)				\$1,800
Total Site Improvement Cost				\$29,500
<b>Assumptions:</b> Assumes lighting is on the north leg				

<b>Recommendation: Clear debris and maintain walkways. Work with utility companies to determine need. Relocate or</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Debris from Sidewalk	1	MILE	\$320	\$320
Subtotal				\$320
<b>Project Cost Summary</b>				
Contingency (40%)				\$128
Preliminary Engineering (15%)				\$48
Construction Engineering (10%)				\$32
Total Site Improvement Cost				\$500
<b>Assumptions:</b> Assumed 25% of sidewalk non-compliant				

**CAMPO LRSP US-50 and Highlands Dr Cost Estimate Details**

<b>Recommendation: Evaluate enhanced pedestrian facility (PHB) with advance warning signs.</b>				
Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Remove Pavement	10,000	SF	\$10	\$100,000
Install S-Island or Raised Median	8,000	SF	\$20	\$160,000
PHB	3	EA	\$350,000	\$1,050,000
Custom Flashing Advisory Sign (with Installation)	4	EA	\$5,000	\$20,000
Subtotal				\$1,330,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$532,000
Preliminary Engineering (15%)				\$199,500
Construction Engineering (10%)				\$133,000
<b>Total Site Improvement Cost</b>				<b>\$2,194,500</b>
<b>Assumptions:</b>				
Assumes raised median extends for 500 feet on either side of Highlands Drive				
Assumes location requires three PHB				
Assumes one flashing advisory sign on each side of road in each direction				

<b>Recommendation: Install intersection lighting with LED bulbs.</b>				
Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Install Dual Mast-Arm Lighting with LED Bulbs	1	EA	\$13,000	\$13,000
Subtotal				\$13,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$5,200
Preliminary Engineering (15%)				\$1,950
Construction Engineering (10%)				\$1,300
<b>Total Site Improvement Cost</b>				<b>\$21,500</b>
<b>Assumptions:</b>				
Assumed one light on SWC of Highlands Drive and US-50				

<b>Recommendation: Rehabilitate pavement and shoulder area.</b>				
Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Remove Pavement	32,000	SF	\$10	\$320,000
Aggregate Base (10")	32,000	SF	\$11	\$352,000
1" UTACS Paving	32,000	SF	\$11	\$352,000
Turn Arrow Markings	100	SF	\$15	\$1,500
Install 4" White Edge Line	700	LF	\$2	\$1,400
Subtotal				\$1,026,900
<b>Project Cost Summary</b>				
Contingency (40%)				\$410,760
Preliminary Engineering (15%)				\$154,035
Construction Engineering (10%)				\$102,690
<b>Total Site Improvement Cost</b>				<b>\$1,694,500</b>
<b>Assumptions:</b>				
Assumed improvements to 200 feet of shoulder in each direction				

**CAMPO LRSP US-50 and Highlands Dr Cost Estimate Details**

**Recommendation: Conduct speed study and enhance speed reduction zones signs. Install advanced street signs and oversized speed limit signs.**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Speed Study	1	EA	\$10,000	\$10,000
Sign and Pole (with Installation)	2	EA	\$600	\$1,200
Subtotal				\$11,200
<b>Project Cost Summary</b>				
Contingency (40%)				\$4,480
Preliminary Engineering (15%)				\$1,680
Construction Engineering (10%)				\$1,120
<b>Total Site Improvement Cost</b>				<b>\$18,500</b>

**Assumptions:**

Assumed one sign in each direction entering speed reduction zone

**Recommendation: Consider acceleration lane in the median for northbound to westbound left turns.**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Remove Pavement	6,000	SF	\$10	\$60,000
1" UTACS Paving	6,000	SF	\$11	\$66,000
Aggregate Base (10")	6,000	SF	\$11	\$66,000
Subtotal				\$192,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$76,800
Preliminary Engineering (15%)				\$28,800
Construction Engineering (10%)				\$19,200
<b>Total Site Improvement Cost</b>				<b>\$317,000</b>

**Assumptions:**

Assumed 300 feet in eastbound and westbound directions

**Recommendation: Consider roundabout in this location or realign Red Rock Rd and Highlands Dr for a full (signalized) intersection.**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Install Roundabout	1	EA	\$1,718,705	\$1,718,705
Subtotal				\$1,718,705
<b>Project Cost Summary</b>				
Contingency (40%)				\$687,482
Preliminary Engineering (15%)				\$257,806
Construction Engineering (10%)				\$171,871
<b>Total Site Improvement Cost</b>				<b>\$2,836,000</b>

**Assumptions: None**

**CAMPO LRSP US-50 and Highlands Dr Cost Estimate Details**

<b>Recommendation: Add acceleration lane for left turns out of Red Rock Road.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Pavement	6,000	SF	\$10	\$60,000
1" UTACS Paving	6,000	SF	\$11	\$66,000
Aggregate Base (10")	6,000	SF	\$11	\$66,000
Subtotal				\$192,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$76,800
Preliminary Engineering (15%)				\$28,800
Construction Engineering (10%)				\$19,200
<b>Total Site Improvement Cost</b>				<b>\$317,000</b>
<b>Assumptions:</b>				
Assumed one sign in each direction entering speed reduction zone				

<b>Recommendation: Study segment of US 50 from Linehan Road to Highlands Drive to limit lefts out of the side streets with median islands and reroute truck and bus traffic.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Large Traffic Impact Study	1	EA	\$100,000	\$100,000
Subtotal				\$100,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$40,000
Preliminary Engineering (15%)				\$15,000
Construction Engineering (10%)				\$10,000
<b>Total Site Improvement Cost</b>				<b>\$165,000</b>
<b>Assumptions: None</b>				

**CAMPO LRSP US-50 and Airport Rd Cost Estimate Details**

**Reconfigure roadway to accommodate for improved pedestrian or bicycle facilities throughout corridor. Restripe roadway and shift lanes by narrowing median to add bicycle facilities. Consider green paint at bicycle conflict zones.**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
On Street Bike Facility	3,000	SF	\$20	\$60,000
<b>Subtotal</b>				<b>\$60,000</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$24,000</b>
<b>Preliminary Engineering (15%)</b>				<b>\$9,000</b>
<b>Construction Engineering (10%)</b>				<b>\$6,000</b>
<b>Total Site Improvement Cost</b>				<b>\$99,000</b>

**Assumptions:**

Assumed bike N/S and E/W bike facilities.

**Recommendation: Coordinate signal timing with Jacks Valley/Clear Creek intersection.**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Signal Retiming	1	INT	\$3,000	\$3,000
<b>Subtotal</b>				<b>\$3,000</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$1,200</b>
<b>Preliminary Engineering (15%)</b>				<b>\$450</b>
<b>Construction Engineering (10%)</b>				<b>\$300</b>
<b>Total Site Improvement Cost</b>				<b>\$5,000</b>

**Assumptions: None**

**Recommendation: Pedestrian improvements with PROWAG compliant crossings and pedestrian curb ramps.**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Remove Concrete Ramps	8	EA	\$784	\$6,272
Install Sidewalk Ramp (includes Detectable Warnings)	8	EA	\$7,080	\$56,640
Accessible Pedestrian Signal (APS)	8	EA	\$500	\$4,000
<b>Subtotal</b>				<b>\$66,912</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$26,765</b>
<b>Preliminary Engineering (15%)</b>				<b>\$10,037</b>
<b>Construction Engineering (10%)</b>				<b>\$6,691</b>
<b>Total Site Improvement Cost</b>				<b>\$110,500</b>

**Assumptions:**

Assumed number of ramps remains constant

**CAMPO LRSP US-50 and Airport Rd Cost Estimate Details**

<b>Recommendation: Rehabilitate pavement along intersection and repaint striping.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Pavement	24,750	SF	\$10	\$247,500
Aggregate Base (10")	24,750	SF	\$11	\$272,250
1" UTACS Paving	24,750	SF	\$11	\$272,250
Turn Arrow Markings	100	SF	\$15	\$1,500
Install 6" White Edge Line	700	LF	\$3	\$2,100
Subtotal				\$795,600
<b>Project Cost Summary</b>				
Contingency (40%)				\$318,240
Preliminary Engineering (15%)				\$119,340
Construction Engineering (10%)				\$79,560
<b>Total Site Improvement Cost</b>				<b>\$1,312,500</b>
<b>Assumptions:</b>				
Assumed area of 150 ft x 150 ft for intersection area				

<b>Recommendation: Install dual-mast arm light poles on all corners.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement</b>
<b>Site Improvement Costs</b>				
Install Dual Mast-Arm Lighting with LED Bulbs	4	EA	\$13,000	\$52,000
Subtotal				\$52,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$20,800
Preliminary Engineering (15%)				\$7,800
Construction Engineering (10%)				\$5,200
<b>Total Site Improvement Cost</b>				<b>\$86,000</b>
<b>Assumptions:</b>				
Assume dual mast-arm streetlight at each corner				

<b>Recommendation: Replace all pushbuttons with Accessible Pedestrian Signals (APS).</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Pedestrian Pushbutton	8	EA	\$50	\$400
Accessible Pedestrian Signal (APS)	8	EA	\$500	\$4,000
Subtotal				\$4,400
<b>Project Cost Summary</b>				
Contingency (40%)				\$1,760
Preliminary Engineering (15%)				\$660
Construction Engineering (10%)				\$440
<b>Total Site Improvement Cost</b>				<b>\$7,500</b>
<b>Assumptions:</b>				
Assumed two pushbuttons on each corner of the intersection				

**CAMPO LRSP US-50 and Airport Rd Cost Estimate Details**

<b>Recommendation: Install 1A/1B signal pole for pedestrian signal head for improved visibility.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Sign and Pole	8	EA	\$100	\$800
Install Dual Mast-Arm Lighting with LED Bulbs	8	EA	\$13,000	\$104,000
Subtotal				\$104,800
<b>Project Cost Summary</b>				
Contingency (40%)				\$41,920
Preliminary Engineering (15%)				\$15,720
Construction Engineering (10%)				\$10,480
<b>Total Site Improvement Cost</b>				<b>\$173,000</b>
<b>Assumptions:</b>				
Assumed two pushbuttons on each corner of the intersection				

<b>Recommendation: Realign the intersection to improve sight distance.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Pavement	6,720	SF	\$10	\$67,200
Aggregate Base (10")	6,720	SF	\$11	\$73,920
1" UTACS Paving	6,720	SF	\$11	\$73,920
Remove Concrete Ramps	4	EA	\$784	\$3,136
Remove Sidewalk	1,200	SF	\$5	\$6,000
Curb & Gutter	240	LF	\$40	\$9,600
Install Sidewalk	1,200	SF	\$20	\$24,000
Install Sidewalk Ramp (includes Detectable Warnings)	4	EA	\$7,080	\$28,320
Subtotal				\$286,096
<b>Project Cost Summary</b>				
Contingency (40%)				\$114,438
Preliminary Engineering (15%)				\$42,914
Construction Engineering (10%)				\$28,610
<b>Total Site Improvement Cost</b>				<b>\$472,000</b>
<b>Assumptions:</b>				

**CAMPO LRSP US-50 and Airport Rd Cost Estimate Details**

<b>Recommendation: Evaluate need for extra signal head. Center signal heads with each travel lane.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Traffic Signal Head	2	EA	\$1,120	\$2,240
			Subtotal	\$2,240
<b>Project Cost Summary</b>				
			<b>Contingency (40%)</b>	<b>\$896</b>
			<b>Preliminary Engineering (15%)</b>	<b>\$336</b>
			<b>Construction Engineering (10%)</b>	<b>\$224</b>
			<b>Total Site Improvement Cost</b>	<b>\$3,500</b>
<b>Assumptions:</b>				
Assumed two pushbuttons on each corner of the intersection				

**CAMPO LRSP Goni Road and Old Hot Springs Road Cost Estimate Details**

<b>Recommendation: Realign the intersection to improve sight distance.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Pavement	6,720	SF	\$10	\$67,200
Aggregate Base (10")	6,720	SF	\$11	\$73,920
1" UTACS Paving	6,720	SF	\$11	\$73,920
Remove Concrete Ramps	4	EA	\$784	\$3,136
Remove Sidewalk	1,200	SF	\$5	\$6,000
Curb & Gutter	240	LF	\$40	\$9,600
Install Sidewalk	1,200	SF	\$20	\$24,000
Install Sidewalk Ramp (includes Detectable Warnings)	4	EA	\$7,080	\$28,320
Subtotal				\$286,096
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$114,438</b>
<b>Preliminary Engineering (15%)</b>				<b>\$42,914</b>
<b>Construction Engineering (10%)</b>				<b>\$28,610</b>
<b>Total Site Improvement Cost</b>				<b>\$472,000</b>
<b>Assumptions:</b>				

<b>Recommendation: Rehabilitate pavement and restripe crosswalks and other pavement markings.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Pavement	8,400	SF	\$10	\$84,000
Aggregate Base (10")	8,400	SF	\$11	\$92,400
1" UTACS Paving	8,400	SF	\$11	\$92,400
Subtotal				\$176,400
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$70,560</b>
<b>Preliminary Engineering (15%)</b>				<b>\$26,460</b>
<b>Construction Engineering (10%)</b>				<b>\$17,640</b>
<b>Total Site Improvement Cost</b>				<b>\$291,000</b>
<b>Assumptions:</b>				
Uses intersection area of 8,400 SF				

**CAMPO LRSP Goni Road and Old Hot Springs Road Cost Estimate Details**

**Recommendation: Install streetlights at the intersection with LED bulbs in coordination with adjacent development and intersection improvements.**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Lighting Study	1	EA	\$5,000	\$5,000
Install Dual Mast-Arm Lighting with LED Bulbs	4	EA	\$13,000	\$52,000
Subtotal				\$57,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$22,800
Preliminary Engineering (15%)				\$8,550
Construction Engineering (10%)				\$5,700
<b>Total Site Improvement Cost</b>				<b>\$94,000</b>

**Assumptions:**

Assume dual mast-arm streetlight on each corner.

