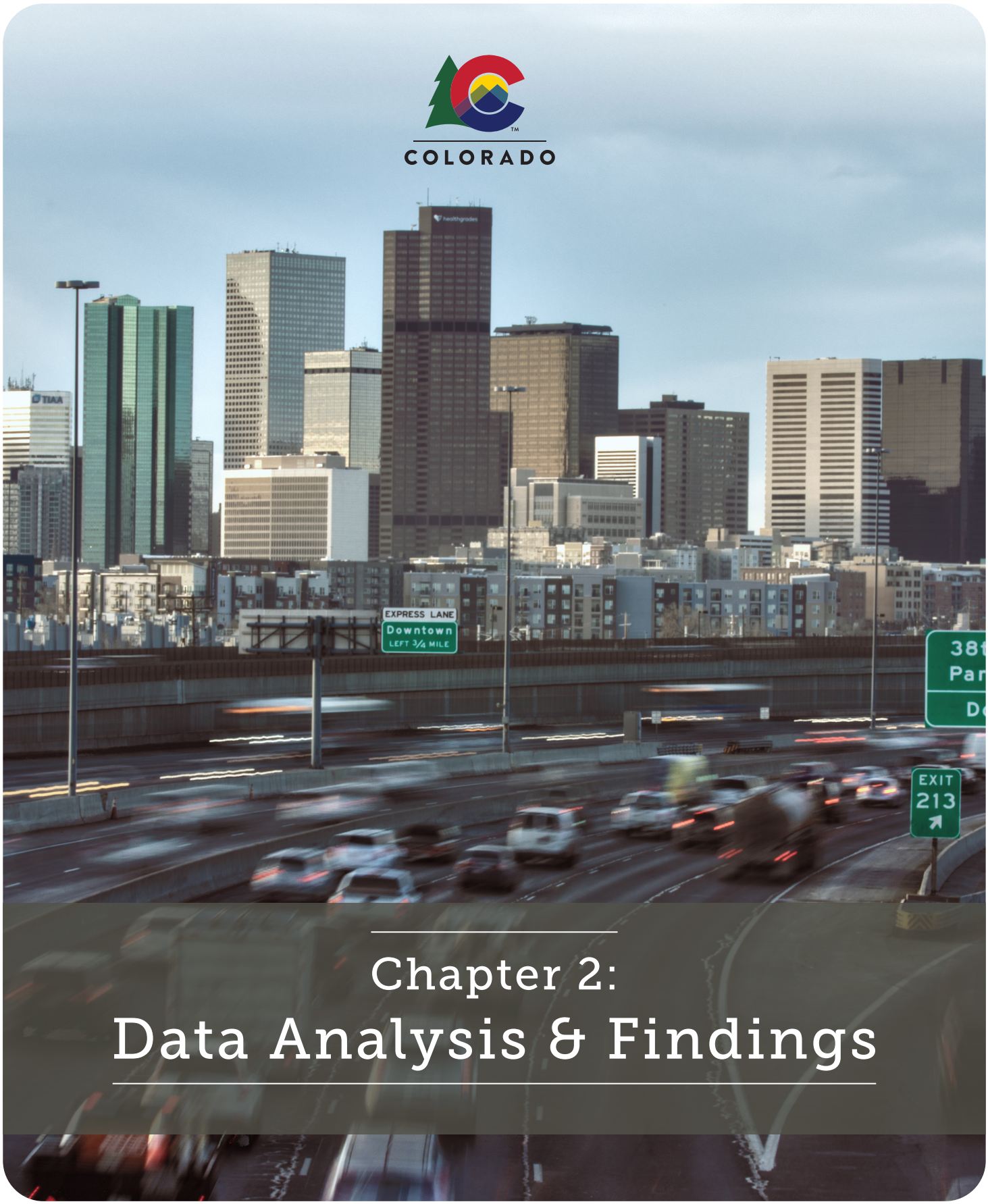


Chapter 2:
Data Analysis & Findings

The Strategic Highway Safety Plan (SHSP) utilizes a data-driven process, using safety data to identify trends, pinpoint problems, and develop targeted strategies with actionable implementation measures. This section provides an overview of key safety trends in Colorado. Each Emphasis Area and relevant Focus Areas have a distinct data profile and set of characteristics that expand upon this data. For more details on data trends for specific Emphasis Areas and Focus Areas, see Chapters 5 through 9.

Background

There are numerous ways to measure "safety," so it is important to understand what safety means in the context of this plan. Historically, a roadway was said to be "safe" if it complied with accepted standards and guidelines. Later, safety was measured by the total number of crashes or a simple crash rate. This plan utilizes current best practices by measuring fatalities and serious injuries, following the SSA principle "death and serious injuries are unacceptable." This method entails measuring safety in terms of crash severity or the highest level of injury resulting from a crash.

The following are common terms utilized in describing transportation safety (AASHTO, 2010):

- Crash frequency: the number of crashes in a given study area and study period. Crash frequency can relate to all crashes or a subset of crash severities, crash types, or a combination of the two.
- Crash rate: the number of crashes normalized by some level of exposure, such as vehicle miles traveled (VMT).
- Crash severity: the level of injury resulting from a crash. Crash severity can be defined at either the person level or at the crash level. At the person level, this represents the severity reported for each person involved in a crash. At the crash level, this represents the most severe injury resulting from the crash. Crash severity is commonly categorized on crash reports using the KABCO scale, where:
    - K is a fatality.
    - A is a suspected serious injury.
    - B is a suspected minor injury.
    - C is a possible injury.
    - O is no apparent injury, also known as property damage only (PDO).

Methodology

Data analyses were performed to identify key factors contributing to traffic related fatalities and serious injuries. The data analysis focuses on fatal (K) and serious injury (A) crashes, also referred to as severe crashes. Stakeholder input, including feedback from the Steering Committee and Subject Matter Experts (SMEs), aided in the development and interpretation of the analysis.

The analysis provided context for each of the five Emphasis Areas and helped identify factors contributing to observed crash data trends:

Safety Culture | Safe Driving | Safe People | Safe Roads | Post-Crash Care

- **Safety Culture:** Community engagement, law enforcement collaboration, data access, and public outreach.
- **Safe Driving:** Behavioral risk factors, high-risk corridors, high-risk counties, and legislation.
- **Safe People:** High-risk populations, overrepresented travel modes, roadway workers and first responders.
- **Safe Roads:** Common crash types, roadway-related risk factors, high-crash locations, and high-risk counties, municipalities, and tribal territories.
- **Post-Crash Care:** EMS response and transport times, hospital admissions, access to trauma centers, secondary crash rates, and post-crash care analysis.

The SHSP is a statewide plan, making a "hot spot" approach to identifying and treating specific locations based on crash history inappropriate. In contrast, a "systemic approach" to safety acknowledges that crash frequency or rates at specific locations are not always sufficient to determine which safety improvement actions to implement and where to implement them. Systemic implementation of safety actions helps address the most serious crash types on the entire road system, not just at specific high-crash spot locations. The systemic safety approach offers a means to identify crash types (e.g., intersection, roadway departure, pedestrians) and the location-related factors that contribute to the highest number of fatal and serious injury crashes of each type, and widely implement low-cost countermeasures over several locations with similar crash characteristics and/or similar roadway features.

In addition to the factors that contribute to observed crash trends, cost-effectiveness of strategies and the benefit-cost of subsequent strategy-based actions are important considerations. The SMEs, FHWA's Proven Safety Countermeasures, National Highway Traffic Safety Administration's (NHTSA) Countermeasures that Work, and FHWA's Crash Modification Factors Clearinghouse all influenced strategy identification and definition. See Chapter 10 Implementation for more details related to the effectiveness of strategies.

Data Sources

Colorado agencies collect, maintain, and analyze transportation, socioeconomic, EMS, community engagement and other data. This collective data, in addition to the national sources such as the Fatality Analysis Reporting System (FARS), the Fatality and Injury Reporting System Tool (FIRST), U.S. Census Data, and Emergency Responder Safety Institute (ERSI) data, provides a comprehensive understanding of Colorado's transportation safety landscape.

The SHSP is built upon a comprehensive understanding of historical crash data. In Colorado, crash data originates with law enforcement officers who prepare crash reports and submit the information to the Department of Revenue (DOR). The DOR is the custodian of record for crash reports and disseminates the data to other systems, including those associated with the driver and the vehicle. CDOT receives, processes, and analyzes crash data and provides summary reports to FHWA and NHTSA.

Crash data originates from police crash reports. Different reporting practices among law enforcement officers or agencies can result in inconsistencies in the crash data. Furthermore, the reporting officer may not have complete information when filling out the report, which results in some subjectivity in the data. For instance, it can be difficult for an officer to determine if distraction or speeding were factors in a crash unless there is evidence such as testimonial evidence (e.g., admission of high-risk driving behavior). It is also noteworthy that Colorado's crash report form changed in 2020, resulting in different data being available before and after this date. Because of these changes, some analyses are only performed using data after 2020, including speed-involved crashes.

