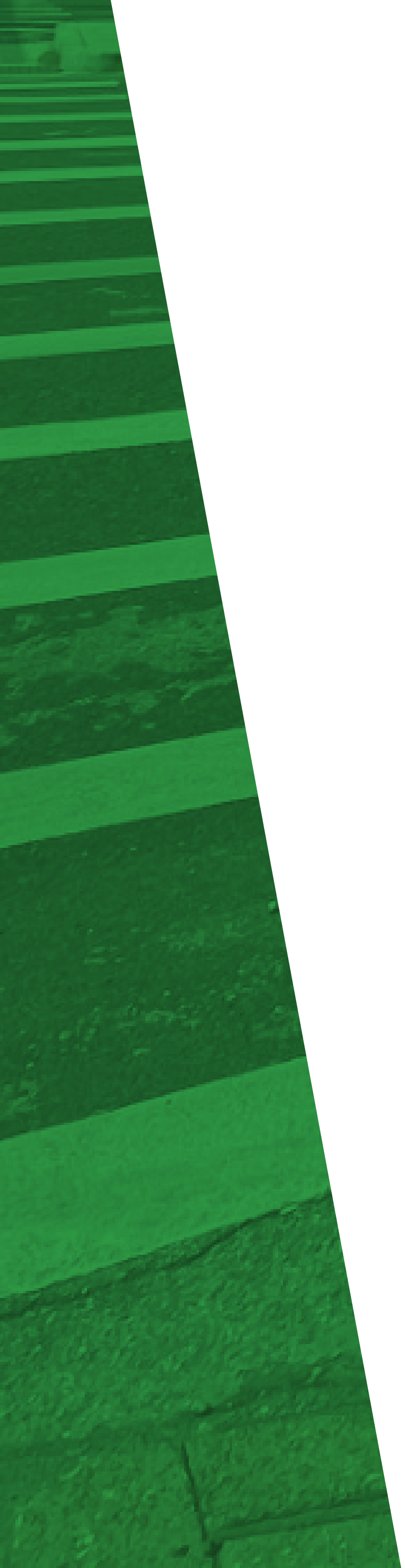

DESTINATION SAFE STREETS

OTO Safety Action Plan

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CONTENTS

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1. Introduction

Fatalities

2022	2040
44	0

Serious Injuries

2022	2050
232	0

Safety as a Priority

Formalizing Safety Planning

ABOUT THE OTO

The Ozarks Transportation Organization (OTO) is the regional Metropolitan Planning Organization (MPO) for the Springfield region. The MPO, located in southwest Missouri, includes elected and appointed officials from Christian and Greene counties and the cities of Battlefield, Nixa, Ozark, Republic, Springfield, Strafford, and Willard. The OTO has identified safety as the number one priority in its planning process.

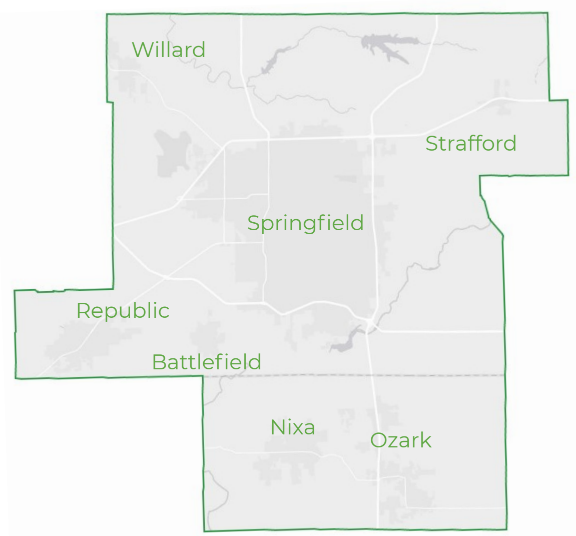
CULTURE OF SAFETY

Since its creation as a transportation management area, the OTO has actively used crash data to prioritize its Long Range Transportation Plan (LRTP) and Transportation Improvement Program (TIP) projects and has tracked this as a locally developed performance measure since 2011. This is highlighted in the annual state of transportation report.

Additionally, OTO has participated in the Missouri Blueprint for Roadway Safety/Southwest Coalition for Roadway Safety since its inception. OTO also stepped up for the region when it helped create a Traffic Incident Management (TIM) committee. This group is comprised of emergency responders and meets quarterly to build relationships, improve response times, and ensure responder safety. This cooperation also makes the region's roads safer for the traveling public.

SAFETY ACTION PLAN

On February 1, 2023, the U.S. Department of Transportation announced that the Ozarks Transportation Organization was awarded a Safe Streets and Roads for All grant, in the amount of $228,800. This grant will provide support for the development of a comprehensive Safety Action Plan. With this plan in place, OTO member jurisdictions will be able to apply for implementation grant funding in future years.



Safety as a Problem

Fatal and Severe Crashes 2018-2022

CRASHES

Between 2018 and 2022, the OTO region experienced 181 fatal crashes with a total of 197 fatalities. For the same time period, there were 972 serious injury crashes and 1,083 serious injuries, 25 of which occurred as part of fatal crashes.

Throughout this plan, most statistics will refer to the number of crashes, as opposed to the number of injuries with each crash.

DATA

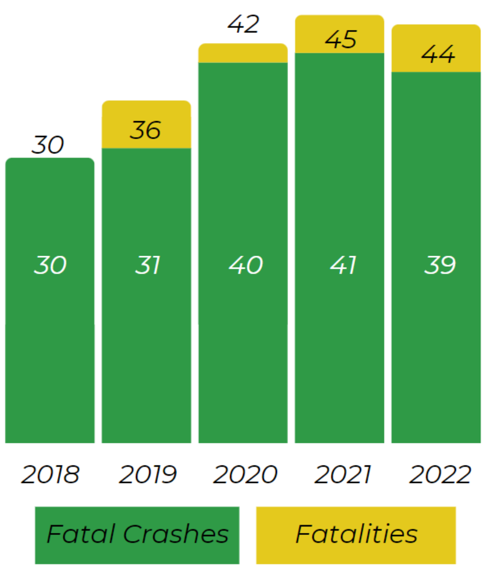
Crash data used in this plan was provided by the Missouri Department of Transportation (MoDOT). The analysis region was the Ozarks Transportation Organization planning area (see map on prior page). Analysis years were five years from 2018 to 2022.

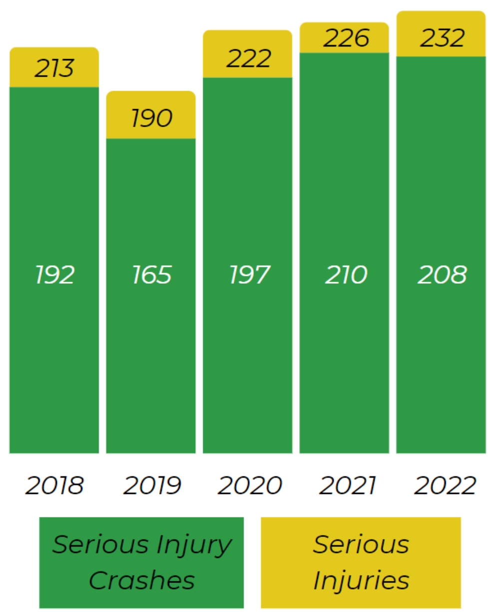
CATEGORIZATION

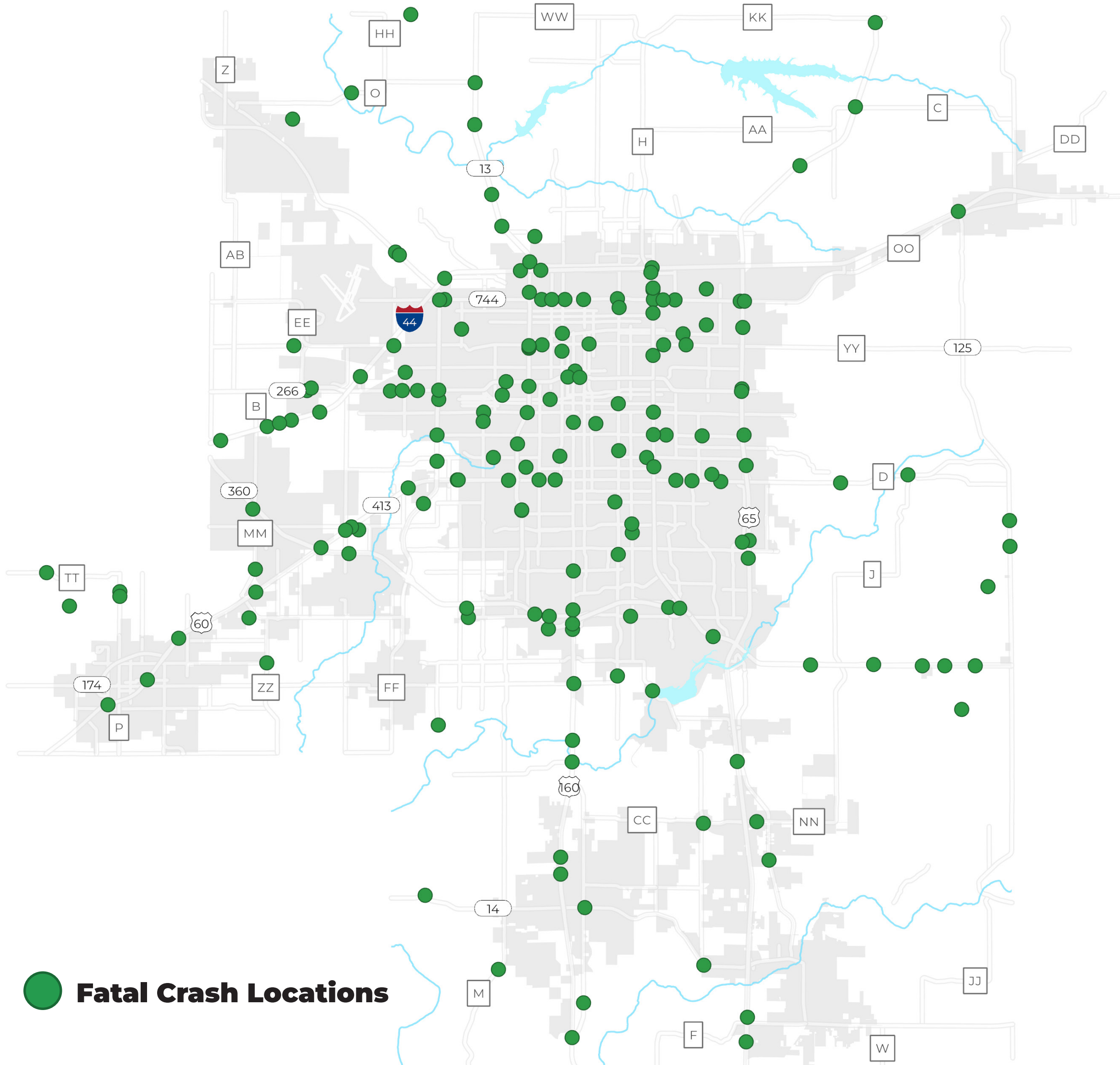
Crashes can be categorized in numerous ways. Most simply, they are described as being along a segment (along the roadway) or at an intersection. Crash Classes are derived from the crash reports and include 32 characteristics such as Deer, Fixed Object, Left Turn, Out of Control, and Rear End. A third way to classify crashes is by the 23 Involving Types, which can include Aggressive Driver, Distracted Driver, Driver Age, Lane Departure, Motorcycle, and Pedestrian.

THE GOAL

It is the goal of this plan for the region to have zero fatalities by 2040 and zero serious injuries by 2050.





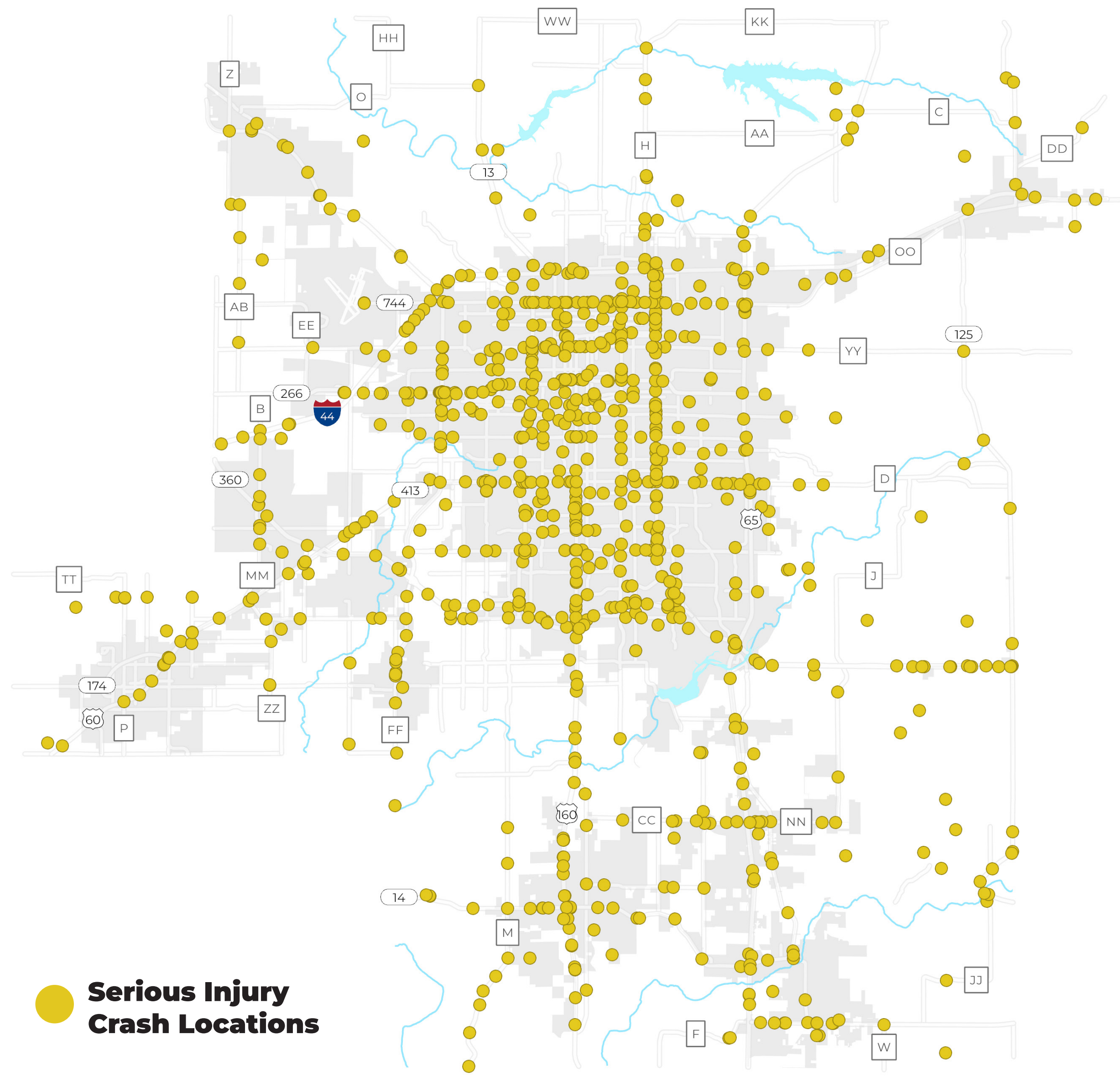


FATAL CRASHES

In the OTO area, more than two-thirds of the 181 fatal crashes occurred on state roads, showing that higher travel speeds are a major factor in crash severity. Between 2018 and 2022, fatal crashes were almost equally split between roadway segments (48%) and intersections (52%). Vulnerable road users, such as pedestrians and cyclists, were involved in 15% of fatal crashes, even though they make up only 2% of all crashes. After a decline in 2020 and 2021, when fatal crashes involving vulnerable road users dropped to 12%, this number rose sharply to 18% in 2022.

SERIOUS INJURY CRASHES

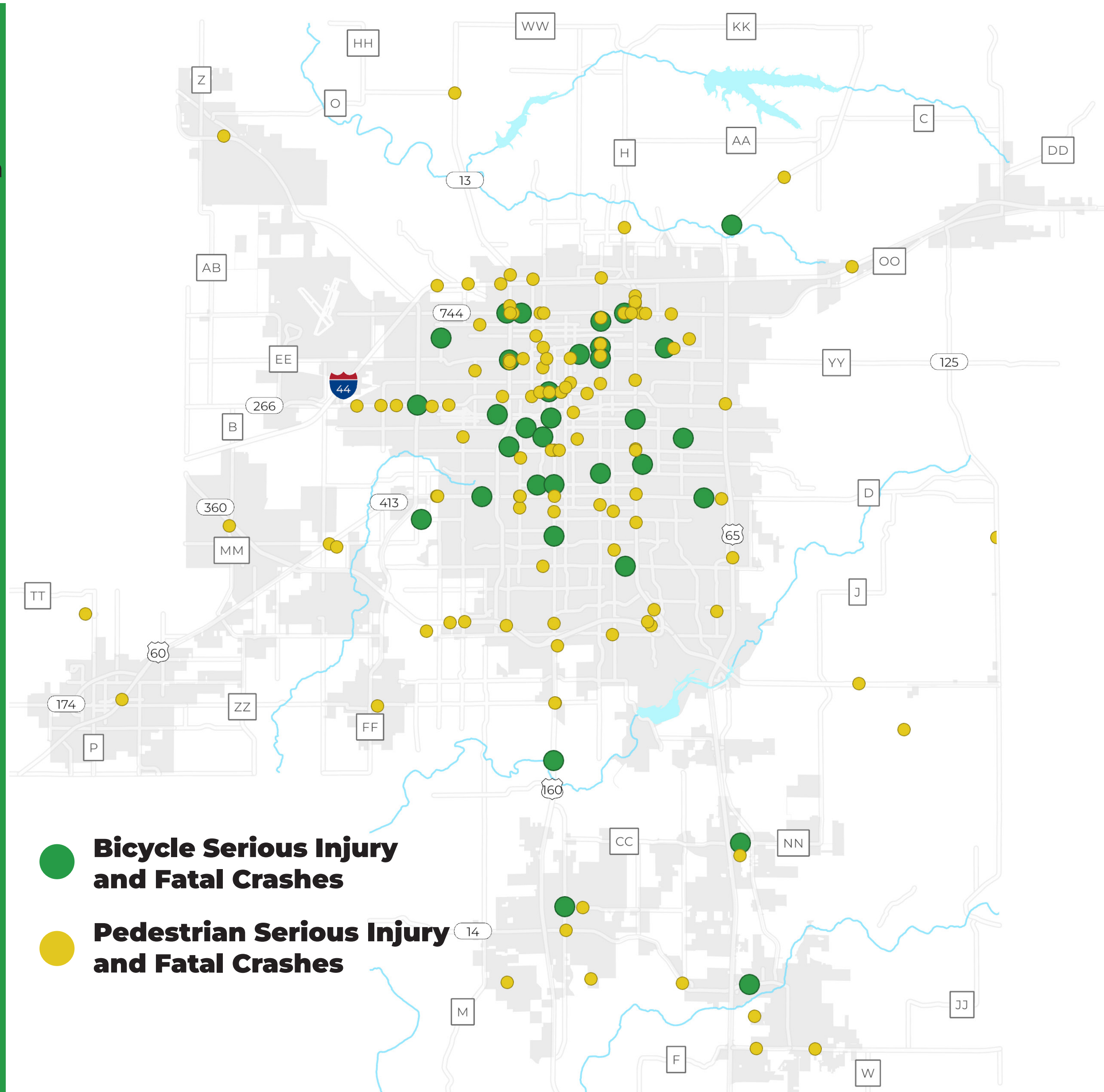
Between 2018 and 2022, 3% of all crashes in the OTO area were serious injury crashes. Like fatal crashes, most serious injury crashes occurred on state roads. However, a larger percentage of serious injury crashes, 60%, took place at intersections, showing a higher involvement of intersections compared to fatal crashes. Turning movements were a major factor, contributing to 45% of serious injury crashes at intersections. Vulnerable road users, such as pedestrians and cyclists, were involved in 12% of serious injury crashes, with a noticeable increase of over 4% from 2021 to 2022, similar to trends seen in fatal crashes.



BICYCLE AND PEDESTRIAN CRASHES

Of the bicycle crashes between 2018 and 2022, there were 28 serious injury and 5 fatal crashes. Of the pedestrian crashes for the same time period, 88 were serious injury and 30 were fatal.

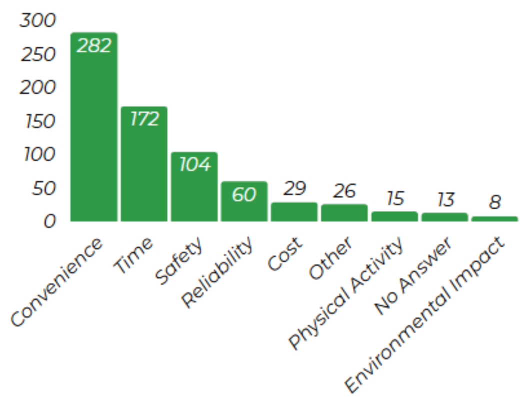
OTO has separately analyzed this crash history and that report can be requested from OTO.



PUBLIC SAFETY PERCEPTION

The initial survey developed for the Plan highlighted concerns of area residents.

Safety is a top three factor influencing why people choose the mode of transport they use to get around, after Convenience and Time.



By Roadway Type

The public cited distracted driving as a concern on both major thoroughfares and local streets, while aggressive driving was more of a concern on major thoroughfares and speeding was more of a concern on local streets.

Bicycle and pedestrian-related concerns were also cited more often for local streets, with disconnected sidewalks as the third highest concern after distracted driving and speeding. Other concerns for local streets included a lack of bike lanes, limited places to cross on foot, and sidewalk connections.

By Mode

Driver's top three safety concerns are distracted driving, aggressive driving, and speeding.

Bicyclists top three concerns are a lack of bike lanes, disconnected sidewalks, and distracted driving.

Both Pedestrians and Transit Users were concerned with disconnected sidewalks, limited places to cross on foot, and sidewalk conditions. Limited places to cross streets was a transit user's top concern on major thoroughfares.

Observed Safety Problems

Top safety problems noted by pedestrians and bicyclists include cars going too fast, cars not stopping, distracted driving, and a lack of sidewalks.

Top safety problems cited by drivers were a lack of sidewalks/crosswalks/bike lanes, pedestrians not using sidewalks, and pedestrians/bicyclists not being visible enough.

Improving Safety

Survey respondents ranked improving street design as the best way to increase safety for all users, followed by promoting safe speeds.

The community appears aware that the way the transportation network is designed is a key component of determining safety and aspects like driver behavior. Infrastructure that safely and comfortably includes all road users will likely have a more impactful outcome than education alone.

Safety as a System

The Safe System Approach

THE SAFE SYSTEM APPROACH FOCUSES ON BOTH HUMAN MISTAKES AND HUMAN VULNERABILITY, DESIGNING A SYSTEM WITH MANY REDUNDANCIES IN PLACE TO PROTECT EVERYONE.

PRINCIPLES OF A SAFE SYSTEM APPROACH

Death and Serious Injuries are Unacceptable

Humans Make Mistakes

Humans are Vulnerable

Responsibility is Shared

Safety is Proactive

Redundancy is Crucial

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2. Engagement

Background

Engagement Summary

Public engagement forms the backbone of successful transportation planning, ensuring that communities' needs, values, and aspirations are at the forefront of decision-making. Throughout 2024, the OTO conducted extensive public outreach events, workshops, and interactive demonstrations. These activities sought to foster dialogue around safety, accessibility, and connectivity in the transportation network across the Ozarks region.

This summary outlines the key engagement efforts, feedback received, and the thematic takeaways that will shape future plans, including the Safe Streets for All (SS4A) initiative. Detailed results can be found in the Engagement Appendices - B and C.

ADVISORY TEAM

The Advisory Team was appointed by the Technical Planning Committee and has guided the planning process and key decision points over the past year.

Members

- Corey Becker
- Mandy Büttgen-Quinn
- John Matthews
- Angela Nelson
- Beth Schaller
- Cliff Spangler
- Mark Webb

John Miller with the Federal Highway Administration also participated and provided support.

Meetings

- December 18, 2023
- April 29, 2024
- May 21, 2024
- May 28, 2024
- June 26, 2024
- July 10, 2024
- September 9, 2024
- December 9, 2024

ENGAGEMENT OPPORTUNITIES

A mix of opportunities were provided for the public to learn about and provide input to the plan. Additional outreach was made in underserved areas to ensure representation in the planning process.

- Open Houses
- Surveys (2)
- Intercept Events
- Stakeholder Meetings
- Focus Groups
- Outreach Events
- Dedicated Web Page
- Pop-Up Demonstration

Open Houses
Launching the Plan

GOAL

To gather in-person feedback from community members on safety concerns and needs for the SS4A Plan.

REACH

Dates

January 29-30, 2024

Locations

The Library Station, Springfield, MO.

The Ozark Community Center, Ozark, MO.

Republic Community Center, Republic, MO

Participation

150+ (plus local news coverage on KY3)

Methods

Advertised through print and digital channels as well as coverage through local broadcasting, including a full-page flyer and a QR code for easy access to project materials.

Ads were placed on all transit buses and at the Transit Center.

Included discussion stations, feedback forms, and possible design solutions visual displays.

INPUT RECEIVED

Common Concerns

Speeding and distracted driving were frequently mentioned issues, especially in residential and school zones.

Attendees flagged specific intersections for safety improvements, noting frequent crashes or near misses.

Notable Voices

A visually impaired participant emphasized the importance

of accessible and equitable transportation systems.

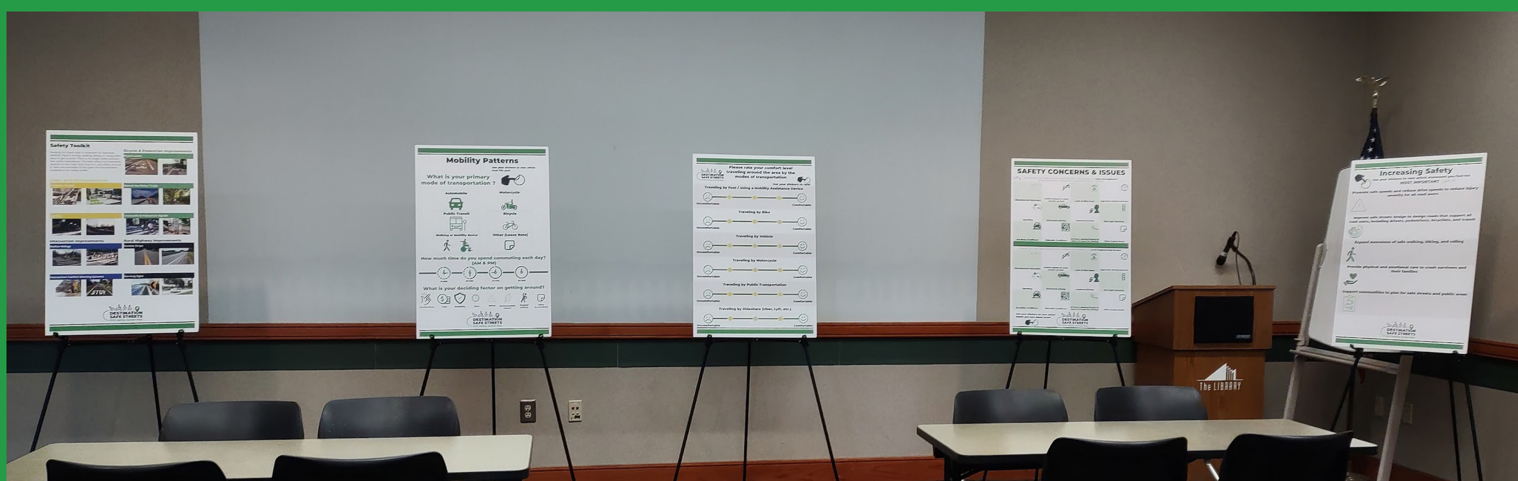
Concerns were raised about the lack of infrastructure to support non-drivers, including people walking and biking.