**Recommendation: Install streetlights at the intersection with LED bulbs in coordination with adjacent development and intersection improvements.**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Remove Concrete Ramps	4	EA	\$784	\$3,136
Install Sidewalk Ramp (includes Detectable)	4	EA	\$7,080	\$28,320
Subtotal				\$31,456
<b>Project Cost Summary</b>				
Contingency (40%)				\$12,582
Preliminary Engineering (15%)				\$4,718
Construction Engineering (10%)				\$3,146
<b>Total Site Improvement Cost</b>				<b>\$52,000</b>

**Assumptions:**

Assume dual mast-arm streetlight on each corner.

**Recommendation: Add signage for limited sight distance, install advanced warning signs, and relocate stop bars on Old Hot Springs Road to improve sight distance.**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Sign and Pole (with Installation)	4	EA	\$600	\$2,400
Milling and Overlay	240	SF	\$5	\$1,200
Install 24" Solid White Stop Line	240	LF	\$10	\$2,400
Subtotal				\$6,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$2,400
Preliminary Engineering (15%)				\$900
Construction Engineering (10%)				\$600
<b>Total Site Improvement Cost</b>				<b>\$10,000</b>

**Assumptions:**

Assumed one sign per leg.

**CAMPO LRSP Goni Road and Old Hot Springs Road Cost Estimate Details**

**Recommendation: Review existing speed limit sign locations and add new locations using oversized speed limit signs.**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Speed Study	1	EA	\$10,000	\$10,000
Remove Sign and Pole	2	EA	\$100	\$200
Sign and Pole (with Installation)	4	EA	\$600	\$2,400
Subtotal				\$12,600
<b>Project Cost Summary</b>				
Contingency (40%)				\$5,040
Preliminary Engineering (15%)				\$1,890
Construction Engineering (10%)				\$1,260
<b>Total Site Improvement Cost</b>				<b>\$21,000</b>

**Assumptions:**  
Assumed adding sign on two of four legs.

**Recommendation: Install signage for heavy vehicles.**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
Sign and Pole (with Installation)	4	EA	\$600	\$2,400
Subtotal				\$2,400
<b>Project Cost Summary</b>				
Contingency (40%)				\$960
Preliminary Engineering (15%)				\$360
Construction Engineering (10%)				\$240
<b>Total Site Improvement Cost</b>				<b>\$4,000</b>

**Assumptions:**  
Assume one sign per leg.

**Reconfigure roadway to accommodate for improved pedestrian or bicycle facilities throughout corridor. Restripe**

Improvements	Quantity	Units	Unit Cost	Improvement Cost
<b>Site Improvement Costs</b>				
On Street Bike Facility	3,000	SF	\$20	\$60,000
Subtotal				\$60,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$24,000
Preliminary Engineering (15%)				\$9,000
Construction Engineering (10%)				\$6,000
<b>Total Site Improvement Cost</b>				<b>\$99,000</b>

**Assumptions:**  
Assumed bike N/S and E/W bike facilities.

**CAMPO LRSP US-395 and Topsy Ln Cost Estimate Details**

<b>Recommendation: Install retroreflective backplates on each signal head.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Retroreflective Backplates	30	EA	\$710	\$21,300
Subtotal				\$21,300
<b>Project Cost Summary</b>				
Contingency (40%)				\$8,520
Preliminary Engineering (15%)				\$3,195
Construction Engineering (10%)				\$2,130
<b>Total Site Improvement Cost</b>				<b>\$35,000</b>
<b>Assumptions:</b>				
Assumed retroreflective backplates on all signal heads.				

<b>Recommendation: Coordinate signal timing with Jacks Valley/Clear Creek intersection.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Signal Retiming	1	INT	\$3,000	\$3,000
Subtotal				\$3,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$1,200
Preliminary Engineering (15%)				\$450
Construction Engineering (10%)				\$300
<b>Total Site Improvement Cost</b>				<b>\$5,000</b>
<b>Assumptions:</b>				
Assumed retroreflective backplates on all signal heads.				

<b>Recommendation: Clear debris from curb ramps.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Debris from Sidewalk	1	MILE	\$320	\$320
Subtotal				\$320
<b>Project Cost Summary</b>				
Contingency (40%)				\$128
Preliminary Engineering (15%)				\$48
Construction Engineering (10%)				\$32
<b>Total Site Improvement Cost</b>				<b>\$500</b>
<b>Assumptions: None</b>				

**CAMPO LRSP US-395 and Topsy Ln Cost Estimate Details**

<b>Recommendation: Redesign right turn lanes to improve sight visibility, reduce speeds for right turning vehicles, and</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
Intersection Realignment	1	INT	\$10,000,000	\$10,000,000
<b>Subtotal</b>				<b>\$10,000,000</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$4,000,000</b>
<b>Preliminary Engineering (15%)</b>				<b>\$1,500,000</b>
<b>Construction Engineering (10%)</b>				<b>\$1,000,000</b>
<b>Total Site Improvement Cost</b>				<b>\$16,500,000</b>
<b>Assumptions:</b>				
Intersection realignment assumes civil work, pedestrian facilities, and hardware components.				

<b>Recommendation: Install oversized speed limit signage.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
Sign and Pole (with Installation)	2	EA	\$600	\$1,200
<b>Subtotal</b>				<b>\$1,200</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$480</b>
<b>Preliminary Engineering (15%)</b>				<b>\$180</b>
<b>Construction Engineering (10%)</b>				<b>\$120</b>
<b>Total Site Improvement Cost</b>				<b>\$2,000</b>
<b>Assumptions:</b>				
Assumed one new sign on NB and SB directions.				

<b>Recommendation: Install advance street name signs.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
Sign and Pole (with Installation)	2	EA	\$600	\$1,200
<b>Subtotal</b>				<b>\$1,200</b>
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$480</b>
<b>Preliminary Engineering (15%)</b>				<b>\$180</b>
<b>Construction Engineering (10%)</b>				<b>\$120</b>
<b>Total Site Improvement Cost</b>				<b>\$2,000</b>
<b>Assumptions:</b>				
Assumed one new sign on NB and SB directions.				

**CAMPO LRSP US-395 and Topsy Ln Cost Estimate Details**

<b>Recommendation: Rehabilitate pavement and restripe crosswalks and lane lines.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
High Friction Surface Treatment	400	SY	\$34	\$13,600
			Subtotal	\$13,600
<b>Project Cost Summary</b>				
			<b>Contingency (40%)</b>	<b>\$5,440</b>
			<b>Preliminary Engineering (15%)</b>	<b>\$2,040</b>
			<b>Construction Engineering (10%)</b>	<b>\$1,360</b>
			<b>Total Site Improvement Cost</b>	<b>\$22,500</b>
<b>Assumptions:</b>				
Assumed one new sign on NB and SB directions.				

<b>Recommendation: Install bike lane signage on Topsy Lane.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Sign and Pole (with Installation)	2	EA	\$600	\$1,200
			Subtotal	\$1,200
<b>Project Cost Summary</b>				
			<b>Contingency (40%)</b>	<b>\$480</b>
			<b>Preliminary Engineering (15%)</b>	<b>\$180</b>
			<b>Construction Engineering (10%)</b>	<b>\$120</b>
			<b>Total Site Improvement Cost</b>	<b>\$2,000</b>
<b>Assumptions:</b>				

<b>Recommendation: Align signal heads with one centered over each lane.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Traffic Signal Head with Installation	2	EA	\$3,985	\$7,970
			Subtotal	\$7,970
<b>Project Cost Summary</b>				
			<b>Contingency (40%)</b>	<b>\$3,188</b>
			<b>Preliminary Engineering (15%)</b>	<b>\$1,196</b>
			<b>Construction Engineering (10%)</b>	<b>\$797</b>
			<b>Total Site Improvement Cost</b>	<b>\$13,000</b>
<b>Assumptions:</b>				
One additional signal head in EB and WB direction needed.				

**CAMPO LRSP US-395 and Topsy Ln Cost Estimate Details**

<b>Recommendation: Evaluate intersection design and modify medians to prevent vehicles from making a left out of</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Traffic Impact Study	1	EA	\$10,000	\$10,000
Subtotal				\$10,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$4,000
Preliminary Engineering (15%)				\$1,500
Construction Engineering (10%)				\$1,000
<b>Total Site Improvement Cost</b>				<b>\$16,500</b>
<b>Assumptions:</b>				
One additional signal head in EB and WB direction needed.				

<b>Recommendation: Design compliant taper on northbound US 395 to allow for vehicles to merge.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Pavement	3,000	SF	\$10	\$30,000
1" UTACS Paving	3,000	SF	\$11	\$33,000
Aggregate Base (10")	3,000	SF	\$11	\$33,000
Subtotal				\$96,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$38,400
Preliminary Engineering (15%)				\$14,400
Construction Engineering (10%)				\$9,600
<b>Total Site Improvement Cost</b>				<b>\$158,500</b>
<b>Assumptions:</b>				
One additional signal head in EB and WB direction needed.				

<b>Recommendation: Design compliant taper on Topsy Lane to allow for vehicles to merge.</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
Remove Pavement	3,000	SF	\$10	\$30,000
1" UTACS Paving	3,000	SF	\$11	\$33,000
Aggregate Base (10")	3,000	SF	\$11	\$33,000
Subtotal				\$96,000
<b>Project Cost Summary</b>				
Contingency (40%)				\$38,400
Preliminary Engineering (15%)				\$14,400
Construction Engineering (10%)				\$9,600
<b>Total Site Improvement Cost</b>				<b>\$158,500</b>
<b>Assumptions:</b>				
One additional signal head in EB and WB direction needed.				

**CAMPO LRSP US-395 and Topsy Ln Cost Estimate Details**

<b>Recommendation: Reconfigure bike lane to avoid drop inlet or relocate drop inlet. Consider a more bike traversable</b>				
<b>Improvements</b>	<b>Quantity</b>	<b>Units</b>	<b>Unit Cost</b>	<b>Improvement Cost</b>
<b>Site Improvement Costs</b>				
On Street Bike Facility	500	SF	\$20	\$10,000
Subtotal				\$10,000
<b>Project Cost Summary</b>				
<b>Contingency (40%)</b>				<b>\$4,000</b>
<b>Preliminary Engineering (15%)</b>				<b>\$1,500</b>
<b>Construction Engineering (10%)</b>				<b>\$1,000</b>
<b>Total Site Improvement Cost</b>				<b>\$16,500</b>
<b>Assumptions:</b>				
Assumed bike N/S and E/W bike facilities.				