Historical crash data is also used to identify expected safety performance of roadways and intersections. Level of Service of Safety (LOSS) reflects the safety performance of a particular location through a comparison with other similar locations. Locations with a higher-than-expected crash severity or frequency are typically considered good candidates for safety improvement.

Population trends and public health data also play a role in safety analysis. The Colorado State Demographer and the Department of Local Affairs track current and projected population data. CDPHE collects and maintains data pertaining EMS. Data relating to EMS dispatch and response, medical treatment, and hospital-related data are important to understanding the factors that contribute to the survivability of the crash.

Road Safety Audits (RSAs) continue to be an emerging practice in Colorado. As they become more commonplace, RSA findings and recommendations can be used to inform subsequent strategies and actions, including identification of systemic safety countermeasures. Chapter 7: Safe People and Chapter 8: Safe Roads include strategies intended to strengthen RSA practices.

The Appendix provides a full list of data sources.

Safety Trends

This section provides an overview of statewide safety trends. More detailed analysis of crash trends and contributing factors for each Emphasis Area are presented in their respective chapters (Chapters 5 through 9).

Traffic-related fatalities have increased steadily since 2013 and more sharply within the last few years. Based on 5-year rolling averages, fatalities increased by 11% from 2019 to 2023. Over this same period, the 5-year rolling average for serious injuries rose by 28%. This reflects a sharp increase since 2020 when stay-at-home conditions were widespread due to the COVID-19 pandemic. Considering the amount of motor vehicle travel in Colorado, measured in VMT, fatality rates have also increased steadily since 2013, and more sharply since 2019.

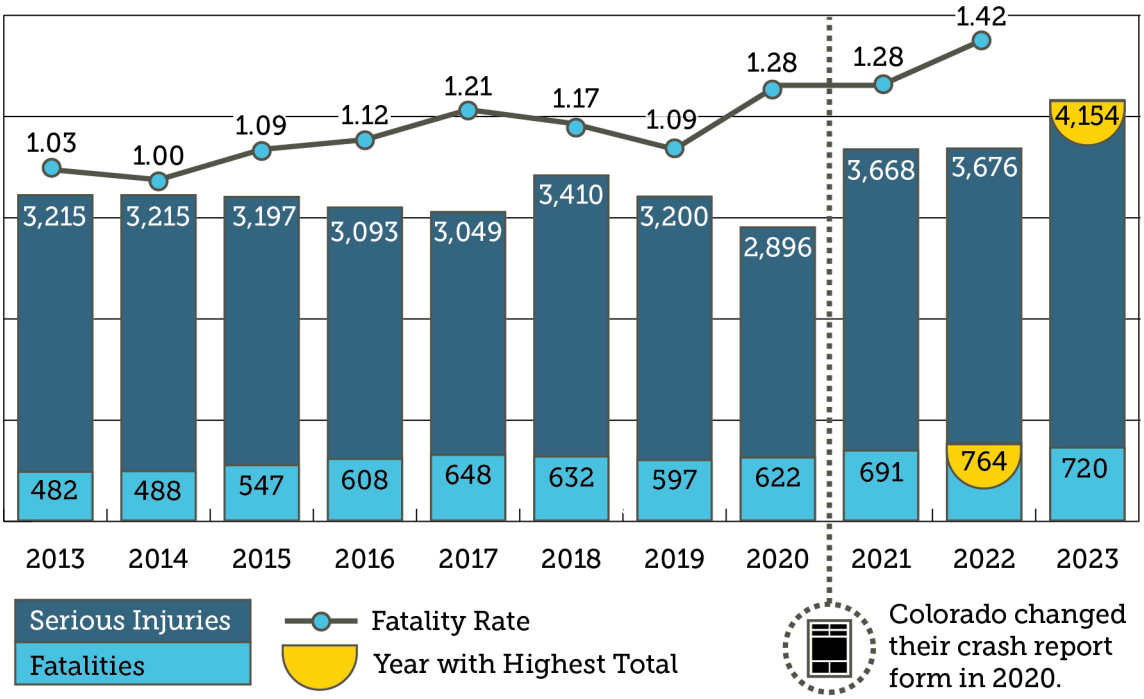


Figure 2-1: Fatalities and Serious Injuries by Year**

*VMT data not available for 2023

**Sources: FHWA Highway Statistics Tables VM-2. (2017 to 2022); CO Crash Database as of January 2024 (2017 to 2023); HSIP 2022 Report (2013 to 2016)

Emphasis Areas and Key Crash Factors in Colorado

One of the central roles of Colorado's SHSP is to identify and categorize Focus Areas—safety categories that offer the greatest potential to reduce fatalities and serious injuries. The 20 Focus Areas, which are grouped by Emphasis Areas, were selected through crash data analysis and stakeholder input, including Subject Matter Experts (SMEs). Fourteen (14) of these identified Focus Areas have substantial data to accompany them.. Figures 2-2 through 2-4 omit the following six focus areas: Public Safety Culture, Organizational Safety Culture, First Responders, Speed Management, Traffic Incident Management, and EMS, as the related data do not fit these analyses.

While each Emphasis Area and Focus Area is addressed in its own chapter, the plan recognizes that multiple contributing factors often intersect in a single crash. For example, addressing speeding may also help reduce lane departure and impaired driving crashes. The SHSP identifies strategies that proactively target overlapping risks, as well as individual contributing factors.

Intersections, lane departures, and improper use of occupant protection remain some of the leading contributors to fatal and serious injury crashes in Colorado.

Although crashes involving pedestrians, bicyclists, and motorcyclists make up a lesser share of total crashes, they result in disproportionately severe outcomes. For example, since 2021, pedestrians and bicyclists accounted for approximately 17% of all traffic fatalities, despite being involved in far fewer crashes overall.

The figures on the following page illustrate the relative severity of different Focus Area crashes. While some crash types have lower total numbers, such as those involving pedestrians or bicycles, they more frequently result in fatal or serious injury outcomes on a per-crash basis.

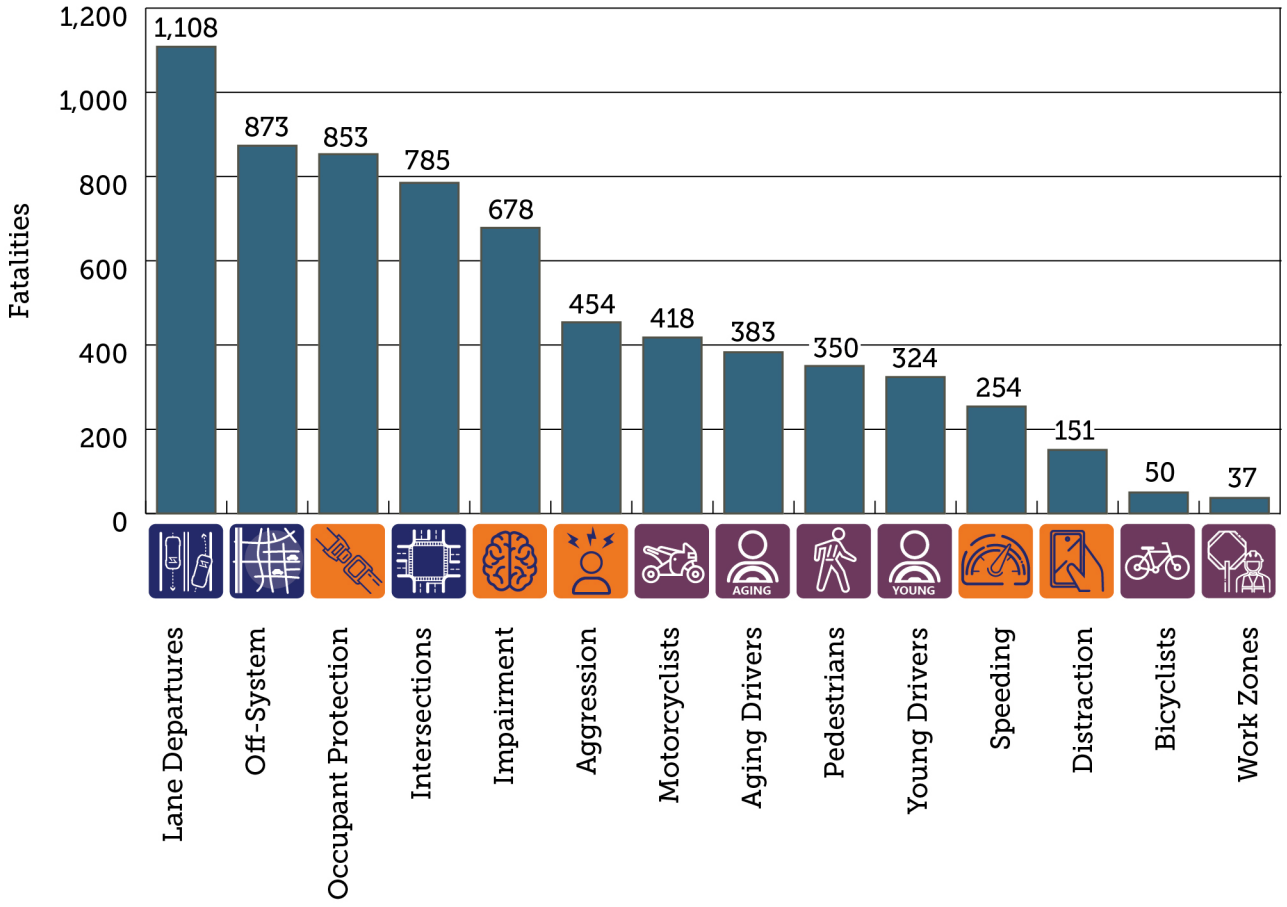


Figure 2-2: Total Fatalities by Focus Area (2021 to 2023)