KEY TAKEAWAYS

Addressing dangerous automotive users is a top priority for attendees.

Improved infrastructure, such as crosswalks, signage, and lighting at key intersections, is needed to enhance safety.

Participants stressed the importance of designing streets for all users, with a focus on accessibility and equity.



Survey One

Initial Input

REACH

Over 700 respondents.

Methods

Distributed online via email newsletters, OTO's website, and social media channels. Paper copies available at senior centers and libraries. Intercept surveys conducted at transit stops and community locations.

An online map was also made available for the public to identify and discuss specific locations of safety concern.

INPUT RECEIVED

A summary of Survey One responses can be found in Appendix B.

Modal Breakdown

90% primarily use cars; 34% also walk, and 20% also bike.

Public transit users reported significantly longer commute times (30-90+ minutes) compared to drivers (under one hour).

Demographics

About 88% identified as White/Caucasian, 5% as Black or African American, 2% as American Indian or Alaskan Native, 1% as Asian/Pacific Islander, and 4% as multiple/other. This is similar to the demographics of the OTO region - 86.4% White/Caucasian, 3.3% Black or African American, 0.6 American Indian or Alaskan Native, 2.5% Asian/Pacific Islander, and 5.6% multiple/other.

Safety Concerns

Distracted driving ranked as the top concern across all road types.

On neighborhood streets, disconnected sidewalks (35%) and speeding (50%) were major issues.

Limited places to cross streets safely were significant for pedestrians and transit users.

Comfort by Mode

80% of drivers felt comfortable or very comfortable.

74% of bicyclists felt uncomfortable or very uncomfortable due to a lack of protected bike lanes.

Safety Priorities

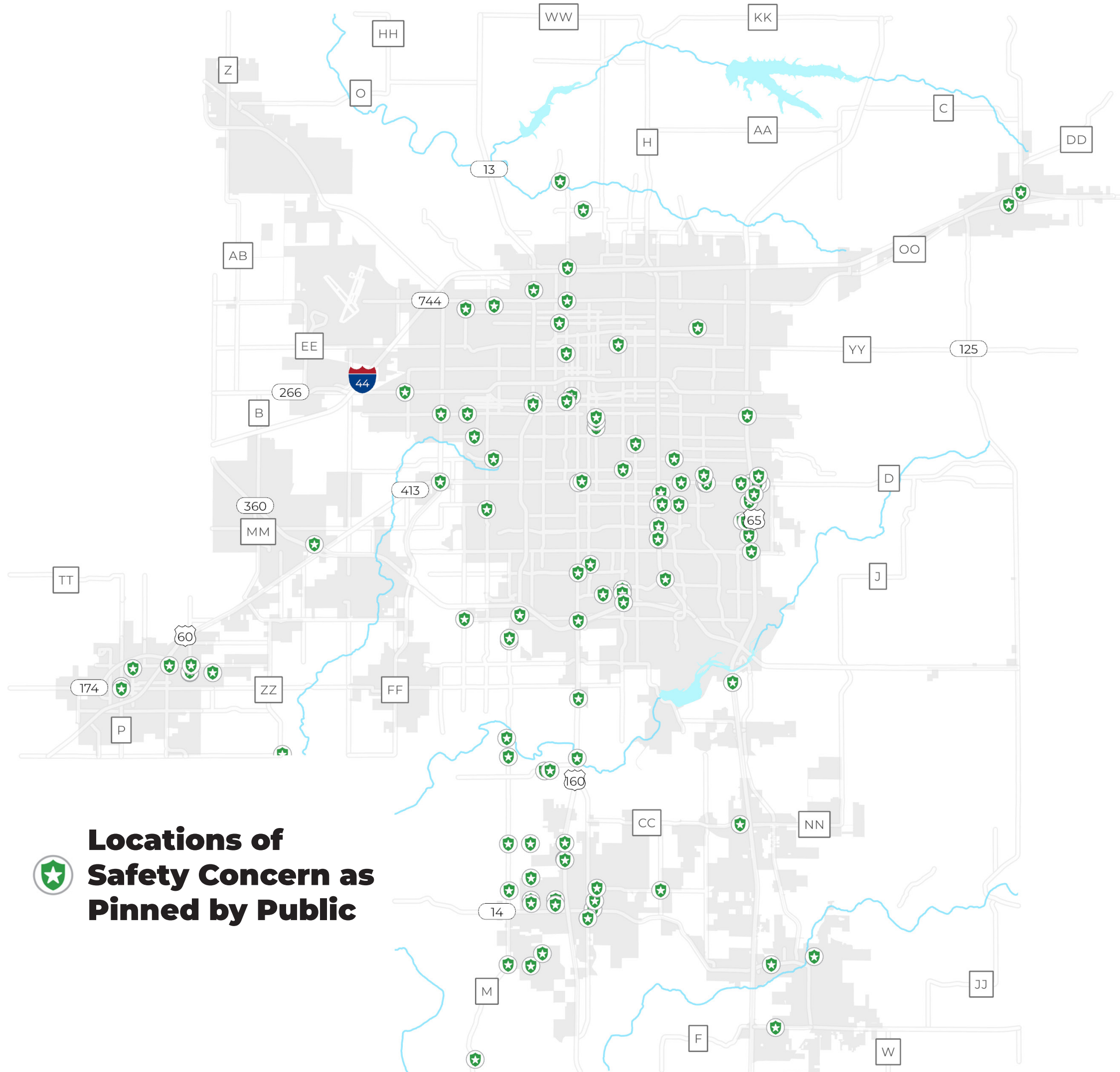
The highest-ranked improvement was redesigning streets to accommodate all users (4.11/5), followed by reducing vehicle speeds and expanding awareness campaigns.

KEY TAKEAWAYS

Infrastructure improvements, such as adding protected bike lanes and improving sidewalk connectivity, are critical for safety.

Transit users face significant challenges due to long commute times and limited pedestrian infrastructure near bus stops.

Respondents prioritized physical improvements over education campaigns, signaling strong community support for tangible changes to the transportation network.



Survey Two

Safety Solutions

GOAL

To validate initial findings and prioritize safety solutions proposed in the SS4A Draft Plan, as found in the Safety Toolkit in Appendix A.

REACH

69 participants engaged through online surveys and intercept outreach.

Methods

Online distribution via Survey123, advertised through digital channels, including emails to OTO members and interested parties, OTO website, and social media.

Engagement at community events and pop-up demonstrations.

INPUT RECEIVED

Policy Priorities

59% prioritized developing a traffic-calming toolbox for school zones.

56% supported adopting Complete Streets policies and using crash data to identify high-risk areas.

Intersection Improvements

Top solutions included road safety audits (74%), intersection conflict warning systems (57%), and double-sided "Stop Ahead" signs (54%).

Systemic Safety Enhancements

61% selected corridor access management and roadway lighting as critical improvements.

Enhanced signage and pavement markings ranked highly (59%).

Educational and Behavioral Campaigns

Anti-speeding campaigns and Safe Routes to School programs tied as top priorities (54%).

Community events promoting road-sharing among users of different types of transportation were favored by 52%.

Community Suggestions

Numerous requests for ADA-compliant sidewalks along Sunshine Corridor and other areas.

Suggestions for more roundabouts, flashing stop signs, and improved bike lanes.

KEY TAKEAWAYS

Participants emphasized a balanced approach between infrastructure improvements and community education.

Road safety audits and better intersection designs are seen as critical for reducing accidents.

Investments in ADA compliance and expanded bike infrastructure align with equity-focused priorities.

Stakeholders and Focus Groups

Targeted Engagement

All OTO Committee meetings are also open to the public.

BICYCLE PEDESTRIAN ADVISORY COMMITTEE (BPAC) MEETING

Date

March 12, 2024

Location

OTO Office, Springfield, MO

The Bicycle Pedestrian Advisory Committee convened to discuss critical issues surrounding trail and sidewalk development in the OTO region.

Key Discussions

A recap of 704 public survey responses and comments highlighted community priorities, such as safer intersections and enhanced pedestrian pathways.

Outcome

The committee reaffirmed its commitment to leveraging public input for regional connectivity and safety improvements.

LOCAL COORDINATING BOARD FOR TRANSIT

Date

May 2, 2024

Location

Hybrid meeting at OTO Office, Springfield, MO and via Zoom

The Local Coordinating Board for Transit met to discuss regional transit and how transit fits within the safety action plan.

Key Discussions

Discussion revolved around the experience of transit users as pedestrians, the experience of transit drivers in traffic, and the need for ADA accommodations along rural routes.

Outcome

The committee plans to increase focus on safe access to public transportation services, especially improving safe access for people with disabilities.

TRAFFIC INCIDENT MANAGEMENT (TIM) SUBCOMMITTEE

Dates

May 6 and August 5, 2024

Location

Hybrid meeting at OTO Office, Springfield, MO and via Microsoft Teams

These quarterly meetings brought together public safety officials, transportation experts, and local leaders to address incident management and traffic safety strategies.

Key Discussions

Incident reviews highlighted the need for improved emergency response times and coordination.

Updates on the Safe Streets plan explored strategies to reduce severe traffic incidents across high-risk corridors.

Stakeholders emphasized the importance of integrating construction and maintenance schedules with safety initiatives to minimize disruptions.

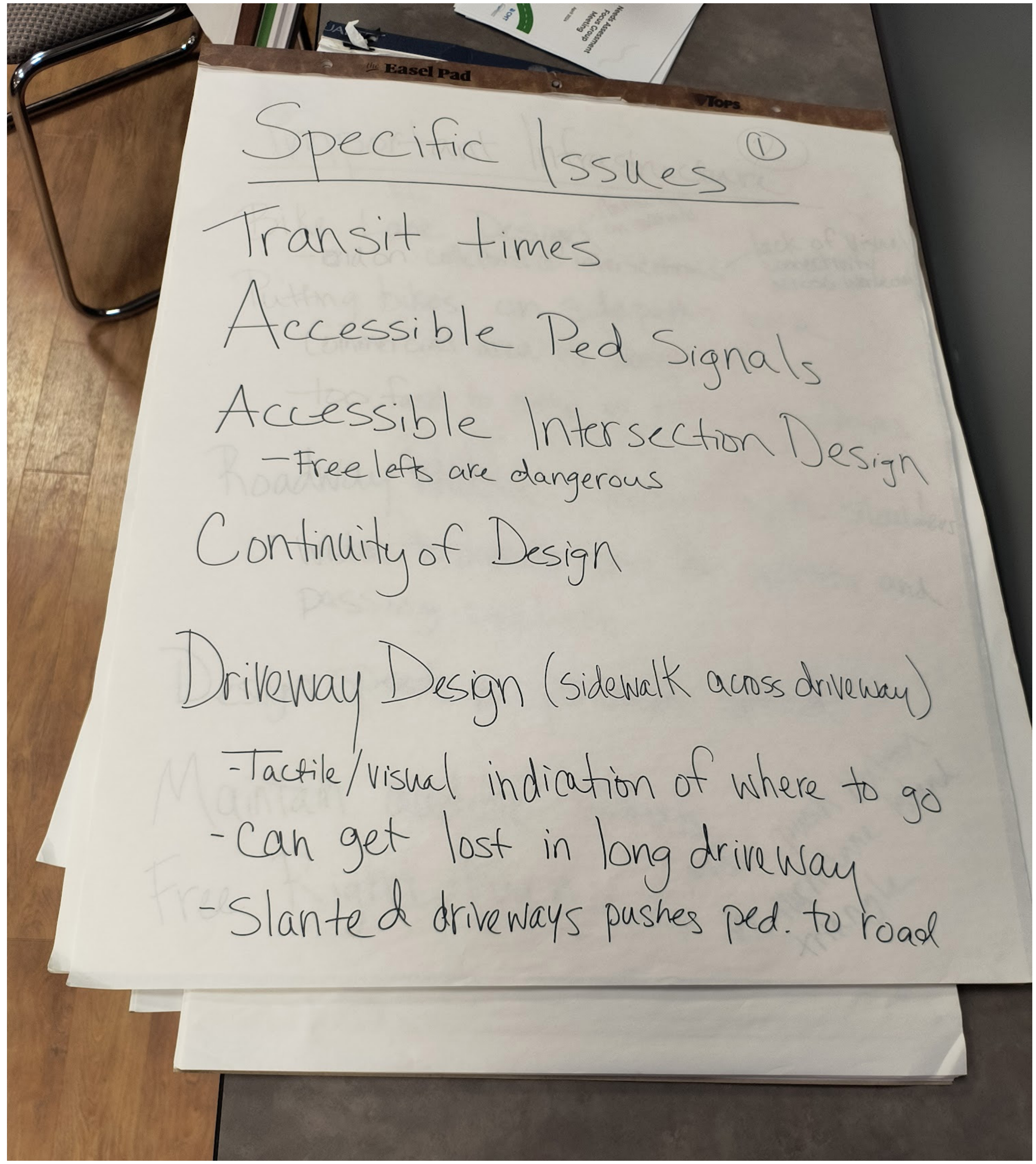
Outcome

The subcommittee identified actionable steps to enhance traffic safety and streamline incident management, reinforcing inter-agency collaboration.

STAKEHOLDER MEETINGS

Goal

To engage members of the community around safety needs within the region. The audience for these focus groups included more vulnerable road users such as those that regularly bike and walk, as well as elderly adults and people living with disabilities.



Date

April 2024 (in person at Missouri Job Center on 4/4; and virtual option Thursday 4/18)

Location

In person & virtual

Participation

Direct invitations to known stakeholders and associated organizations. Approximately 10 total participants

Methods

Presentation about a safety action plan.

Polling questions about needs and experience traveling around the region walking, biking or using transit

Input Received

Participants expressed a strong need for a more robust transit system, including ADA facilities that connect to transit stops.

Participants expressed challenges navigating from local roads (where they live) to transit locations on arterials due to a lack of connected sidewalks and separated facilities.

Feedback shared indicated that many participants do not feel like biking because of reckless driving or an overall disregard for people not traveling by car.

Key Takeaways

The event successfully highlighted the need to better connect transit facilities within the region.

People living with disabilities have higher concerns about safety given that they are not driving and are more likely to walk, wheel, and bike to local transit connections.

There are other programmatic and social elements that should be considered as more long term solutions, such as food and grocery delivery apps accepting EBT benefits.

Intercept Events and Outreach

Targeted Engagement

GOAL

To engage historically underserved communities and gather diverse perspectives on transportation safety and accessibility to ensure an equitable SS4A Plan.

REACH

Dates

January 27–28, February 7, February 21, June 8, June 16, August 9-10, September 7, and October 4, 2024

Participation

Over 300 individuals engaged across five events, with 242 survey responses collected.

Methods

SAAB/Brother to Brother Program (January 27)
Mentoring activities with 80 young men. Collected 35 surveys focusing on transportation needs and challenges.

Courageous Church Engagements (January 28)
Partnered with congregations to gather 150+ responses. Discussions emphasized safety and accessibility concerns.

Southwest Missouri Coalition for Roadway Safety (February 7)
Introduced Safety Action Plan and shared survey with meeting participants, including first responders and roadway safety interested parties/stakeholders.

Veteran's Coming Home Center (February 21)
Provided information and received 22 surveys and comments from clients of a day shelter for homeless.

Juneteenth Celebration (June 16)
Engaged 57 attendees, highlighting equity gaps in the transportation system, particularly for African American residents.

PrideFest (June 8)
Route 66 Festival (August 9-10)
Ozark Expo (September 7)
Community Focus (October 4)
Broadened representation in transportation planning discussions, promoting inclusivity in outcomes. Included private sector outreach.

INPUT RECEIVED

Equity concerns dominated discussions, particularly in underserved neighborhoods Participants identified challenges related to accessibility, safety, and infrastructure quality.

Specific needs included safer pedestrian crossings, improved lighting, and better transit options.

FIRST AID STATION
BWI
SANITATION
1 877 BWI 1000
Clifford
Takes a Walk

KEY TAKEAWAYS

Addressing transportation equity is critical for underserved populations.

Ongoing outreach is essential to ensure the voices of marginalized communities shape planning decisions. Inclusive engagement fosters broader community support for proposed safety improvements.

Pop Up Demonstration

Safety in Action

GOAL

To engage the community in understanding and providing feedback on potential safety enhancements through a hands-on demonstration.

REACH

Date

October 7, 2024.

Location

W Dale Street, Springfield, MO.

Participation

Approximately 50-75 attendees.

Methods

Advertised online via press release, email, OTO's website, and social media channels, as well as door hangers in the nearby neighborhood.

Ads were also placed on all transit buses and at the Transit Center.

Temporary road safety enhancements were demonstrated, including, reduced lane widths with curbing bump-outs, and marked crosswalks for improved pedestrian safety.

Engagement tools such as real-time feedback stations and interactive displays.

Community Attraction

The "I Love Tacos" food truck encouraged attendance and informal discussions.

INPUT RECEIVED

Participants expressed strong support for safer intersection designs and measures to reduce traffic speeds in residential neighborhoods.

Feedback emphasized the importance of implementing permanent safety measures like improved crosswalk visibility and lane adjustments.

Also discussed was the importance for non-motorized neighborhood and regional connections, such as continuing the Grant Avenue Parkway.

KEY TAKEAWAYS

The event successfully highlighted the potential impact of proposed safety enhancements.

Direct community feedback validated the need for prioritizing pedestrian safety and speed management.

Interactive and creative engagement methods, such as food trucks and displays, fostered positive public participation and dialogue.


STOP
EVENT


Implementation Plan - Tier I Safety Projects


i love TACOS
TAQUERIA
TACOS
BURRITOS
TAMALES
QUESADILLAS

Key Takeaways

From All Engagement

The community engagement efforts for the OTO SS4A Plan provided valuable insights into regional transportation needs and safety priorities. Across surveys, open houses, intercept events, and the pop-up demonstration, several recurring themes and critical points emerged.

COMMUNITY-WIDE FOCUS ON SAFETY

Speeding and distracted driving were consistently identified as top safety concerns, especially in residential areas and school zones.

Safer intersections, improved pedestrian crossings, and reduced traffic speeds were common priorities.

EQUITY AND ACCESSIBILITY

Outreach efforts successfully engaged historically underserved communities, highlighting transportation equity gaps.

Feedback from visually impaired participants and other marginalized groups underscored the need for accessible infrastructure that serves all residents.

PRIORITIZATION OF INFRASTRUCTURE IMPROVEMENTS

Respondents across all engagement activities emphasized the importance of physical changes to the transportation network, including:

ADA-compliant sidewalks.

Protected bike lanes.

Enhanced crosswalk visibility and lighting.

Infrastructure upgrades were favored over public awareness campaigns as a more impactful approach to improving safety.

BROAD COMMUNITY PARTICIPATION

Over 1,000 individuals participated through surveys, open houses, intercept events, and the pop-up demonstration.

A variety of events through different applications and venues ensured diverse perspectives were included in the planning process.

SUPPORT FOR INNOVATIVE ENGAGEMENT

The pop-up demonstration highlighted the value of creative engagement tools, such as interactive displays and real-time feedback stations.

Combining traditional methods

(surveys and open houses) with informal approaches (tabling at festivals and food trucks) increased community buy-in.

ACTIONABLE INSIGHTS FOR PLAN DEVELOPMENT

Community feedback consistently prioritized infrastructure changes that improve safety and accessibility for pedestrians, cyclists, and transit users.

The plan must address equity challenges and provide solutions that serve vulnerable populations, such as the elderly, people with disabilities, and low-income residents.

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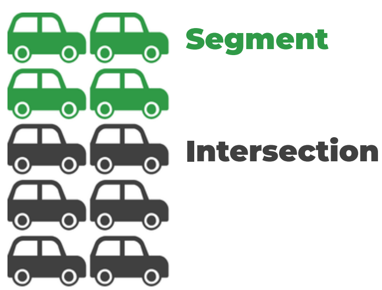
3. Safety Analysis

Crash Characteristics

2018-2022 Crashes in the OTO

SEGMENTS VS. INTERSECTIONS

About 40 percent of fatal and serious injury crashes in the OTO region occur on segments, while 60 percent happen at intersections.



SEGMENT CRASHES

Of the 471 fatal and serious injury segment crashes between 2018 and 2022, 219 were classified as Out of Control, or over 46 percent. The top 5 frequently occurring classes of segment crashes include Out of Control, Rear End, Pedestrian, and Head-On.

Fatal and serious injury crashes were also compared to all crashes and analyzed for the types of crashes that are more likely to result in a fatal or serious injury. For segments these include:

- Lane Departures
- Horizontal Curves
- No License or Permit
- Alcohol/Drugs
- Motorcycle
- Head-On
- Speeding
- Drowsy Driver
- Pedestrian
- Cross-Median
- Bicycle
- Wrong-Way

INTERSECTION CRASHES

Of the 682 fatal and serious injury intersection crashes between 2018 and 2022, 120 were classified as Out of Control, or over 17 percent. Left urn, Right Angle, and Left-Turn Right-Angle Collision, account for nearly 45 percent of intersection classes. Other frequently occurring classes include Pedestrian and Rear End.

For intersections, crashes that are more likely to result in a fatal or serious injury include:

- Lane Departures
- No License or Permit
- Alcohol/Drugs
- Motorcycle
- Head On
- Speeding
- Pedestrian
- Cross Median
- Bicycle

TRAVEL SPEED AND SPEED LIMIT

Roadways with higher speeds experience higher severity crashes. This is demonstrated by both actual speeds and speed limits. The majority of all crashes occur on roadways with speeds of 40 mph. These roads comprise the majority of routes in the region and also carry the most traffic. That said, the likelihood of a crash being fatal or resulting in a serious injury increases with speed limit.

Average Roadway Speed by Crash Severity	
Severity Rating	**Average Speed***
Fatal	42.3
Serious Injury	38.8
Minor Injury	34.3
Property Damage Only	37.1
**On segments where speed data is available*	

Proportion of Crashes by Severity Rating & Speed Limit

Severity Rating	20 mph	25 mph	30 mph	35 mph	40 mph	45 mph	50 mph	55 mph	60 mph	65 mph	70 mph
Fatal	2%	4%	10%	6%	25%	18%	3%	9%	12%	6%	4%
Serious Injury	1%	7%	16%	10%	25%	16%	2%	9%	10%	3%	3%
Minor Injury	1%	8%	15%	12%	35%	13%	2%	6%	7%	2%	2%
Property Damage Only	1%	11%	19%	10%	23%	13%	2%	6%	9%	3%	3%

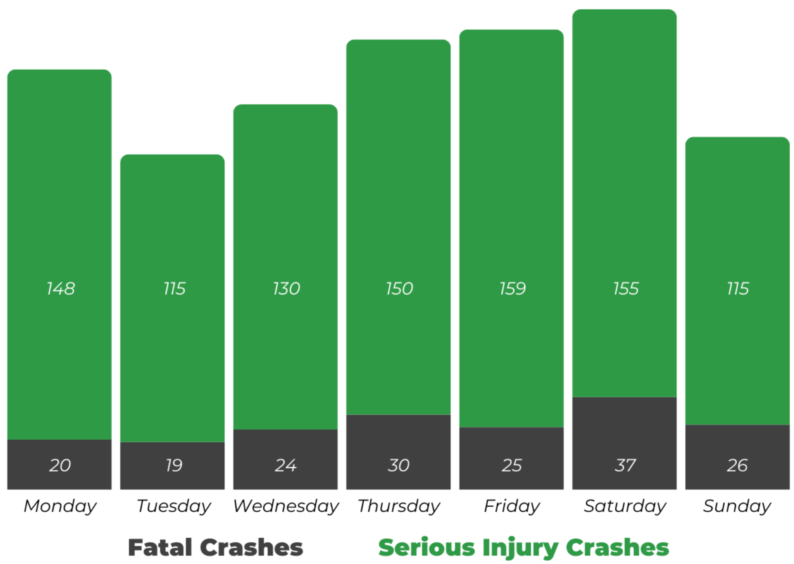
WEATHER AND ROADWAY CONDITIONS

While the majority of crashes do happen during clear days, cloudy and rainy weather do contribute to fatal and serious crashes. This is further demonstrated by reviewing crashes compared to roadway conditions. The following crash types are more likely to occur on wet, icy, and snowy roadways:

- Out of Control
- Too Fast for Conditions
- Aggressive Driver
- Lane Departure

Weather Condition	Fatal	Serious Injury
Clear	121	671
Cloudy	52	219
Fog/Mist	-	8
Freezing	-	12
Rain	7	53
Sleet	-	1
Snow	-	5
Unknown/ Other	1	3
Totals	181	972

Fatal and Serious Injury Crashes by Day of the Week

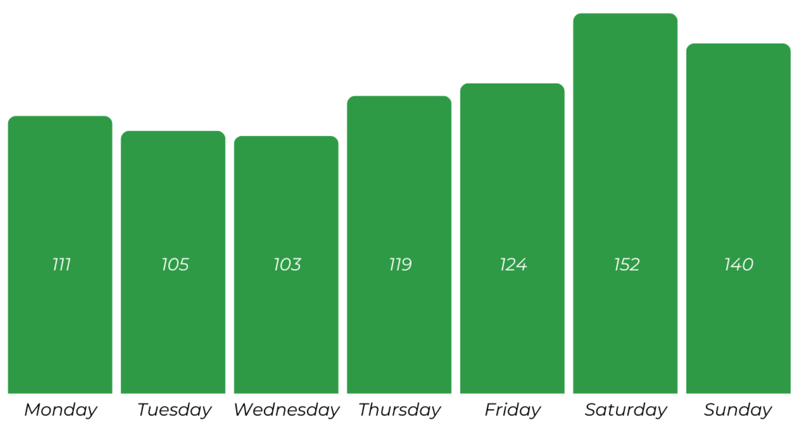


DAYS OF THE WEEK

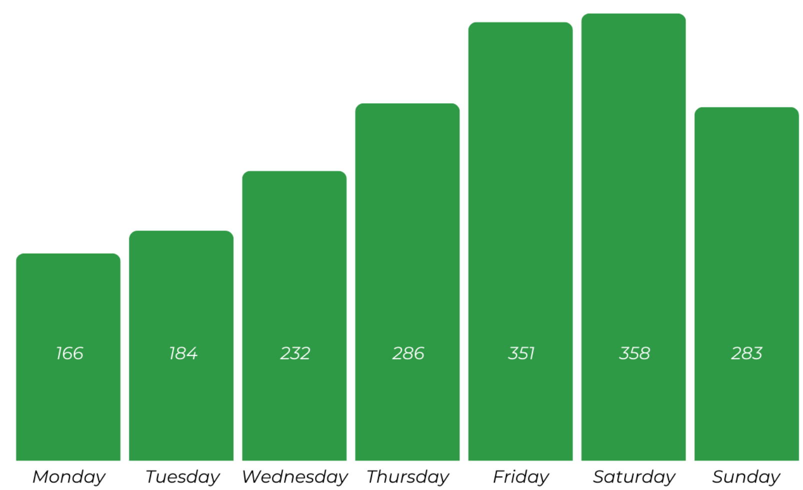
Fatal and serious injury crashes tend to happen more often on Thursdays, Fridays, and Saturdays. There are more fatal and serious crashes on Saturdays that involve speeding, while those involving drugs and/or alcohol are more pronounced on Fridays and Saturdays.