## Updated Societal Costs

Consumer Price Index (CPI) and Employment Cost Index (ECI) are used from the Bureau of Labor Statistics website (www.bls.gov). All calculations are from the Highway Safety Manual 1st Ed. Vol. 1, page 4-85 annual adjustments

2001 CPI= 177.1  
 August 2023 CPI= 307.026

2001 ECI= 85.8  
 June 2023 ECI= 159.2

Crash Severity	2001 Human Capital Cost	2001 Comprehensive Societal Cost	2023 CPI - Adjusted Human Capital Costs	2023 CPI - Adjusted Societal Costs	Cost Difference	2023 ECI - Adjusted Cost Difference	2023 Comprehensive Societal Costs
K	\$1,245,600	\$4,008,900	\$2,159,410	\$7,286,652	\$2,763,300	\$5,127,242	\$7,286,652
A	\$111,400	\$216,000	\$193,126	\$387,209	\$104,600	\$194,083	\$387,209
B	\$41,900	\$79,000	\$72,639	\$141,477	\$37,100	\$68,838	\$141,477
C	\$28,400	\$44,900	\$49,235	\$79,850	\$16,500	\$30,615	\$79,850
O	\$6,400	\$7,400	\$11,095	\$12,951	\$1,000	\$1,855	\$12,951



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install Dynamic Speed Feedback Sign CMF ID: 6885
PROJECT LOCATION	N Carson Street from I-580 to Long Street
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWI ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTERIAL ▼
IMPLEMENTATION COSTS	\$119,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENANCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	1	5.00%	0.01
INJURY A	\$387,209	6	5.00%	0.06
INJURY B	\$141,477	17	5.00%	0.17
INJURY C	\$79,850	25	5.00%	0.25
PDO	\$12,951	114	5.00%	1.14

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.01	\$7,286,652	\$72,867
INJURY A	0.06	\$387,209	\$23,233
INJURY B	0.17	\$141,477	\$24,051
INJURY C	0.25	\$79,850	\$19,963
PDO	1.14	\$12,951	\$14,764

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$154,877
TOTAL ANNUAL BENEFITS (Including Growth)	\$157,974
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$8,219
TOTAL ANNUALIZED COSTS	\$8,219
AVERAGE ANNUAL NET RETURN	\$149,755
<b>BENEFIT/COST</b>	<b>19.22</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install On-Street Bike Facility (NDOT CMF # BP-01)
PROJECT LOCATION	N Carson Street from I-580 to Long Street
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWI ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTERIAL ▼
IMPLEMENTATION COSTS	\$435,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENANCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	60.00%	0.00
INJURY A	\$387,209	0	60.00%	0.00
INJURY B	\$141,477	1	60.00%	0.12
INJURY C	\$79,850	0	60.00%	0.00
PDO	\$12,951	1	60.00%	0.12

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.12	\$141,477	\$16,977
INJURY C	0.00	\$79,850	\$0
PDO	0.12	\$12,951	\$1,554

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$18,531
TOTAL ANNUAL BENEFITS (Including Growth)	\$18,902
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$29,953
TOTAL ANNUALIZED COSTS	\$29,953
AVERAGE ANNUAL NET RETURN	(\$11,051)
<b>BENEFIT/COST</b>	<b>0.63</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Lighting (FHWA Proven Safety Countermeasures CMF ID: 192)
PROJECT LOCATION	N Carson Street from I-580 to Long Street
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWI ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTERIAL ▼
IMPLEMENTATION COSTS	\$528,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENANCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	1	28.00%	0.06
INJURY A	\$387,209	4	28.00%	0.22
INJURY B	\$141,477	3	28.00%	0.17
INJURY C	\$79,850	2	28.00%	0.11
PDO	\$12,951	14	28.00%	0.78

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.06	\$7,286,652	\$408,053
INJURY A	0.22	\$387,209	\$86,735
INJURY B	0.17	\$141,477	\$23,768
INJURY C	0.11	\$79,850	\$8,943
PDO	0.78	\$12,951	\$10,153

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$537,652
TOTAL ANNUAL BENEFITS (Including Growth)	\$548,405
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$36,315
TOTAL ANNUALIZED COSTS	\$36,315
AVERAGE ANNUAL NET RETURN	\$512,090
<b>BENEFIT/COST</b>	<b>15.10</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Convert Non-Signalized Urban Intersection to Roundabout (NDOT CMF # US-14)
PROJECT LOCATION	N Carson Street from I-580 to Long Street
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWI ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTERIAL ▼
IMPLEMENTATION COSTS	\$8,903,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENANCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 ▼ YEAR(S)
LENGTH OF STUDY	5 ▼ YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	1	71.00%	0.14
INJURY A	\$387,209	6	71.00%	0.85
INJURY B	\$141,477	17	71.00%	2.41
INJURY C	\$79,850	25	71.00%	3.55
PDO	\$12,951	114	0.00%	0.00

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.14	\$7,286,652	\$1,034,705
INJURY A	0.85	\$387,209	\$329,902
INJURY B	2.41	\$141,477	\$341,526
INJURY C	3.55	\$79,850	\$283,469
PDO	0.00	\$12,951	\$0

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$1,989,603
TOTAL ANNUAL BENEFITS (Including Growth)	\$2,029,395
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$612,373
TOTAL ANNUALIZED COSTS	\$612,373
AVERAGE ANNUAL NET RETURN	\$1,417,022
<b>BENEFIT/COST</b>	<b>3.31</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Improve Pavement Friction - High Friction Surface Treatment (HFST) (NDOT CMF # CS-02)
PROJECT LOCATION	N Carson Street from I-580 to Long Street
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWI ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTERIAL ▼
IMPLEMENTATION COSTS	\$352,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	1	35.00%	0.07
INJURY A	\$387,209	6	35.00%	0.42
INJURY B	\$141,477	17	35.00%	1.19
INJURY C	\$79,850	25	35.00%	1.75
PDO	\$12,951	114	35.00%	7.98

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.07	\$7,286,652	\$510,066
INJURY A	0.42	\$387,209	\$162,628
INJURY B	1.19	\$141,477	\$168,358
INJURY C	1.75	\$79,850	\$139,738
PDO	7.98	\$12,951	\$103,347

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$1,084,137
TOTAL ANNUAL BENEFITS (Including Growth)	\$1,105,819
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$24,210
TOTAL ANNUALIZED COSTS	\$24,210
AVERAGE ANNUAL NET RETURN	\$1,081,609
<b>BENEFIT/COST</b>	<b>45.68</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install Rectangular Rapid Flashing Beacons (RRFB) (NDOT CMF # BP-03)
PROJECT LOCATION	N Carson Street from I-580 to Long Street
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWI ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTERIAL ▼
IMPLEMENTATION COSTS	\$1,070,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENANCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 ▼ YEAR(S)
LENGTH OF STUDY	5 ▼ YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	1	47.00%	0.09
INJURY A	\$387,209	2	47.00%	0.19
INJURY B	\$141,477	0	47.00%	0.00
INJURY C	\$79,850	2	47.00%	0.19
PDO	\$12,951	4	47.00%	0.38

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.09	\$7,286,652	\$684,945
INJURY A	0.19	\$387,209	\$72,795
INJURY B	0.00	\$141,477	\$0
INJURY C	0.19	\$79,850	\$15,012
PDO	0.38	\$12,951	\$4,869

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$777,622
TOTAL ANNUAL BENEFITS (Including Growth)	\$793,175
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$73,628
TOTAL ANNUALIZED COSTS	\$73,628
AVERAGE ANNUAL NET RETURN	\$719,547
<b>BENEFIT/COST</b>	<b>10.77</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Improve Street Lighting Illuminance and Uniformity (CMF ID: 11026)
PROJECT LOCATION	N Carson Street from I-580 to Long Street
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWI ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTERIAL ▼
IMPLEMENTATION COSTS	\$515,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENANCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	1	32.00%	0.06
INJURY A	\$387,209	4	32.00%	0.26
INJURY B	\$141,477	3	32.00%	0.19
INJURY C	\$79,850	2	32.00%	0.13
PDO	\$12,951	14	32.00%	0.90

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.06	\$7,286,652	\$466,346
INJURY A	0.26	\$387,209	\$99,126
INJURY B	0.19	\$141,477	\$27,164
INJURY C	0.13	\$79,850	\$10,221
PDO	0.90	\$12,951	\$11,604

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$614,460
TOTAL ANNUAL BENEFITS (Including Growth)	\$626,749
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$35,421
TOTAL ANNUALIZED COSTS	\$35,421
AVERAGE ANNUAL NET RETURN	\$591,328
<b>BENEFIT/COST</b>	<b>17.69</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

05/06/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Lower Posted Speed Limit (CMF ID: 11288)
PROJECT LOCATION	S Carson Street from Stewart Street to I-580
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWI ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTERIAL ▼
IMPLEMENTATION COSTS	\$103,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENANCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	1	14.40%	0.03
INJURY A	\$387,209	6	14.40%	0.17
INJURY B	\$141,477	22	14.40%	0.63
INJURY C	\$79,850	30	14.40%	0.86
PDO	\$12,951	149	0.00%	0.00

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.03	\$7,286,652	\$209,856
INJURY A	0.17	\$387,209	\$66,910
INJURY B	0.63	\$141,477	\$89,131
INJURY C	0.86	\$79,850	\$68,671
PDO	0.00	\$12,951	\$0

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$434,568
TOTAL ANNUAL BENEFITS (Including Growth)	\$443,259
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$7,119
TOTAL ANNUALIZED COSTS	\$7,119
AVERAGE ANNUAL NET RETURN	\$436,140
<b>BENEFIT/COST</b>	<b>62.27</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Replace TWLTL with Raised Median (CMF ID: 2514)
PROJECT LOCATION	S Carson Street from Stewart Street to I-580
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWLT ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$4,948,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### **CALCULATION OF REDUCTIONS**

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	1	23.00%	0.05
INJURY A	\$387,209	6	23.00%	0.28
INJURY B	\$141,477	22	23.00%	1.01
INJURY C	\$79,850	30	23.00%	1.38
PDO	\$12,951	149	23.00%	6.85

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### **CALCULATION OF BENEFITS**

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.05	\$7,286,652	\$335,186
INJURY A	0.28	\$387,209	\$106,870
INJURY B	1.01	\$141,477	\$143,175
INJURY C	1.38	\$79,850	\$110,194
PDO	6.85	\$12,951	\$88,764

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$784,189
TOTAL ANNUAL BENEFITS (Including Growth)	\$799,873
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$340,318
TOTAL ANNUALIZED COSTS	\$340,318
AVERAGE ANNUAL NET RETURN	\$459,555
<b>BENEFIT/COST</b>	<b>2.35</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Lighting (FHWA Proven Safety Countermeasures)
PROJECT LOCATION	S Carson Street from Stewart Street to I-580
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWLT ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$759,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 ▼ YEAR(S)
LENGTH OF STUDY	5 ▼ YEAR(S)

#### **CALCULATION OF REDUCTIONS**

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	33.00%	0.00
INJURY A	\$387,209	2	33.00%	0.13
INJURY B	\$141,477	4	33.00%	0.26
INJURY C	\$79,850	3	33.00%	0.20
PDO	\$12,951	19	33.00%	1.25

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### **CALCULATION OF BENEFITS**

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.13	\$387,209	\$51,112
INJURY B	0.26	\$141,477	\$37,350
INJURY C	0.20	\$79,850	\$15,810
PDO	1.25	\$12,951	\$16,240

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$120,512
TOTAL ANNUAL BENEFITS (Including Growth)	\$122,923
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$52,203
TOTAL ANNUALIZED COSTS	\$52,203
AVERAGE ANNUAL NET RETURN	\$70,719
<b>BENEFIT/COST</b>	<b>2.35</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO. NONE

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PROJECT NO. 092202057: CAMPO LRSP

COUNTERMEASURE Install Advanced Street Name Signs (NDOT CMF # SI-13)

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PROJECT LOCATION S Carson Street from Stewart Street to I-580

ROADWAY CHARACTERISTICS 4 LANE UNDIVIDED W/TWLT

DEMOGRAPHIC DESIGNATION URBAN

FUNCTIONAL CLASSIFICATION 4 MINOR ARTFRIAI

IMPLEMENTATION COSTS \$26,500 (NDOT Bid Tabs and other Local Projects)

ANNUAL MAINTENENCE COSTS \$0

CURRENT PRIME INTEREST RATE 3.25%

PERCENTAGE OF GROWTH 2.00%

ESTIMATED SERVICE LIFE 20 YEAR(S)

LENGTH OF STUDY 5 YEAR(S)

#### **CALCULATION OF REDUCTIONS**

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	1	2.00%	0.00
INJURY A	\$387,209	6	2.00%	0.02
INJURY B	\$141,477	22	2.00%	0.09
INJURY C	\$79,850	30	2.00%	0.12
PDO	\$12,951	149	2.00%	0.60

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### **CALCULATION OF BENEFITS**

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$29,147
INJURY A	0.02	\$387,209	\$9,293
INJURY B	0.09	\$141,477	\$12,450
INJURY C	0.12	\$79,850	\$9,582
PDO	0.60	\$12,951	\$7,719

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$68,190
TOTAL ANNUAL BENEFITS (Including Growth)	\$69,554
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$1,823
TOTAL ANNUALIZED COSTS	\$1,823
AVERAGE ANNUAL NET RETURN	\$67,731
<b>BENEFIT/COST</b>	<b>38.16</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Change from Permitted or Permitted-Protected to Protected (CMF ID: 333)
PROJECT LOCATION	S Carson Street from Stewart Street to I-580
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWLT ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$38,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	1	99.00%	0.20
INJURY A	\$387,209	6	99.00%	1.19
INJURY B	\$141,477	22	99.00%	4.36
INJURY C	\$79,850	30	99.00%	5.94
PDO	\$12,951	149	99.00%	29.50

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.20	\$7,286,652	\$1,442,757
INJURY A	1.19	\$387,209	\$460,005
INJURY B	4.36	\$141,477	\$616,275
INJURY C	5.94	\$79,850	\$474,312
PDO	29.50	\$12,951	\$382,072