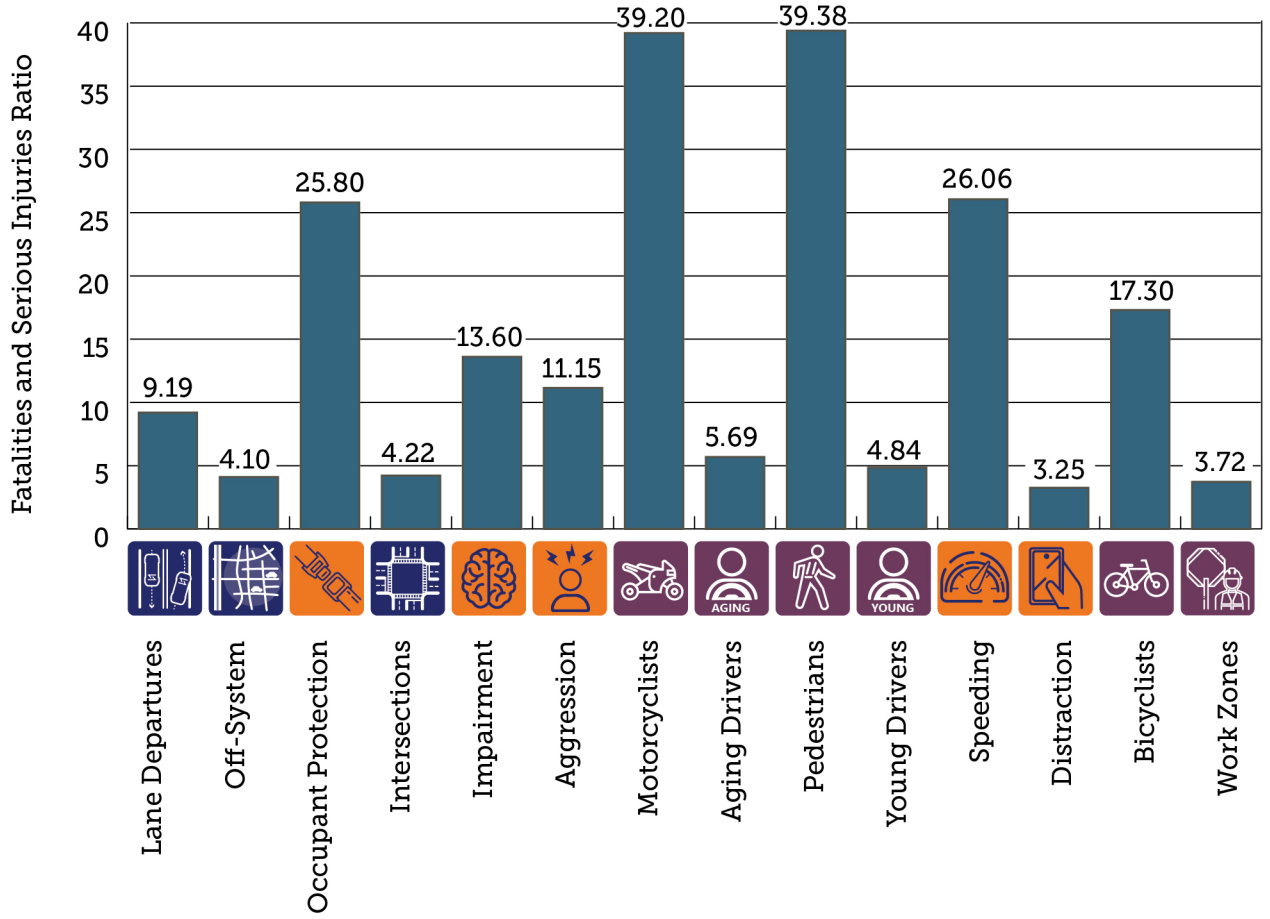


Figure 2-3: Ratio of Fatalities and Serious Injuries to Total Crashes by Focus Area (2021 to 2023)

Figure 2-3 highlights how crashes within certain Focus Areas have a much higher likelihood of resulting in deaths or serious injuries. For example, 39.2% of motorcycle crashes result in a serious injury or fatality. In contrast, 9.2% of lane departure crashes result in serious injury or fatality. It is important to note that although each lane departure crash is less likely to result in a serious injury or fatality, they nevertheless make up a large proportion of the total number of crashes resulting in fatalities and serious injuries and therefore are an important Focus Area of the SHSP.

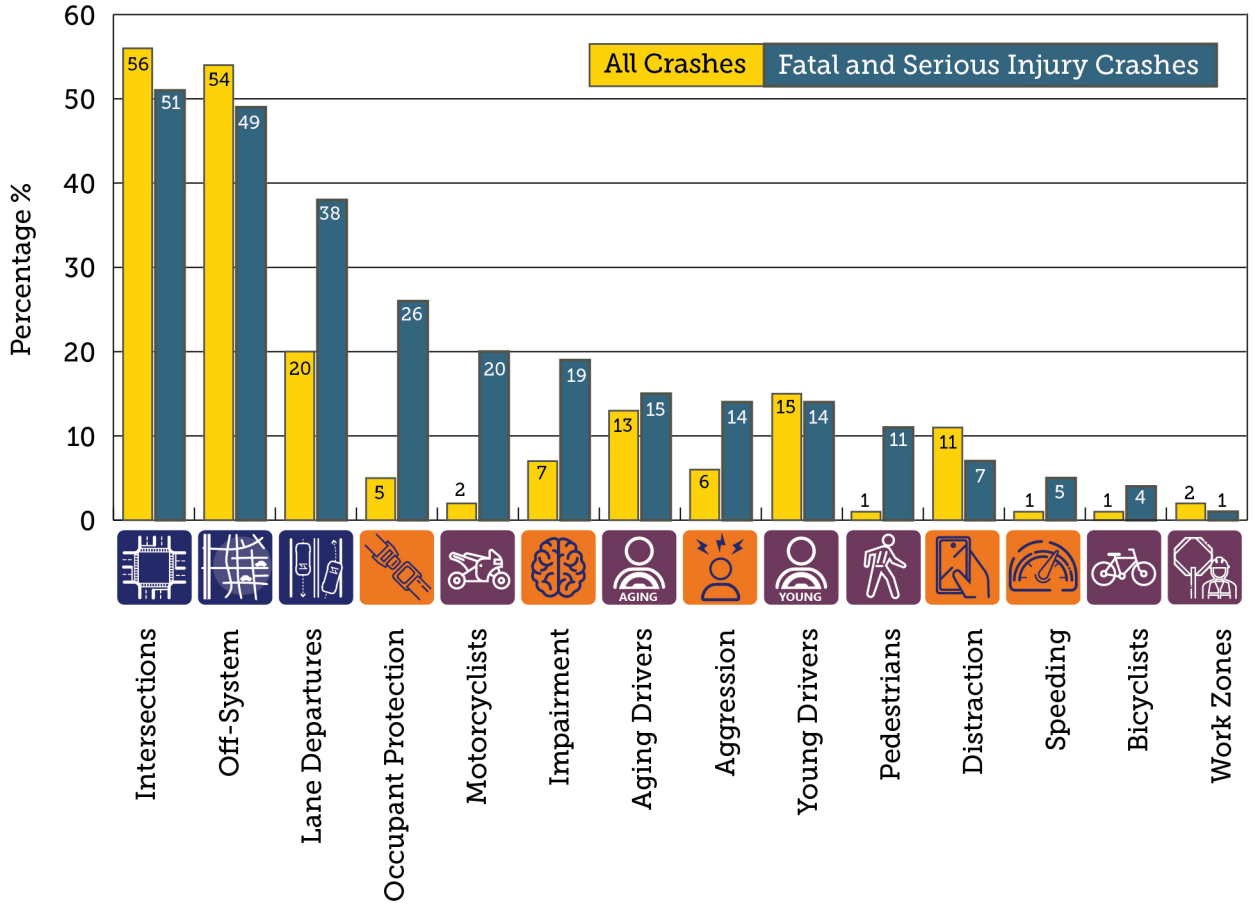


Figure 2-4: Proportion of Fatal and Serious Injury Crashes vs. All Crashes by Focus Area (2021 to 2023)

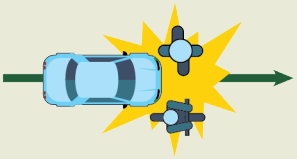
The number of fatal and serious injury crashes by Focus Area is important, as is the proportion of fatal and serious injury crashes to all crashes, as these illustrate areas where disproportionality creates opportunity for the application of safety improvement strategies. Trends within each Focus Area are also informative as they reveal whether existing strategies are yielding improvement (fewer crashes year-over-year) or if the opposite is true. As shown in Table 2-1, these trends indicate whether a Focus Area is grouped into Safety Culture, High-Impact, Emerging and Monitoring, and Doubling Down on Success categories. As described more thoroughly in Chapter 10 Implementation, the Focus Area category provides a glimpse into the effectiveness of current safety improvement efforts, and aids in the identification of new strategies.