When reviewing crashes by the hour, there is a higher frequency during most of the day on Friday, as well as the overnight hours between Friday and Saturday, and then between Saturday and Sunday.

Fatal and Serious Injury Crashes Involving Speeding



Fatal and Serious Injury Crashes Involving Drugs/Alcohol



EQUITY ANALYSIS

Crash statistics were reviewed against OTO's Equity Index. Specifically, crashes involving these factors were reviewed:

- Pedestrian
- Bicycle
- No License or Permit
- Motorcycle

The equity factors considered were:

- Aged 17 and Under
- Aged 65 and Over
- Aged 65 and Over Alone
- Disabled
- Limited English Proficiency
- No Car
- No Diploma
- No Internet
- Poverty
- Minority
- SNAP
- Rent Burdened
- Single Parent

Crashes were analyzed based on the demographic characteristics of the geography where they occurred. While these equity demographics were not a known factor in each crash, the population residing where the crash occurred do meet these factors.

For pedestrian-involved, bicycle-involved, and no license or permit-involved fatal and serious injury crashes, these populations were more likely to reside where these crashes occurred:

- Disabled
- Poverty
- No Car
- No Internet
- SNAP
- Rent Burdened

Motorcycle crashes were more likely to occur where these populations resided:

- No Internet
- Poverty
- SNAP
- Aged 17 and Under
- Single Parent

The OTO Equity Index

The Equity Index is a tool available on the OTO website, which compares 13 separate demographic characteristics to identify underserved and transit-dependent populations. This includes minority, those in poverty, and disabled, as well as age, educational attainment, and vehicle ownership.

MORE INFORMATION

High Injury Network

Identifying High Injury Locations

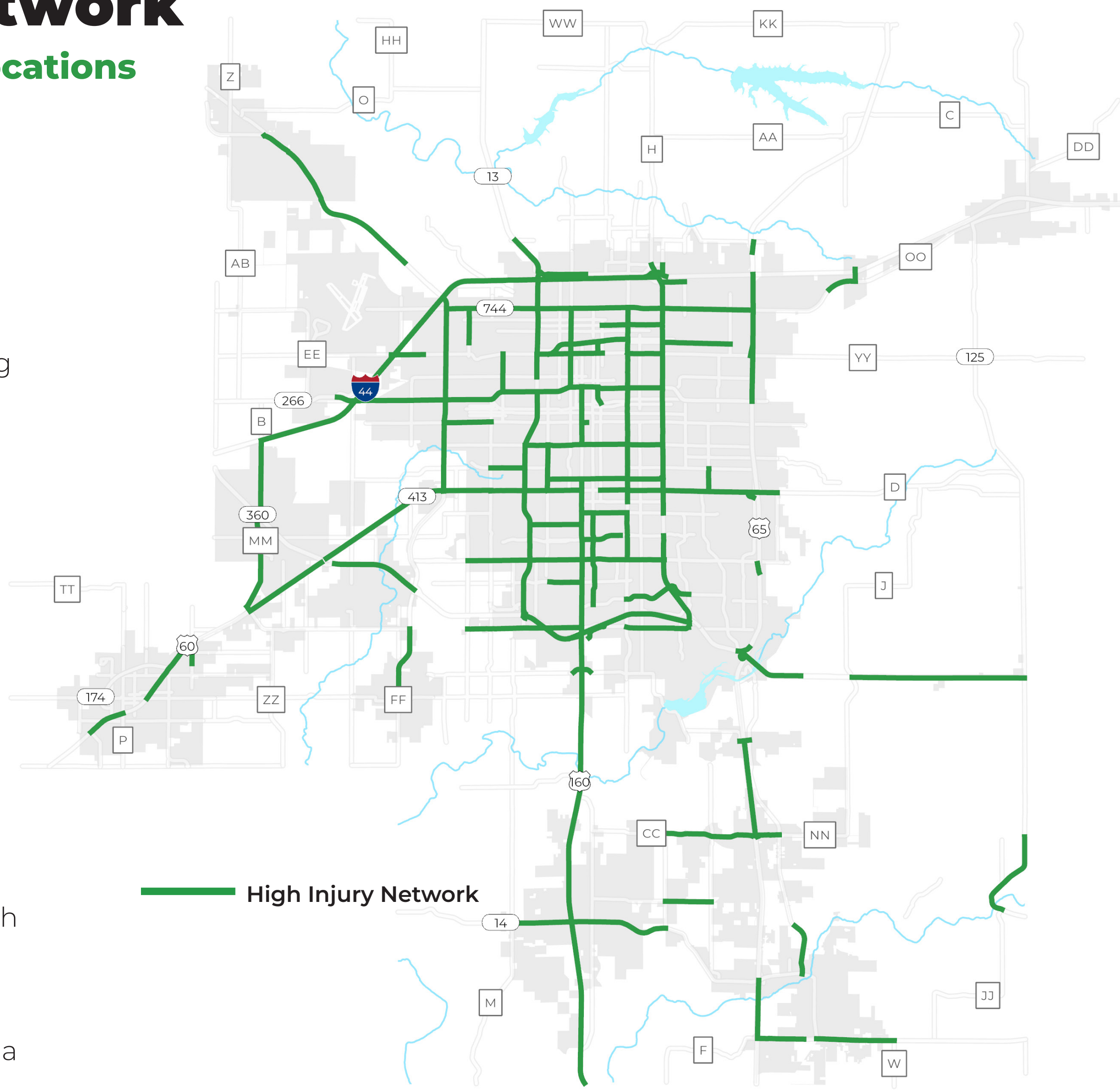
The High Injury Network (HIN) represents a subset of area roadways where most fatal and serious injury crashes occur. Identifying HIN locations provides focus for prioritizing and addressing crashes and their causes.

DETERMINING THE HIN

Various methods were reviewed for deciding the HIN. It was determined that selecting the top two quantiles for crashes per mile provided the best regional distribution along various roadway types. Other methods over-favored roadways with fewer crashes.

QUICK FACTS

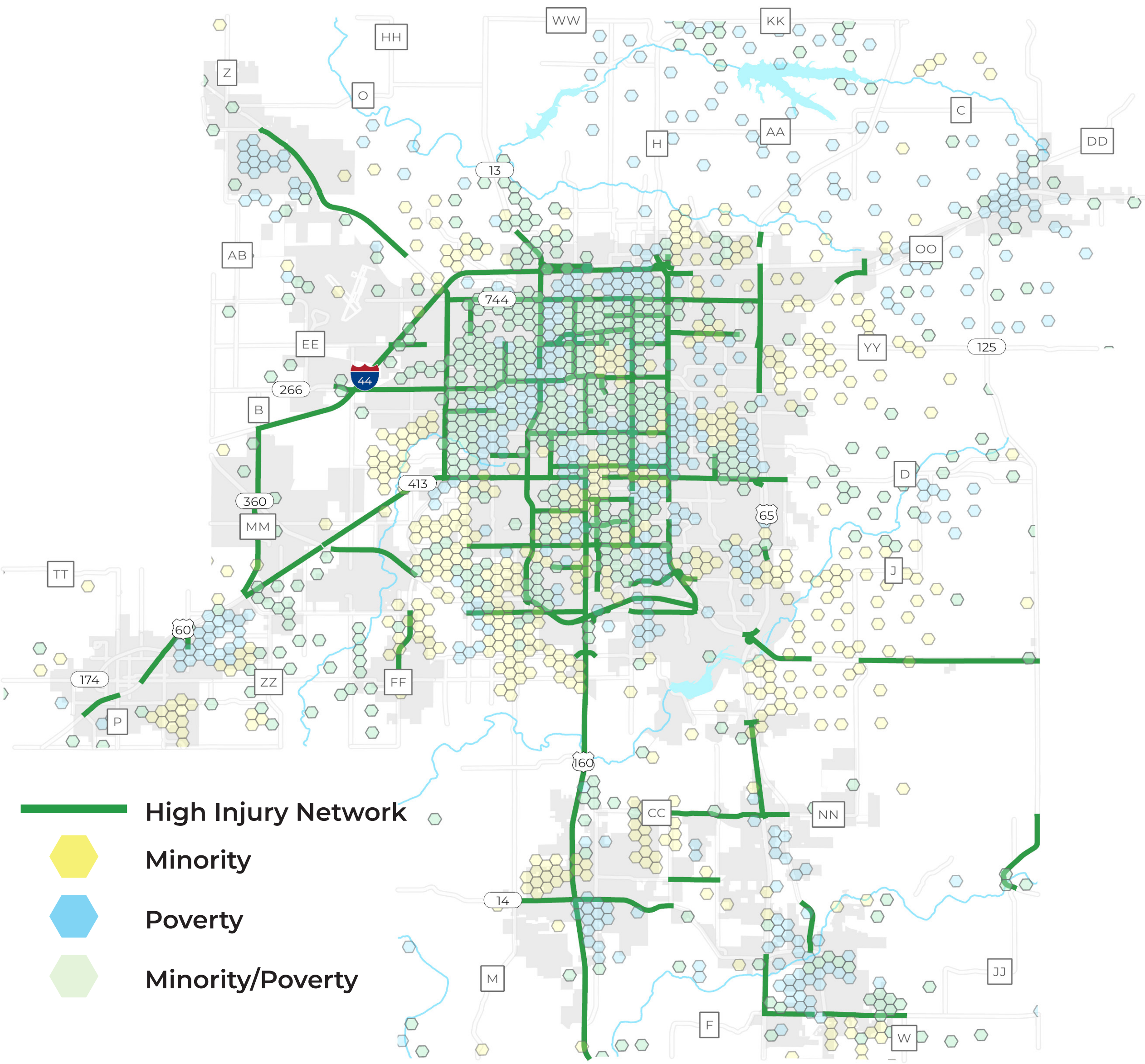
The top 40 percent of roads by crash per mile include over 70 percent of serious and fatal injury crashes, while only accounting for less than a quarter of analyzed roadways.



EQUITY AND THE HIN

The High Injury Network is strongly represented in areas that have higher than the OTO average of minority populations and those who live in poverty.

This highlights the importance of addressing safety in the region, as well as for all users. Addressing infrastructure to improve safety, as well as encouraging safe driving behaviors in areas of concern will support vulnerable road users and their safety when navigating the region.



Systemic Safety Analysis

Identifying and Mitigating Risk

THE SYSTEMIC APPROACH

A systemic safety analysis is a data-driven, multi-step process that includes identifying and evaluating risk factors, identifying locations with greatest risk, and selecting appropriate countermeasures to mitigate risk, thereby improving safety outcomes. Different from the High Injury Network, which relies on observed crash history, a systemic safety analysis identifies high-risk roadway features throughout the network, determining locations with the greatest risk.

DEFINITIONS

Risk - exposure to a crash that results in a fatal or serious injury.

Killed or Seriously Injured (KSI) - any crash that results in a fatal or serious injury.

Risk Factor - Roadway characteristic or other contextual feature that increases risk of a KSI crash; risk factors are ratios based on the percentage of KSI crashes and roadway length (or other appropriate roadway measure).

High Injury Analysis Location - developed by OTO, these 40 locations are a subset of the high injury network that experience a high number of KSI crashes and collectively illustrate various roadway types, roadway characteristics, and member jurisdictions throughout the OTO region.

High Risk (Roadway) Feature - roadway features with a risk factor greater than 1 are considered a high-risk roadway feature.

Risk Index - a composite index that combines all high-risk roadway features in a single index score that can be mapped and visualized to assess overall risk throughout the network.

RISK FACTORS

Methodology

To focus the analysis on high-risk roadway features that contribute to KSI (Killed or Serious Injury) crashes, OTO identified 40 high injury analysis locations that collectively illustrate various roadway types, roadway characteristics, and member jurisdictions throughout the OTO region. Only KSI crashes at high injury analysis locations were used to determine risk factors. Between 2018 and 2022, there were 269 KSI crashes within the 40 analysis locations, representing about 25 percent of all KSI crashes in the OTO region.

Ten roadway characteristics were selected and included in the development of risk factors:

- Intersection Type
- Functional Classification
- Number of Lanes
- Shoulder Type
- Shoulder Width
- Access Control
- Horizontal Curvature
- Roadway Type
- Area Type
- Multimodal Activity

For each roadway characteristic, the percentage of KSI crashes was compared to the percentage of roadway length or other roadway measure to determine the risk factor for that characteristic. Roadway features with risk factors above 1 have a higher-than-average risk and are considered a high risk roadway feature.

As an example, if 30 percent of KSI crashes occurred along 20 percent of the roadways (length) with a given feature, the risk factor would be 1.5 (30%/20%), meaning the roadways with the given risk feature have 1.5 times the expected number of KSI crashes.

Once risk factors were calculated for each of the roadway features, an index scoring system was used to determine the highest risk locations for the application of systemic countermeasures.

The details for determining each risk factor can be found in Appendix D-2 Systemic Safety Analysis. The risk factors and scores are summarized on the next page.

Regional Risk Assessment

Roadway features that were found to have risk factors greater than 1 are considered high-risk features and are therefore included in the composite risk index.

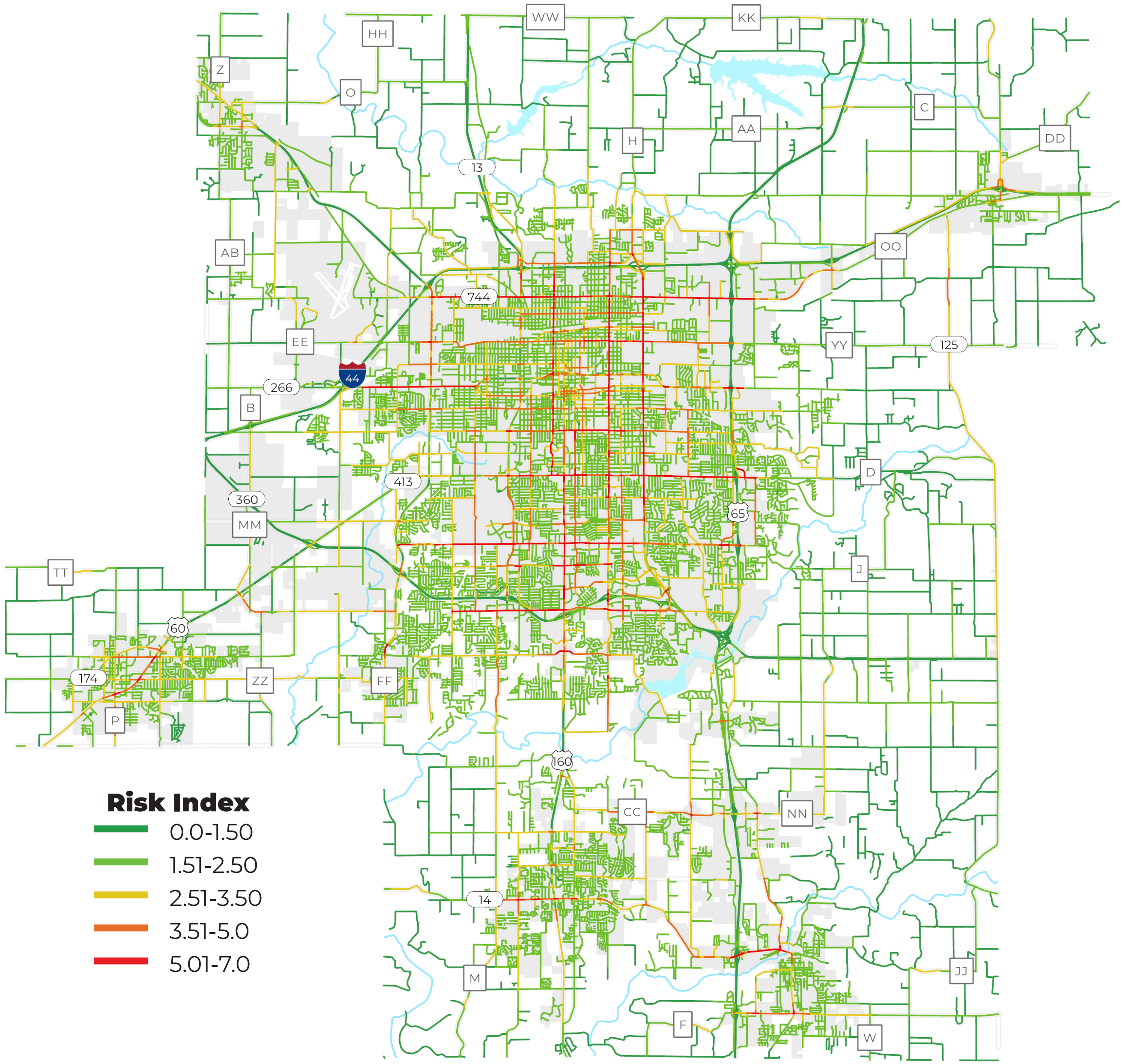
The score for each high-risk feature is based on a confidence metric and the total share of KSI crashes. High-risk features with a confidence of 10 percent or more AND a percent of KSI crashes of 30% or more were given a score of 1. High-risk features that do not meet both of these conditions are given a score of 0.5. The scores for all high-risk features are summed to create the risk index.

The risk index illustrates the roadways with high-risk features based on the risk profile of the high injury analysis location. It highlights locations at which to deploy a systemic application of safety countermeasures to mitigate the risk of fatal and serious injury crashes.

Roadway Characteristic	High-Risk Feature	Risk Factor	Percent of KSI Crashes	Confidence (%)	Score
Intersection Type	Signalized Intersection	6.1	73.7	61.6	1
Functional Class	Minor Arterial	1.8	16.5	7.1	0.5
	Principal Arterial	1.8	35.0	15.4	1
Shoulder Type	Aggregate	4.8	4.8	3.8	0.5
	Asphalt	1.2	25.7	4.5	0.5
	Curb and Gutter	1.4	32.7	10.1	1
	Earth	1.6	9.7	3.6	0.5
Shoulder Width	1 foot	2.3	6.6	3.7	0.5
	2 foot	1.5	20.4	6.3	0.5
	3 foot	1.1	17.8	2.1	0.5
	4 foot	1.5	3.5	1.2	0.5
Number of Lanes	3 lanes	2.1	30.0	15.7	1
	4 lanes	1.8	0.3	0.1	0.5
Undivided	Undivided	1.4	46.3	13.3	1
Horizontal Curvature	Class 4	1.5	32.7	10.6	1
Multimodal Activity	Yes	1.2	45.7	8.1	0.5
Area Type	Urban	1.1	84.8	4.8	0.5
Roadway Type	3-Lane Section	1.4	3.7	1.0	0.5
	5-Lane Section	1.5	27.5	9.4	0.5
	Expressway	1.1	37.9	4.0	0.5
	Two Lane	1.2	11.9	2.2	0.5

HIGH RISK INDEX CORRIDORS

- Grant Avenue
- National Avenue
- Glenstone Avenue
- S. Campbell Avenue
- Kearney Street
- Division Street
- Chestnut Expressway
- Sunshine Street
- Battlefield Street
- Republic Street
- MO 14 (Nixa and Ozark)
- US 60 (Republic)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Risk Index
0.0-1.50
1.51-2.50
2.51-3.50
3.51-5.0
5.01-7.0

Project Identification

Systemic and Specific Roadway Projects

SYSTEMIC STRATEGIES

While multiple corridors were highlighted as high-risk locations based on their roadway features, systemic strategies can be deployed throughout the network, in addition to any potential focus on these routes. To mitigate the effects of high-risk features along roadways throughout the OTO region, a systemic application of safety countermeasures is recommended. Each of the high-risk roadway features established in the risk factor analysis is listed. Details about how they relate to frequently occurring KSI crash types can be found in Appendix D-2 Systemic Safety Analysis.

Safety Toolkit

Developed alongside this plan, and included as Appendix A, is a Safety Toolkit which provides crucial insights and actionable strategies to enhance transportation safety and accessibility. The Toolkit provides a list of proven safety countermeasures that can be implemented throughout the region to improve safety for all roadway users. For each countermeasure, general guidance is provided and includes the purpose/description of the countermeasure, applicable locations, expected safety benefits, and additional design considerations, along with information on targeted users and planning-level cost estimates.

Look for this symbol in the Toolkit:

S Appropriate for Systemic Applications

Mitigating High-Risk Features

The following list of strategies also identifies which high-risk roadway features can be mitigated.

Bicycle Lanes

- Curb and Gutter Shoulder Types

Corridor Access Management

- 3+ Lanes
- 3-Lane Sections
- 5-Lane Sections
- Minor/Principal Arterials
- Multimodal Activity
- Urban Areas

Crosswalk Enhancements

- Multimodal Activity
- Signalized Intersections

Curve Improvements

- 1 to 4 foot Shoulder Widths
- Aggregate Shoulder Types

- Asphalt Shoulder Types
- Earth Shoulder Types
- Class 4 Curves
- 2-Lane Sections

Dilemma Zone Detection

- 3-Lane Sections
- 5-Lane Sections
- Minor/Principal Arterials
- Signalized Intersections

Dynamic Speed Displays

- Expressways
- 2-Lane Sections
- Multimodal Activity

Enhanced Delineation

- 1 to 4 foot Shoulder Widths
- Aggregate Shoulder Types
- Asphalt Shoulder Types
- Curb and Gutter Shoulder Types
- Earth Shoulder Types
- Class 4 Curves
- 2-Lane Sections
- Undivided Roadways

Guardrail, Clear Zone

- Class 4 Curves
- 2-Lane Sections

High Friction Surface Treatment

- 1 to 4 foot Shoulder Widths
- Aggregate Shoulder Types
- Asphalt Shoulder Types
- Class 4 Curves
- Expressways
- 2-Lane Sections
- Undivided Roadways

Improved Channelized Right Turn Angle

- Signalized Intersections

Intersection Conflict Warning

- Multimodal Activity
- Expressways
- 2-Lane Sections
- Undivided Roadways

Leading Pedestrian Intervals

- Multimodal Activity
- Signalized Intersections

Left or Right Turn

- Minor/Principal Arterials

Left Turn Offset Improvement

- Signalized Intersections

Median Barriers

- 3+ Lanes
- 3-Lane Sections
- 5-Lane Sections
- Expressways
- Minor/Principal Arterials

Pedestrian Hybrid Beacons

- Curb and Gutter Shoulder Types
- Multimodal Activity
- 2-Lane Sections
- 3-Lane Sections
- Urban Areas

Pedestrian Refuge Islands

- 3-Lane Sections
- 5-Lane Sections
- Multimodal Activity
- Signalized Intersections
- Urban Areas

Permissive to Protected Left Turn

- 3-Lane Sections
- 5-Lane Sections
- Signalized Intersections
- Urban Areas

Rectangular Rapid Flashing Beacons

- Curb and Gutter Shoulder Types
- Multimodal Activity
- 5-Lane Sections
- Urban Areas

Retroreflective Backplates

- Signalized Intersections

Road Diets

- 3+ Lanes
- 3-Lane Sections
- 5-Lane Sections
- Minor/Principal Arterials
- Multimodal Activity
- Urban Areas

Roadway Lighting

- Expressways
- Multimodal Activity
- Urban Areas

Roundabouts

- Signalized Intersections

Rumble Strips

- 1 to 4 foot Shoulder Widths
- Asphalt Shoulder Types
- Class 4 Curves
- 2-Lane Sections
- Undivided Roadways

Shared Use Paths

- Earth Shoulder Types
- 3+ Lanes
- 3-Lane Sections
- 5-Lane Sections
- Minor/Principal Arterials
- Multimodal Activity
- Urban Areas

Sidewalks

- 3+ Lanes
- 3-Lane Sections
- 5-Lane Sections
- Minor/Principal Arterials
- Multimodal Activity
- Urban Areas

Wider Edge Lines

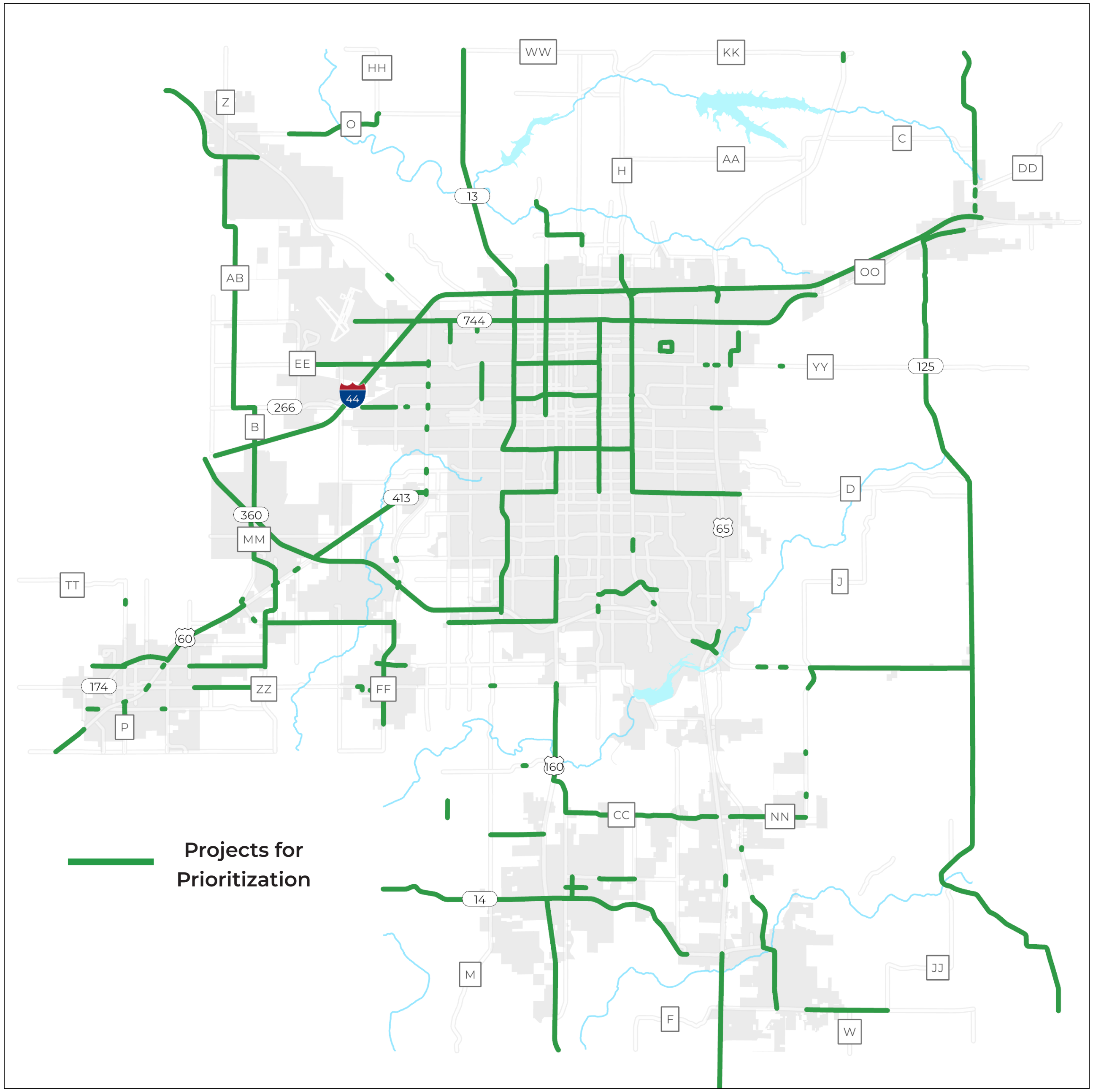
- Expressways

Yellow Change Intervals

- Multimodal Activity
- Signalized Intersections

DEVELOPING A SPECIFIC PROJECT LIST

Specific projects for prioritization were developed with guidance from the Advisory Team and assembled from public engagement, stakeholders, the systemic safety analysis, the High Injury Network, a survey of member jurisdictions, and OTO's STIP Priority list. This resulted in 202 projects for prioritization (see Appendix D-5 Implementation Matrix), while the prioritization process and top tiered projects can be found in the Prioritization and Implementation Section.