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$3,375,421
TOTAL ANNUAL BENEFITS (Including Growth)	\$3,442,930
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$2,648
TOTAL ANNUALIZED COSTS	\$2,648
AVERAGE ANNUAL NET RETURN	\$3,440,282
<b>BENEFIT/COST</b>	<b>1300.21</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

05/06/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Implement Systemic Signing and Visibility Improvements at Signalized Intersection (NDOT Planning Level CMF SI-14)
PROJECT LOCATION	S Carson Street from Stewart Street to I-580
ROADWAY CHARACTERISTICS	6 LANE DIVIDED
DEMOGRAPHIC DESIGNATION	URBAN
FUNCTIONAL CLASSIFICATION	4 MINOR ARTERIAL
IMPLEMENTATION COSTS	\$1,892,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S)
LENGTH OF STUDY	5 YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	4.00%	0.00
INJURY A	\$387,209	0	4.00%	0.00
INJURY B	\$141,477	0	4.00%	0.00
INJURY C	\$79,850	0	4.00%	0.00
PDO	\$12,951	0	4.00%	0.00

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.00	\$141,477	\$0
INJURY C	0.00	\$79,850	\$0
PDO	0.00	\$12,951	\$0

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$0
TOTAL ANNUAL BENEFITS (Including Growth)	\$0
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$130,164
TOTAL ANNUALIZED COSTS	\$130,164
AVERAGE ANNUAL NET RETURN	(\$130,164)
<b>BENEFIT/COST</b>	<b>0.00</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Lighting (FHWA Proven Safety Countermeasures)
PROJECT LOCATION	S Carson Street from Stewart Street to I-580
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWLT ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$33,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### **CALCULATION OF REDUCTIONS**

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	33.00%	0.00
INJURY A	\$387,209	2	33.00%	0.13
INJURY B	\$141,477	4	33.00%	0.26
INJURY C	\$79,850	3	33.00%	0.20
PDO	\$12,951	19	33.00%	1.25

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### **CALCULATION OF BENEFITS**

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.13	\$387,209	\$51,112
INJURY B	0.26	\$141,477	\$37,350
INJURY C	0.20	\$79,850	\$15,810
PDO	1.25	\$12,951	\$16,240

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$120,512
TOTAL ANNUAL BENEFITS (Including Growth)	\$122,923
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$2,270
TOTAL ANNUALIZED COSTS	\$2,270
AVERAGE ANNUAL NET RETURN	\$120,653
<b>BENEFIT/COST</b>	<b>54.16</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install Reduced Conflict Intersection (S-Island, J-Turn, or RCUT) (NDOT CMF # US-02)
PROJECT LOCATION	S Carson Street from Stewart Street to I-580
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWLT ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$4,574,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 ▼ YEAR(S)
LENGTH OF STUDY	5 ▼ YEAR(S)

#### **CALCULATION OF REDUCTIONS**

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	1	19.00%	0.04
INJURY A	\$387,209	6	19.00%	0.23
INJURY B	\$141,477	22	19.00%	0.84
INJURY C	\$79,850	30	19.00%	1.14
PDO	\$12,951	149	19.00%	5.66

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### **CALCULATION OF BENEFITS**

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.04	\$7,286,652	\$276,893
INJURY A	0.23	\$387,209	\$88,284
INJURY B	0.84	\$141,477	\$118,275
INJURY C	1.14	\$79,850	\$91,030
PDO	5.66	\$12,951	\$73,327

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$647,808
TOTAL ANNUAL BENEFITS (Including Growth)	\$660,764
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$314,595
TOTAL ANNUALIZED COSTS	\$314,595
AVERAGE ANNUAL NET RETURN	\$346,170
<b>BENEFIT/COST</b>	<b>2.10</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO. NONE

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PROJECT NO. 092202057: CAMPO LRSP

COUNTERMEASURE Install Advanced Street Name Signs (NDOT CMF # SI-13)

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PROJECT LOCATION S Carson Street from Stewart Street to I-580

ROADWAY CHARACTERISTICS 4 LANE UNDIVIDED W/TWLT

DEMOGRAPHIC DESIGNATION URBAN

FUNCTIONAL CLASSIFICATION 4 MINOR ARTFRIAI

IMPLEMENTATION COSTS \$26,500 (NDOT Bid Tabs and other Local Projects)

ANNUAL MAINTENENCE COSTS \$0

CURRENT PRIME INTEREST RATE 3.25%

PERCENTAGE OF GROWTH 2.00%

ESTIMATED SERVICE LIFE 20 YEAR(S)

LENGTH OF STUDY 5 YEAR(S)

#### **CALCULATION OF REDUCTIONS**

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	2.00%	0.00
INJURY A	\$387,209	0	2.00%	0.00
INJURY B	\$141,477	1	2.00%	0.00
INJURY C	\$79,850	0	2.00%	0.00
PDO	\$12,951	0	2.00%	0.00

\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.

#### **CALCULATION OF BENEFITS**

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.00	\$141,477	\$566
INJURY C	0.00	\$79,850	\$0
PDO	0.00	\$12,951	\$0

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$566
TOTAL ANNUAL BENEFITS (Including Growth)	\$577
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$1,823
TOTAL ANNUALIZED COSTS	\$1,823
AVERAGE ANNUAL NET RETURN	(\$1,245)
<b>BENEFIT/COST</b>	<b>0.32</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Lower Posted Speed Limit (CMF ID: 11288)
PROJECT LOCATION	S Curry Street from Lake Glen Drive to Curry Circle
ROADWAY CHARACTERISTICS	2 LANE UNDIVIDED
DEMOGRAPHIC DESIGNATION	URBAN
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI
IMPLEMENTATION COSTS	\$20,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S)
LENGTH OF STUDY	5 YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	14.00%	0.00
INJURY A	\$387,209	0	14.00%	0.00
INJURY B	\$141,477	2	14.00%	0.06
INJURY C	\$79,850	2	14.00%	0.06
PDO	\$12,951	3	14.00%	0.08

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.06	\$141,477	\$7,923
INJURY C	0.06	\$79,850	\$4,472
PDO	0.08	\$12,951	\$1,088

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$13,482
TOTAL ANNUAL BENEFITS (Including Growth)	\$13,752
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$1,410
TOTAL ANNUALIZED COSTS	\$1,410
AVERAGE ANNUAL NET RETURN	\$12,342
<b>BENEFIT/COST</b>	<b>9.75</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Prohibit On-Street Parking (CMF ID: 153)
PROJECT LOCATION	S Curry Street from Lake Glen Drive to Curry Circle
ROADWAY CHARACTERISTICS	2 LANE UNDIVIDED
DEMOGRAPHIC DESIGNATION	URBAN
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI
IMPLEMENTATION COSTS	\$14,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S)
LENGTH OF STUDY	5 YEAR(S)

#### **CALCULATION OF REDUCTIONS**

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	20.00%	0.00
INJURY A	\$387,209	0	20.00%	0.00
INJURY B	\$141,477	2	20.00%	0.08
INJURY C	\$79,850	2	20.00%	0.08
PDO	\$12,951	3	20.00%	0.12

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### **CALCULATION OF BENEFITS**

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.08	\$141,477	\$11,318
INJURY C	0.08	\$79,850	\$6,388
PDO	0.12	\$12,951	\$1,554

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$19,260
TOTAL ANNUAL BENEFITS (Including Growth)	\$19,646
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$963
TOTAL ANNUALIZED COSTS	\$963
AVERAGE ANNUAL NET RETURN	\$18,683
<b>BENEFIT/COST</b>	<b>20.40</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

05/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Change Lane Width From 10 to 12 (in feet) (CMF ID: 10223)
PROJECT LOCATION	S Curry Street from Lake Glen Drive to Curry Circle
ROADWAY CHARACTERISTICS	2 LANE UNDIVIDED
DEMOGRAPHIC DESIGNATION	URBAN
FUNCTIONAL CLASSIFICATION	4 MINOR ARTERIAL
IMPLEMENTATION COSTS	\$13,767,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S)
LENGTH OF STUDY	5 YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	49.70%	0.00
INJURY A	\$387,209	0	49.70%	0.00
INJURY B	\$141,477	2	49.70%	0.20
INJURY C	\$79,850	2	49.70%	0.20
PDO	\$12,951	3	49.70%	0.30

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.20	\$141,477	\$28,128
INJURY C	0.20	\$79,850	\$15,876
PDO	0.30	\$12,951	\$3,862

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$47,866
TOTAL ANNUAL BENEFITS (Including Growth)	\$48,824
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$946,879
TOTAL ANNUALIZED COSTS	\$946,879
AVERAGE ANNUAL NET RETURN	(\$898,055)
<b>BENEFIT/COST</b>	<b>0.05</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Lower Posted Speed Limit (CMF ID: 11288)
PROJECT LOCATION	Saliman Road from Long Street to Fairview Drive
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWLT ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$121,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### **CALCULATION OF REDUCTIONS**

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	14.00%	0.00
INJURY A	\$387,209	4	14.00%	0.11
INJURY B	\$141,477	17	14.00%	0.48
INJURY C	\$79,850	21	14.00%	0.59
PDO	\$12,951	82	0.00%	0.00

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### **CALCULATION OF BENEFITS**

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.11	\$387,209	\$43,367
INJURY B	0.48	\$141,477	\$67,343
INJURY C	0.59	\$79,850	\$46,952
PDO	0.00	\$12,951	\$0

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$157,663
TOTAL ANNUAL BENEFITS (Including Growth)	\$160,816
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$8,357
TOTAL ANNUALIZED COSTS	\$8,357
AVERAGE ANNUAL NET RETURN	\$152,459
<b>BENEFIT/COST</b>	<b>19.24</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Prohibit On-Street Parking (CMF ID: 153)
PROJECT LOCATION	Saliman Road from Long Street to Fairview Drive
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWLT ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$55,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	0.00%	0.00
INJURY A	\$387,209	4	20.00%	0.16
INJURY B	\$141,477	17	20.00%	0.68
INJURY C	\$79,850	21	20.00%	0.84
PDO	\$12,951	82	0.00%	0.00

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.16	\$387,209	\$61,954
INJURY B	0.68	\$141,477	\$96,205
INJURY C	0.84	\$79,850	\$67,074
PDO	0.00	\$12,951	\$0

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$225,233
TOTAL ANNUAL BENEFITS (Including Growth)	\$229,737
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$3,783
TOTAL ANNUALIZED COSTS	\$3,783
AVERAGE ANNUAL NET RETURN	\$225,954
<b>BENEFIT/COST</b>	<b>60.73</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Replace TWLTL with Raised Median (CMF ID: 2514)
PROJECT LOCATION	Saliman Road from Long Street to Fairview Drive
ROADWAY CHARACTERISTICS	6 LANE DIVIDED ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$3,760,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	23.00%	0.00
INJURY A	\$387,209	4	23.00%	0.18
INJURY B	\$141,477	17	23.00%	0.78
INJURY C	\$79,850	21	23.00%	0.97
PDO	\$12,951	82	23.00%	3.77

\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.18	\$387,209	\$71,247
INJURY B	0.78	\$141,477	\$110,635
INJURY C	0.97	\$79,850	\$77,136
PDO	3.77	\$12,951	\$48,850

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$307,868
TOTAL ANNUAL BENEFITS (Including Growth)	\$314,025
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$258,609
TOTAL ANNUALIZED COSTS	\$258,609
AVERAGE ANNUAL NET RETURN	\$55,416
<b>BENEFIT/COST</b>	<b>1.21</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Improve Street Lighting Illuminance and Uniformity (CMF: 11026)
PROJECT LOCATION	Saliman Road from Long Street to Fairview Drive
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWLT ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAL ▼
IMPLEMENTATION COSTS	\$30,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	32.00%	0.00
INJURY A	\$387,209	1	32.00%	0.06
INJURY B	\$141,477	2	32.00%	0.13
INJURY C	\$79,850	6	32.00%	0.38
PDO	\$12,951	10	32.00%	0.64

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.06	\$387,209	\$24,781
INJURY B	0.13	\$141,477	\$18,109
INJURY C	0.38	\$79,850	\$30,663
PDO	0.64	\$12,951	\$8,288

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$81,842
TOTAL ANNUAL BENEFITS (Including Growth)	\$83,478
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$2,063
TOTAL ANNUALIZED COSTS	\$2,063
AVERAGE ANNUAL NET RETURN	\$81,415
<b>BENEFIT/COST</b>	<b>40.46</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Lighting (FHWA Proven Safety Countermeasures CMF ID: 192)
PROJECT LOCATION	Saliman Road from Long Street to Fairview Drive
ROADWAY CHARACTERISTICS	6 LANE DIVIDED ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$396,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 ▼ YEAR(S)
LENGTH OF STUDY	5 ▼ YEAR(S)