Table 2-1: Focus Area Trends and Resulting Category

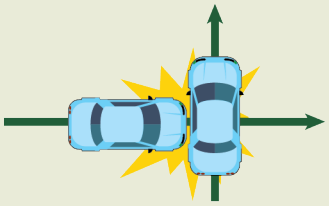
Focus Area	2021 Fatal & Serious Injuries	2022 Fatal & Serious Injuries	2023 Fatal & Serious Injuries	Total (2021-2023)	% Change (2021-2023)	Focus Area Category
Intersections	2,062	2,183	2,529	6,774	23%	High-Impact
Off-System	1,993	2,092	2,315	6,400	16%	High-Impact
Lane Departure	1,805	1,827	1,775	5,407	-2%	High-Impact
Occupant Protection	1,263	1,271	1,246	3,780	-1%	High-Impact
Impairment	913	986	992	2,891	9%	High-Impact
Motorcycles	800	800	842	2,442	5%	High-Impact
Young Drivers	606	735	794	2,135	31%	Emerging & Monitoring
Aging Drivers	673	679	771	2,123	15%	Emerging & Monitoring
Pedestrians	446	484	625	1,555	40%	Emerging & Monitoring
Speeding	178	236	292	706	64%	Emerging & Monitoring
Bicyclists	164	149	210	523	28%	Emerging & Monitoring
Work Zones	43	52	65	160	51%	Emerging & Monitoring
Aggression	608	731	690	2,029	13%	Emerging & Monitoring
First Responders*	N/A	N/A	N/A	N/A	N/A	Emerging & Monitoring
Emergency Medical Services*	N/A	N/A	N/A	N/A	N/A	Emerging & Monitoring
Distraction	353	339	348	1,040	-1%	Doubling Down
Speed Management*	N/A	N/A	N/A	N/A	N/A	Doubling Down
Traffic Incident Management*	N/A	N/A	N/A	N/A	N/A	Doubling Down
Wildlife-Vehicle Collisions	25	36	31	92	24%	Doubling Down
Commercial Vehicles*	N/A	N/A	N/A	N/A	N/A	Doubling Down
Children Passenger Safety (Under 15)	173	147	176	496	2%	Doubling Down
Winter Weather Related*	N/A	N/A	N/A	N/A	N/A	Doubling Down
Highway-Rail Grade Crossings	13	9	20	42	54%	Doubling Down

*Note: Data for these Focus Areas either do not apply in this way, or are not available.

Collision with Fixed Object
20%



Pedestrian and Bicyclists Crashes
17%



Broadside Collision
15%

While the Focus Areas help guide strategic priorities and actions, it is equally important to understand the specific types of crashes contributing to fatalities and serious injuries on Colorado's roadways. From 2019 to 2023, the most common fatal and serious injury crash types statewide were collision with a fixed object (20%), pedestrian and bicyclist crashes (17%), and broadside collisions (15%). These crashes frequently occur at intersections and in areas with high conflict points between road users. Reducing these crash types is essential to improving roadway safety across Colorado.

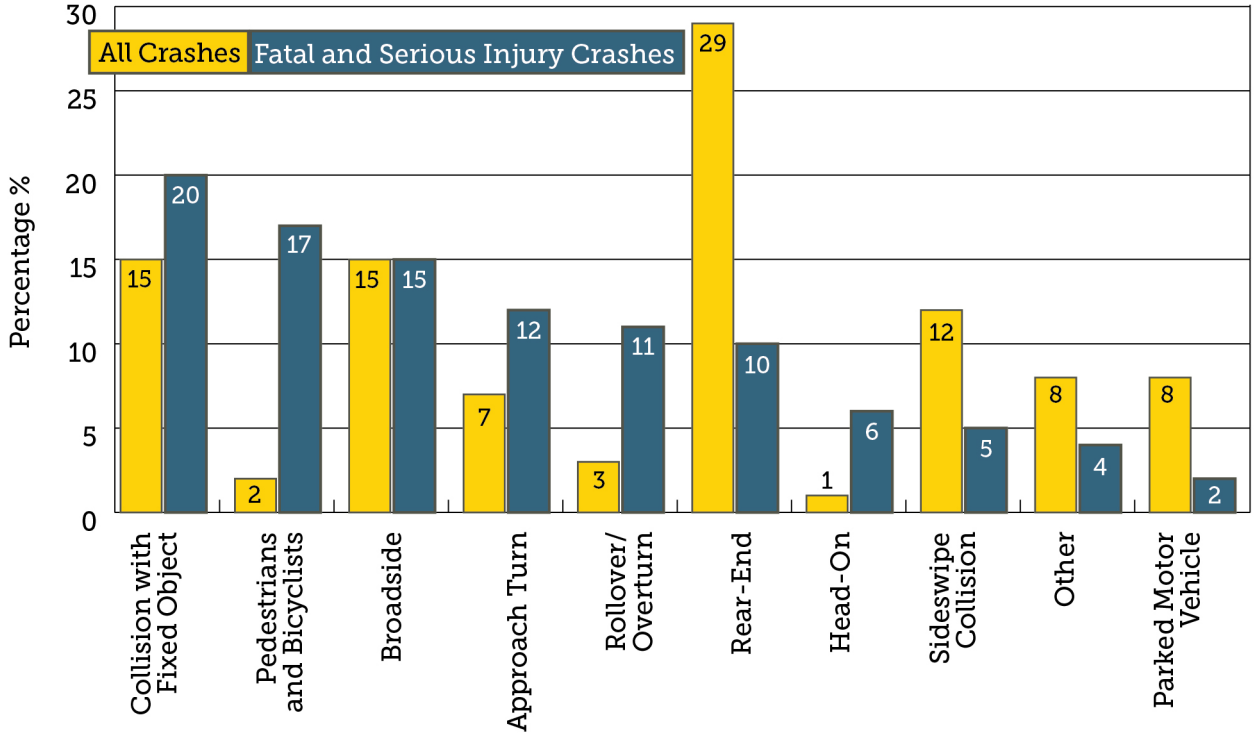


Figure 2-5: Fatalities and Serious Injuries by Crash Type (2021-2023)

Evolving Travel Trends

The societal shifts from the COVID-19 pandemic had significant impacts on travel patterns and safety across Colorado. VMT declined sharply due to stay-at-home conditions, yet fatal crashes increased, leading to a spike in the fatality rate. This trend highlights how external factors, such as cultural and economic shifts, may compound safety risks.

In Colorado, urban areas account for over double the VMT of rural areas in a typical year. Urban VMT saw the steepest decline in 2020, but since then, travel has largely rebounded to pre-pandemic levels, with continued growth expected. While urban areas have higher traffic volumes and more crashes overall, rural areas experience disproportionately severe crashes on a per-crash basis. Understanding these geographic differences is crucial for improving safety statewide.

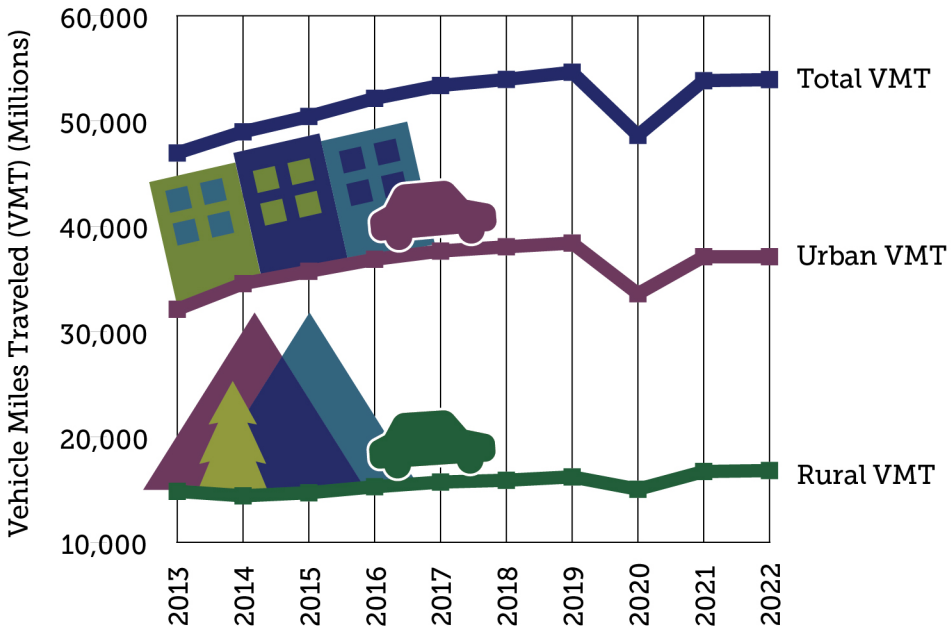


Figure 2-6: Urban vs. Rural VMT Trend (2013-2022)