Projects for Prioritization
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4. Policy Analysis

Policies and Process

A Review of Existing Policies

INTRODUCTION

It is one thing to know where crashes occur and to identify solutions for addressing those specific issues, but like systemic safety improvements for the roadway, policies and processes can promote a culture of safety, creating solutions at each level of the process.

Policies, procedures, and programs are important strategies to improve safety outcomes for all users throughout the region.

This section assesses existing policies and procedures to inform recommendations for updates or new best practices as recommended in the Implementation Section.

ASSESSMENT OF POLICIES AND PROCESSES

OTO member jurisdictions were surveyed to determine if each has a policy, plan, guideline, standard, or other formalized process that addresses the following topics such as project selection procedures, design guidelines, speed management policies, and performance management processes.

The 15 topics on the following page are related to vulnerable road users (VRU) and transportation safety. It is not required that agencies have or adopt policies addressing these, rather the assessment is to collectively gauge policy and procedural influence on safety decision-making across the metropolitan planning area.

If a member has a formalized policy as described, it was assigned a "Yes" designation. If a member does not have a formalized policy, or one could not be readily defined, it was assigned a "No" designation. If a member has a tangentially-related policy, it was assigned a "Partial" designation. The five "Partial" designations are described following the policy matrix.

TOPIC	ADDRESSES
ADA Transition Plan	Pedestrian infrastructure improvements with respect to Americans with Disabilities Act (ADA) compliance
Complete Streets	Roadway design for all users
Educational Campaigns	Educational efforts regarding unsafe driving behavior and/or awareness of vulnerable road users
Equity	Funding dedication specifically for roadway safety projects in underserved and disadvantaged areas
Funding	Funding dedication specifically for roadway safety, vulnerable road users, etc.
Land Development	Incorporation of roadway safety and/or multimodal access standards into development review processes for new developments
Narrow Lanes	Roadway lane widths (could be part of Complete Streets Policy)
Performance Management	The annual tracking of fatal and serious injury crashes and safety projects; annual public updates; an entity to review fatal/serious injury crashes
Project Selection	Improvement project prioritization based on proven safety countermeasures and/or safety for vulnerable road users
Roundabout Pedestrian Crossings	Pedestrian crossings at roundabouts
Safe Routes to School (SRTS)	Partnering with school districts to develop Safe Routes to School programs
School Zones	Traffic calming strategies and deployments in school zones
Speed Limits	Consistent speed limits are set on similar roadways throughout the region
Speed Management	A means for residents to formally request speed humps/bumps/cushions, signage, or other traffic calming features to reduce vehicle speeds
Traffic Operations	Levels of Service (LOS) along urban/high-pedestrian corridors

TOPIC	OTO Member Agency								
	County		City						
	Christian	Greene	Battlefield	Nixa	Ozark	Republic	Springfield	Strafford	Willard
ADA Transition Plan	No	Yes	No	No	Yes	Yes	Yes	No	No
Complete Streets	No	No	Yes	No	No	No	Yes	No	No
Educational Campaigns	No	No	No	No	No	Partial	Partial	No	No
Equity	No	No	No	No	No	No	No	No	No
Funding	No	Yes	No	Yes	Yes	Yes	Yes	No	No
Land Development	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Narrow Lanes	Yes	Yes	No	No	No	Yes	No	No	No
Performance Management	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Project Selection	No	Yes	No	Yes	No	Yes	No	No	No
Roundabout Pedestrian Crossings	No	Partial	No	No	No	No	No	No	No
Safe Routes to School	No	Yes	No	No	No	No	Partial	No	No
School Zones	Yes	No	No	No	No	No	Yes	No	No
Speed Limits	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Speed Management	No	No	No	No	Partial	Yes	Yes	No	No
Traffic Operations	No	No	No	No	No	No	No	No	No

"PARTIAL" EXPLANATIONS

Roundabout Pedestrian Crossings - Greene County noted that this is determined by the project designer and in most cases, Greene County does not desire additional or large amounts of right-of-way to accommodate pedestrian crossings.

Speed management - Ozark uses a form for traffic sign installations, which is one aspect of a speed management program.

SRTS - Springfield has dedicated manuals for school crossings, but don't incorporate all aspects of a SRTS program.

Educational Campaigns - Springfield's Public Works Department has a focused pedestrian-crossing safety program called "SGF Yields," but the program does not cover additional aspects of roadway safety. The Republic Police Department engages in sharing roadway safety tips with the public through social media, but does not maintain a policy that formalizes such efforts.

Identified Recommendations

Topics by Emphasis Areas

Guided by the policy and process assessment and public engagement activities, the 15 topics were grouped into seven emphasis areas. Collectively, the emphasis area topics form the 7 identified policy and process recommendations to improve roadway safety for all users throughout the OTO region. Resources for each recommendation have been identified and are available in Appendix D-1 Policy Process.

AMERICANS WITH DISABILITIES (ADA) COMPLIANCE

The Americans with Disabilities Act (ADA) is a federal civil rights law that prohibits discrimination against people with disabilities in everyday activities, and it guarantees that people with disabilities have the same opportunities as everyone else to enjoy employment opportunities, purchase goods and services, and participate in state and local government programs.

Furthermore, the updated Public Right of Way Accessibility Guidelines (PROWAG) were finalized on August 8, 2023. Identifying and inventorying accessibility barriers and non-compliances that exist within a transportation network enables agencies to prioritize and incorporate needed improvements into projects.

ADA Transition Plan

An effective means to document such needs is with an ADA Transition Plan, which is required for agencies with 50 or more employees and solidifies a community's effort to improve accessibility. A plan also acts as a tool to assess, document, and monitor locations for ADA compliance.

Recommendation #1

Develop or update ADA Transition Plans (when required by the public entity).

COMPLETE STREETS

A variety of safety concerns regarding bicyclists and pedestrians were noted in the public survey for OTO residents. Complete Streets is a holistic approach to roadway planning and design, encompassing all types of road users (pedestrians, bicyclists, motorists, and transit users of all ages and abilities) and encouraging safety and inclusion.

Complete Streets

Smart Growth America and the

National Complete Streets Coalition identify a Complete Streets Policy Framework, which lists ten ideal elements of a policy. This includes a vision and commitment, addressing all projects and phases, allowing only for clear exceptions, adopting excellent design guidance, and creating a plan for implementation. OTO also hosts a web-based Complete Streets Toolbox to assist member communities to consider the safety aspects for all users during the project development process.

Land Development

Established and adopted policies can ensure the consistent incorporation of vulnerable road user accommodations as communities develop.

Narrow Lanes

The narrowing of roadway travel lanes is a common consideration of a Complete Street.

Roundabout Pedestrian Crossings

Accommodating pedestrians safely within roundabouts can be challenging. FHWA offers resources for key elements to include, as well as educational information. In general, roundabouts can reduce severe crashes by about 80 percent. Adding certain design elements and enhanced crossing treatments can improve accessibility for visually impaired pedestrians. Crosswalks are also shorter with pedestrians crossing only one direction of traffic at a time, allowing drivers to focus on pedestrians separately from the entering, circulating, and exiting maneuvers.

Traffic Operations

In urban and high-pedestrian volume corridors, vehicular traffic and pedestrians must operate harmoniously. One mode cannot prevent the other from operating safely and effectively. Considering level of service for pedestrians is a means to support the interactions between the two. A pedestrian level of service tool, like that found in Sacramento's *Best Practices for Pedestrian Master Planning and Design*, can be used to measure impacts to walkability, which can inform vehicular operational decisions during project development.

Recommendation #2

Adopt a Complete Streets Policy.

DATA-BASED DECISION-MAKING

Comprehensive data and information are necessities for making sound transportation investments. Understanding and utilizing the available data and information brings the decision-making process full circle.

Equity

Disadvantaged communities have been underserved and overburdened. Identifying such communities and understanding the relevant data is foundational for addressing inequities in communities and improve roadway safety for all users. Prioritizing new and additional funding for projects in these areas is a means to improving roadway safety for the underserved. Using a community's equity data and information, multiple resources are available for integrating equity into procedures, including FHWA's *Integrating Equity into Transportation Planning*.

The OTO Social Equity Index can provide much of the data communities might need to evaluate projects through an equity lens. The US Department of Transportation's Climate and Economic Justice Screening Tool is another good resource.

Funding

Targeted funding is a key strategy to address inequities in communities regarding roadway safety for all users. Many funding programs instituted under the 2021 Infrastructure Investment and Jobs Act focus on, or at a minimum incorporate, equity in transportation. Similarly, agencies or municipalities can designate funding that prioritizes or incorporates equity.

Performance Management

Performance management is the process by which safety targets are monitored over time to assess the outcomes of projects. Safety projects should go under regular evaluations to assess safety performance by tracking the number and rate of fatalities, number and rate of serious injuries, and number of non-motorized fatalities and serious injuries.

The OTO currently incorporates these measures into its long range transportation plan and annual state of transportation report.

Project Selection

With competing interests and entities, project selection needs to be rooted in priorities. Once defined, a prioritization can be developed to objectively support transportation decision-making.

Recommendation #3

Develop guidance to utilize OTO's Social Equity Index data.

Recommendation #4

Develop guidance to utilize OTO's crash and High Injury Network (HIN) data.

SAFE ROUTES TO SCHOOL (SRTS)

Safe Routes to School

SRTS programs encourage walking and biking to and from schools with an emphasis on safety. SRTS programs are required to have a designated coordinator and typically include safety education for students, targeted traffic enforcement, encouragement activities such as Walk to School

Day or "walking school buses," and can incorporate infrastructure improvements to slow vehicular traffic near schools or provide contiguous sidewalk connections. Additionally, the intent is to embed safety knowledge and mindfulness into the young minds of students.

School Zones

A school zone is a unique location that often accommodates high pedestrian, bicycle, vehicular, and bus traffic daily during short windows of time. Understanding this setting, with respect to each individual school layout, is important to determining traffic calming needs and other opportunities.

From a vehicular perspective, traffic calming strategies can increase safety for students in school zones and also for the walking public at any appropriate location.

Recommendation #5

Establish Safe Routes to School programs.

Recommendation #6

Include school zones in the traffic calming tool box.

VEHICULAR SPEEDS

Law enforcement and engineering measures can be effective tools to mitigate dangerous driving behaviors such as aggressive driving, distracted driving, and speeding - the top three safety concerns received during this plan's public engagement activities.

Speed Limits

As found during the policy assessment process, most members have a formalized policy or process for determining speed limits, which ensures consistency within a jurisdiction.

Speed Management

Identifying locations where speed management countermeasures and strategies can be deployed is not straightforward. Although vehicular speed data and crash history can be easily collected, perspectives and perceptions can vary between users (pedestrians, drivers, bicyclists), between residents and passers-by, and between other variants of transportation network users. Offering a mechanism to obtain the public's requests to manage speed can supplement speed data or help pinpoint locations where speed data should be analyzed.

Traffic Calming

Traffic calming treatments are intended to reduce vehicle speed and encourage more deliberate driving behavior. Basic examples of traffic calming measures include speed bumps, crosswalks, and high visibility crosswalks.

Recommendation #7

Partner with law enforcement agencies to implement targeted enforcement efforts.

Recommendation #8

Develop a tool box of traffic calming strategies.

PUBLIC EDUCATIONAL CAMPAIGNS

Communicating with community members about on-going efforts and initiatives is an effective means to directly, or indirectly, educate citizens about transportation safety matters. US Department of Transportation agencies maintain a wide variety of educational campaign materials that are intended to be used by local agencies and other entities.

Additional resources can be found through SafeKids, Safe Across, and the Missouri Coalition for Roadway Safety.

Recommendation #9

Using available resources, develop an educational campaign to educate citizens about transportation safety.

Summary of Recommendations

Emphasis Area	Recommended Strategy	Responsibility
ADA Compliance	Develop or update ADA Transition Plans (when required by the public entity).	Members
Complete Streets	Adopt a Complete Streets Policy.	Members
Data-Based Decision-Making	Develop guidance to utilize OTO's Social Equity Index data.	OTO
Data-Based Decision-Making	Develop guidance to utilize OTO's crash and High Injury Network (HIN) data.	OTO
Safe Routes to School	Establish Safe Routes to School programs.	Members/OTO
Safe Routes to School	Include school zones in the traffic calming tool box.	OTO
Vehicular Speeds	Partner with law enforcement agencies to implement targeted enforcement efforts.	Members
Vehicular Speeds	Develop a tool box of traffic calming strategies.	OTO
Public Educational Campaigns	Using available resources, develop an educational campaign to educate citizens about transportation safety.	Members/OTO

Strategies

Additional Recommendations

The policy analysis highlighted key actions that OTO and members should take to institutionalize safety into every day activities and processes. Through discussions with the Advisory Team, stakeholders, and the public, additional strategies that are neither policies nor infrastructure projects are also recommended.

SUPPORT MEMBER SAFETY EFFORTS

Republic and Springfield have both been awarded supplemental planning grants through the SS4A program.

Republic ADA Transition Plan

Republic will conduct a comprehensive 10-year update of their ADA Transition Plan, as well as develop a comprehensive sidewalk plan. This will move the city toward a complete streets surface transportation strategy.

Time frame - Short

Cost - $300,000

Safe Streets SGF

Springfield will be addressing multiple aspects of safety planning with their award, including a Regional Transportation Culture Study, Strategic Education and Vision Zero Marketing Plan, Traffic Safety Education and Training Recommendations, developing a Street Typology Overlay, and an evaluation of speeding and inappropriate behavior plus a Neighborhood Traffic Calming Plan.

Time frame - Short

Cost - $1,140,000

SAFETY VILLAGE AND TRAINING CENTER

In order to support the behavioral aspects of fatal and serious crashes, a safety village is proposed. This would include classrooms, offices, distracted/drunk driving simulators, and 5/8th scale infrastructure.

Time frame - Medium

Cost - $20-$40 million

OPERATIONS

The Transportation Management Center is a partnership between MoDOT and the City of Springfield. Support for roadway operations would include crossing improvements such as audible pedestrian heads at signals, identifying locations for leading pedestrian intervals, evaluating signal operations at crash locations, and integrating signals with emergency response. Additional technologies should be considered as they become available.

Time frame - Short/Medium

Cost - Variable

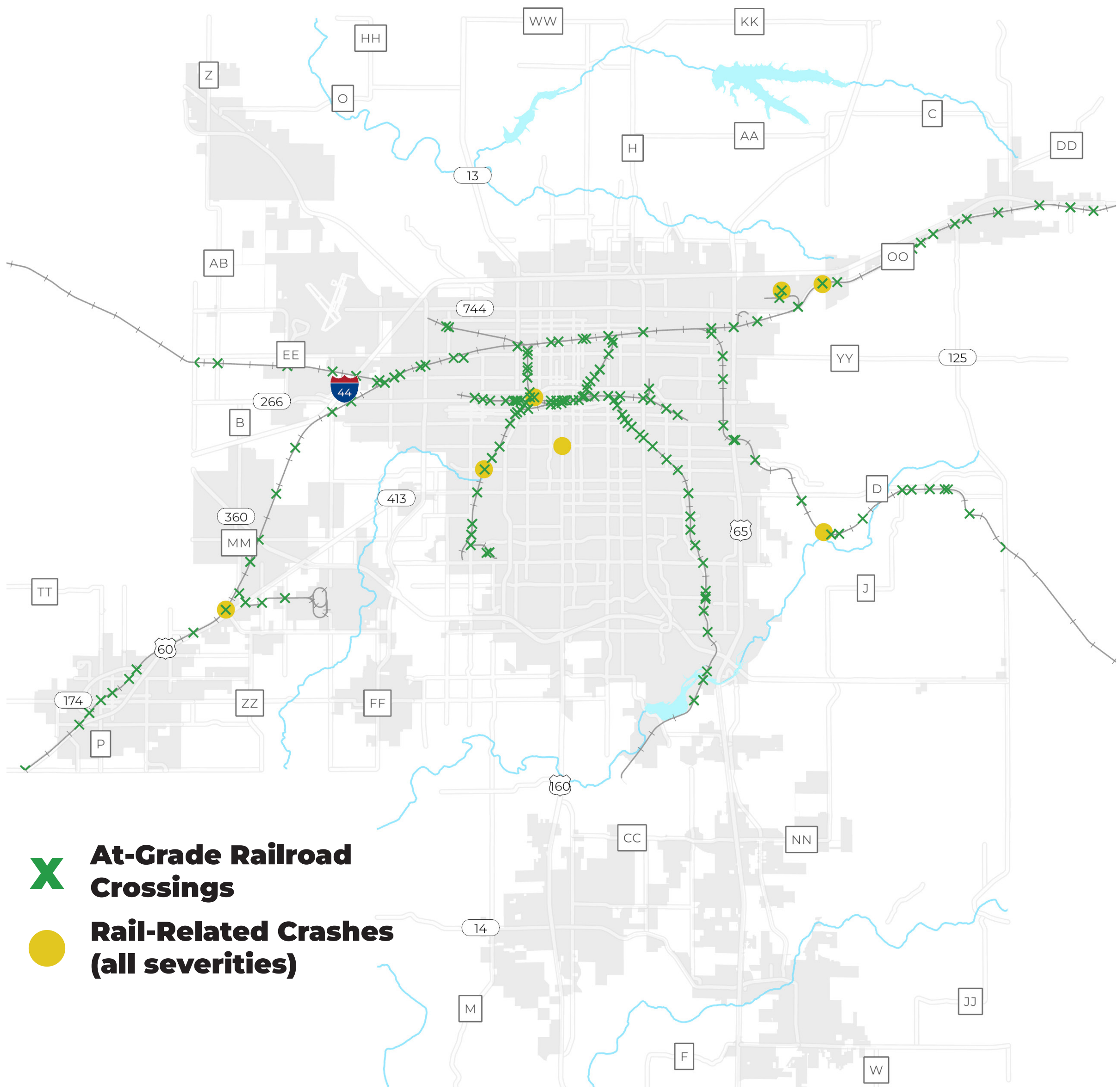
REMOVE AT-GRADE RAILROAD CROSSINGS

During 2018-2022, only one serious injury crash was classified as having been at a railroad crossing. There were not fatals in the OTO region during that time. At-grade railroad crossings, however, are a safety concern and their removal is encouraged. There are three ways to remove a railroad crossing - separate the crossing from the roadway, close the road at the crossing, and close the rail at the road.

OTO already prioritizes projects that remove at-grade rail crossings. A grade separation is planned for the MM corridor and a study is proposed for the Division crossing just west of US 65.

Time frame - Short/Medium/Long

Cost - Variable



5. Prioritization and Implementation

Prioritization

Evaluating and Recommending Projects

Once the 202 projects were determined for prioritization, the Advisory Team used available data and guidance from the public engagement process to identify evaluation criteria.

QUANTITATIVE EVALUATION

Prioritization Criteria Development

OTO and the Advisory Committee collaboratively identified six criteria to evaluate the project list and rank the criteria in order of importance. A measurement was identified for each criterion as well as an associated point value.

Prioritization Criteria	Ranking	Measurement	Assigned Point Value
Number KSI Crashes	1	If greater than the mean (≥ 5)	6 points
High Injury Network	2	If yes	5 points
Number Fatal Injuries	3	If greater than the mean (≥ 1)	4 points
Number Serious Injuries	4	If greater than the mean (≥ 5)	3 points
STIP Priority	5	If yes	2 points
Public Input	6	If yes	1 point

Priority Scoring

Using project location-specific data, point values were assigned for each project location and then summed to determine a Priority Score.

Sample Project Score

High priority scores represent a higher quantitative priority. The most points possible is 21, with 0 as the lowest.

Prioritization Criteria	Project Data	Metric Met	Assigned Point Value
Number KSI Crashes	5	Yes	6
High Injury Network	Yes	Yes	5
Number Fatal Injuries	1	Yes	4
Number Serious Injuries	4	No	0
STIP Priority	Yes	Yes	2
Public Input	No	No	0
		Priority Score	17

QUALITATIVE EVALUATION

Once projects were assigned a quantitative score, they were further evaluated to better focus future efforts and resources toward a strategically identified set of projects focused on member jurisdictions.

OTO and the Advisory Team intended to identify a set of priority project locations that represent diversity in:

- Disadvantaged Communities
- Urban and Rural Locations
- Segments and Intersections
- Multimodal
- OTO Member Agencies

About 80 percent of the project locations are on the State system. This is due to the fact that the roadways with the most traffic and therefore more crashes, are also on the State system. These locations are representative of safety needs in the region, cross municipal boundaries, and affect all users. A state transportation agency, however, cannot directly apply for SS4A funding. To broaden the applicability of the plan and support local jurisdiction needs, identifying locally owned project locations was a goal of OTO and the Advisory Team.

PRIORITY PROJECT LOCATION IDENTIFICATION

The 202 project locations were quantified by Priority Score and qualitatively evaluated in collaboration with the Advisory Team. The project locations were categorized into one of the following three tiers.

Tier 0 - 10 Project Locations

These 10 project locations are under the jurisdiction of the Missouri Department of Transportation and have already been studied and/or identified for initial project development; however each has safety merit with respect to the comprehensive safety analysis process for the region. Accordingly, these have been categorized as Tier 0 project locations.

Tier 1 - 21 Project Locations

The Tier 1 project locations represent the **top safety priorities** in the OTO region. The Tier 1 project locations represent the OTO member agencies, disadvantaged communities, and a mix of urban/rural locations, state/local routes, segments/intersections, and multimodal improvement needs. For each Tier 1 project location, an evaluation of existing conditions and crash history was performed and a set of safety countermeasure recommendations was developed to illustrate potential safety improvements.

Tier 2 - 171 Project Locations

The remaining 171 projects have safety merit, as documented by the project data and priority scores, and are important elements of the comprehensive safety analysis process and action plan. Tier 2 project locations can be subject to future project development if funding becomes available and/or local priorities change. Accordingly, they are collectively categorized in Tier 2 as secondary priorities.

IMPLEMENTATION MATRIX

The complete implementation matrix exists as a spreadsheet, saved separately from this plan, but available on the OTO website and by request. The matrix includes all 202 projects and incorporates all data elements, including the resulting priority as categorized by Tier.

Time frames

Time frames are specifically identified for each project. It is important to note that time frames are not indicative of urgency, which is represented by the prioritization process results. Rather, time frame is estimated to represent the duration to develop and implement a construction project (of undefined scope) at the location. Time frames are estimated to fall into the following three categories:

Short Term

- Signal Improvements
- Signing
- Pedestrian Crossings
- Sidewalks/Trails

Mid Term

- Intersection Improvements
- Roundabouts
- Corridor Improvements
- Context-Sensitive Solutions

Long Term

- Capacity Improvements
- Widening
- Interchanges
- Overpasses

TIER 0 PROJECT LIST
(ALPHABETICAL BY ROUTE NAME)

Chestnut Expressway - Kansas to National

Glenstone Avenue - Chestnut Expressway to Sunshine

Glenstone Avenue - Evergreen to Chestnut Expressway

I-44 - Route 125 to US 65

MO 744 - Springfield-Branson National Airport to LeCompte

Route D - Glenstone to Blackman Road

Route MM - Route 360 to Haile St.

US 60 East - Routes NN/J to west of Route 125

US 60 Republic - Rte 174 to Bailey

US 65 - Interchange at Route 744

Tier 1 Projects

Recommended Safety Countermeasures

As part of the comprehensive project list and prioritization process, 21 Tier 1 locations were identified as the top safety needs throughout the OTO region. Appendix D-4 Tier 1 Recommendations contains details about each location, as well as the recommended safety counter measures:

- Existing Conditions
- Crash History
- Key Prioritization Criteria

Just the recommendations are summarized in this Section.

RECOMMENDATIONS

Safety countermeasures are recommended based on the context of the location, as well as the identified safety problem. In some cases, countermeasures are implemented together, while in other cases, countermeasures reflect options to implement based on funding availability, time-frame, or other agency priorities.

Purpose

The purpose of the recommended safety countermeasure is to address the observed safety need.

Benefit

The expected safety benefits of the proposed countermeasure based on national statistics found in FHWA's Proven Safety Countermeasure Initiative.

Time Frame

The time frame to implement a countermeasure based on cost and complexity.

Right-of-Way (ROW)

The expectation that a countermeasure will require additional right-of-way.

Planning Level Cost

The per unit construction cost of a countermeasure.

Quantity

The unit quantity of a countermeasure recommended at the project location.

Estimated Cost

The estimated cost to construct a countermeasure at the project location.