#### **CALCULATION OF REDUCTIONS**

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	28.00%	0.00
INJURY A	\$387,209	1	28.00%	0.06
INJURY B	\$141,477	2	28.00%	0.11
INJURY C	\$79,850	6	28.00%	0.34
PDO	\$12,951	10	28.00%	0.56

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### **CALCULATION OF BENEFITS**

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.06	\$387,209	\$21,684
INJURY B	0.11	\$141,477	\$15,845
INJURY C	0.34	\$79,850	\$26,830
PDO	0.56	\$12,951	\$7,252

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$71,611
TOTAL ANNUAL BENEFITS (Including Growth)	\$73,044
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$27,236
TOTAL ANNUALIZED COSTS	\$27,236
AVERAGE ANNUAL NET RETURN	\$45,807
<b>BENEFIT/COST</b>	<b>2.68</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install On-Street Bike Facility (NDOT CMF # BP-05)
PROJECT LOCATION	Saliman Road from Long Street to Fairview Drive
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWLT ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$2,892,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	60.00%	0.00
INJURY A	\$387,209	0	60.00%	0.00
INJURY B	\$141,477	3	60.00%	0.36
INJURY C	\$79,850	1	60.00%	0.12
PDO	\$12,951	0	60.00%	0.00

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.36	\$141,477	\$50,932
INJURY C	0.12	\$79,850	\$9,582
PDO	0.00	\$12,951	\$0

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$60,514
TOTAL ANNUAL BENEFITS (Including Growth)	\$61,724
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$198,943
TOTAL ANNUALIZED COSTS	\$198,943
AVERAGE ANNUAL NET RETURN	(\$137,219)
<b>BENEFIT/COST</b>	<b>0.31</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install Chevron Signs, Curve Warning Signs, and Subsequent Flashing Beacons (CMF: 1914)
PROJECT LOCATION	Saliman Road from Long Street to Fairview Drive
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWLT ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$16,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	48.00%	0.00
INJURY A	\$387,209	4	48.00%	0.38
INJURY B	\$141,477	17	48.00%	1.63
INJURY C	\$79,850	21	48.00%	2.02
PDO	\$12,951	82	48.00%	7.87

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.38	\$387,209	\$148,688
INJURY B	1.63	\$141,477	\$230,891
INJURY C	2.02	\$79,850	\$160,979
PDO	7.87	\$12,951	\$101,948

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$642,506
TOTAL ANNUAL BENEFITS (Including Growth)	\$655,356
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$1,135
TOTAL ANNUALIZED COSTS	\$1,135
AVERAGE ANNUAL NET RETURN	\$654,221
<b>BENEFIT/COST</b>	<b>577.48</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install Rectangular Rapid Flashing Beacons (RRFB) (NDOT CMF # BP-03)
PROJECT LOCATION	Saliman Road from Long Street to Fairview Drive
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWLT ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$225,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	47.00%	0.00
INJURY A	\$387,209	0	47.00%	0.00
INJURY B	\$141,477	0	47.00%	0.00
INJURY C	\$79,850	1	47.00%	0.09
PDO	\$12,951	1	47.00%	0.09

\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.00	\$141,477	\$0
INJURY C	0.09	\$79,850	\$7,506
PDO	0.09	\$12,951	\$1,217

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$8,723
TOTAL ANNUAL BENEFITS (Including Growth)	\$8,898
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$15,510
TOTAL ANNUALIZED COSTS	\$15,510
AVERAGE ANNUAL NET RETURN	(\$6,612)
<b>BENEFIT/COST</b>	<b>0.57</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install Chevron Signs, Curve Warning Signs, and Subsequent Flashing Beacons (CMF: 1914)
PROJECT LOCATION	E College Parkway from I-580 to US-50
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWLT ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$26,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	1	48.00%	0.10
INJURY A	\$387,209	3	48.00%	0.29
INJURY B	\$141,477	12	48.00%	1.15
INJURY C	\$79,850	27	48.00%	2.59
PDO	\$12,951	96	48.00%	9.22

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.10	\$7,286,652	\$699,519
INJURY A	0.29	\$387,209	\$111,516
INJURY B	1.15	\$141,477	\$162,982
INJURY C	2.59	\$79,850	\$206,972
PDO	9.22	\$12,951	\$119,354

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$1,300,343
TOTAL ANNUAL BENEFITS (Including Growth)	\$1,326,350
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$1,823
TOTAL ANNUALIZED COSTS	\$1,823
AVERAGE ANNUAL NET RETURN	\$1,324,527
<b>BENEFIT/COST</b>	<b>727.71</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install On-Street Bike Facility (NDOT CMF # BP-05)
PROJECT LOCATION	E College Parkway from I-580 to US-50
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWLT ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAL ▼
IMPLEMENTATION COSTS	\$3,485,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 ▼ YEAR(S)
LENGTH OF STUDY	5 ▼ YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	60.00%	0.00
INJURY A	\$387,209	0	60.00%	0.00
INJURY B	\$141,477	1	60.00%	0.12
INJURY C	\$79,850	0	60.00%	0.00
PDO	\$12,951	0	60.00%	0.00

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.12	\$141,477	\$16,977
INJURY C	0.00	\$79,850	\$0
PDO	0.00	\$12,951	\$0

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$16,977
TOTAL ANNUAL BENEFITS (Including Growth)	\$17,317
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$239,694
TOTAL ANNUALIZED COSTS	\$239,694
AVERAGE ANNUAL NET RETURN	(\$222,378)
<b>BENEFIT/COST</b>	<b>0.07</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Resurface Pavement (CMF ID: 10280)
PROJECT LOCATION	E College Parkway from I-580 to US-50
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWLT ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$16,727,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	1	21.00%	0.04
INJURY A	\$387,209	3	21.00%	0.13
INJURY B	\$141,477	12	21.00%	0.50
INJURY C	\$79,850	27	21.00%	1.13
PDO	\$12,951	96	0.00%	0.00

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.04	\$7,286,652	\$306,039
INJURY A	0.13	\$387,209	\$48,788
INJURY B	0.50	\$141,477	\$71,305
INJURY C	1.13	\$79,850	\$90,550
PDO	0.00	\$12,951	\$0

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$516,683
TOTAL ANNUAL BENEFITS (Including Growth)	\$527,016
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$1,150,464
TOTAL ANNUALIZED COSTS	\$1,150,464
AVERAGE ANNUAL NET RETURN	(\$623,448)
<b>BENEFIT/COST</b>	<b>0.46</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Improve Street Lighting Illuminance and Uniformity (CMF: 11026)
PROJECT LOCATION	E College Parkway from I-580 to US-50
ROADWAY CHARACTERISTICS	4 LANE UNDIVIDED W/TWLT ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$20,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 ▼ YEAR(S)
LENGTH OF STUDY	5 ▼ YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	1	32.00%	0.06
INJURY A	\$387,209	1	32.00%	0.06
INJURY B	\$141,477	1	32.00%	0.06
INJURY C	\$79,850	7	32.00%	0.45
PDO	\$12,951	8	32.00%	0.51

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.06	\$7,286,652	\$466,346
INJURY A	0.06	\$387,209	\$24,781
INJURY B	0.06	\$141,477	\$9,055
INJURY C	0.45	\$79,850	\$35,773
PDO	0.51	\$12,951	\$6,631

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$542,585
TOTAL ANNUAL BENEFITS (Including Growth)	\$553,437
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$1,376
TOTAL ANNUALIZED COSTS	\$1,376
AVERAGE ANNUAL NET RETURN	\$552,062
<b>BENEFIT/COST</b>	<b>402.33</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Implement Leading Pedestrian Interval (NDOT CMF # BP-05)
PROJECT LOCATION	E College Parkway from I-580 to US-50
ROADWAY CHARACTERISTICS	6 LANE DIVIDED ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$5,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	36.00%	0.00
INJURY A	\$387,209	0	36.00%	0.00
INJURY B	\$141,477	0	36.00%	0.00
INJURY C	\$79,850	1	36.00%	0.07
PDO	\$12,951	1	36.00%	0.07

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.00	\$141,477	\$0
INJURY C	0.07	\$79,850	\$5,749
PDO	0.07	\$12,951	\$932

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$6,682
TOTAL ANNUAL BENEFITS (Including Growth)	\$6,815
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$344
TOTAL ANNUALIZED COSTS	\$344
AVERAGE ANNUAL NET RETURN	\$6,471
<b>BENEFIT/COST</b>	<b>19.82</b>

# DRAFT



## PROJECT SAFETY PROCESS CMF METHOD BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/24/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install Edgelines (CMF ID: 1945)
PROJECT LOCATION	E College Parkway from I-580 to US-50
ROADWAY CHARACTERISTICS	6 LANE DIVIDED
DEMOGRAPHIC DESIGNATION	URBAN
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI
IMPLEMENTATION COSTS	\$16,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S)
LENGTH OF STUDY	5 YEAR(S)

### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	11.00%	0.00
INJURY A	\$387,209	0	11.00%	0.00
INJURY B	\$141,477	0	11.00%	0.00
INJURY C	\$79,850	0	11.00%	0.00
PDO	\$12,951	2	11.00%	0.04

### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.00	\$141,477	\$0
INJURY C	0.00	\$79,850	\$0
PDO	0.04	\$12,951	\$570

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$570
TOTAL ANNUAL BENEFITS (Including Growth)	\$581
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$1,100
TOTAL ANNUALIZED COSTS	\$1,100
AVERAGE ANNUAL NET RETURN	(\$519)
<b>BENEFIT/COST</b>	<b>0.53</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install Raised Median with Marked Crosswalk (Uncontrolled) (CMF ID: 175)
PROJECT LOCATION	N Carson Street & W Nye Lane
ROADWAY CHARACTERISTICS	4ST (2 WAY STOP) ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAL ▼
IMPLEMENTATION COSTS	<b>\$16,500,000</b> (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 ▼ YEAR(S)
LENGTH OF STUDY	5 ▼ YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	46.00%	0.00
INJURY A	\$387,209	0	46.00%	0.00
INJURY B	\$141,477	0	46.00%	0.00
INJURY C	\$79,850	0	46.00%	0.00
PDO	\$12,951	0	46.00%	0.00

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.00	\$141,477	\$0
INJURY C	0.00	\$79,850	\$0
PDO	0.00	\$12,951	\$0

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$0
TOTAL ANNUAL BENEFITS (Including Growth)	\$0
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$1,134,852
TOTAL ANNUALIZED COSTS	\$1,134,852
AVERAGE ANNUAL NET RETURN	(\$1,134,852)
<b>BENEFIT/COST</b>	<b>0.00</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Resurface Pavement (CMF ID: 10280)
PROJECT LOCATION	N Carson Street & W Nye Lane
ROADWAY CHARACTERISTICS	4ST (2 WAY STOP) ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$541,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	1	21.00%	0.04
INJURY A	\$387,209	1	21.00%	0.04
INJURY B	\$141,477	2	21.00%	0.08
INJURY C	\$79,850	7	21.00%	0.29
PDO	\$12,951	14	21.00%	0.59

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.04	\$7,286,652	\$306,039
INJURY A	0.04	\$387,209	\$16,263
INJURY B	0.08	\$141,477	\$11,884
INJURY C	0.29	\$79,850	\$23,476
PDO	0.59	\$12,951	\$7,615

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$365,277
TOTAL ANNUAL BENEFITS (Including Growth)	\$372,583
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$37,209
TOTAL ANNUALIZED COSTS	\$37,209
AVERAGE ANNUAL NET RETURN	\$335,374
<b>BENEFIT/COST</b>	<b>10.01</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install Rectangular Rapid Flashing Beacons (RRFB) (NDOT CMF # BP-03)
PROJECT LOCATION	N Carson Street & W Nye Lane
ROADWAY CHARACTERISTICS	6 LANE DIVIDED ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$552,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### **CALCULATION OF REDUCTIONS**

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	47.00%	0.00
INJURY A	\$387,209	0	47.00%	0.00
INJURY B	\$141,477	0	47.00%	0.00
INJURY C	\$79,850	0	47.00%	0.00
PDO	\$12,951	0	47.00%	0.00

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### **CALCULATION OF BENEFITS**

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.00	\$141,477	\$0
INJURY C	0.00	\$79,850	\$0
PDO	0.00	\$12,951	\$0

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$0
TOTAL ANNUAL BENEFITS (Including Growth)	\$0
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$38,000
TOTAL ANNUALIZED COSTS	\$38,000
AVERAGE ANNUAL NET RETURN	(\$38,000)
<b>BENEFIT/COST</b>	<b>0.00</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install Reduced Conflict Intersection (S-Island, J-Turn, or RCUT) (NDOT CMF # US-02)
PROJECT LOCATION	N Carson Street & W Nye Lane
ROADWAY CHARACTERISTICS	6 LANE DIVIDED ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$49,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	1	19.00%	0.04
INJURY A	\$387,209	1	19.00%	0.04
INJURY B	\$141,477	2	19.00%	0.08
INJURY C	\$79,850	7	19.00%	0.27
PDO	\$12,951	14	19.00%	0.53