Source: FHWA Highway Statistics Tables VM-2. (2013 to 2022)

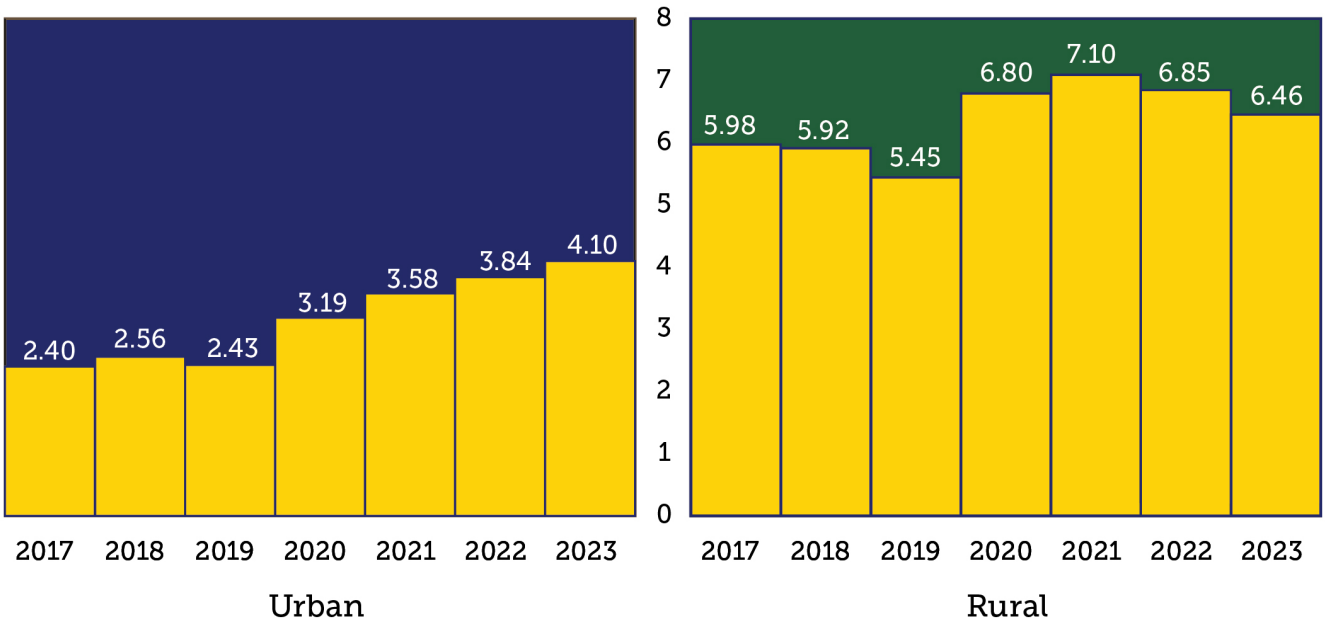


Figure 2-7: Urban vs. Rural Fatal Crash Rate per 100 Crashes (2017-2023)

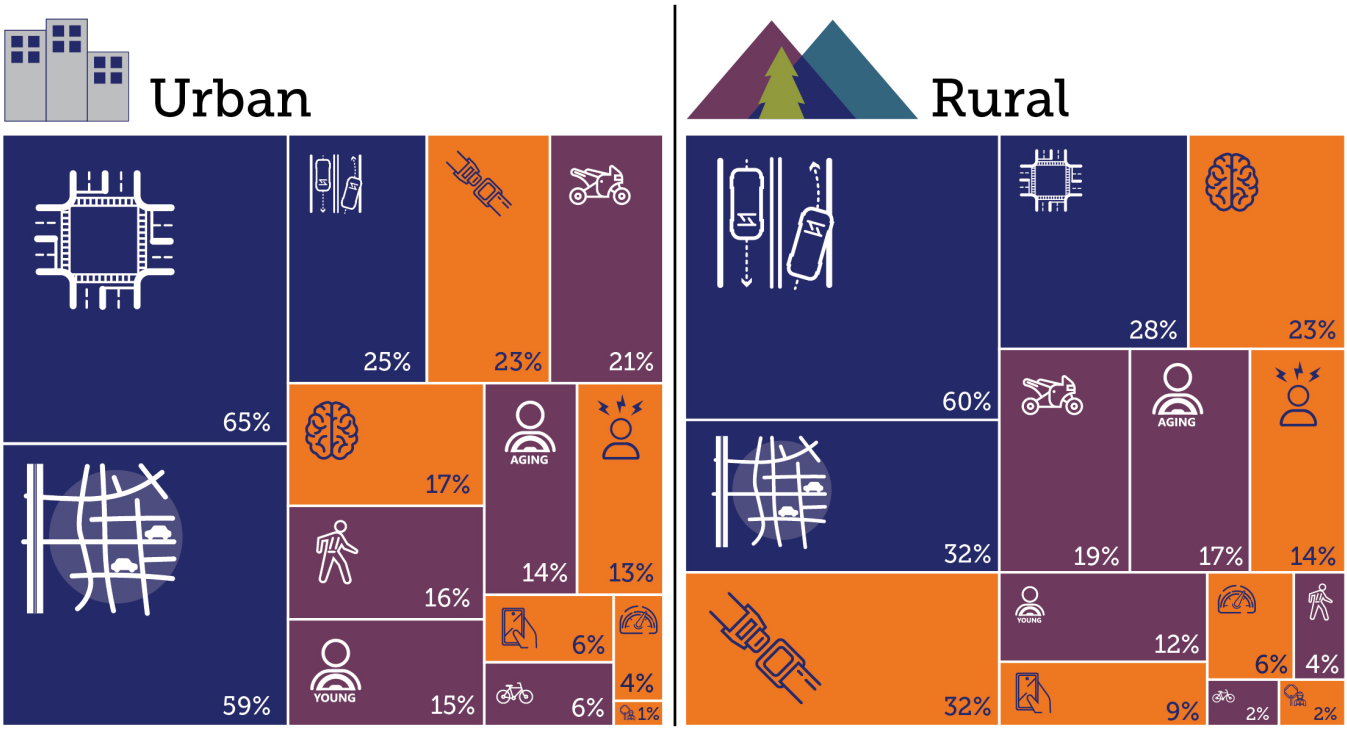
Source: CO Crash Database as of January 2025 (2017 to 2023)

Urban and Rural Contexts

Urban and growing communities face safety challenges shaped by their environment. With more pedestrians, bicyclists, and other VRUs, urban areas see a higher proportion of severe crashes involving these road users. This is primarily due to more frequent daily interactions between vehicles and other road users on city streets.

While Colorado continues to urbanize, rural communities experience distinct safety risks that require attention. Although urban areas have three times as many crashes as rural areas, rural crashes more frequently result in fatalities and serious injuries. Factors such as higher speed, lower seat belt use, and lower access to post-crash care contribute to the severity of rural crashes. Addressing these differences is critical for improving safety statewide.

Figure 2-8 illustrates the percentage of fatal and serious injury crashes in urban and rural areas across key Focus Areas. Note that crashes often include multiple contributing factors and represent multiple Focus Areas. For example, a single crash may involve speeding, impairment, and lane departure. As such, the percentages in the figure total more than 100 percent.



Urban	
Intersection 65%	Young Driver 15%
Off-System 59%	Aging Driver 14%
Lane Departure 25%	Aggression 13%
Occupant Protection 23%	Distraction 6%
Motorcyclists 21%	Speeding 4%
Impairment 17%	Bicyclists 6%
Pedestrians 16%	Work Zone 1%

Rural	
Lane Departure 60%	Aggression 14%
Off-System 32%	Young Driver 12%
Occupant Protection 32%	Distraction 9%
Intersection 28%	Speeding 6%
Impairment 23%	Pedestrians 4%
Motorcyclists 19%	Bicyclists 2%
Aging Driver 17%	Work Zone 2%

Figure 2-8: Urban and Rural Fatal and Serious Injuries by Focus Area

Source: CO Crash Database as of January 2025 (2021 to 2023)

State and Local Road Contexts

The state's roadway system also plays a critical role in crash trends. Though the state highway system accounts for only 10% of Colorado's total roadway miles, it carries 49% of the total VMT. Reflecting this pattern, 52% of fatal and serious injury crashes occur on state highways, while 48% happen on off-system roadways. This means that strategic safety improvements on a smaller subset of high-risk state highways could address a significant portion of severe crashes.