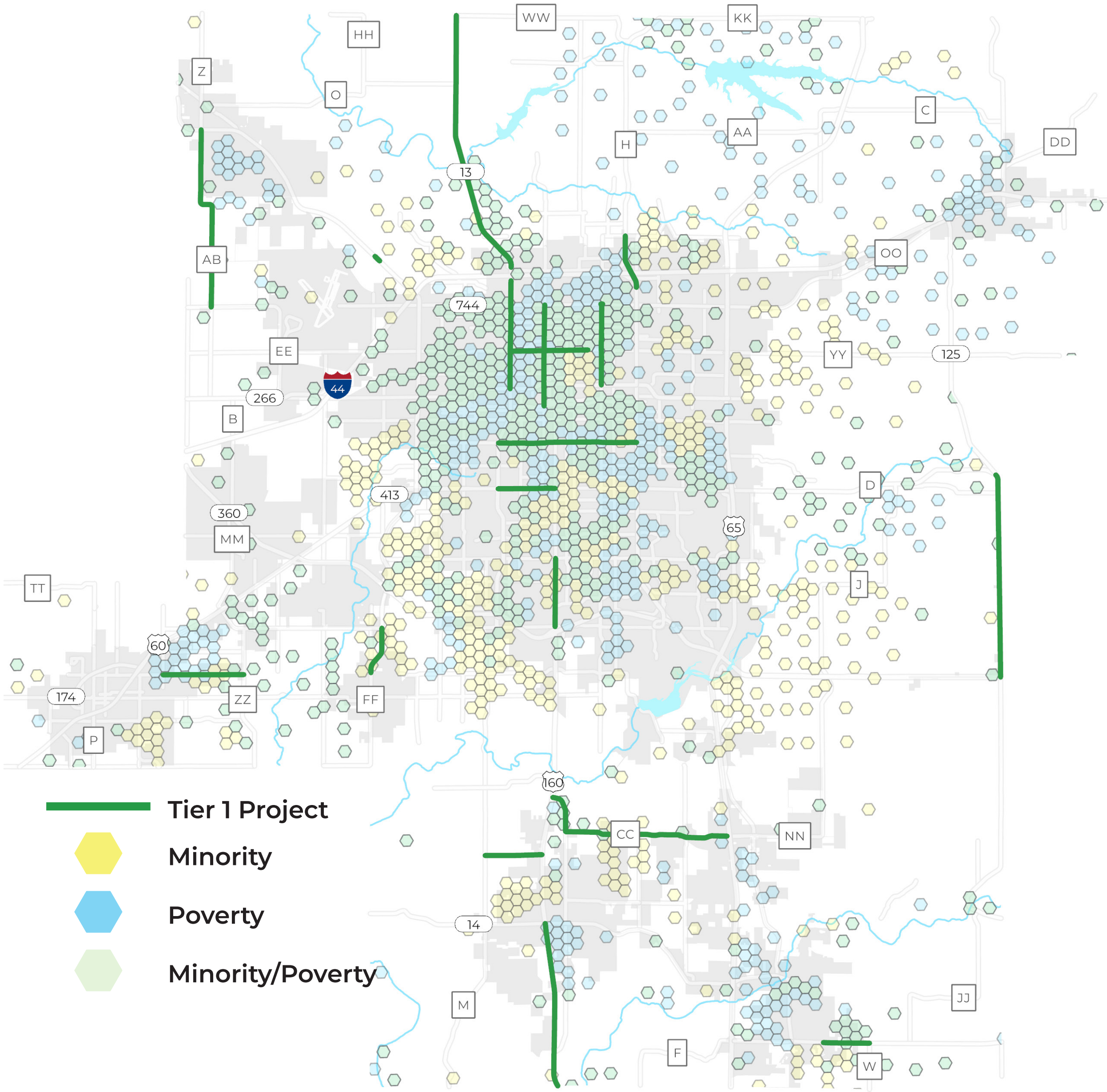
Baseline Estimated Total Cost

Sum of estimated costs for each countermeasure. This is the baseline construction total and does not include design, environmental review, ROW, utility coordination, maintenance of traffic, or contingency.

EQUITY

The Climate and Economic Justice (CEJST) Screening Tool was used in the selection of projects for the Tier 1 list. The results provided by CEJST for all projects can be seen in the Implementation Matrix.

Furthermore, when mapping the Tier 1 projects against minority and poverty populations, the connection is apparent. The outreach, engagement, and considerations included in this plan should lead to projects that create safer roadways for underserved and vulnerable users.



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MO 13/Kansas Expressway

Evergreen Street to Division Street

EXISTING CONDITIONS

MO 13/Kansas Expressway from Evergreen Street to Division Street is a 1.5-mile principal arterial/freeway in Springfield, MO. There are two through lanes in each direction and a center median south of Kearney Street and a center turn lane north of Kearney Street. Average daily vehicle traffic is around 25,000 – 30,000 vehicles per day. Sidewalks are disconnected and crossings appear challenging. There are no dedicated bicycle facilities.

Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Sidewalks	Reduce Pedestrian Crashes	65-89% reduction in pedestrian crashes	Short	No	1.3 miles	$370,000 per mile	$481,000
Pedestrian Hybrid Beacons	Reduce Pedestrian Crashes Reduce Vehicle Speeds	55% reduction in pedestrian crashes	Short	No	2 crossings	$120,000 each	$240,000
Crosswalk Enhancements	Reduce Pedestrian Crashes Reduce Vehicle Speeds	40% reduction in pedestrian crashes	Short	No	4 intersections	$25,000 per intersection	$100,000
Pedestrian Refuge Islands	Reduce Pedestrian Crashes Reduce Vehicle Speeds	56% reduction in pedestrian crashes	Mid	No	8 islands	$115,000 per island	$920,000
Dilemma Zone Detection	Reduce rear end and right-angle crashes	39% reduction in KSI crashes at intersections	Short	No	4 signalized intersections	$60,000 per intersection	$240,000
Signal Heads with Retroreflective Backplates	Reduce rear end and right-angle crashes	15% reduction in total crashes	Short	No	56 signals	$3,000 per signal	$168,000
Permissive to Protected Left Turn Phase	Reduce left turn and right-angle crashes	--	Short	No	4 signalized intersections	$5,000 per intersection	$20,000
Improved Right Turn Angles	Reduce Pedestrian Crashes Reduce Vehicle Speeds	--	Mid	Yes	8 right turns	$400,000 per right turn	$3,200,000
Corridor Access Management	Reduce pedestrian, rear end, and right-angle crashes	25-31% reduction in KSI crashes	Long	Yes	1.3 miles	--	--
						BASELINE ESTIMATED TOTAL	**$5,400,000**

Tier 1 Project

Intersection Improvements

Pedestrian Hybrid Beacon

MO 13/Kansas Expressway

Division Street to Chestnut Expressway

EXISTING CONDITIONS

MO 13/Kansas Expressway from Division Street to Chestnut Expressway is a 0.8-mile divided freeway in Springfield, MO. There are two through lanes in each direction, eight-foot-wide shoulders, and a center median and the speed limit is 40 mph. Average daily vehicle traffic is around 15,000 – 20,000 vehicles per day. There are signalized intersections at Division Street, Nichols Street, and the Chestnut Expressway. There are no sidewalks between Division Street and Nichols Street; sidewalks are present on the east side south of Nichols Street. Crossings on foot appear challenging with no dedicated crossings or crosswalks except for those at the signalized intersections. There are no dedicated bicycle facilities, but shared lanes markings are present along Nichols Street. Land use is primarily residential with nearby community features such as Nichols Park and York Elementary School.

Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Sidewalks	Reduce Pedestrian Crashes	65-89% reduction in pedestrian crashes	Short	No	1 mile	$370,000 per mile	$370,000
Pedestrian Hybrid Beacons	Reduce Pedestrian Crashes Reduce Vehicle Speeds	55% reduction in pedestrian crashes	Short	No	1 crossing	$120,000 per unit	$120,000
Crosswalk Enhancements	Reduce Pedestrian Crashes Reduce Vehicle Speeds	40% reduction in pedestrian crashes	Short	No	3 intersections	$25,000 per intersection	$75,000
Pedestrian Refuge Islands	Reduce Pedestrian Crashes Reduce Vehicle Speeds	56% reduction in pedestrian crashes	Mid	No	6 islands	$115,000 per island	$690,000
Road Diet	Reduce vehicle speeds and out of control crashes Reduce pedestrian and pedalcycle crashes	19-47% reduction in total crashes	Long	No	1.7 miles	$150,000 per mile	$255,000
						BASELINE ESTIMATED TOTAL	**$1,500,000**

Tier 1 Project
Intersection Improvements
Pedestrian Hybrid Beacon
Division
Kansas Expy
Calhoun
13
Nichols
Chestnut Expy

MO 13

Norton Road to Route WW (OTO North Boundary)

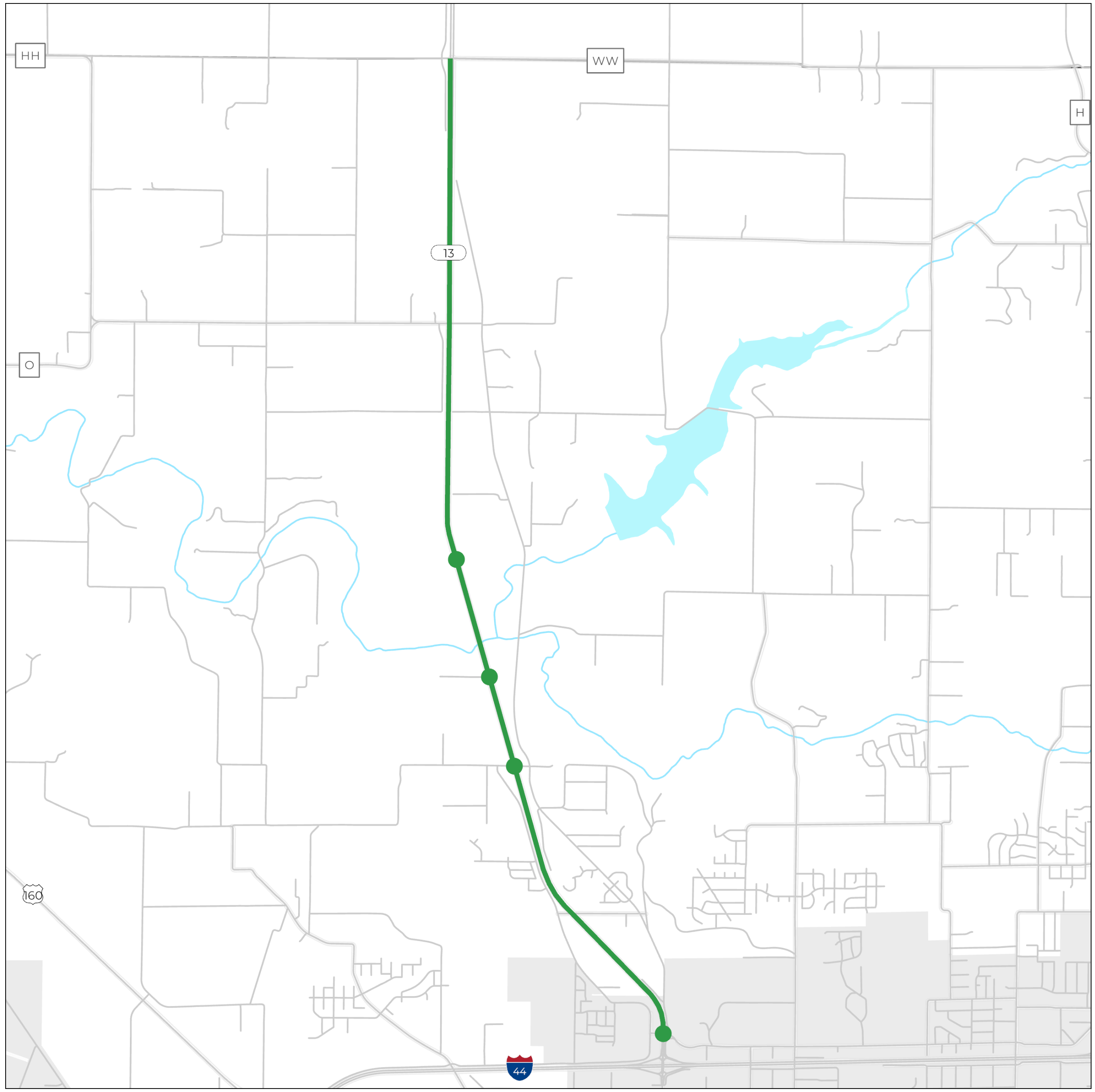
EXISTING CONDITIONS

This section of MO-13 is a freeway that stretches nearly six miles and is two lanes in each direction separated by a grass median with ten-foot-wide paved shoulders on both sides. Average daily traffic is approximately 20,000 – 25,000 vehicles per day and the speed limit is 65 mph. There is one signalized intersection at Norton Road and at-grade stop-controlled intersections at Farm Road 94, Farm Road 88, Little Sac River Road, Route O, and Route WW. Serving rural areas with little commercial or residential development, there are no dedicated bicycle or pedestrian facilities. The Fulbright Springs Greenway crosses the corridor at the Little Sac River near Farm Road 88 with a nearby trailhead on Farm Road 141.

Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Intersection Conflict Warning Systems	Reduce right angle crashes	20-30% reduction in KSI crashes at intersections	Short	No	4 intersections	$35,000 per intersection	$140,000
Lighting	Reduce crashes at intersections	28% reduction in injury crashes	Long	No	4 intersections	$30,000 per intersection	$120,000
Median Barriers	Reduce out of control crashes	97% reduction in cross median crashes	Mid	No	5.9 miles	$525,000 per mile	$3,100,000
						BASELINE ESTIMATED TOTAL	**$3,400,000**

Tier 1 Project

Intersection Improvements



MO 13/Kansas Expressway and Division Street

Intersection

EXISTING CONDITIONS

MO-13 is two through lanes with left and right turn lanes in both directions. Division Street is one through lane with left and right turn lanes in each direction. Right-turn lanes on northbound MO-13 and westbound Division Street are channelized slip lanes. Sidewalk connectivity is lacking at the intersection with missing connections along the south leg on MO-13 and west leg on Division Street.

Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short	No	1 intersection	$25,000 per intersection	$25,000
Pedestrian Refuge Islands	Reduce pedestrian and out of control crashes	56% reduction in pedestrian crashes	Short	No	2 islands	$115,000 per island	$230,000
Dilemma Zone Detection	Reduce rear end and right angle crashes	39% reduction in KSI crashes at intersections	Short	No	1 intersection	$60,000 per intersection	$60,000
Signal Heads with Retroreflective Backplates	Reduce rear end and right angle crashes	15% reduction in total crashes	Short	No	13 signals	$3,000 per signal	$40,000
Permissive to Protected Left Turn Phase	Reduce left turn and right angle crashes	--	Short	No	1 intersection	$5,000 per intersection	$5,000
Improved Right Turn Angles	Reduce pedestrian crashes Reduce vehicle speeds	--	Mid	Yes	2 right turns	$400,000 per right turn	$800,000
						BASELINE ESTIMATED TOTAL	**$1,200,000**

Tier 1 Intersection Project

Route 14

14th Street to Route W

EXISTING CONDITIONS

Route 14 is a two-lane, rural, minor arterial, around 1-mile long, that serves approximately 5,000 – 10,000 vehicles per day. There are no signalized intersections; 14th Street and Route W are side street stop controlled intersections. The speed limit along the corridor is 45 mph. There are no dedicated bicycle or pedestrian facilities, and the adjacent land uses include commercial, light industrial, and residential.

Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Intersection Conflict Warning Systems	Reduce right angle crashes	20-30% reduction in KSI crashes at intersections	Short	No	2 intersections	$35,000 per intersection	$70,000
Lighting	Reduce crashes at intersections	28% reduction in injury crashes	Long	No	2 intersections	$30,000 per intersection	$60,000
Systemic Signing & Marking	Reduce rear end and intersection crashes	27% reduction in KSI crashes at rural intersections	Short	No	2 intersections	$15,000 per intersection	$30,000
						BASELINE ESTIMATED TOTAL	**$160,000**

Tier 1 Project

Intersection Improvements

Route 125

Route D to US 60

EXISTING CONDITIONS

Route 125 is a two-lane, rural, minor arterial, 4.5 miles long, from Route D to US 60. The corridor carries approximately 5,000 vehicles per day. There are no shoulders or bicycle or pedestrian facilities. The speed limit along the corridor is 55mph. The signalized intersection at Route 125 and US 60 is being replaced by a grade separated interchange (completion in late 2024). There are no other signalized intersections along the corridor. The corridor primarily serves rural residential land uses.

Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Intersection Conflict Warning Systems	Reduce right angle crashes	20-30% reduction in KSI crashes at intersections	Short	No	3 intersections	$35,000 per intersection	$105,000
Lighting	Reduce crashes at intersections	28% reduction in injury crashes	Long	No	3 intersections	$30,000 per intersection	$90,000
Systemic Signing & Marking	Reduce rear end and intersection crashes	$27% reduction in KSI crashes at rural intersections	Short	No	9 intersections	$15,000 per intersection	$135,000
Rumble Strips	Reduce out of control crashes	13-51% reduction in out of control crashes	Short	No	4.5 miles	$10,000 per mile	$45,000
						BASELINE ESTIMATED TOTAL	**$375,000**

The new interchange at Route 125 and US 60 should be evaluated after completion once data become available.

Tier 1 Project

Intersection Improvements

Kearney Street and National Avenue

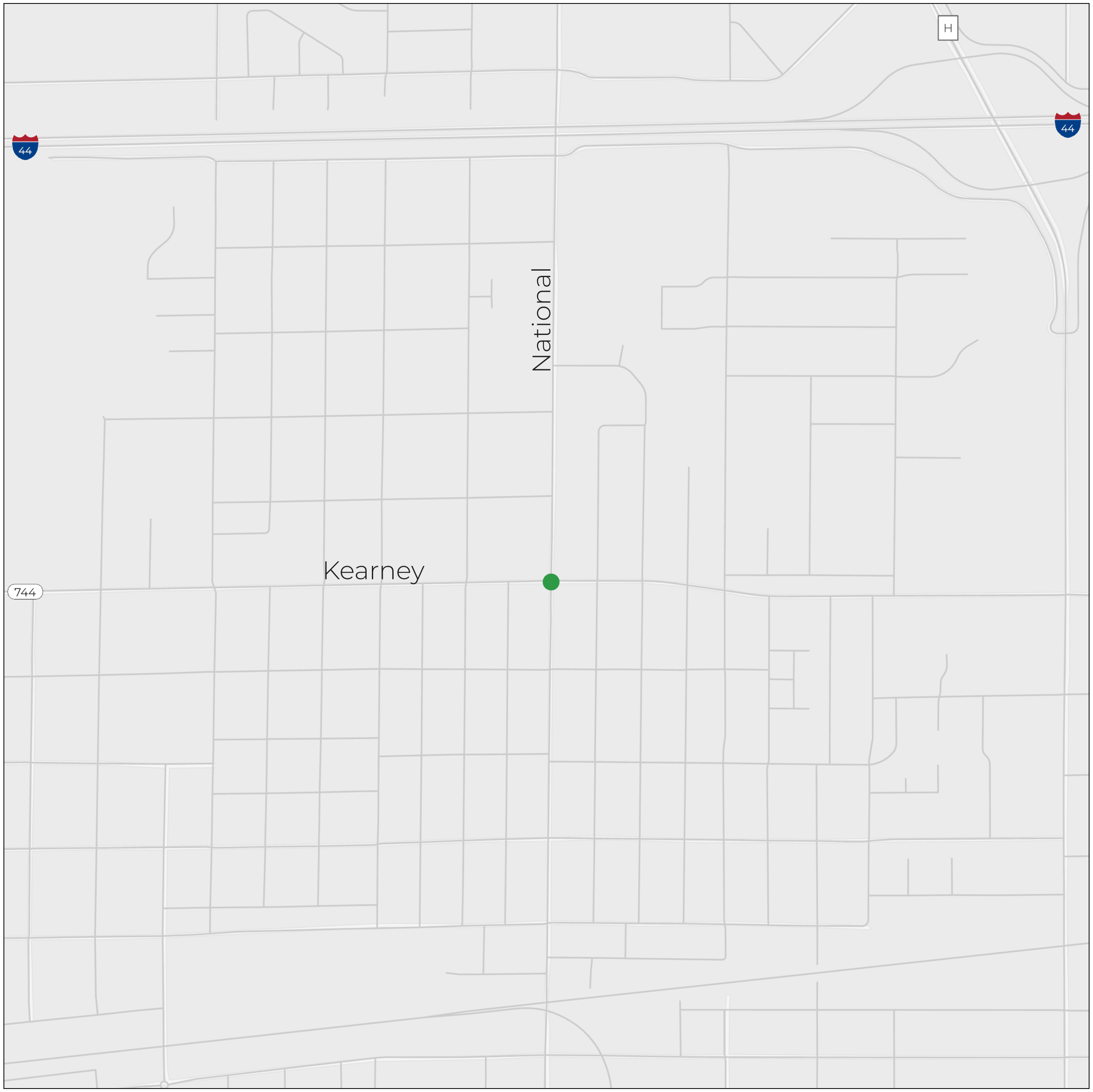
Intersection

EXISTING CONDITIONS

Route 125 is a two-lane, rural, minor arterial, 4.5 miles long, from Route D to US 60. The corridor carries approximately 5,000 vehicles per day. There are no shoulders or bicycle or pedestrian facilities. The speed limit along the corridor is 55 mph. The signalized intersection at Route 125 and US 60 is being replaced by a grade separated interchange (completion scheduled for late 2024). There are no other signalized intersections along the corridor. The corridor primarily serves rural residential land uses.

Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Permissive to Protected Left Turn Phase	Reduce left turn and head on crashes	--	Short	No	1 intersection	$5,000 per intersection	$5,000
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short	No	1 intersection	$25,000 per intersection	$25,000
Leading Pedestrian Interval	Reduce pedestrian crashes	13% reduction in pedestrian crashes	Short	No	1 intersection	$5,000 per intersection	$5,000
Pedestrian Refuge Islands	Reduce pedestrian and out of control crashes	56% reduction in pedestrian crashes	Short	No	2 islands	$115,000 per island	$230,000
Signal Heads with Retroreflective Backplates	Reduce rear end and right angle crashes	15% reduction in total crashes	Short	No	12 signals	$3,000 per signal	$36,000
Dilemma Zone Detection	Reduce left turn and right angle crashes	--	Short	No	1 intersection	$60,000 per intersection	$60,000
						BASELINE ESTIMATED TOTAL	**$360,000**

Tier 1 Intersection Project



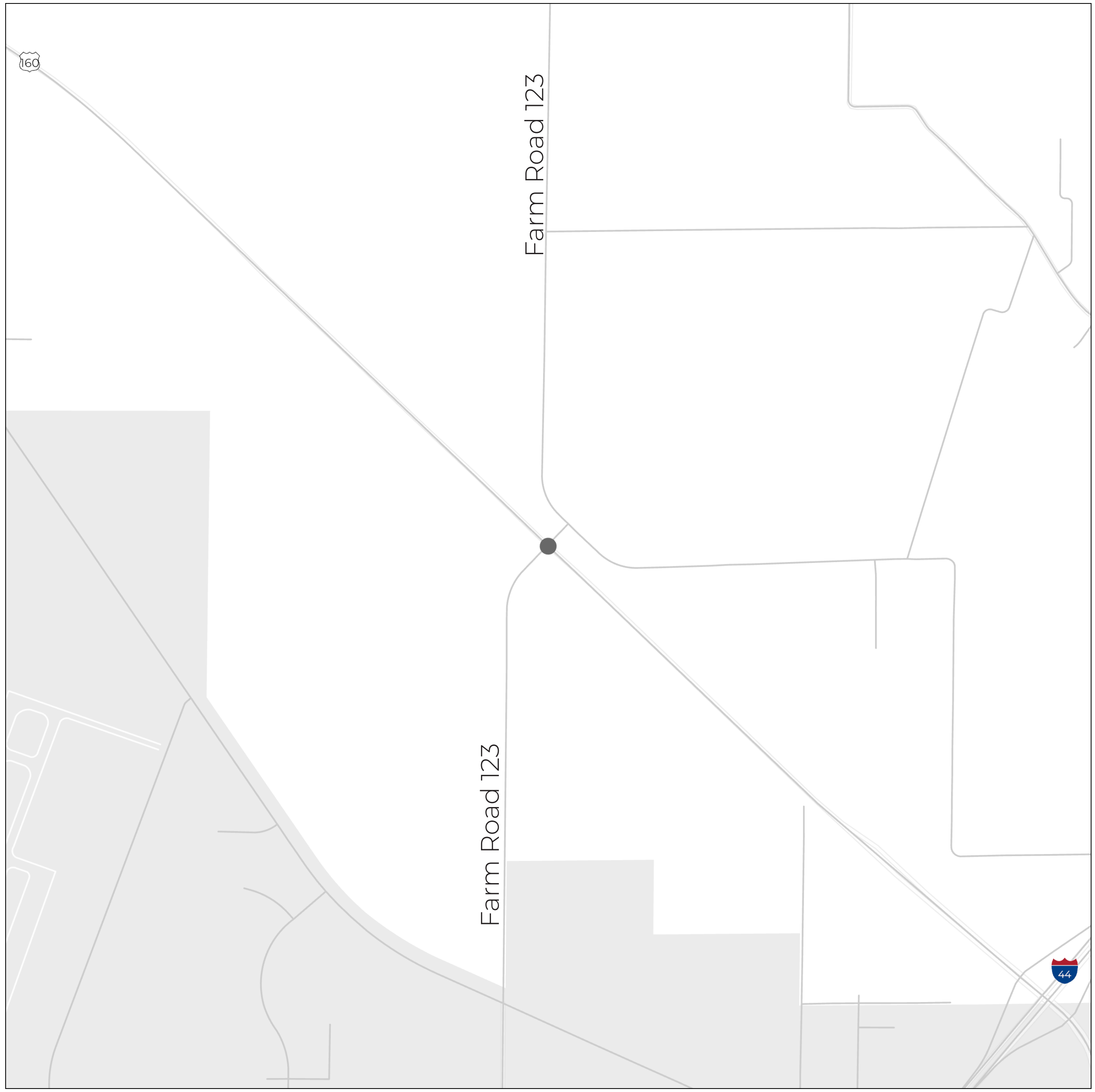
US 160 and Farm Road 123

Intersection

EXISTING CONDITIONS

Reduced Left Turn Conflict Intersection completed in 2021. Not providing any recommendations at this time.