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.04	\$7,286,652	\$276,893
INJURY A	0.04	\$387,209	\$14,714
INJURY B	0.08	\$141,477	\$10,752
INJURY C	0.27	\$79,850	\$21,240
PDO	0.53	\$12,951	\$6,890

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$330,489
TOTAL ANNUAL BENEFITS (Including Growth)	\$337,099
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$3,405
TOTAL ANNUALIZED COSTS	\$3,405
AVERAGE ANNUAL NET RETURN	\$333,694
<b>BENEFIT/COST</b>	<b>99.01</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Improve Street Lighting Illuminance and Uniformity (CMF: 11026)
PROJECT LOCATION	N Carson Street & W Nye Lane
ROADWAY CHARACTERISTICS	4ST (2 WAY STOP) ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTERIAL ▼
IMPLEMENTATION COSTS	\$1,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 ▼ YEAR(S)
LENGTH OF STUDY	5 ▼ YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	32.00%	0.00
INJURY A	\$387,209	0	32.00%	0.00
INJURY B	\$141,477	0	32.00%	0.00
INJURY C	\$79,850	0	32.00%	0.00
PDO	\$12,951	2	32.00%	0.13

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.00	\$141,477	\$0
INJURY C	0.00	\$79,850	\$0
PDO	0.13	\$12,951	\$1,658

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$1,658
TOTAL ANNUAL BENEFITS (Including Growth)	\$1,691
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$103
TOTAL ANNUALIZED COSTS	\$103
AVERAGE ANNUAL NET RETURN	\$1,588
<b>BENEFIT/COST</b>	<b>16.39</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install Intersection Lighting (NDOT CMF # US-10)
PROJECT LOCATION	N Carson Street & W Nye Lane
ROADWAY CHARACTERISTICS	6 LANE DIVIDED ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$29,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### **CALCULATION OF REDUCTIONS**

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	10.00%	0.00
INJURY A	\$387,209	0	10.00%	0.00
INJURY B	\$141,477	0	10.00%	0.00
INJURY C	\$79,850	0	10.00%	0.00
PDO	\$12,951	2	10.00%	0.04

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### **CALCULATION OF BENEFITS**

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.00	\$141,477	\$0
INJURY C	0.00	\$79,850	\$0
PDO	0.04	\$12,951	\$518

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$518
TOTAL ANNUAL BENEFITS (Including Growth)	\$528
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$2,029
TOTAL ANNUALIZED COSTS	\$2,029
AVERAGE ANNUAL NET RETURN	(\$1,501)
<b>BENEFIT/COST</b>	<b>0.26</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install a Pedestrian Hybrid Beacons (PHBs) (NDOT CMF #BP-02)
PROJECT LOCATION	US-50 and Highlands Drive
ROADWAY CHARACTERISTICS	3ST (1 WAY STOP) ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$2,194,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 ▼ YEAR(S)
LENGTH OF STUDY	5 ▼ YEAR(S)

#### **CALCULATION OF REDUCTIONS**

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	1	60.00%	0.12
INJURY A	\$387,209	0	60.00%	0.00
INJURY B	\$141,477	0	60.00%	0.00
INJURY C	\$79,850	0	60.00%	0.00
PDO	\$12,951	0	60.00%	0.00

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### **CALCULATION OF BENEFITS**

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.12	\$7,286,652	\$874,398
INJURY A	0.00	\$387,209	\$0
INJURY B	0.00	\$141,477	\$0
INJURY C	0.00	\$79,850	\$0
PDO	0.00	\$12,951	\$0

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$874,398
TOTAL ANNUAL BENEFITS (Including Growth)	\$891,886
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$150,935
TOTAL ANNUALIZED COSTS	\$150,935
AVERAGE ANNUAL NET RETURN	\$740,951
<b>BENEFIT/COST</b>	<b>5.91</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install Intersection Lighting (NDOT CMF # US-10)
PROJECT LOCATION	US-50 and Highlands Drive
ROADWAY CHARACTERISTICS	3ST (1 WAY STOP) ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$21,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	1	10.00%	0.02
INJURY A	\$387,209	0	10.00%	0.00
INJURY B	\$141,477	0	10.00%	0.00
INJURY C	\$79,850	1	10.00%	0.02
PDO	\$12,951	3	10.00%	0.06

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.02	\$7,286,652	\$145,733
INJURY A	0.00	\$387,209	\$0
INJURY B	0.00	\$141,477	\$0
INJURY C	0.02	\$79,850	\$1,597
PDO	0.06	\$12,951	\$777

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$148,107
TOTAL ANNUAL BENEFITS (Including Growth)	\$151,069
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$1,479
TOTAL ANNUALIZED COSTS	\$1,479
AVERAGE ANNUAL NET RETURN	\$149,590
<b>BENEFIT/COST</b>	<b>102.16</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Resurface Pavement (CMF ID: 10280)
PROJECT LOCATION	US-50 and Highlands Drive
ROADWAY CHARACTERISTICS	3ST (1 WAY STOP) ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$1,694,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 ▼ YEAR(S)
LENGTH OF STUDY	5 ▼ YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	2	21.00%	0.08
INJURY A	\$387,209	0	21.00%	0.00
INJURY B	\$141,477	0	21.00%	0.00
INJURY C	\$79,850	2	21.00%	0.08
PDO	\$12,951	5	0.00%	0.00

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.08	\$7,286,652	\$612,079
INJURY A	0.00	\$387,209	\$0
INJURY B	0.00	\$141,477	\$0
INJURY C	0.08	\$79,850	\$6,707
PDO	0.00	\$12,951	\$0

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$618,786
TOTAL ANNUAL BENEFITS (Including Growth)	\$631,162
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$116,546
TOTAL ANNUALIZED COSTS	\$116,546
AVERAGE ANNUAL NET RETURN	\$514,616
<b>BENEFIT/COST</b>	<b>5.42</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO. NONE

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PROJECT NO. 092202057: CAMPO LRSP

COUNTERMEASURE Install Advanced Street Name Signs (CMD ID: 2449)

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PROJECT LOCATION US-50 and Highlands Drive

ROADWAY CHARACTERISTICS 3ST (1 WAY STOP)

DEMOGRAPHIC DESIGNATION URBAN

FUNCTIONAL CLASSIFICATION 4 MINOR ARTFRIAI

IMPLEMENTATION COSTS \$18,500 (NDOT Bid Tabs and other Local Projects)

ANNUAL MAINTENENCE COSTS \$0

CURRENT PRIME INTEREST RATE 3.25%

PERCENTAGE OF GROWTH 2.00%

ESTIMATED SERVICE LIFE 20 YEAR(S)

LENGTH OF STUDY 5 YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	2	1.60%	0.01
INJURY A	\$387,209	0	1.60%	0.00
INJURY B	\$141,477	0	1.60%	0.00
INJURY C	\$79,850	2	1.60%	0.01
PDO	\$12,951	5	1.60%	0.02

\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.01	\$7,286,652	\$46,635
INJURY A	0.00	\$387,209	\$0
INJURY B	0.00	\$141,477	\$0
INJURY C	0.01	\$79,850	\$511
PDO	0.02	\$12,951	\$207

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$47,353
TOTAL ANNUAL BENEFITS (Including Growth)	\$48,300
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$1,272
TOTAL ANNUALIZED COSTS	\$1,272
AVERAGE ANNUAL NET RETURN	\$47,027
<b>BENEFIT/COST</b>	<b>37.96</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install Reduced Conflict Intersection (S-Island, J-Turn, or RCUT) (NDOT CMF # US-02)
PROJECT LOCATION	US-50 and Highlands Drive
ROADWAY CHARACTERISTICS	3ST (1 WAY STOP) ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$317,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 ▼ YEAR(S)
LENGTH OF STUDY	5 ▼ YEAR(S)

#### **CALCULATION OF REDUCTIONS**

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	2	51.00%	0.20
INJURY A	\$387,209	0	51.00%	0.00
INJURY B	\$141,477	0	51.00%	0.00
INJURY C	\$79,850	2	51.00%	0.20
PDO	\$12,951	5	0.00%	0.00

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### **CALCULATION OF BENEFITS**

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.20	\$7,286,652	\$1,486,477
INJURY A	0.00	\$387,209	\$0
INJURY B	0.00	\$141,477	\$0
INJURY C	0.20	\$79,850	\$16,290
PDO	0.00	\$12,951	\$0

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$1,502,767
TOTAL ANNUAL BENEFITS (Including Growth)	\$1,532,822
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$21,803
TOTAL ANNUALIZED COSTS	\$21,803
AVERAGE ANNUAL NET RETURN	\$1,511,019
<b>BENEFIT/COST</b>	<b>70.30</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Convert Non-Signalized Urban Intersection to Roundabout (NDOT CMF # US-14)
PROJECT LOCATION	US-50 and Highlands Drive
ROADWAY CHARACTERISTICS	3ST (1 WAY STOP) ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$2,836,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	2	71.00%	0.28
INJURY A	\$387,209	0	71.00%	0.00
INJURY B	\$141,477	0	71.00%	0.00
INJURY C	\$79,850	2	71.00%	0.28
PDO	\$12,951	5	71.00%	0.71

US-1

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.28	\$7,286,652	\$2,069,409
INJURY A	0.00	\$387,209	\$0
INJURY B	0.00	\$141,477	\$0
INJURY C	0.28	\$79,850	\$22,678
PDO	0.71	\$12,951	\$9,195

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$2,101,282
TOTAL ANNUAL BENEFITS (Including Growth)	\$2,143,307
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$195,057
TOTAL ANNUALIZED COSTS	\$195,057
AVERAGE ANNUAL NET RETURN	\$1,948,251
<b>BENEFIT/COST</b>	<b>10.99</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install Reduced Conflict Intersection (S-Island, J-Turn, or RCUT) (NDOT CMF # US-02)
PROJECT LOCATION	US-50 and Highlands Drive
ROADWAY CHARACTERISTICS	3ST (1 WAY STOP) ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$165,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	2	51.00%	0.20
INJURY A	\$387,209	0	51.00%	0.00
INJURY B	\$141,477	0	51.00%	0.00
INJURY C	\$79,850	2	51.00%	0.20
PDO	\$12,951	5	0.00%	0.00

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.20	\$7,286,652	\$1,486,477
INJURY A	0.00	\$387,209	\$0
INJURY B	0.00	\$141,477	\$0
INJURY C	0.20	\$79,850	\$16,290
PDO	0.00	\$12,951	\$0

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$1,502,767
TOTAL ANNUAL BENEFITS (Including Growth)	\$1,532,822
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$11,349
TOTAL ANNUALIZED COSTS	\$11,349
AVERAGE ANNUAL NET RETURN	\$1,521,473
<b>BENEFIT/COST</b>	<b>135.07</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO. NONE

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PROJECT NO. 092202057: CAMPO LRSP

COUNTERMEASURE Install On-Street Bike Facility (NDOT CMF # BP-05)

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PROJECT LOCATION US-50 and Airport Road

ROADWAY CHARACTERISTICS 45G

DEMOGRAPHIC DESIGNATION URBAN

FUNCTIONAL CLASSIFICATION 4 MINOR ARTFRIAI

IMPLEMENTATION COSTS \$99,000 (NDOT Bid Tabs and other Local Projects)

ANNUAL MAINTENENCE COSTS \$0

CURRENT PRIME INTEREST RATE 3.25%

PERCENTAGE OF GROWTH 2.00%

ESTIMATED SERVICE LIFE 20 YEAR(S)

LENGTH OF STUDY 5 YEAR(S)

#### **CALCULATION OF REDUCTIONS**

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	60.00%	0.00
INJURY A	\$387,209	0	60.00%	0.00
INJURY B	\$141,477	0	60.00%	0.00
INJURY C	\$79,850	0	60.00%	0.00
PDO	\$12,951	1	60.00%	0.12

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### **CALCULATION OF BENEFITS**

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.00	\$141,477	\$0
INJURY C	0.00	\$79,850	\$0
PDO	0.12	\$12,951	\$1,554

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$1,554
TOTAL ANNUAL BENEFITS (Including Growth)	\$1,585
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$6,809
TOTAL ANNUALIZED COSTS	\$6,809
AVERAGE ANNUAL NET RETURN	(\$5,224)
<b>BENEFIT/COST</b>	<b>0.23</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO. NONE

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PROJECT NO. 092202057: CAMPO LRSP

COUNTERMEASURE Resurface Pavement (CMF ID: 10280)

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PROJECT LOCATION US-50 and Airport Road

ROADWAY CHARACTERISTICS 45G

DEMOGRAPHIC DESIGNATION URBAN

FUNCTIONAL CLASSIFICATION 4 MINOR ARTFRIAI

IMPLEMENTATION COSTS \$1,312,500 (NDOT Bid Tabs and other Local Projects)