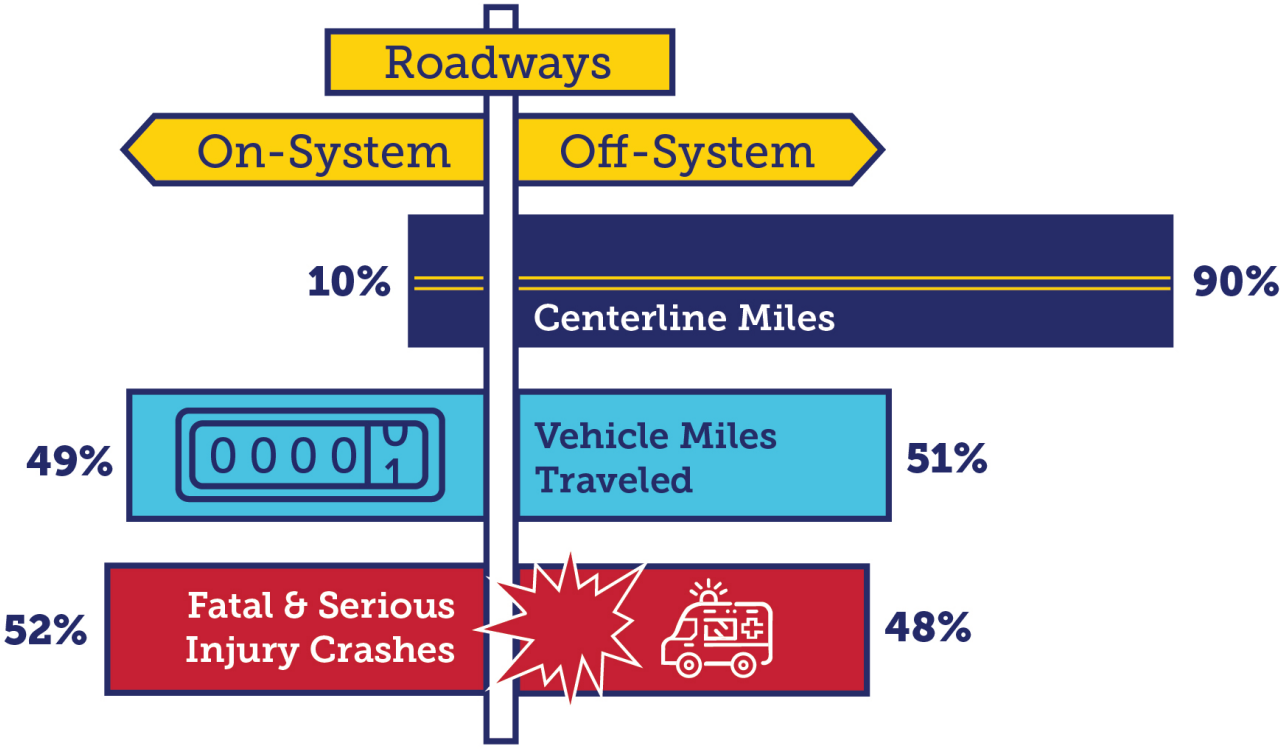


Figure 2-9: Centerline Miles, Annual Vehicle Miles Traveled, and Fatal and Serious Injury Crashes by On vs. Off-System Roadways

Demographic Shifts

As Colorado's population grows and shifts, the state faces new challenges in ensuring roadway safety. Over the past decade, Colorado's population grew by 10%, adding approximately 52,000 new residents in 2023 alone. However, traffic-related fatalities and serious injuries increased by 24% during the same period—growing more than twice as fast as the population. With forecasts projecting another 26% increase in residents by 2050, addressing this widening gap between growth and roadway safety is critical.

Demographic changes are also reshaping travel patterns and crash risk. Older adults are becoming a larger share of Colorado's drivers, pedestrians, and bicyclists, which has direct safety implications (Figure 2-10). Older adults, especially pedestrians, are more likely to sustain severe injuries or fatalities in crashes. Older adults are less likely to survive a crash due to factors such as increased vulnerability, comorbidities (e.g., heart disease), medications that impair blood clotting, and delayed recovery. As the state plans for the future, it must accommodate aging populations and their mobility needs.

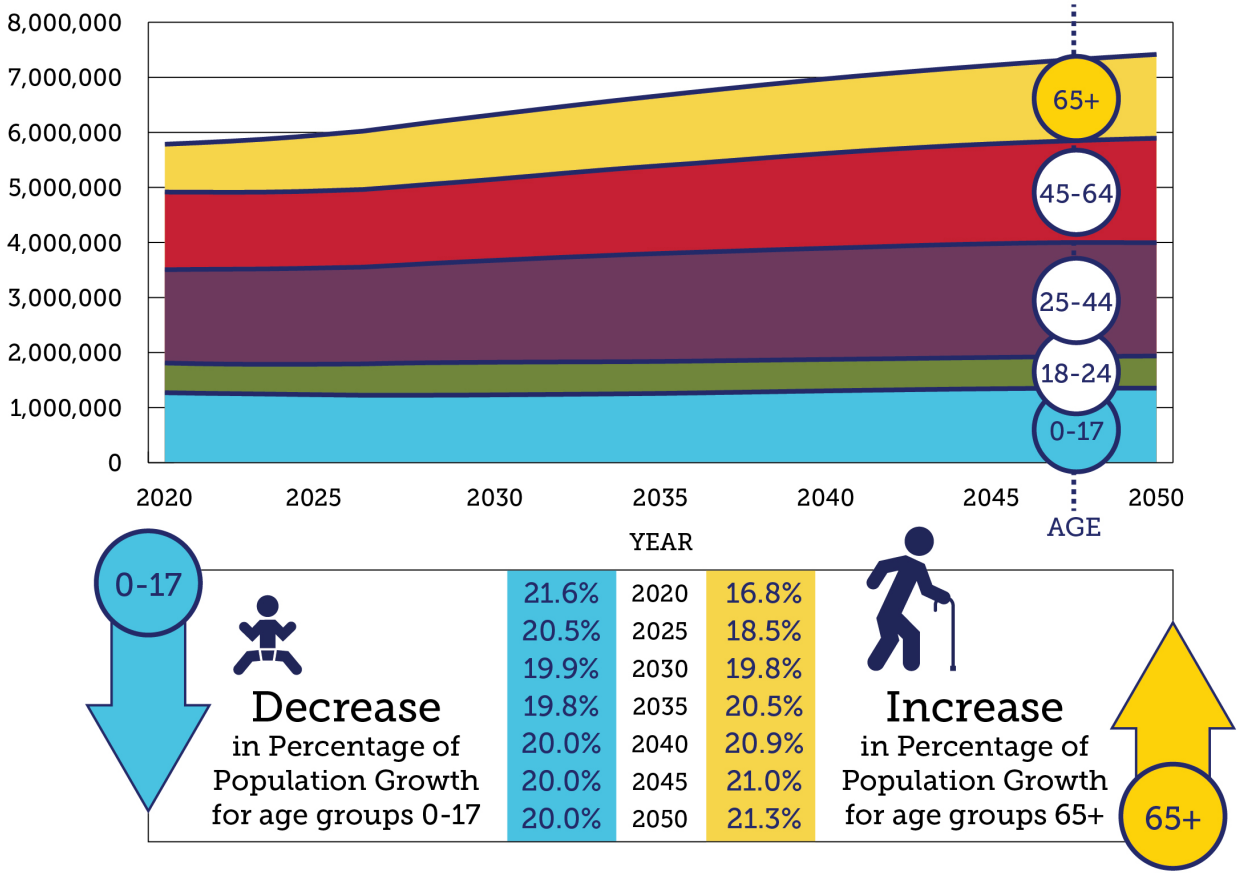


Figure 2-10: Population Growth in Colorado by Age Group (2020-2050)

Source: CO State Demography Office (https://demography.dola.colorado.gov/assets/lookups/county_sya_lookup.html)

Disparities in crash risk extend beyond age. National data shows that racial minorities are overrepresented in fatal crashes. Research also suggests that the location and quality of transportation infrastructure in communities play a significant role in crash risk. The next section overlays Colorado's crash data with more extensive details on the socioeconomic and demographic characteristics of those involved in crashes to analyze disparities.