Intersection Location



US 160

Route 14 to OTO South Boundary

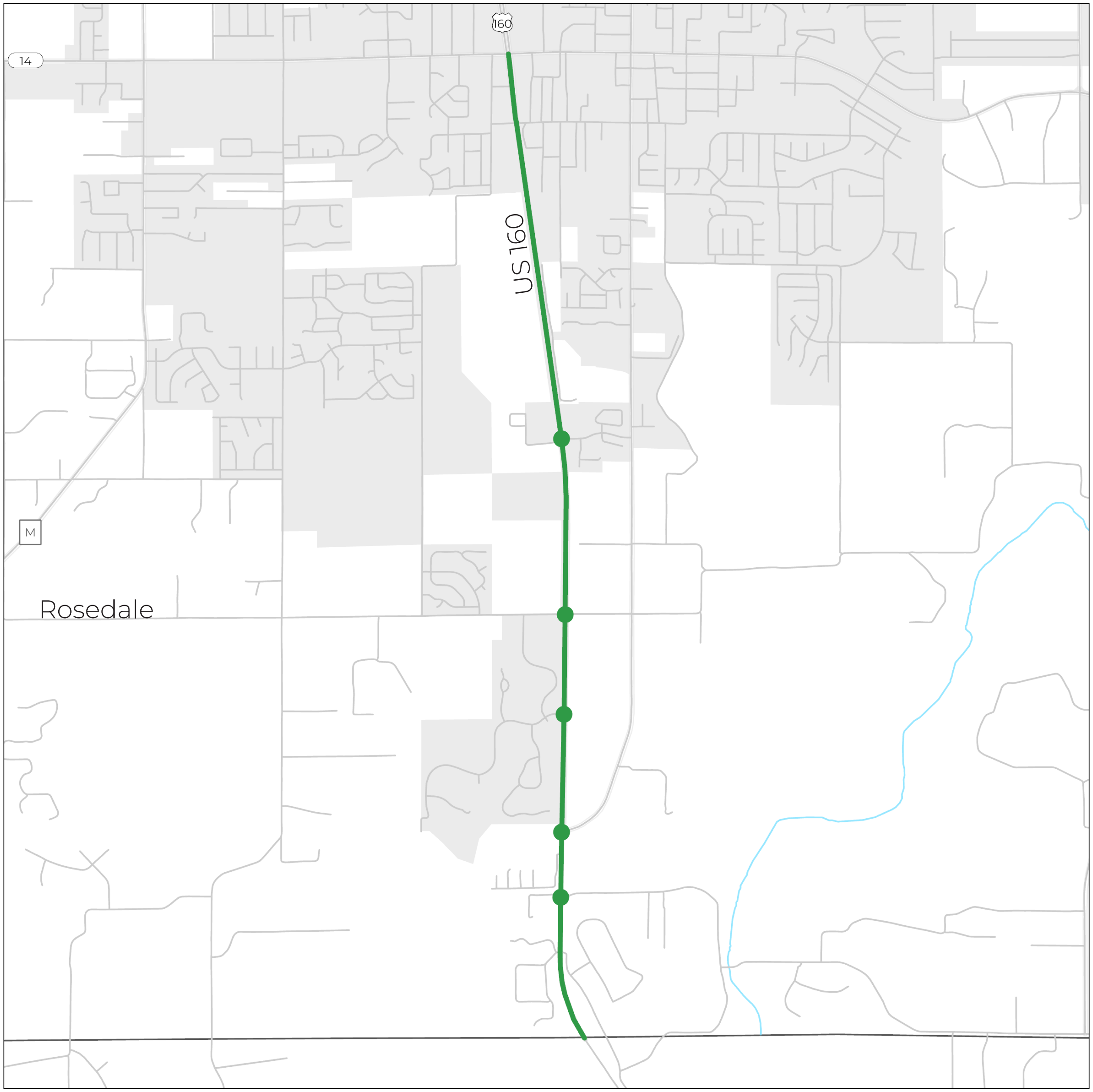
EXISTING CONDITIONS

This section of US 160 is a principal arterial extending 3.6 miles from Route 14 in Nixa south to the OTO boundary. There is one through lane in each direction and ten-foot-wide paved shoulders. The speed limit is 60 mph. US 160 at Route 14 and at South Street (reconstructed in 2021) are the only signalized intersections along the corridor. Other major intersections include left turn lanes at Sunrise Drive, Rosedale Road, Kelby Parkway, S Main Street, and Pawnee Road. The corridor carries approximately 5,000 vehicles per day.

Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Intersection Conflict Warning Systems	Reduce right angle and rear end crashes	20-30% reduction in KSI crashes at intersections	Short	No	5 intersections	$35,000 per intersection	$175,000
Lighting	Reduce crashes at intersections	28% reduction in injury crashes	Long	No	5 intersections	$30,000	$150,000
Systemic Signing & Marking	Reduce rear end and intersection crashes	27% reduction in KSI crashes at rural intersections	Short	No	5 intersections	$15,000 per intersection	$75,000
Rumble Strips	Reduce out of control crashes	13-51% reduction in out of control crashes	Short	No	3.6 miles	$10,000 per miles	$36,000
Reduced Conflict Left Turn Intersections	Reduce left turn and right angle crashes	63% reduction in KSI crashes	Long	Yes	2 intersections	$1,000,000 per intersection	$2,000,000
						BASELINE ESTIMATED TOTAL	**$2,400,000**

Tier 1 Project

Intersection Improvements



Route AB

US 160 to Route EE

EXISTING CONDITIONS

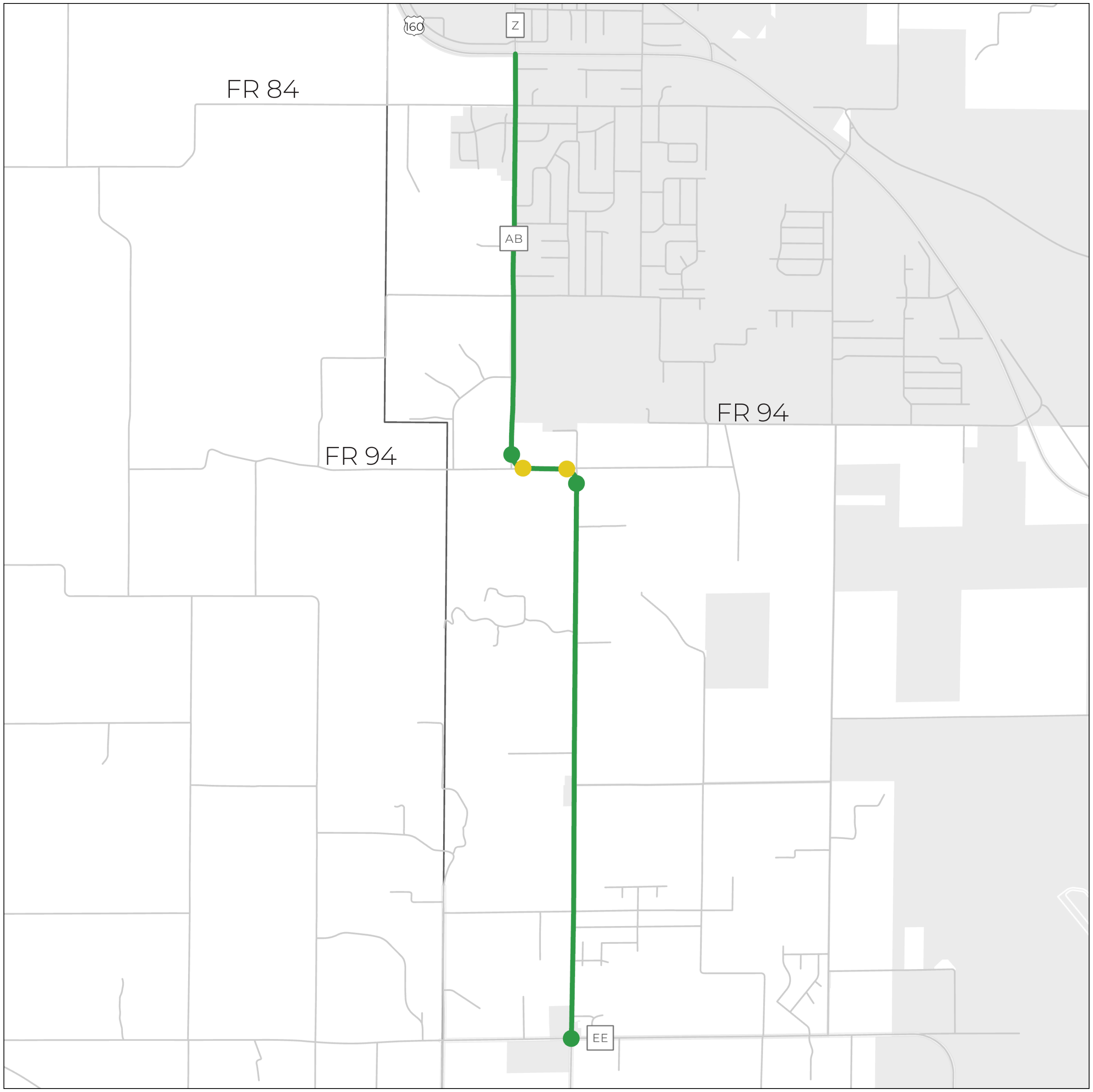
Route AB is a major collector with one lane in each direction and narrow shoulders stretching 4 miles from US 160 to Route EE. The route carries approximately 2,500 vehicles per day and has a speed limit of 55 mph. There is a signalized intersection at US 160 and a four-way stop controlled intersection at Route EE. Land use along the corridor is rural residential and agricultural with some suburban residential developments near US 160 in Willard, MO. There are no dedicated bicycle or pedestrian facilities.

Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Intersection Conflict Warning Systems	Reduce right angle and rear end crashes	20-30% reduction in KSI crashes at intersections	Short	No	3 intersections	$35,000 per intersection	$105,000
Lighting	Reduce crashes at intersections	28% reduction in injury crashes	Long	No	3 intersections	$30,000 per intersection	$90,000
Systemic Signing & Marking	Reduce rear end and intersection crashes	27% reduction in KSI crashes at rural intersections	Short	No	3 intersections	$15,000 per intersection	$45,000
Rumble Strips	Reduce out of control crashes	13-51% reduction in out of control crashes	Short	No	4 miles	$10,000 per mile	$40,000
Curve Improvements - Signs & Markings	Reduce out of control crashes	--	Short	No	2 curves	$35,000 per curve	$70,000
Curve Improvements - Radius Improvement	Reduce out of control crashes	--	Long	Yes	2 curves	$1,500,000 per curve	$3,000,000
						BASELINE ESTIMATED TOTAL	**$3,400,000**

Tier 1 Project

Intersection Improvements

Curve Improvement



Route CC

US 160 to US 65

EXISTING CONDITIONS

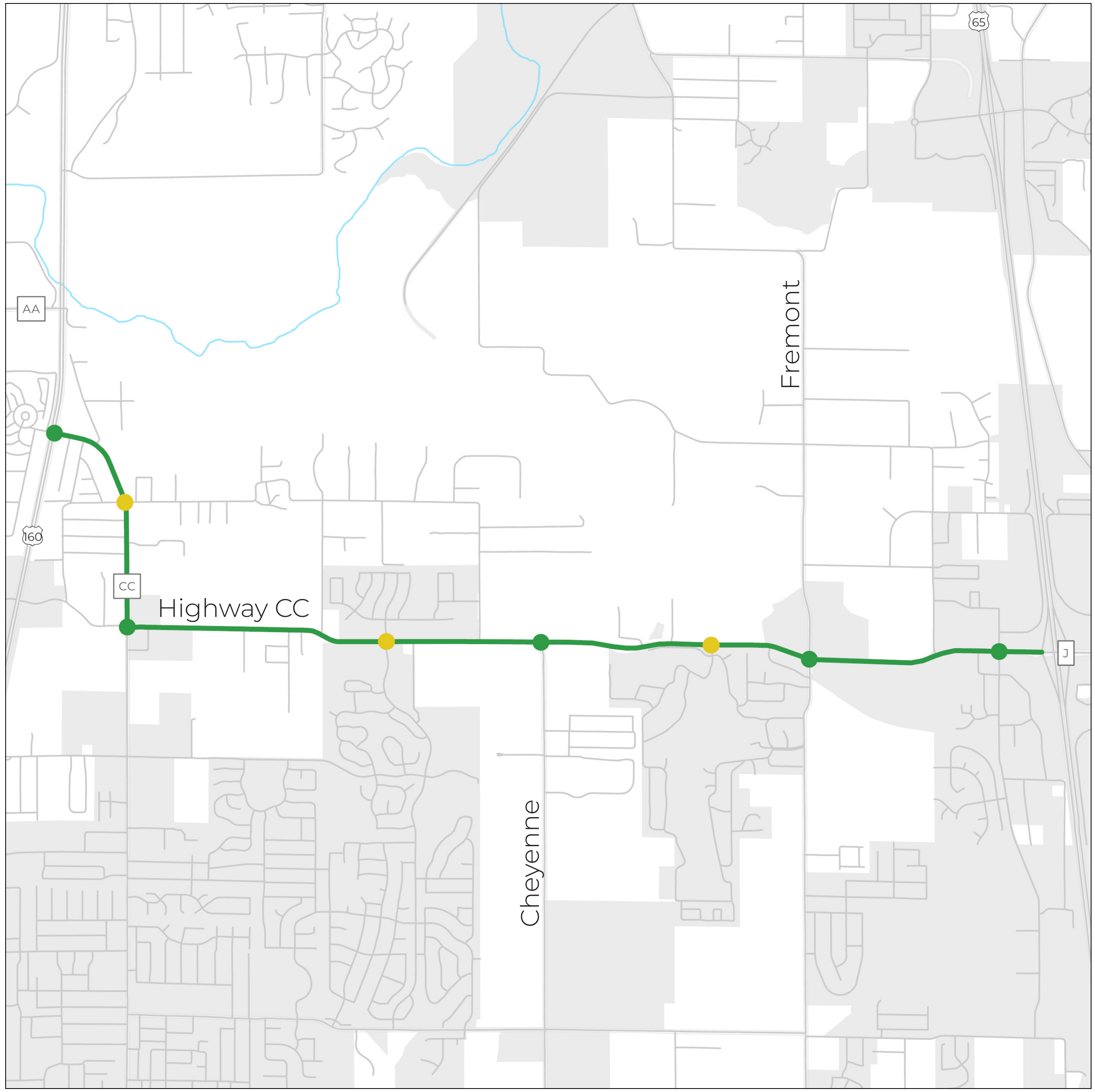
Route CC is a minor arterial, 4.5 miles long, from US 160 to US 65 spanning the communities of Nixa, Fremont Hills, and Ozark. The corridor is one lane in each direction with narrow shoulders and has a speed limit of 45 mph. Approximately 12,000 – 18,000 vehicles per day use the facility which provides access to various land uses such as suburban residential neighborhoods, commercial uses, and schools. Intersections at US 160, Cedar Street, Cheyenne Road, Fremont Road, and 22nd Street are signalized. The intersection at US 65 is a diverging diamond interchange (DDI) completed in 2016. There are sidewalks on the south side of Route CC between 22nd Street and US 65 and a 0.15-mile disconnected walkway/shared use path just west of Fremont Road.

Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Shared Use Path	Reduce bicycle and pedestrian crashes	--	Mid	Yes	4.5 miles	$700,000 per mile	$3,150,000
Rectangular Rapid Flashing Beacons	Reduce pedestrian and speed related crashes	47% reduction in pedestrian crashes	Short	No	3 crossings	$25,000 each	$75,000
Crosswalk Enhancements	Reduce pedestrian and speed related crashes	40% reduction in pedestrian crashes	Short	No	5 intersections	$25,000 per intersection	$125,000
						BASELINE ESTIMATED TOTAL	**$3,400,000**

Tier 1 Project

Intersection Improvements

Rectangular Rapid Flashing Beacon



Route FF

Republic Road to Weaver Road

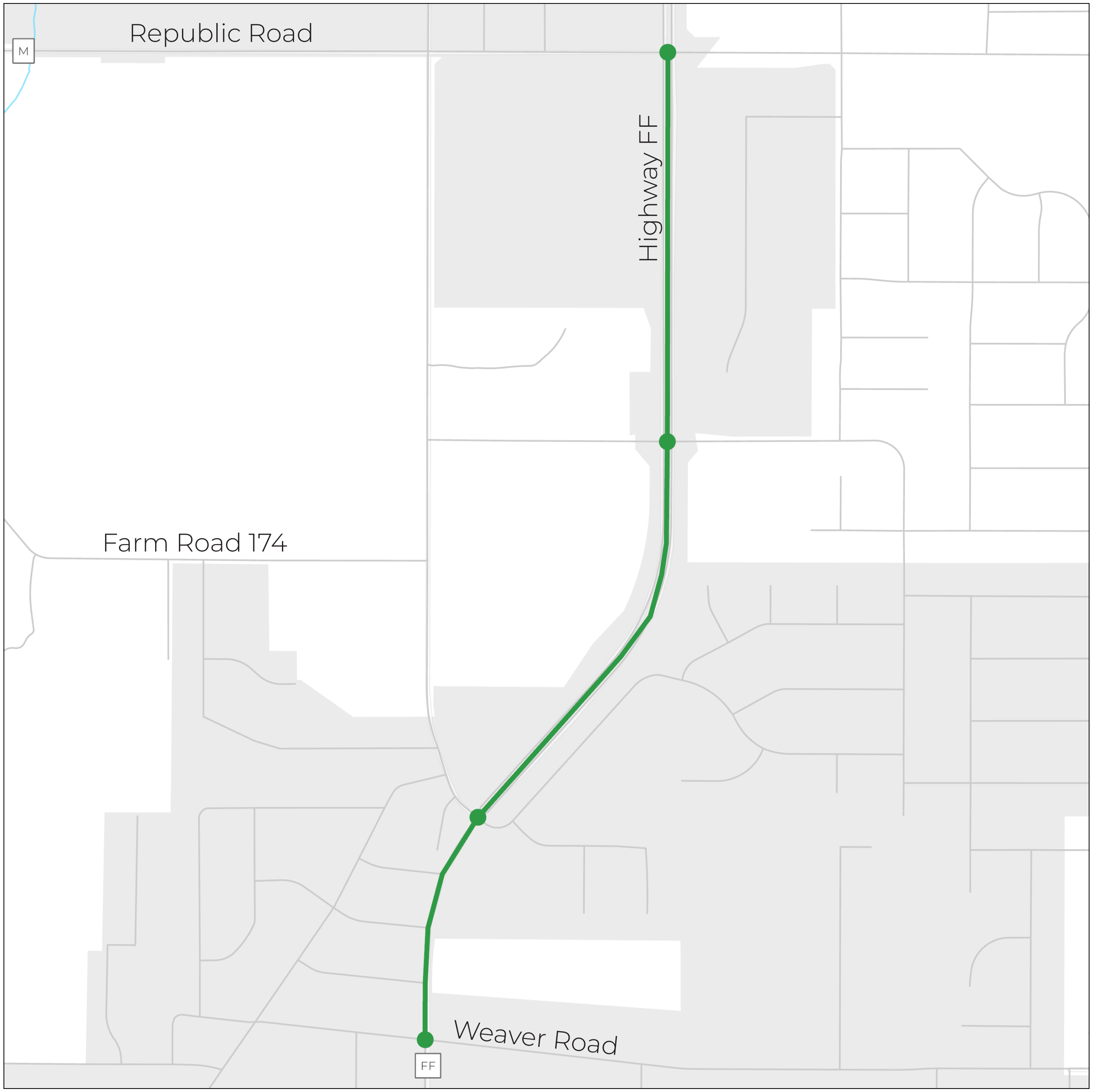
EXISTING CONDITIONS

Route FF is a 1-mile divided minor arterial with a grass median and two through lanes in each direction from Republic Road to Farm Road 123. South of Farm Road 123 to Weaver Road, Route FF is one through lane in each direction with a center turn lane. The corridor carries around 5,000 vehicles per day and the speed limit is 55 mph. The intersection at Republic Road is the only signalized intersection. Route FF is a signed bike route, but no dedicated facilities are available for bicyclists or pedestrians. Land uses in the area include suburban residential, commercial uses, schools, and a senior living community.

Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Shared Use Path	Reduce bicycle and pedestrian crashes	--	Mid	Yes	1 mile	$700,000 per mile	$700,000
Rectangular Rapid Flashing Beacons	Reduce pedestrian and speed related crashes	47% reduction in pedestrian crashes	Short	No	2 crossings	$25,000 each	$50,000
Pedestrian Hybrid Beacons	Reduce pedestrian and speed related crashes	55% reduction in pedestrian crashes	Short	No	2 crossings	$120,000 each	$240,000
Crosswalk Enhancements	Reduce pedestrian and speed related crashes	40% reduction in pedestrian crashes	Short	No	4 intersections	$25,000 per intersection	$100,000
						BASELINE ESTIMATED TOTAL	**$390,000**

Tier 1 Project

Intersection Improvements



Glenstone Avenue

Valley Water Mill Road to Evergreen Street

EXISTING CONDITIONS

Glenstone Avenue is a principal arterial south of I-44 and a minor arterial north of I-44. The corridor is a 1.2-mile divided expressway with two through lanes in each direction from Evergreen Street to Mcclernon Street. From Mcclernon Street to Valley Water Mill Road, the corridor is one through lane in each direction with a center turn lane. Daily traffic varies from around 11,000 vehicles per day north of I-44 to nearly 24,000 vehicles per day south of I-44. Signalized intersections include Evergreen Street, I-44 on/off ramps, Mcclernon Street, and Valley Water Mill Road. There are no sidewalks south of I-44 and the sidewalks are disconnected north of I-44. There are no dedicated bicycle facilities. Land use is primarily commercial.

Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Sidewalks	Reduce pedestrian crashes	65-89% reduction in pedestrian crashes	Short	No	2 miles	$370,000 per mile	$740,000
Permissive to Protected Left Turn Phase	Reduce left turn and head on crashes	--	Short	No	5 intersections	$5,000 per intersection	$25,000
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short	No	5 intersections	$25,000 per intersection	$125,000
Leading Pedestrian Interval	Reduce pedestrian crashes	13% reduction in pedestrian crashes	Short	No	5 intersections	$5,000 per intersection	$25,000
Pedestrian Refuge Islands	Reduce pedestrian and out of control crashes	56% reduction in pedestrian crashes	Mid	No	10 islands	$115,000 per island	$1,150,000
						BASELINE ESTIMATED TOTAL	**$2,100,000**

Tier 1 Project

Intersection Improvements

Grant Avenue

College Street to Kearney Street

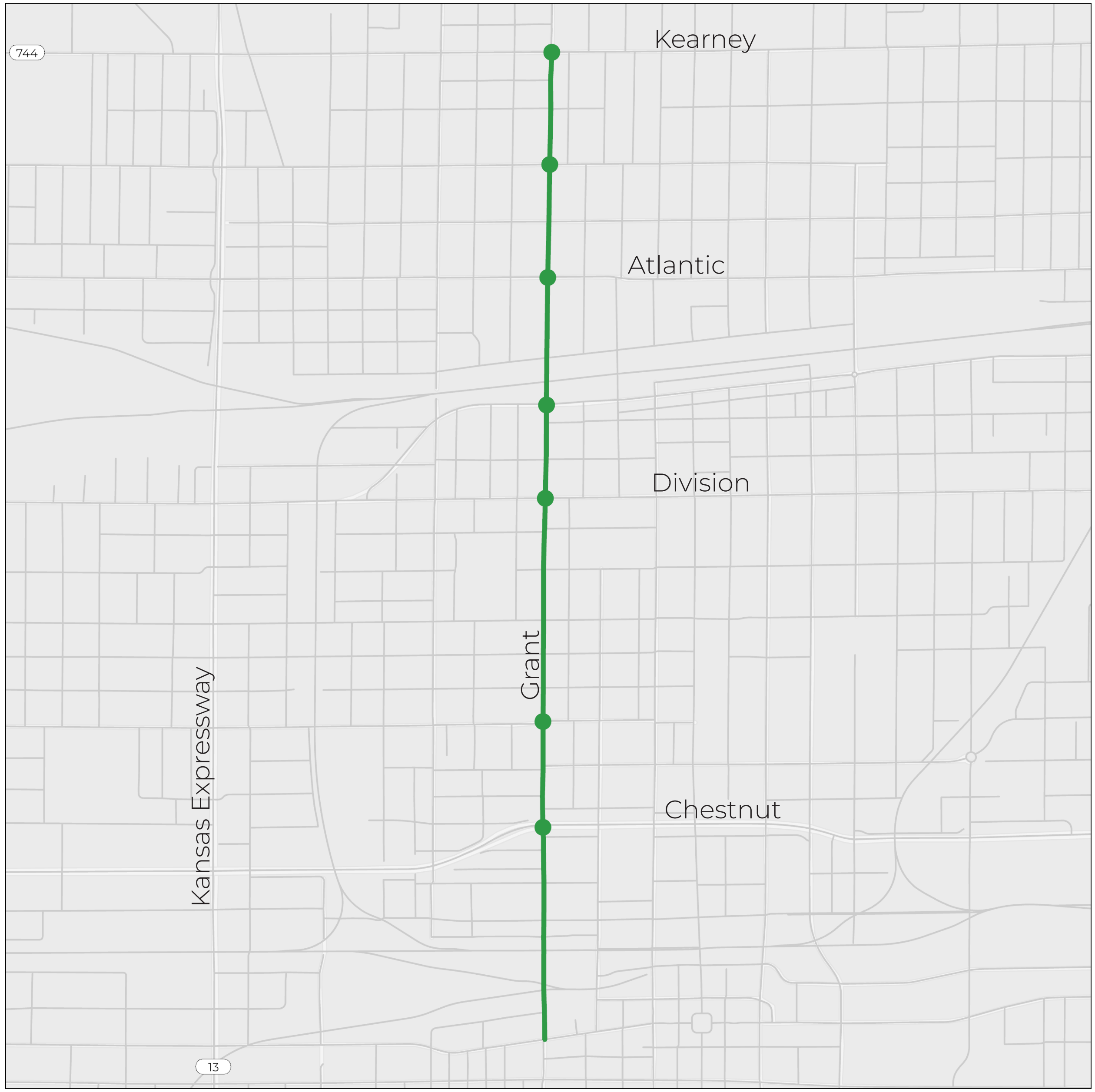
EXISTING CONDITIONS

Grant Avenue is a 2.2-mile minor arterial with one through lane in each direction with a center turn lane. The corridor runs from College Street in Downtown Springfield north to Kearney Street. Approximately 7,000 – 9,000 vehicles per day utilize the corridor. The speed limit is 30 mph. Signalized intersections along the corridor include College Street, Chestnut Expressway, Nichols Street, Division Street, Commercial Street, Atlantic Street, High Street, and Kearney Street. Land uses are primarily residential with commercial uses at the major intersections., with multiple schools along or near Grant Avenue. There are no bicycle facilities; sidewalks are present on both sides throughout the corridor except between Commercial Street and Chase Street where Grant Avenue goes under the railroad tracks.

Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Road Diet	Reduce pedestrian and bicycle crashes and vehicle speeds	--	Long	No	2.2 miles	$150,000 per mile	$330,000
Shared Use Path	Reduce bicycle and pedestrian crashes	--	Long	No	2.2 miles	$700,000 per mile	$1,540,000
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short	No	7 intersections	$25,000 per intersection	$175,000
						BASELINE ESTIMATED TOTAL	**$2,100,000**

Tier 1 Project

Intersection Improvements



Tracker Road

Nicholas Road to US 160

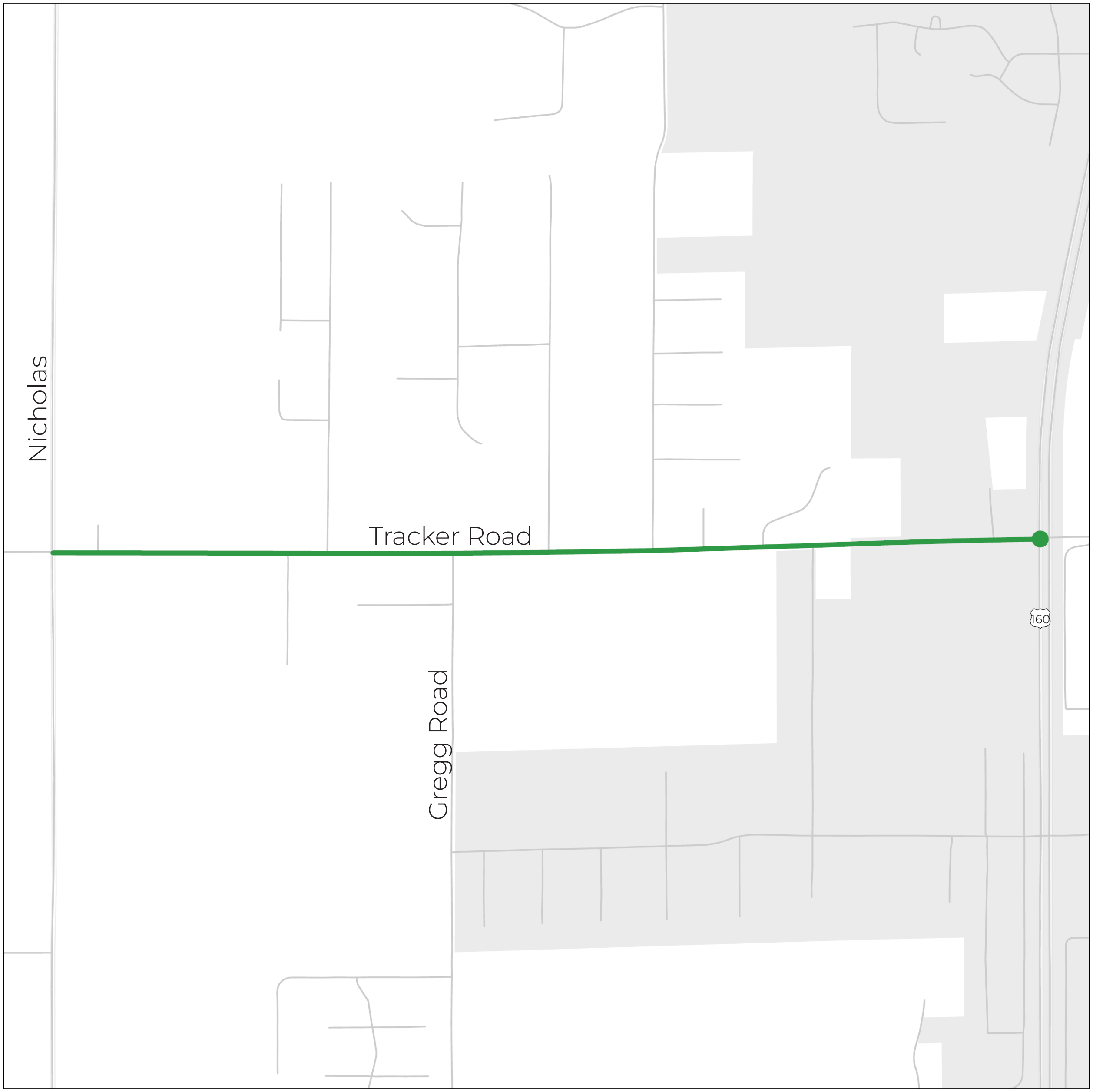
EXISTING CONDITIONS

Tracker Road is a 1.3-mile major collector with one lane in each direction and narrow shoulders. The speed limit is 35 mph. The intersection at Nicholas Road is a four-way stop controlled intersection; Tracker Road and US 160 is a signalized intersection. There are no bicycle or pedestrian facilities. Land uses include rural residential and agricultural.

Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Permissive to Protected Left Turn Phase	Reduce left turn and head on crashes	--	Short	No	1 intersection	$5,000 per intersection	$5,000
Signal Heads with Retroreflective Backplates	Reduce rear end and right angle crashes	15% reduction in total crashes	Short	No	13 signals	$3,000 per signal	$39,000
Reduced Conflict Left Turn Intersections	Reduce left turn and right angle crashes	63% reduction in KSI crashes	Long	Yes	1 intersection	$1,000,000 per intersection	$1,000,000
						BASELINE ESTIMATED TOTAL	**$1,100,000**

Tier 1 Project

Intersection Improvements



National Avenue

Chestnut Expressway to Kearney Street

EXISTING CONDITIONS

National Avenue is a 1.8-mile minor arterial with two through lanes in each direction with a center left turn lane. Average daily traffic volume is approximately 5,000 – 12,000 vehicles per day. The speed limit is 35 mph. Signalized intersections along the corridor include Chestnut Expressway, Central Street, Pythian Street, Division Street, Commercial Street, Dale Street, Turner Street, and Kearney Street. Well-connected sidewalks are present on both sides of the street. There are no bicycle facilities along the corridor but a connection to the Jordan Creek Greenway provides access to Silver Springs Park and Smith Park. Adjacent land uses are primarily residential.

Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Road Diet	Reduce fatal and serious injury crashes and vehicle speeds	--	Long	No	1.8 miles	$150,000 per mile	$270,000
Permissive to Protected Left Turn Phase	Reduce left turn and head on crashes	--	Short	No	2 intersections	$5,000 per intersection	$10,000
Bicycle Lanes - On Street	Reduce bicycle crashes	30-49% reduction in total crashes	Mid	No	1.8 miles	$120,000 per mile	$216,000
Bicycle Lanes - Elevated Cycle Track	Reduce bicycle crashes	30-49% reduction in total crashes	Long	Yes	1.8 miles	$600,000 per mile	$1,080,000
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short	No	8 intersections	$25,000 per intersection	$200,000
Pedestrian Refuge Islands	Reduce pedestrian crashes Reduce vehicle speeds	56% reduction in pedestrian crashes	Mid	No	16 islands	$115,000 per island	$1,840,000
Leading Pedestrian Interval	Reduce pedestrian crashes	13% reduction in pedestrian crashes	Short	No	8 intersections	$5,000 per intersection	$40,000
Medians	Reduce out of control crashes	97% reduction in cross median crashes	Long	No	700 feet	$1,600,000 per mile	$212,000
						BASELINE ESTIMATED TOTAL	**$2,800,000-$3,700,000**

Baseline estimated total range reflects on-street bicycle lanes or an elevated bicycle track

Tier 1 Project

Intersection Improvements

Grand Street

Kansas Expressway to Glenstone Avenue

EXISTING CONDITIONS

Grand is a 3-mile minor arterial. From Kansas Expressway to National, there are two through lanes in each direction with a grassy median from Kansas Expressway to Grant and a center turn lane from Grant to National. From National to Glenstone, there is one through lane in each direction with a center turn lane. Signalized intersections along the corridor include Kansas, Fort, Grant, Campbell, South, Jefferson, Kimbrough, Holland, JQH, King, National, Fremont, and Glenstone. The corridor carries around 14,000 vehicles/day west of National and 4,000 to the east. There are sidewalks on both sides of the street, but no bicycle facilities. Land uses include residential, some commercial, and schools such as Missouri State.

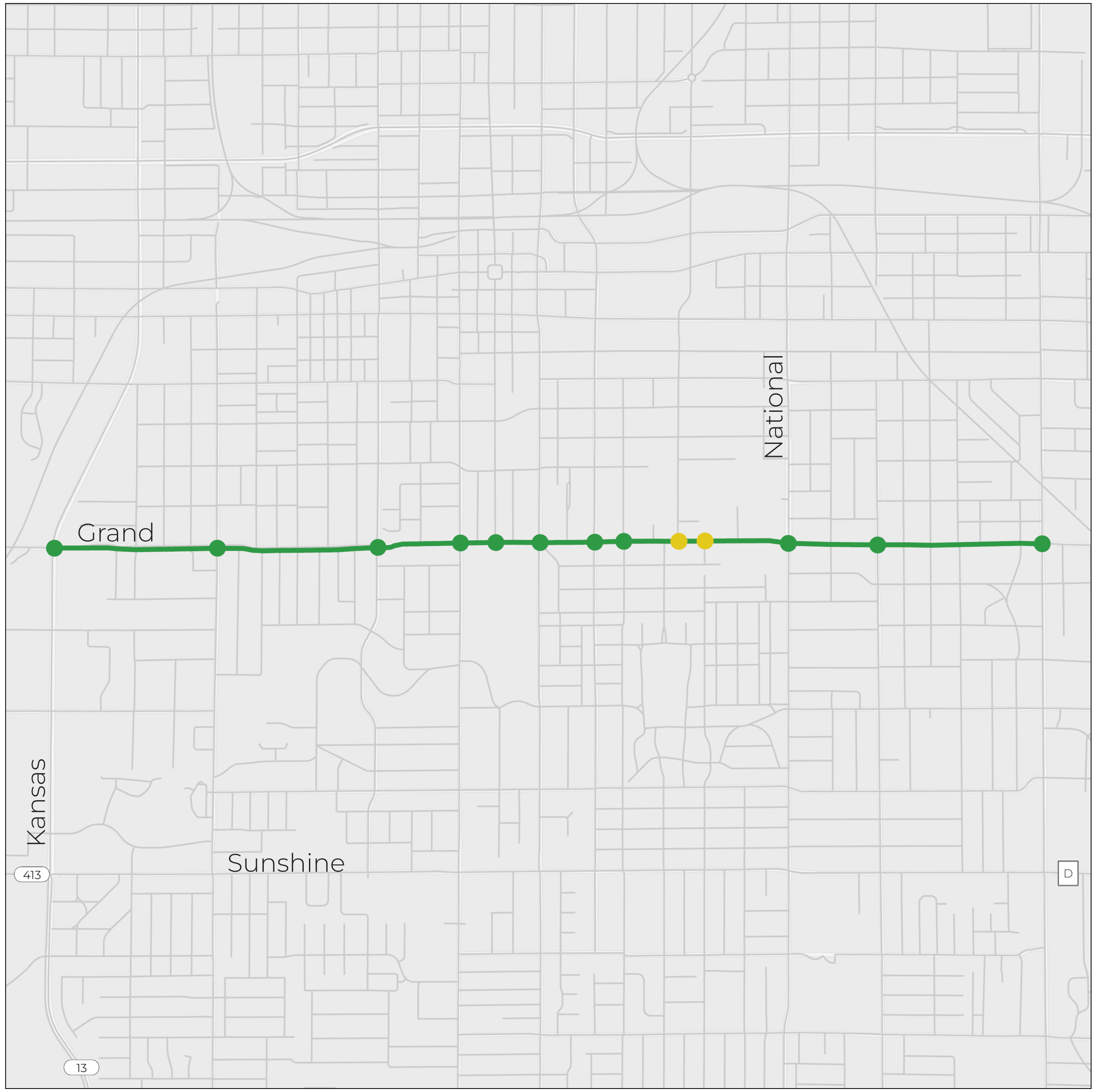
Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Road Diet	Reduce fatal and serious injury crashes and vehicle speeds	--	Long	No	3 miles	$150,000 per mile	$450,000
Permissive to Protected Left Turn Phase	Reduce left turn and head on crashes	--	Short	No	2 intersections	$5,000 per intersection	$10,000
Bicycle Lanes - On-Street	Reduce bicycle crashes	30-49% reduction in total crashes	Mid	No	3 miles	$120,000 per mile	$360,000
Bicycle Lanes - Elevated Cycle Track	Reduce bicycle crashes	30-49% reduction in total crashes	Long	No	3 miles	$600,000 per mile	$1,800,000
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short	No	13 intersections	$25,000 per intersection	$325,000
Pedestrian Refuge Islands	Reduce pedestrian crashes Reduce vehicle speeds	56% reduction in pedestrian crashes	Mid	No	22 islands	$115,000 per island	$2,530,000
Leading Pedestrian Interval	Reduce pedestrian crashes	13% reduction in pedestrian crashes	Short	No	13 intersections	$5,000 per intersection	$65,000
Roundabouts	Reduce left turn crashes	82% reduction in fatal and serious injury crashes	Long	Yes	2 intersections	$2,00,000 per intersection	$4,000,000
						BASELINE ESTIMATED TOTAL	**$7,750,000-$9,200,000**

Baseline estimated total range reflects on-street bicycle lanes or an elevated bicycle track

Tier 1 Project

Intersection Improvements

Roundabout



Division Street

Kansas Expressway to Sherman Avenue

EXISTING CONDITIONS

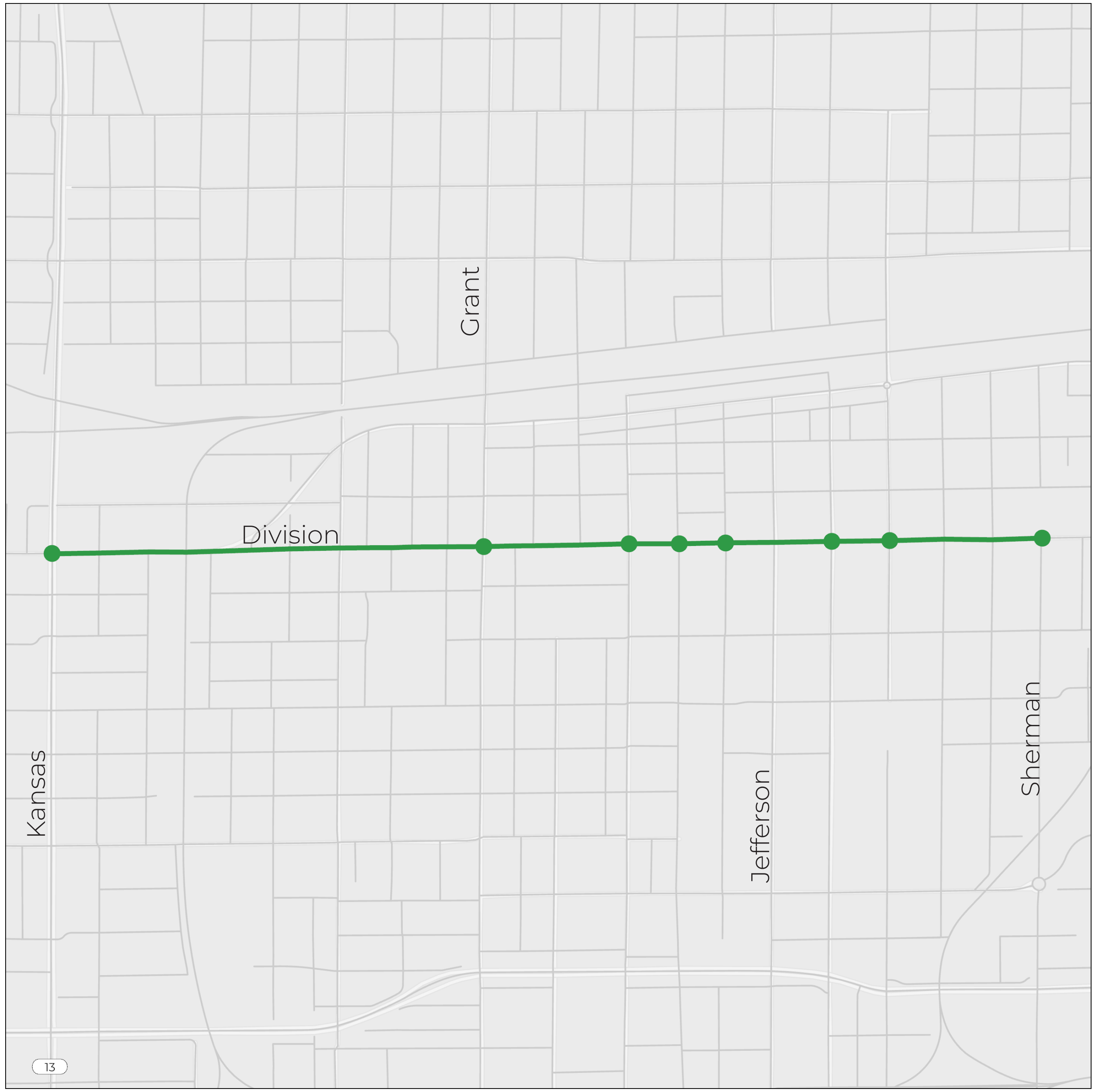
Division Street is a 1.7-mile minor arterial with one through lane in each direction with a center turn lane throughout much of the corridor. The corridor carries approximately 9,000 – 12,000 vehicles per day and the speed limit is 35 mph. Signalized intersections include the Kansas Expressway, Grant Avenue, Campbell Avenue, Boonville Avenue, Robberson Avenue, Benton Avenue, Washington Avenue, and Sherman Avenue. Sidewalks are well connected on both sides of the street; there is a mid-block pedestrian signal near Grant Avenue at Weaver Elementary school. There are a combination of painted bicycle lanes and shared lane markings from around Commercial Street to Washington Ave. Land uses are primarily residential, medical, and educational.

Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Road Diet	Reduce fatal and serious injury crashes and vehicle speeds	--	Long	No	1.7 miles	$150,000 per mile	$255,000
Permissive to Protected Left Turn Phase	Reduce left turn and head on crashes	--	Short	No	8 intersections	$5,000 per intersection	$40,000
Bicycle Lanes - On-Street	Reduce bicycle crashes	30-49% reduction in total crashes	Mid	No	1.7 miles	$120,000 per mile	$204,000
Bicycle Lanes - Elevated Cycle Track	Reduce bicycle crashes	30-49% reduction in total crashes	Long	NO	1.7 miles	$600,000 per mile	$1,020,000
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short	No	8 intersections	$25,000 per intersection	$200,000
Pedestrian Refuge Islands	Reduce pedestrian crashes Reduce vehicle speeds	56% reduction in pedestrian crashes	Short	No	16 islands	$115,000 per island	$1,840,000
Leading Pedestrian Interval	Reduce pedestrian crashes	13% reduction in pedestrian crashes	Short	No	8 intersections	$5,000 per intersection	$40,000
						BASELINE ESTIMATED TOTAL	**$2,600,000-$3,400,000**

Baseline estimated total range reflects on-street bicycle lanes or an elevated bicycle track

Tier 1 Project

Intersection Improvements



Sunshine Street

Kansas Expressway to Campbell Avenue

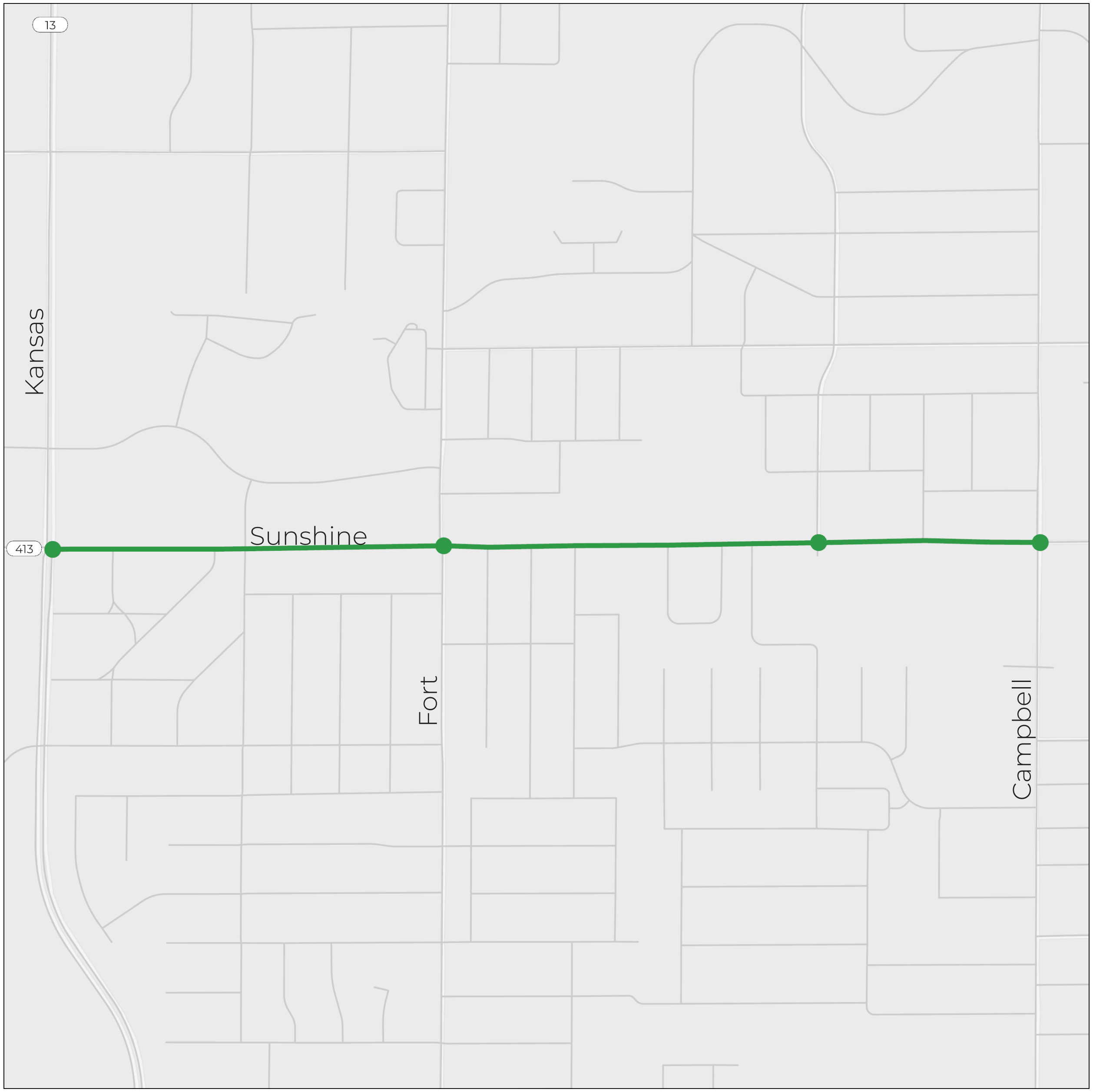
EXISTING CONDITIONS

Sunshine Street is a 1.3-mile principal arterial with two through lanes in each direction with a center turn lane. The corridor carries around 31,000 vehicles per day and the speed limit is 40 mph. There are signalized intersections at the Kansas Expressway, Fort Avenue, Grant Avenue, and Campbell Avenue. There are some sidewalks, but connectivity is lacking, and pedestrian crossings are also lacking. There are no bicycle facilities along the corridor. Land use is primarily commercial.

Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Road Diet	Reduce fatal and serious injury crashes and vehicle speeds	-	Long	No	1.3 miles	$150,000 per mile	$195,000
Medians	Reduce out of control crashes	97% reduction in cross median crashes	Long	No	1.3 miles	$1,600,000 per mile	$2,100,000
Pedestrian Hybrid Beacons	Reduce pedestrian and speed related crashes	55% reduction in pedestrian crashes	Short	No	1 crossing	$120,000 each	$120,000
Signal Heads with Retroreflective Backplates	Reduce rear end and right angle crashes	15% reduction in total crashes	Short	No	55 signals	$3,000 per signal	$275,000
Sidewalks	Reduce pedestrian crashes	65-89% reduction in pedestrian crashes	Short	Yes	1.3 miles	$370,000 per mile	$481,000
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short	No	4 intersections	$25,000 per intersection	$100,000
Pedestrian Refuge Islands	Reduce pedestrian crashes and reduce vehicle speeds	56% reduction in pedestrian crashes	Short	No	8 islands	$115,000 per island	$920,000
Leading Pedestrian Interval	Reduce pedestrian crashes	13% reduction in pedestrian crashes	Short	No	4 intersections	$5,000 per intersection	$20,000
Corridor Access Management	Reduce pedestrian, rear end, and right angle crashes	25-31% reduction in KSI crashes	Long	No	--	--	--
						BASELINE ESTIMATED TOTAL	**$4,200,000**

Tier 1 Project

Intersection Improvements



Hines Street

Oakwood Avenue to Route ZZ

EXISTING CONDITIONS

Hines Street is a 1.8-mile major collector with one through lane in each direction and no shoulders. The street carries around 1,000 – 2,000 vehicles per day and the speed limit is 30 mph. Major intersections include four-way stop controlled intersections at Oakwood Avenue and Route ZZ. There is a short section of sidewalk between Lincoln Avenue and Franklin Avenue but otherwise the corridor lacks sidewalks and bicycle facilities. Land use is primarily suburban residential with some undeveloped agricultural land.

Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Sidewalks	Reduce bicycle and pedestrian crashes	65-89% reduction in pedestrian crashes	Short	Yes	1.3 miles (one side only)	$370,000 per mile	$481,000
Shared Use Path	Reduce bicycle and pedestrian crashes	--	Long	Yes	1.3 miles	$700,000 per mile	$910,000
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short	No	2 intersections	$25,000 per intersection	$50,000
Rectangular Rapid Flashing Beacons	Reduce pedestrian and speed related crashes	47% reduction in pedestrian crashes	Short	No	2 mid-block crossings	$25,000 each	$50,000
						BASELINE ESTIMATED TOTAL	**$580,000-$1,000,000**

Baseline estimated total range reflects a 5-foot sidewalk or a 10-foot shared use path on one side of the street only

Tier 1 Project

Intersection Improvements

Rectangular Rapid Flashing Beacon

S. Campbell Avenue

Battlefield Street to Republic Road

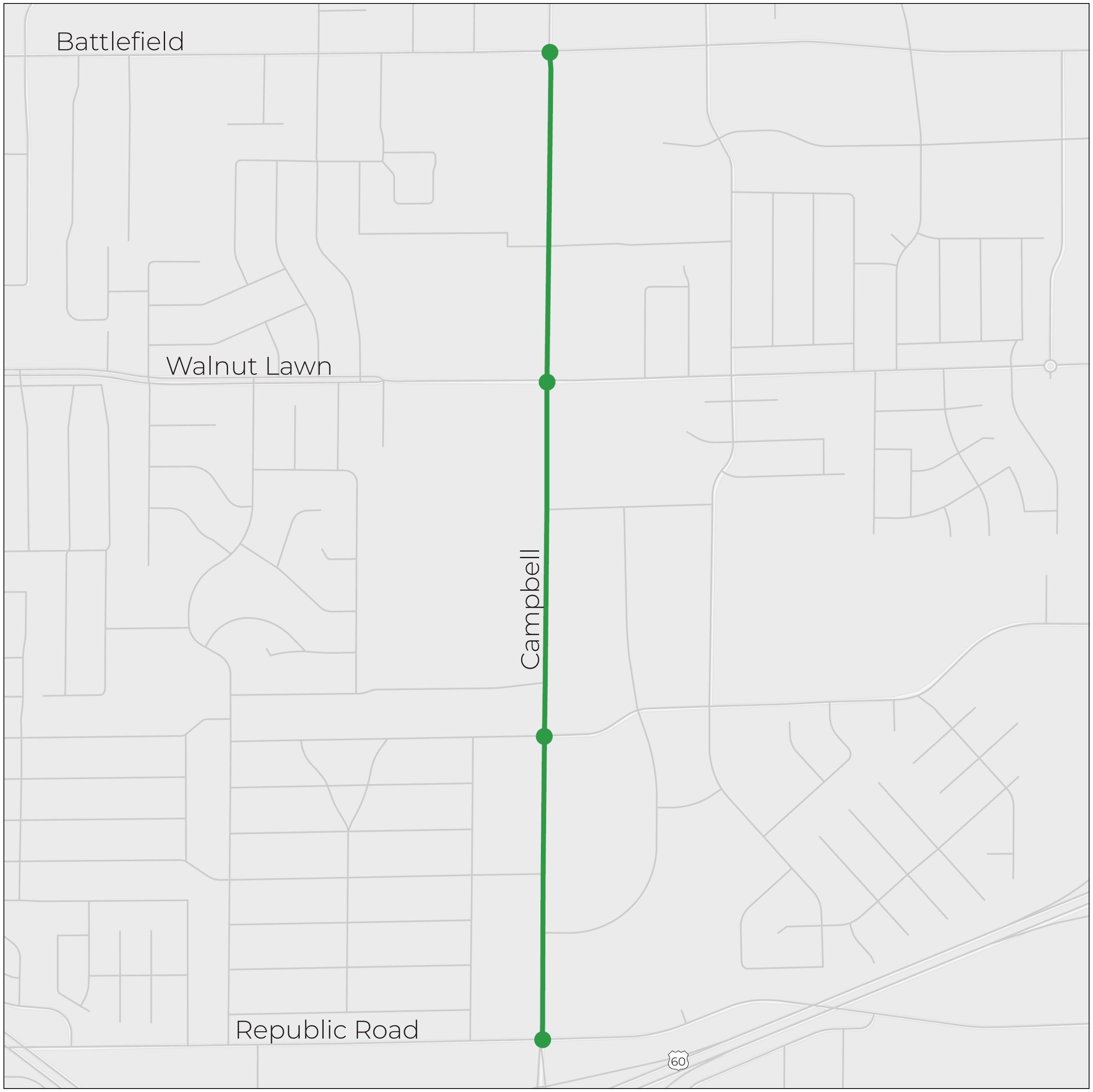
EXISTING CONDITIONS

Campbell Avenue is a 1.5-mile principal arterial with two through lanes in each direction and a center left turn lane. The corridor carries approximately 30,000 vehicles per day and the speed limit is 40 mph. There are signalized intersections at Battlefield Street, Walnut Lawn Street, Westview Street/Primrose Street, and Republic Road. Sidewalks are disconnected and pedestrian crossings are inconvenient. There are no bicycle facilities. Land uses along the corridor are primarily commercial.