ANNUAL MAINTENENCE COSTS \$0

CURRENT PRIME INTEREST RATE 3.25%

PERCENTAGE OF GROWTH 2.00%

ESTIMATED SERVICE LIFE 20 YEAR(S)

LENGTH OF STUDY 5 YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	2	21.00%	0.08
INJURY A	\$387,209	1	21.00%	0.04
INJURY B	\$141,477	3	21.00%	0.13
INJURY C	\$79,850	8	21.00%	0.34
PDO	\$12,951	43	0.00%	0.00

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.08	\$7,286,652	\$612,079
INJURY A	0.04	\$387,209	\$16,263
INJURY B	0.13	\$141,477	\$17,826
INJURY C	0.34	\$79,850	\$26,830
PDO	0.00	\$12,951	\$0

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$672,998
TOTAL ANNUAL BENEFITS (Including Growth)	\$686,457
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$90,272
TOTAL ANNUALIZED COSTS	\$90,272
AVERAGE ANNUAL NET RETURN	\$596,185
<b>BENEFIT/COST</b>	<b>7.60</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO. NONE

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PROJECT NO. 092202057: CAMPO LRSP

COUNTERMEASURE Improve Street Lighting Illuminance and Uniformity (CMF ID: 11026)

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PROJECT LOCATION US-50 and Airport Road

ROADWAY CHARACTERISTICS 4SG

DEMOGRAPHIC DESIGNATION URBAN

FUNCTIONAL CLASSIFICATION 4 MINOR ARTFRIAL

IMPLEMENTATION COSTS \$86,000 (NDOT Bid Tabs and other Local Projects)

ANNUAL MAINTENENCE COSTS \$0

CURRENT PRIME INTEREST RATE 3.25%

PERCENTAGE OF GROWTH 2.00%

ESTIMATED SERVICE LIFE 20 YEAR(S)

LENGTH OF STUDY 5 YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	1	32.00%	0.06
INJURY A	\$387,209	0	32.00%	0.00
INJURY B	\$141,477	1	32.00%	0.06
INJURY C	\$79,850	1	32.00%	0.06
PDO	\$12,951	6	32.00%	0.38

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.06	\$7,286,652	\$466,346
INJURY A	0.00	\$387,209	\$0
INJURY B	0.06	\$141,477	\$9,055
INJURY C	0.06	\$79,850	\$5,110
PDO	0.38	\$12,951	\$4,973

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$485,484
TOTAL ANNUAL BENEFITS (Including Growth)	\$495,193
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$5,915
TOTAL ANNUALIZED COSTS	\$5,915
AVERAGE ANNUAL NET RETURN	\$489,279
<b>BENEFIT/COST</b>	<b>83.72</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO. NONE

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PROJECT NO. 092202057: CAMPO LRSP

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COUNTERMEASURE Change Right-Turn Lane Geometry to Increase Line Of Sight (Intersection Level) (CMF ID: 8496)

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PROJECT LOCATION US-50 and Airport Road

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ROADWAY CHARACTERISTICS 45G

DEMOGRAPHIC DESIGNATION URBAN

FUNCTIONAL CLASSIFICATION 4 MINOR ARTFRIAI

---

IMPLEMENTATION COSTS \$472,000 (NDOT Bid Tabs and other Local Projects)

ANNUAL MAINTENENCE COSTS \$0

CURRENT PRIME INTEREST RATE 3.25%

PERCENTAGE OF GROWTH 2.00%

ESTIMATED SERVICE LIFE 20 YEAR(S)

LENGTH OF STUDY 5 YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	2	44.00%	0.18
INJURY A	\$387,209	1	44.00%	0.09
INJURY B	\$141,477	3	44.00%	0.26
INJURY C	\$79,850	8	44.00%	0.70
PDO	\$12,951	43	44.00%	3.78

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.18	\$7,286,652	\$1,282,451
INJURY A	0.09	\$387,209	\$34,074
INJURY B	0.26	\$141,477	\$37,350
INJURY C	0.70	\$79,850	\$56,215
PDO	3.78	\$12,951	\$49,006

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$1,459,096
TOTAL ANNUAL BENEFITS (Including Growth)	\$1,488,277
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$32,464
TOTAL ANNUALIZED COSTS	\$32,464
AVERAGE ANNUAL NET RETURN	\$1,455,814
<b>BENEFIT/COST</b>	<b>45.84</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Change Right-Turn Lane Geometry to Increase Line Of Sight (Intersection Level) (CMF ID: 8496)
PROJECT LOCATION	Goni Road and Old Hot Springs Road
ROADWAY CHARACTERISTICS	4ST (2 WAY STOP) ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAL ▼
IMPLEMENTATION COSTS	\$472,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 ▼ YEAR(S)
LENGTH OF STUDY	5 ▼ YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	44.00%	0.00
INJURY A	\$387,209	2	44.00%	0.18
INJURY B	\$141,477	4	44.00%	0.35
INJURY C	\$79,850	2	44.00%	0.18
PDO	\$12,951	3	44.00%	0.26

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.18	\$387,209	\$68,149
INJURY B	0.35	\$141,477	\$49,800
INJURY C	0.18	\$79,850	\$14,054
PDO	0.26	\$12,951	\$3,419

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$135,422
TOTAL ANNUAL BENEFITS (Including Growth)	\$138,130
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$32,464
TOTAL ANNUALIZED COSTS	\$32,464
AVERAGE ANNUAL NET RETURN	\$105,666
<b>BENEFIT/COST</b>	<b>4.25</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO. NONE

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PROJECT NO. 092202057: CAMPO LRSP

COUNTERMEASURE Resurface Pavement (CMF ID: 10280)

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PROJECT LOCATION Goni Road and Old Hot Springs Road

ROADWAY CHARACTERISTICS 4ST (2 WAY STOP)

DEMOGRAPHIC DESIGNATION URBAN

FUNCTIONAL CLASSIFICATION 4 MINOR ARTFRIAI

IMPLEMENTATION COSTS \$291,000 (NDOT Bid Tabs and other Local Projects)

ANNUAL MAINTENENCE COSTS \$0

CURRENT PRIME INTEREST RATE 3.25%

PERCENTAGE OF GROWTH 2.00%

ESTIMATED SERVICE LIFE 20 YEAR(S)

LENGTH OF STUDY 5 YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	21.00%	0.00
INJURY A	\$387,209	2	21.00%	0.08
INJURY B	\$141,477	4	21.00%	0.17
INJURY C	\$79,850	2	21.00%	0.08
PDO	\$12,951	3	0.00%	0.00

\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.08	\$387,209	\$32,526
INJURY B	0.17	\$141,477	\$23,768
INJURY C	0.08	\$79,850	\$6,707
PDO	0.00	\$12,951	\$0

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$63,001
TOTAL ANNUAL BENEFITS (Including Growth)	\$64,261
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$20,015
TOTAL ANNUALIZED COSTS	\$20,015
AVERAGE ANNUAL NET RETURN	\$44,247
<b>BENEFIT/COST</b>	<b>3.21</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install Intersection Lighting (NDOT Planning Level CMF US-10)
PROJECT LOCATION	Goni Road and Old Hot Springs Road
ROADWAY CHARACTERISTICS	4ST (2 WAY STOP) ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$94,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	10.00%	0.00
INJURY A	\$387,209	0	10.00%	0.00
INJURY B	\$141,477	1	10.00%	0.02
INJURY C	\$79,850	1	10.00%	0.02
PDO	\$12,951	0	10.00%	0.00

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.02	\$141,477	\$2,830
INJURY C	0.02	\$79,850	\$1,597
PDO	0.00	\$12,951	\$0

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$4,427
TOTAL ANNUAL BENEFITS (Including Growth)	\$4,515
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$6,465
TOTAL ANNUALIZED COSTS	\$6,465
AVERAGE ANNUAL NET RETURN	(\$1,950)
<b>BENEFIT/COST</b>	<b>0.70</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Implement Systemic Signing and Marking Improvements at Stop-Controlled Intersections (NDOT CMF # US-17)
PROJECT LOCATION	Goni Road and Old Hot Springs Road
ROADWAY CHARACTERISTICS	4ST (2 WAY STOP) ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAL ▼
IMPLEMENTATION COSTS	\$10,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 ▼ YEAR(S)
LENGTH OF STUDY	5 ▼ YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	19.00%	0.00
INJURY A	\$387,209	2	19.00%	0.08
INJURY B	\$141,477	4	19.00%	0.15
INJURY C	\$79,850	2	19.00%	0.08
PDO	\$12,951	3	19.00%	0.11

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.08	\$387,209	\$29,428
INJURY B	0.15	\$141,477	\$21,505
INJURY C	0.08	\$79,850	\$6,069
PDO	0.11	\$12,951	\$1,476

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$58,477
TOTAL ANNUAL BENEFITS (Including Growth)	\$59,647
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$688
TOTAL ANNUALIZED COSTS	\$688
AVERAGE ANNUAL NET RETURN	\$58,959
<b>BENEFIT/COST</b>	<b>86.72</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Implement Systemic Signing and Marking Improvements at Stop-Controlled Intersections (NDOT CMF # US-17)
PROJECT LOCATION	Goni Road and Old Hot Springs Road
ROADWAY CHARACTERISTICS	4ST (2 WAY STOP) ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAL ▼
IMPLEMENTATION COSTS	\$21,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 ▼ YEAR(S)
LENGTH OF STUDY	5 ▼ YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	19.00%	0.00
INJURY A	\$387,209	2	19.00%	0.08
INJURY B	\$141,477	4	19.00%	0.15
INJURY C	\$79,850	2	19.00%	0.08
PDO	\$12,951	3	19.00%	0.11

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.08	\$387,209	\$29,428
INJURY B	0.15	\$141,477	\$21,505
INJURY C	0.08	\$79,850	\$6,069
PDO	0.11	\$12,951	\$1,476

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$58,477
TOTAL ANNUAL BENEFITS (Including Growth)	\$59,647
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$1,444
TOTAL ANNUALIZED COSTS	\$1,444
AVERAGE ANNUAL NET RETURN	\$58,203
<b>BENEFIT/COST</b>	<b>41.30</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/08/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install On-Street Bike Facility (NDOT CMF # BP-05)
PROJECT LOCATION	Goni Road and Old Hot Springs Road
ROADWAY CHARACTERISTICS	4ST (2 WAY STOP) ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$99,000 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	60.00%	0.00
INJURY A	\$387,209	0	60.00%	0.00
INJURY B	\$141,477	0	60.00%	0.00
INJURY C	\$79,850	0	60.00%	0.00
PDO	\$12,951	0	60.00%	0.00

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.00	\$141,477	\$0
INJURY C	0.00	\$79,850	\$0
PDO	0.00	\$12,951	\$0

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$0
TOTAL ANNUAL BENEFITS (Including Growth)	\$0
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$6,809
TOTAL ANNUALIZED COSTS	\$6,809
AVERAGE ANNUAL NET RETURN	(\$6,809)
<b>BENEFIT/COST</b>	<b>0.00</b>



# #NAME? CMF METHOD BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/18/24

ENGINEERING AUTHORIZATION NO. NONE

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PROJECT NO. 092202057: CAMPO LRSP

COUNTERMEASURE Add 3-Inch Yellow Retroreflective Sheeting to Signal Backplates (NDOT CMF # SI-10)

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PROJECT LOCATION US-395 and Topsy Lane

ROADWAY CHARACTERISTICS 6 LANE DIVIDED ▼

DEMOGRAPHIC DESIGNATION URBAN ▼

FUNCTIONAL CLASSIFICATION 4 MINOR ARTFRIAI ▼

IMPLEMENTATION COSTS \$35,000 (NDOT Bid Tabs and other Local Projects)

ANNUAL MAINTENENCE COSTS \$0

CURRENT PRIME INTEREST RATE 3.25%

PERCENTAGE OF GROWTH 2.00%

ESTIMATED SERVICE LIFE 20 ▼ YEAR(S)

LENGTH OF STUDY 5 ▼ YEAR(S)

### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	15.00%	0.00
INJURY A	\$387,209	0	15.00%	0.00
INJURY B	\$141,477	5	15.00%	0.15
INJURY C	\$79,850	15	15.00%	0.45
PDO	\$12,951	58	15.00%	1.74

\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.

### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.15	\$141,477	\$21,222
INJURY C	0.45	\$79,850	\$35,933
PDO	1.74	\$12,951	\$22,534

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$79,689
TOTAL ANNUAL BENEFITS (Including Growth)	\$81,282
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$2,407
TOTAL ANNUALIZED COSTS	\$2,407
AVERAGE ANNUAL NET RETURN	\$78,875
<b>BENEFIT/COST</b>	<b>33.77</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/18/24

ENGINEERING AUTHORIZATION NO. NONE

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PROJECT NO. 092202057: CAMPO LRSP

COUNTERMEASURE Install Advanced Street Name Signs (NDOT CMF # SI-13)

---

PROJECT LOCATION US-395 and Topsy Lane

ROADWAY CHARACTERISTICS 6 LANE DIVIDED

DEMOGRAPHIC DESIGNATION URBAN

FUNCTIONAL CLASSIFICATION 4 MINOR ARTFRIAI

IMPLEMENTATION COSTS \$2,000 (NDOT Bid Tabs and other Local Projects)

ANNUAL MAINTENENCE COSTS \$0

CURRENT PRIME INTEREST RATE 3.25%

PERCENTAGE OF GROWTH 2.00%

ESTIMATED SERVICE LIFE 20 YEAR(S)

LENGTH OF STUDY 5 YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	2.00%	0.00
INJURY A	\$387,209	0	2.00%	0.00
INJURY B	\$141,477	5	2.00%	0.02
INJURY C	\$79,850	15	2.00%	0.06
PDO	\$12,951	58	2.00%	0.23

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.02	\$141,477	\$2,830
INJURY C	0.06	\$79,850	\$4,791
PDO	0.23	\$12,951	\$3,005

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$10,625
TOTAL ANNUAL BENEFITS (Including Growth)	\$10,838
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$138
TOTAL ANNUALIZED COSTS	\$138
AVERAGE ANNUAL NET RETURN	\$10,700
<b>BENEFIT/COST</b>	<b>78.79</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/18/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Install Reduced Conflict Intersection (S-Island, J-Turn, or RCUT) (NDOT CMF # SI-01)
PROJECT LOCATION	US-395 and Topsy Lane
ROADWAY CHARACTERISTICS	6 LANE DIVIDED
DEMOGRAPHIC DESIGNATION	URBAN
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI
IMPLEMENTATION COSTS	\$16,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S)
LENGTH OF STUDY	5 YEAR(S)

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	19.00%	0.00
INJURY A	\$387,209	0	19.00%	0.00
INJURY B	\$141,477	5	19.00%	0.19
INJURY C	\$79,850	15	19.00%	0.57
PDO	\$12,951	58	19.00%	2.20

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.19	\$141,477	\$26,881
INJURY C	0.57	\$79,850	\$45,515
PDO	2.20	\$12,951	\$28,543

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$100,939
TOTAL ANNUAL BENEFITS (Including Growth)	\$102,958
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$1,135
TOTAL ANNUALIZED COSTS	\$1,135
AVERAGE ANNUAL NET RETURN	\$101,823
<b>BENEFIT/COST</b>	<b>90.72</b>



# PROJECT SAFETY PROCESS

## CMF METHOD

### BENEFIT-COST RATIO (BCR)

(2023 DOLLAR FIGURES)

04/18/24

ENGINEERING AUTHORIZATION NO.	NONE
PROJECT NO.	092202057: CAMPO LRSP
COUNTERMEASURE	Improve Pavement Friction - High Friction Surface Treatment (NDOT CMF #CS-02)
PROJECT LOCATION	US-395 and Topsy Lane
ROADWAY CHARACTERISTICS	6 LANE DIVIDED ▼
DEMOGRAPHIC DESIGNATION	URBAN ▼
FUNCTIONAL CLASSIFICATION	4 MINOR ARTFRIAI ▼
IMPLEMENTATION COSTS	\$22,500 (NDOT Bid Tabs and other Local Projects)
ANNUAL MAINTENENCE COSTS	\$0
CURRENT PRIME INTEREST RATE	3.25%
PERCENTAGE OF GROWTH	2.00%
ESTIMATED SERVICE LIFE	20 YEAR(S) ▼
LENGTH OF STUDY	5 YEAR(S) ▼

#### CALCULATION OF REDUCTIONS

Crash Reduction Factor (CRF) - Clearinghouse, [www.cmfclearinghouse.org](http://www.cmfclearinghouse.org)

Equate crash types to crash severity for total reductions by severity.

	2023 CRASH COSTS	PRESENT CRASHES (A)	EXPECTED CRF % (B)	CRASHES SAVED ANNUALLY (C)
FATAL	\$7,286,652	0	35.00%	0.00
INJURY A	\$387,209	0	35.00%	0.00
INJURY B	\$141,477	5	35.00%	0.35
INJURY C	\$79,850	15	35.00%	1.05
PDO	\$12,951	58	35.00%	4.06

*\*Since the current process for estimating crash reduction uses crash history, it is not possible to estimate the predicted crashes for those areas in which no existing crashes exist. It is anticipated that the application of the specified countermeasures will lower the probability of future crashes at these locations.*

#### CALCULATION OF BENEFITS

	CRASHES SAVED ANNUALLY (C)	SOCIETAL COST (D)	SOCIETAL BENEFIT (E)
FATAL	0.00	\$7,286,652	\$0
INJURY A	0.00	\$387,209	\$0
INJURY B	0.35	\$141,477	\$49,517
INJURY C	1.05	\$79,850	\$83,843
PDO	4.06	\$12,951	\$52,580

TOTAL ANNUAL BENEFITS (Summation of Column E)	\$185,940
TOTAL ANNUAL BENEFITS (Including Growth)	\$189,659
CAPITAL RECOVERY FACTOR	0.0688
ANNUALIZED IMPLEMENTATION COSTS	\$1,548
TOTAL ANNUALIZED COSTS	\$1,548
AVERAGE ANNUAL NET RETURN	\$188,111
<b>BENEFIT/COST</b>	<b>122.56</b>



**APPENDIX F**  
**FISCAL YEAR 2024 SS4A SELF-CERTIFICATION ELIGIBILITY**  
**WORKSHEET**



All applicants should follow the instructions in the NOFO to correctly apply for a grant. See the [SS4A website](#) for more information.

Table 1 of the SS4A NOFO describes [eight components of an Action Plan](#), which correspond to the questions in this worksheet. Applicants should use this worksheet to determine whether their existing plan(s) contains the required components to be considered an eligible Action Plan for SS4A.

This worksheet is required for all SS4A **Implementation Grant** applications and any **Planning and Demonstration Grant applications to conduct Supplemental Planning/Demonstration Activities only**. Please complete the form in its entirety, do not adjust the formatting or headings of the worksheet, and upload the completed PDF with your application.

## Eligibility

An Action Plan is considered eligible for an SS4A application for an Implementation Grant or a Planning and Demonstration Grant to conduct Supplemental Planning/Demonstration Activities if the following two conditions are met:

- You can answer "YES" to Questions **3, 7, and 9** in this worksheet; *and*
- You can answer "YES" to **at least four of the six remaining** Questions, **1, 2, 4, 5, 6, and 8**.

If both conditions are not met, an applicant is still eligible to apply for a Planning and Demonstration Grant to fund the creation of a new Action Plan or updates to an existing Action Plan to meet SS4A requirements.

## Applicant Information

**Lead Applicant:** Carson Area Metropolitan Planning Organization (CAMPO)

**UEI:** \_\_\_\_\_

## Action Plan Documents

In the table below, list the relevant Action Plan and any additional plans or documents that you reference in this form. Please provide a hyperlink to any documents available online or indicate that the Action Plan or other documents will be uploaded in Valid Eval as part of your application. Note that, to be considered an eligible Action Plan for SS4A, the plan(s) coverage must be broader than just a corridor, neighborhood, or specific location.

Document Title	Link	Date of Most Recent Update
CAMPO Local Road Safety Plan		04/29/2024



# Action Plan Components

For each question below, answer "YES" or "NO." If "YES," list the relevant plan(s) or supporting documentation that address the condition and the specific page number(s) in each document that corroborates your response. This form provides space to reference multiple plans, but please list only the most relevant document(s).

## 1. Leadership Commitment and Goal Setting

Are **BOTH** of the following true?

- A high-ranking official and/or governing body in the jurisdiction publicly committed to an eventual goal of zero roadway fatalities and serious injuries; and
- The commitment includes either setting a target date to reach zero OR setting one or more targets to achieve significant declines in roadway fatalities and serious injuries by a specific date.

YES  
 NO

*Note: This may include a resolution, policy, ordinance, executive order, or other official announcement from a high-ranking official and the official adoption of a plan that includes the commitment by a legislative body.*

If "YES," please list the relevant document(s) and page number(s) that corroborate your response.

Document Title	Page Number(s)
CAMPO Local Road Safety Plan Agency Pledge	i

## 2. Planning Structure

To develop the Action Plan, was a committee, task force, implementation group, or similar body established and charged with the plan's development, implementation, and monitoring?

YES  
 NO

*Note: This should include a description of the membership of the group and what role they play in the development, implementation, and monitoring of the Action Plan.*

If "YES," please list the relevant document(s) and page number(s) that corroborate your response.

Document Title	Page Number(s)
CAMPO Local Road Safety Plan	64-69



### 3. Safety Analysis

Does the Action Plan include **ALL** of the following?

- Analysis of existing conditions and historical trends to provide a baseline level of crashes involving fatalities and serious injuries across a jurisdiction, locality, Tribe, or region;
- Analysis of the location where there are crashes, the severity, as well as contributing factors and crash types;
- Analysis of systemic and specific safety needs, as needed (e.g., high-risk road features or specific safety needs of relevant road users); and,
- A geospatial identification (geographic or locational data using maps) of higher risk locations.

YES

NO

*Note: Availability and level of detail of safety data may vary greatly by location. The [Fatality and Injury Reporting System Tool \(FIRST\)](#) provides county- and city-level data. When available, local data should be used to supplement nationally available data sets.*

If "YES," please list the relevant document(s) and page number(s) that corroborate your response.

Document Title	Page Number(s)
CAMPO Local Road Safety Plan	20-35

### 4. Engagement and Collaboration

Did the Action Plan development include **ALL** of the following activities?

- Engagement with the public and relevant stakeholders, including the private sector and community groups;
- Incorporation of information received from the engagement and collaboration into the plan; and
- Coordination that included inter- and intra-governmental cooperation and collaboration, as appropriate.

YES

NO

*Note: This should be a description of public meetings, participation in public and private events, and proactive meetings with stakeholders.*

If "YES," please list the relevant document(s) and page number(s) that corroborate your response.

Document Title	Page Number(s)
CAMPO Local Road Safety Plan	5-6



## 5. Equity Considerations

Did the Action Plan development include **ALL** of the following?

- Considerations of equity using inclusive and representative processes;
- The identification of underserved communities through data; and
- Equity analysis developed in collaboration with appropriate partners, including population characteristics and initial equity impact assessments of proposed projects and strategies.

YES

NO

*Note: This should include data that identifies underserved communities and/or reflects the impact of crashes on underserved communities, prioritization criteria that consider equity, or a description of meaningful engagement and collaboration with appropriate stakeholders.*

If "YES," please list the relevant document(s) and page number(s) that corroborate your response.

Document Title	Page Number(s)
CAMPO Local Road Safety Plan	18-19 & 28-29

## 6. Policy and Process Changes

Are **BOTH** of the following true?

- The plan development included an assessment of current policies, plans, guidelines, and/or standards to identify opportunities to improve how processes prioritize safety; and
- The plan discusses implementation through the adoption of revised or new policies, guidelines, and/or standards.

YES

NO

*Note: This may include existing and/or recommended Complete Streets policy, guidelines for community engagement and collaboration, policy for prioritizing areas of greatest need, local laws (e.g., speed limit), design guidelines, and other policies and processes that prioritize safety.*

If "YES," please list the relevant document(s) and page number(s) that corroborate your response.

Document Title	Page Number(s)
CAMPO Local Road Safety Plan	13-14 & 65



## 7. Strategy and Project Selections

Does the plan identify a comprehensive set of projects and strategies to address the safety problems in the Action Plan, with information about time ranges when projects and strategies will be deployed, and an explanation of project prioritization criteria?

YES  
 NO

*Note: This should include one or more lists of community-wide multi-modal and multi-disciplinary projects that respond to safety problems and reflect community input and a description of how your community will prioritize projects in the future.*

If "YES," please list the relevant document(s) and page number(s) that corroborate your response.

Document Title	Page Number(s)
CAMPO Local Road Safety Plan	46-57

## 8. Progress and Transparency

Does the plan include **BOTH** of the following?

- A description of how progress will be measured over time that includes, at a minimum, outcome data.
- The plan is posted publicly online.

YES  
 NO

*Note: This should include a progress reporting structure and list of proposed metrics.*

If "YES," please list the relevant document(s) and page number(s) that corroborate your response.

Document Title	Page Number(s)
CAMPO Local Road Safety Plan	70

## 9. Action Plan Date

Was at least one of your plans finalized and/or last updated between 2019 and April 30, 2024?

YES  
 NO

*Note: Updates may include major revisions, updates to the data used for analysis, status updates, or the addition of supplemental planning documents, including but not limited to an Equity Plan, one or more Road Safety Audits conducted in high-crash locations, or a Vulnerable Road User Plan.*

If "YES," please list your most recent document(s), date of finalization, and page number(s) that corroborate your response.

Document Title	Date of Most Recent Update	Page Number(s)
CAMPO Local Road Safety Plan	04/29/2024	i