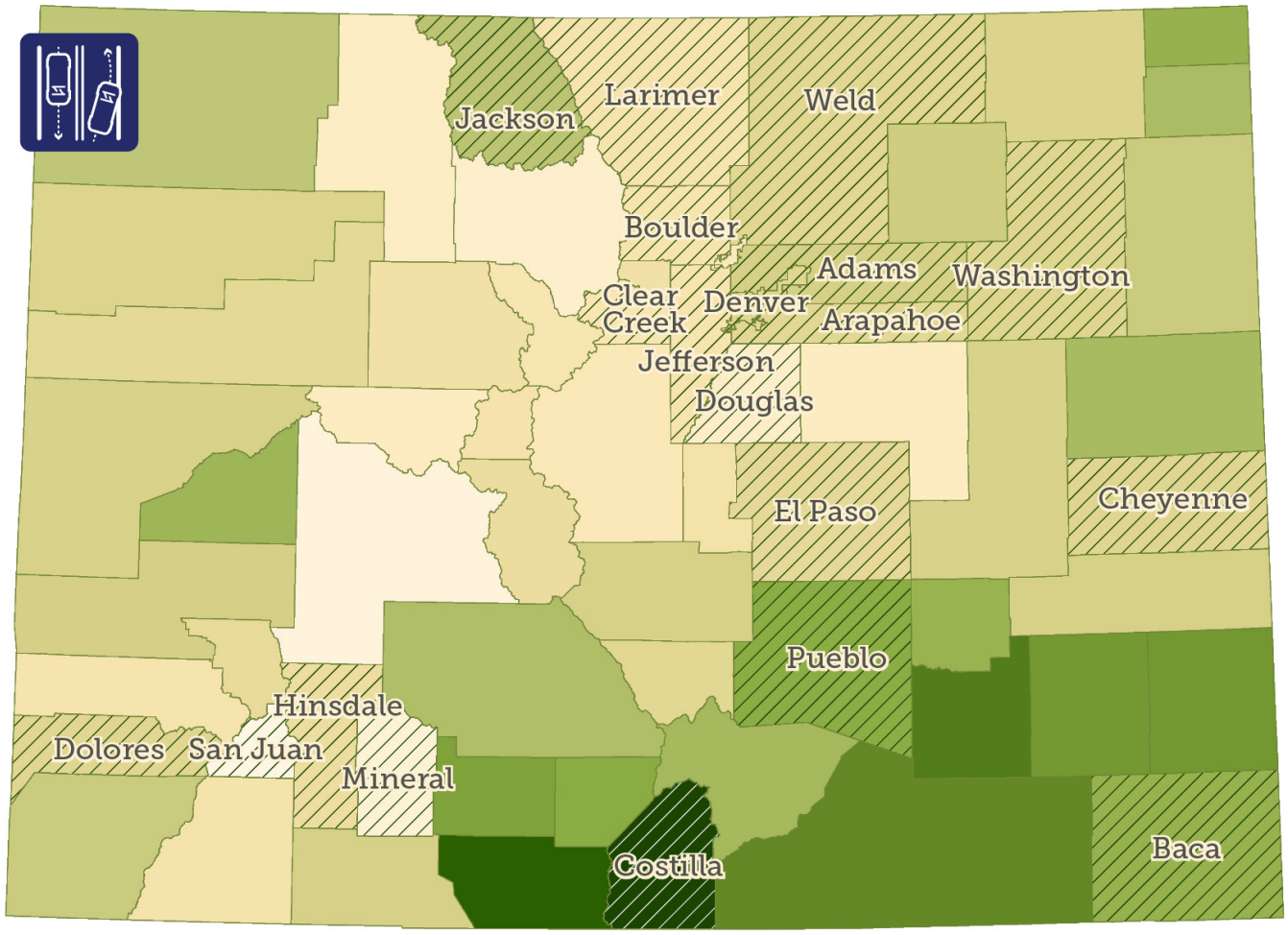
County Transportation Data

This plan utilizes Transportation Disadvantaged Index (TDI) data developed specifically for Colorado. Adapted from a framework originally created by the North Carolina Department of Transportation (NCDOT), the TDI identifies areas with higher transportation needs by comparing local communities to county, regional, and statewide averages.

The TDI is calculated at the U.S. Census Block Group level. These calculations produce a cumulative TDI score, with higher scores indicating greater transportation need. For this plan, TDI scores are aggregated to the county level to provide a broader, policy-oriented view. The index considers factors such as population, age, income and other factors.

Each safety Focus Area (except those in the Safety Culture Emphasis Area) includes a Weighted TDI Map, displaying county-level TDI scores. Darker shades represent higher TDI values, indicating greater levels of transportation need. To further contextualize transportation need, the maps also identify the counties with the highest total fatalities and serious injuries and/or the highest fatality and serious injury rates per resident for the respective Focus Area.

Figure 2-11: TDI Map Example: Total Fatalities and Serious Injuries



Rank	Top Counties Overall	Top Counties per Capita
1	El Paso	Mineral
2	Denver	San Juan
3	Adams	Jackson
4	Jefferson	Cheyenne
5	Weld	Baca
6	Larimer	Hinsdale
7	Arapahoe	Costilla
8	Douglas	Washington
9	Boulder	Clear Creek
10	Pueblo	Dolores

Map Legend

Weighted TDI Score

Low — High

Diagonal Striping = Top 10 overall and/or per capita counties

This map shows the Transportation Disadvantage Index (TDI) and labels the top 10 counties for total fatalities and serious injuries, along with the top 10 counties with the highest per-capita impact among relevant demographics. The table provides rankings for both categories.

2020 STSP Evaluation

The 2020 STSP identified 15 Tier I (High-Priority) Strategies for implementation. Collectively, the state accomplished most of the Tier I strategies identified in the plan. A few successes included:

- Naming a safety champion to lead a proactive safety program.
- Building a safety advocacy coalition (ATS).
- Institutionalizing safety roles/responsibilities.
- Coordinating with existing safety programs.
- Launching the Traffic Safety Summit initiative.
- Promoting consistent safety messages and campaigns.

These strategies and a number of the actions listed in the STSP continue to progress and have been incorporated into the SHSP strategies. The STSP created the ATS as a safety advocacy coalition, which has crafted a path for the future of transportation safety in Colorado. ATS has led the adoption of Colorado's Safe System Approach which changes the alignment of the focus areas identified in the previous STSP. These focus areas have been redeveloped under the emphasis areas of the SSA (Safety Culture, Safe Driving, Safe People, Safe Roads and Post-Crash Care). These emphasis areas have existing SME teams responsible for development, implementation and monitoring of strategies.

Moving forward with this SHSP, most of the focus areas identified in the STSP have been realigned to fit with the existing emphasis area working groups in the SSA. For example Aggressive Driving has been moved from the High-Risk Behavior emphasis area in the STSP to Safe Driving in the SHSP. The Programmatic focus area in the STSP has been moved to fit under each of the emphasis areas of the SSA in a more focused way. Stakeholders identified and data confirmed that most of the focus areas from the STSP should be continued into this plan, with the addition of several new focus areas, under the existing infrastructure of the SSA.

The 2020 STSP also aimed to reduce the number of traffic-related fatalities and serious injuries per 100 million VMT by 15%. While data reveals fatalities and are starting to trend downwards over the last few years, the goals of the STSP were not met as there was still an overall increase since the adoption of the STSP.

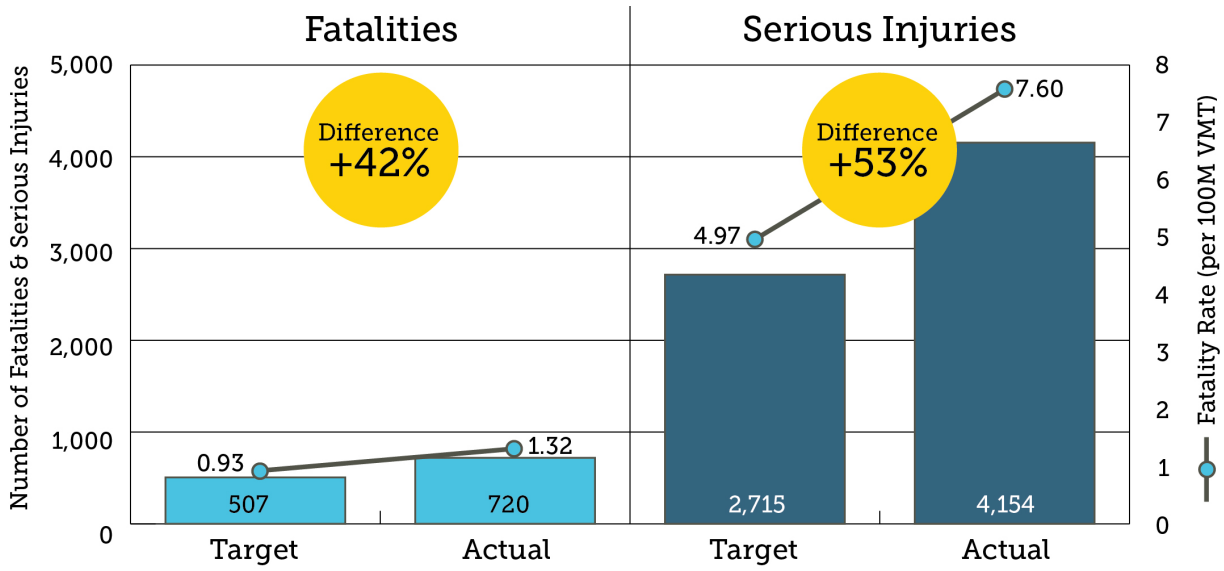


Figure 2-12: 2020 STSP Fatalities and Serious Injuries per 100 Million VMT Goals Versus Actual

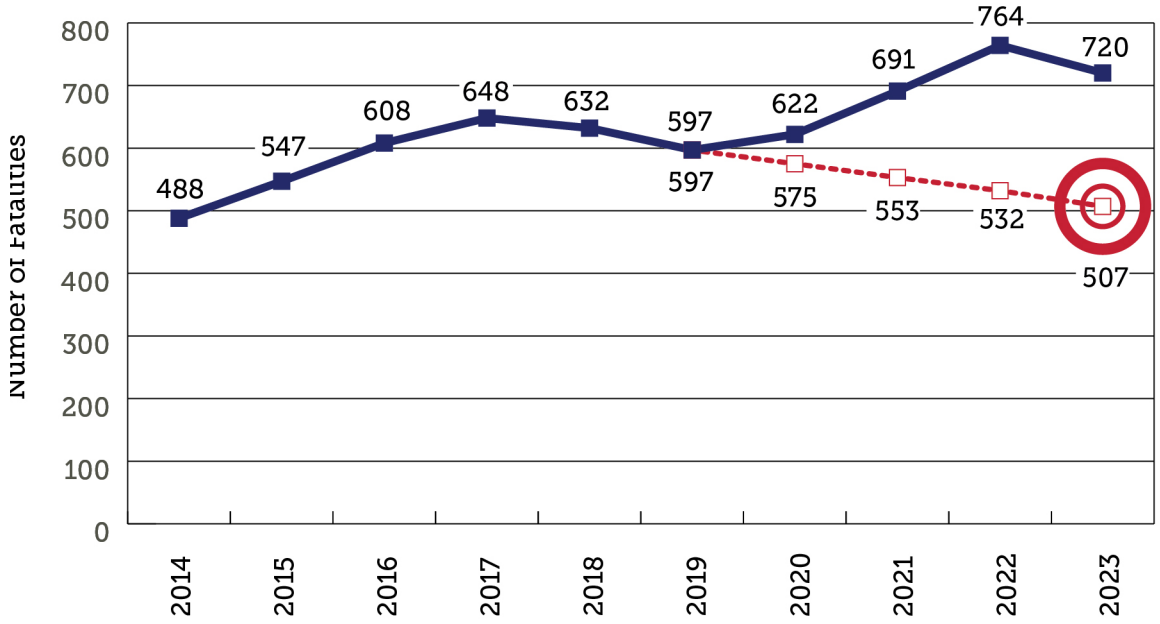


Figure 2-13: 2020 STSP Fatality Goals vs. Actual

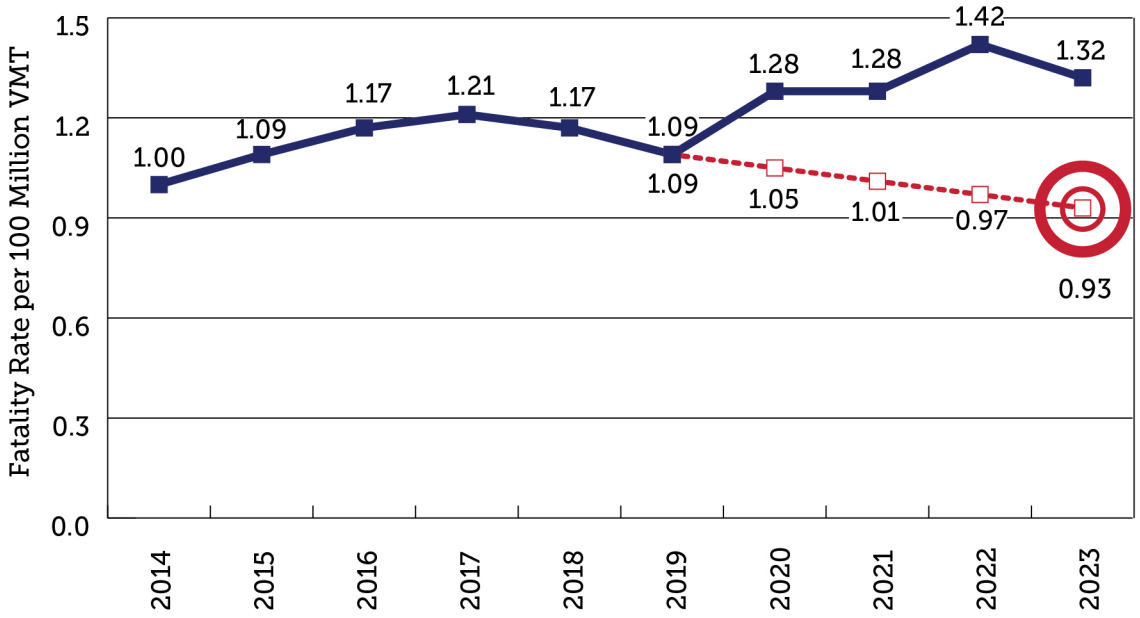


Figure 2-14: 2020 STSP Fatality Rate Goals vs. Actual

Note: 2023 VMT not finalized, projected .06% growth rate used

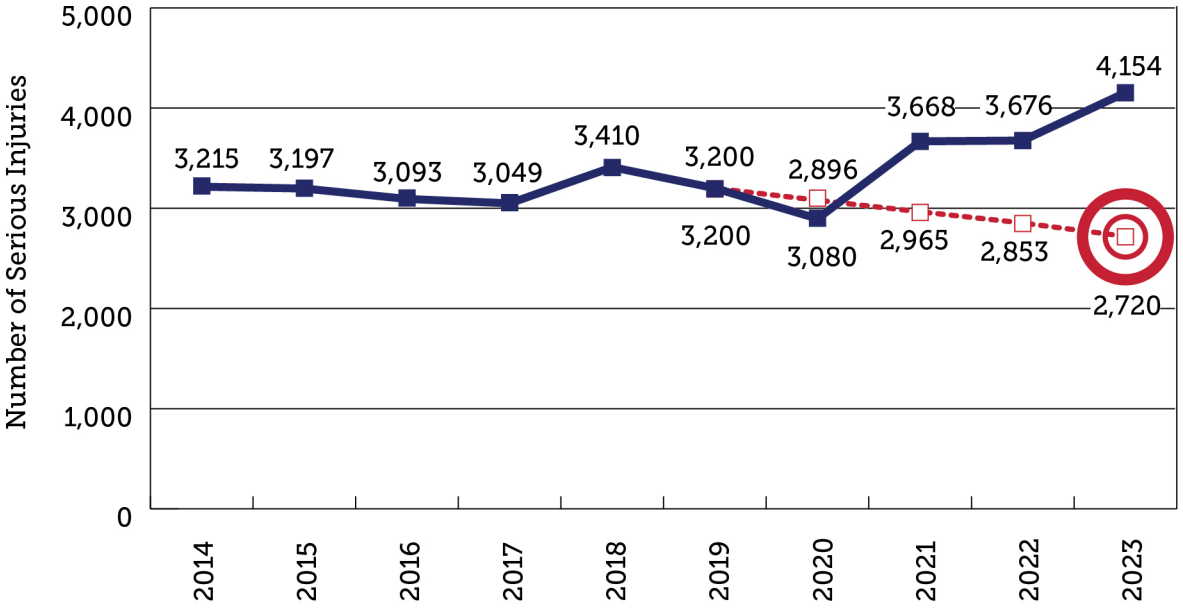


Figure 2-15: 2020 STSP Serious Injury Goals vs. Actual

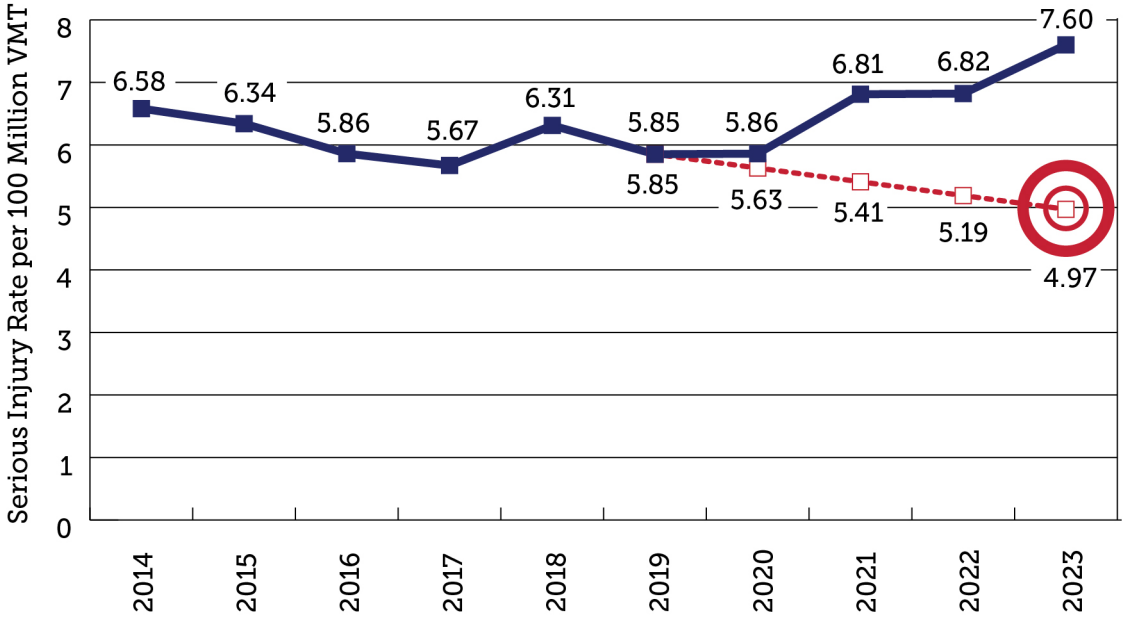


Figure 2-16: 2020 STSP Serious Injury Rate Goals vs. Actual

Note: 2023 VMT not finalized, projected .06% growth rate used