Countermeasure	Purpose	Benefit	Time Frame	ROW	Quantity	Planning Level Cost	Estimated Cost
Dilemma Zone Detection	Reduce rear end and right angle crashes	39% reduction in KSI crashes at intersections	Short	No	4 intersections	$60,000 per intersection	$240,000
Signal Heads with Retroreflective Backplates	Reduce rear end and right angle crashes	15% reduction in total crashes	Short	No	56 signals	$3,000 per signal	$168,000
Permissive to Protected Left Turn Phase	Reduce left turn and right angle crashes	--	Short	No	4 intersections	$5,000 per intersection	$20,000
Improved Right Turn Angles	Reduce pedestrian crashes Reduce vehicle speeds	--	Mid	Yes	12 right turns	$400,000 per right turn	$4,800,000
Medians	Reduce out of control and head on crashes	97% reduction in cross median crashes	Long	No	1.5 miles	$1,600,000 per mile	$2,400,000
Sidewalks	Reduce pedestrian crashes	65-89% reduction in pedestrian crashes	Short	No	1.3 miles	$370,000 per mile	$481,000
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short	No	4 intersections	$25,000 per intersection	$100,000
Corridor Access Management	Reduce pedestrian, rear end, and right angle crashes	25-31% reduction in KSI crashes	Long	Yes	--	--	--
						BASELINE ESTIMATED TOTAL	**$8,200,000**

Tier 1 Project

Intersection Improvements



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6. Community Profiles

Safety is Local

OTO Member Crash Characteristics

While *Destination Safe Streets* is a regional plan, each community has its own safety profile. Also, each community will be responsible for championing their own future projects and providing match for grant applications and federal funds. This plan provides a foundation for improving safety across the region. At the same time, the following community profiles provide context for each OTO member jurisdiction as they undertake their own safety planning.

THE PROFILE

Background

Each profile includes background statistics on each community, including population according to the 2020 Census and some roadway characteristics as calculated by MoDOT, for all roads in the member jurisdiction.

Crashes

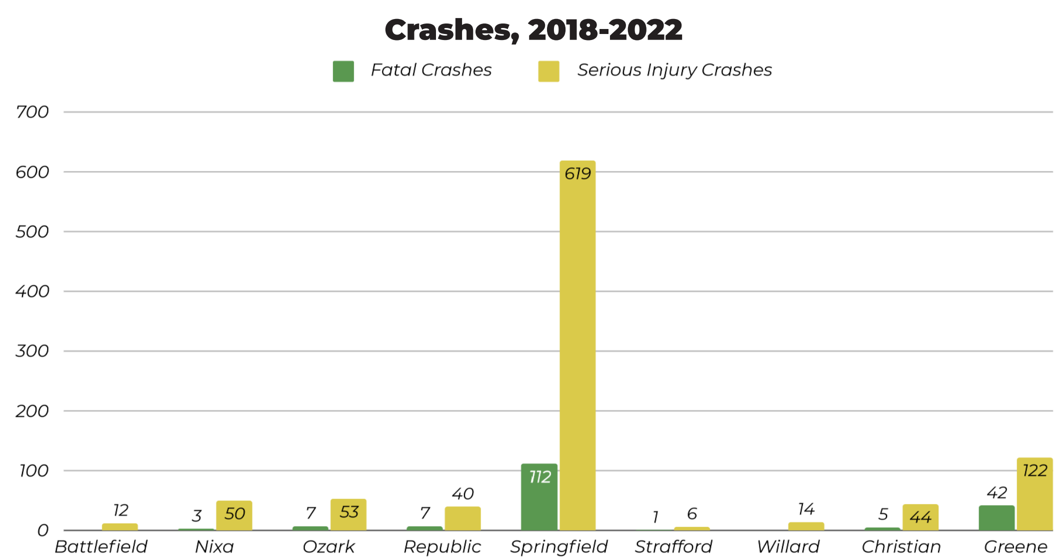
Crash numbers are categorized by severity, location, and involving type.

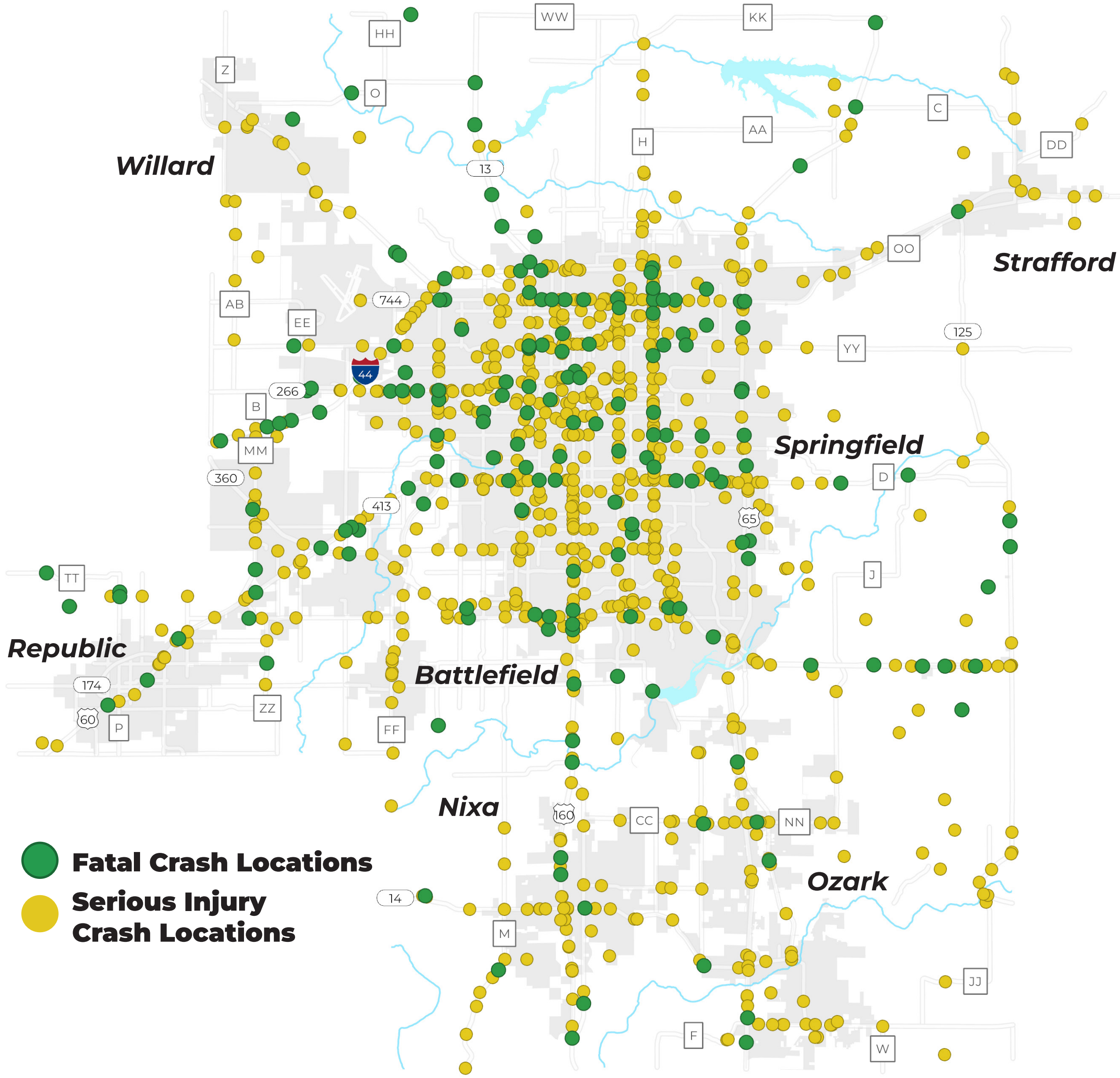
Maps

Each profile includes a map of the High Injury Network, including a local HIN that is based upon a community's own crashes rather than in comparison to the entire region.

There is a map of fatal and serious injury crashes and another map highlights the risk index for the roads in each community.

Finally, each profile includes a map or maps of key crash characteristics, as determined by what is prevalent for the community.




Willard
Strafford
Springfield
Republic
Battlefield
Nixa
Ozark
Fatal Crash Locations
Serious Injury Crash Locations
Z
HH
O
WW
KK
H
AA
C
DD
13
OO
744
AB
EE
44
YY
125
266
B
MM
360
D
413
65
J
TT
174
60
P
ZZ
FF
160
CC
NN
14
M
JJ
F
W

Battlefield

2020 POPULATION
5,990
LANE MILES
69
2023 VEHICLE MILES TRAVELED
56,571

Severity	Number
Property Damage Only	169
Minor Injuries	31
Serious Injuries	12
Total	**212**

Location	Number Serious/ Fatal Crashes
Intersection	8
Segment	4

Type	Number Serious/ Fatal Crashes
Aggressive Driver	3
Bicycle	0
CMV	1
Cross Median	0
Distracted	1
Drowsy	0
Fixed-Object	5
Head-On	0
Horizontal Curve	1
Lane Departure	8
Motorcycle	3
Older Driver (65+)	3
Over Speed Limit	0
Pedestrian	1
Run-Off Road	3
Substance Impaired	0
Too Fast for Conditions	3
Unlicensed/ Improper License	3
Work Zone	0
Wrong-Way	0
Young Driver (15-20)	2

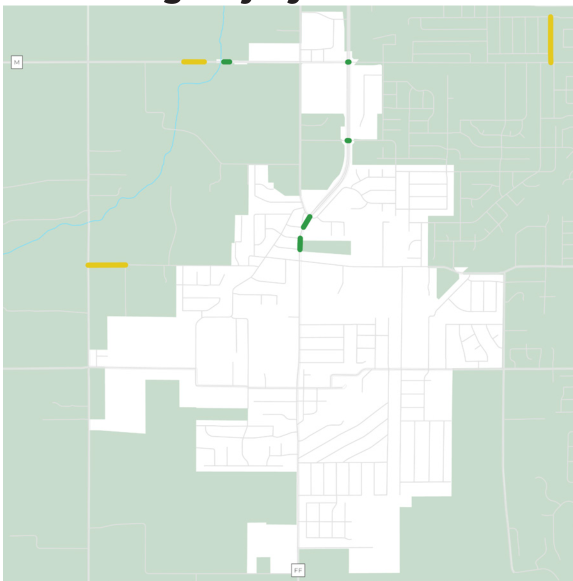
SYNOPSIS

The City of Battlefield had no fatal crashes between 2018 and 2022, though there were 12 with serious injuries. As will be seen with many crashes in this profile serious, several crashes included multiple involving types. For example, one serious injury crash involved running off the road, a pedestrian, a horizontal curve, a fixed object, and an aggressive driver. This is where the safe systems approach becomes important, by introducing countermeasures that may reduce the risk of a crash or injury at any one of these steps.

Of the 8 lane departure crashes in Battlefield, 4 of the 5 included fixed-object crashes.

While there seems to be proportionally more lane departure crashes than the other involving types, overall, twice as many of Battlefield's serious injury crashes are at intersections rather than along roadway segments.

High Injury Network



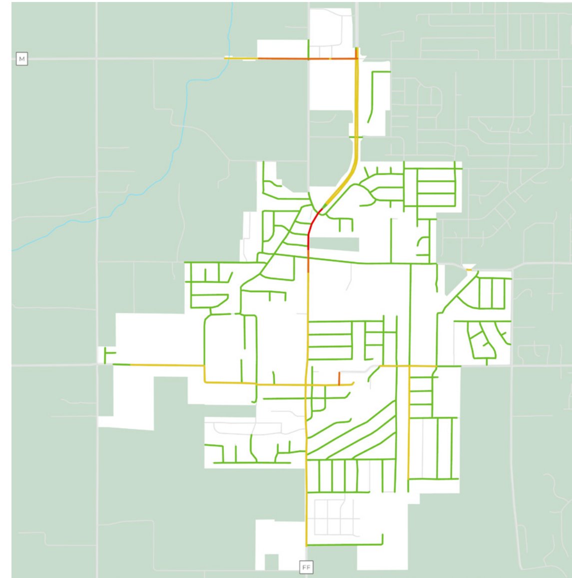
Local High Injury Network

Regional High Injury Network

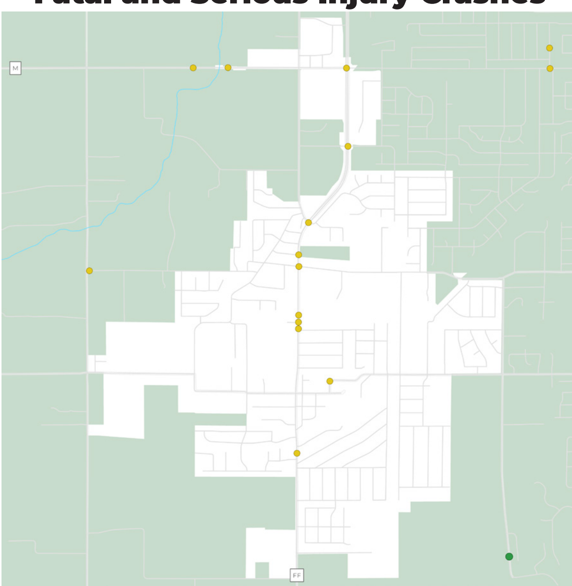
Risk Index

Risk Index

- 0.0-1.50
- 1.51-2.50
- 2.51-3.50
- 3.51-5.0
- 5.01-7.0



Fatal and Serious Injury Crashes



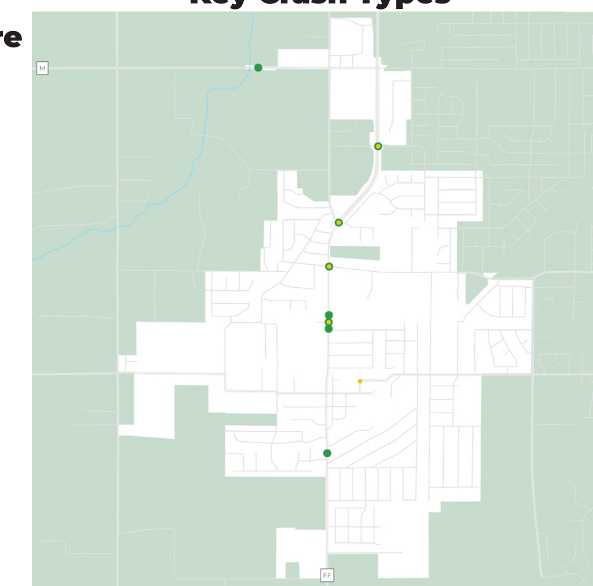
Fatal Crash Locations

Serious Injury Crash Locations

Key Crash Types

Lane Departure

Fixed Object



Nixa

2020 POPULATION
23,257
LANE MILES
266
2023 VEHICLE MILES TRAVELED
261,877

Severity	Number
Property Damage Only	1,180
Minor Injuries	312
Serious Injuries	50
Fatal	3
Total	**1,545**

Location	Number Serious/ Fatal Crashes
Intersection	36
Segment	17

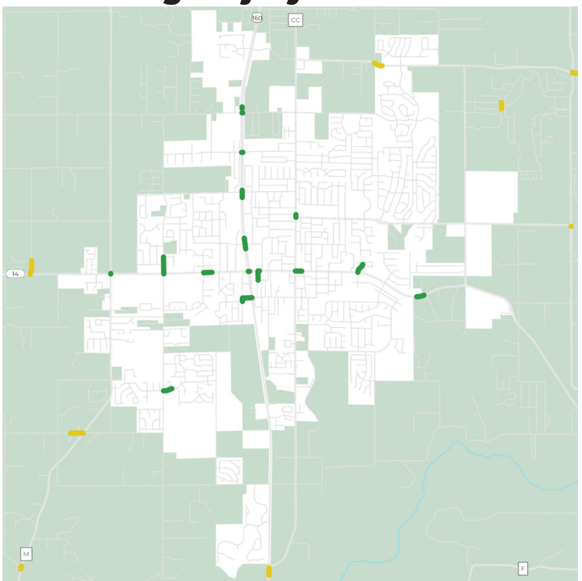
Type	Number Serious/ Fatal Crashes
Aggressive Driver	9
Bicycle	1
CMV	4
Cross Median	0
Distracted	7
Drowsy	3
Fixed-Object	12
Head-On	1
Horizontal Curve	3
Lane Departure	19
Motorcycle	4
Older Driver (65+)	22
Over Speed Limit	2
Pedestrian	4
Run-Off Road	8
Substance Impaired	1
Too Fast for Conditions	1
Unlicensed/ Improper License	8
Work Zone	0
Wrong-Way	0
Young Driver (15-20)	5

SYNOPSIS

There were three fatal crashes in Nixa between 2018 and 2022. These involved a combination of driver types, including a pedestrian, a driver over the age of 65, a young driver between the ages of 15 and 22, a commercial motor vehicle, aggressive driving, driving over the speed limit, lane departure, and hitting a fixed object. One was on a segment and two were at an intersection.

Crash characteristics in Nixa do highlight the need to address vulnerable road users. Of the 53 serious injury and fatal crashes in Nixa, 22 involved older drivers. While many of the safety countermeasures surrounding older drivers point to in-vehicle assistance technology, older drivers are also more at risk for injury due to age-related vulnerabilities. Intersection crashes are more than double the number of segment crashes. These primarily took place along US 160 at Kathryn (3), Tracker (5), Aldersgate (3), Northview (3), Wasson (5), and 14/Mount Vernon (2) with 3 at the adjacent Village Center Street.

High Injury Network

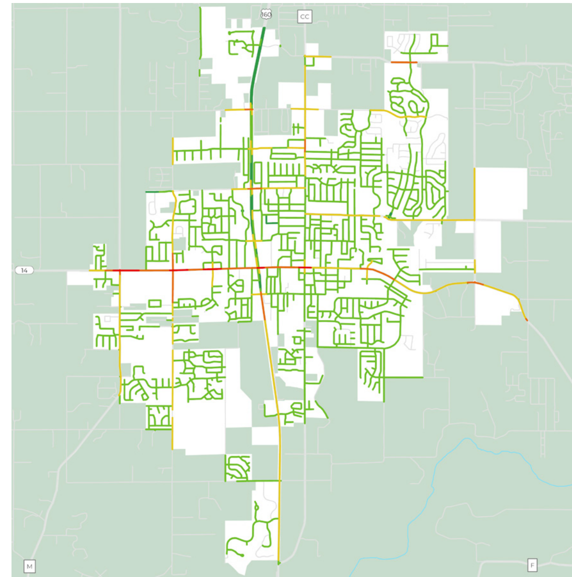


Local High Injury Network

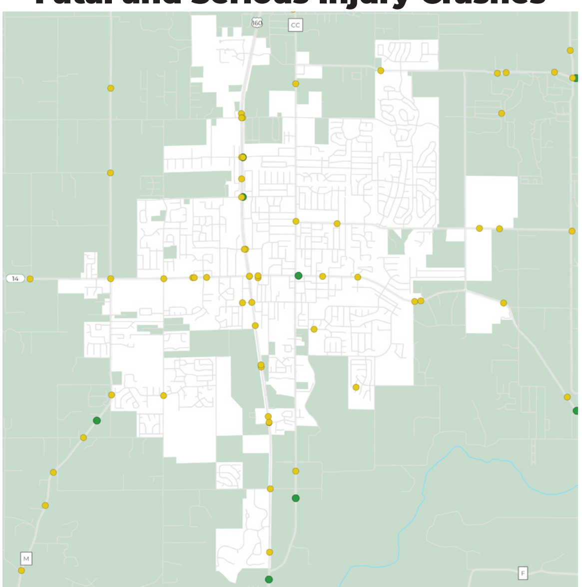
Regional High Injury Network

Risk Index

Risk Index
- 0.0-1.50
- 1.51-2.50
- 2.51-3.50
- 3.51-5.0
- 5.01-7.0



Fatal and Serious Injury Crashes

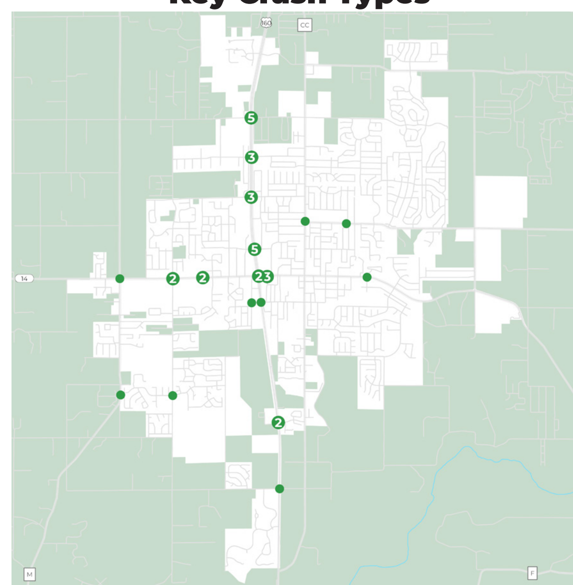


Fatal Crash Locations

Serious Injury Crash Locations

Key Crash Types

Intersection Crashes



Ozark

2020 POPULATION
21,284
LANE MILES
291
2023 VEHICLE MILES TRAVELED
623,606

Severity	Number
Property Damage Only	1,456
Minor Injuries	323
Serious Injuries	53
Fatal	7
Total	**1,839**

Location	Number Serious/ Fatal Crashes
Intersection	29
Segment	31

Type	Number Serious/ Fatal Crashes
Aggressive Driver	21
Bicycle	2
CMV	5
Cross Median	2
Distracted	8
Drowsy	2
Fixed-Object	21
Head-On	5
Horizontal Curve	8
Lane Departure	32
Motorcycle	4
Older Driver (65+)	8
Over Speed Limit	8
Pedestrian	5
Run-Off Road	18
Substance Impaired	6
Too Fast for Conditions	9
Unlicensed/ Improper License	10
Work Zone	2
Wrong-Way	0
Young Driver (15-20)	12

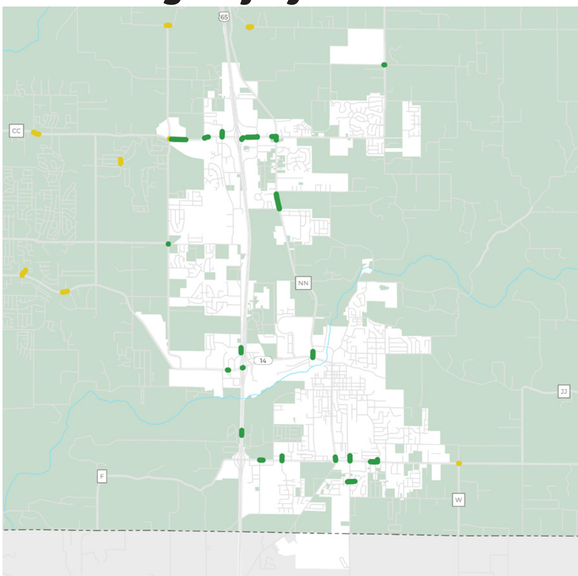
SYNOPSIS

Of the 21 aggressive driving crashes in the City of Ozark between 2018 and 2022, just six were on US 65, with others occurring throughout the city. Proportionally, these were out of control crashes, but also included several rear end and head on collisions, with one including a pedestrian.

The majority of lane departure crashers were mostly out of control crashes, with 12 involving aggressive drivers and 7 involving younger drivers aged between 15 and 20. Younger drivers in Ozark are also more likely to have serious injury or fatal crashes at intersections.

Overall, Ozark has a similar number of intersection and segment crashes. This can be attributed to the long stretches of roadway that is US 65.

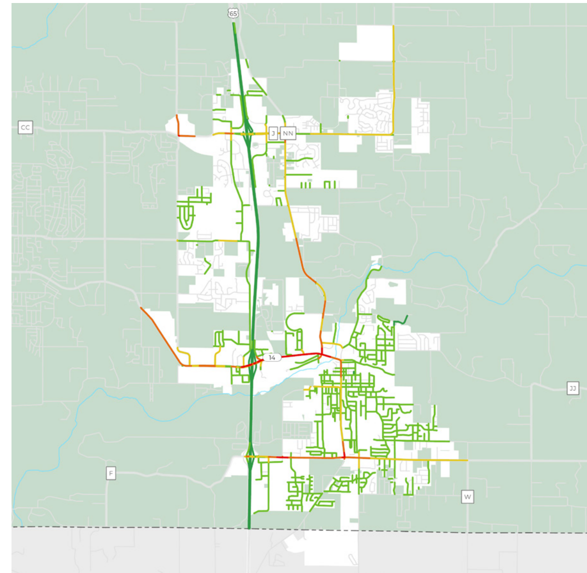
High Injury Network



Local High Injury Network

Regional High Injury Network

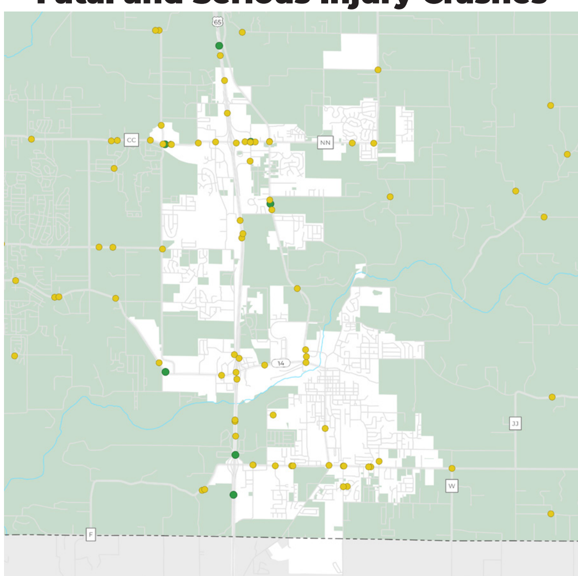
Risk Index



Risk Index

- 0.0-1.50
- 1.51-2.50
- 2.51-3.50
- 3.51-5.0
- 5.01-7.0

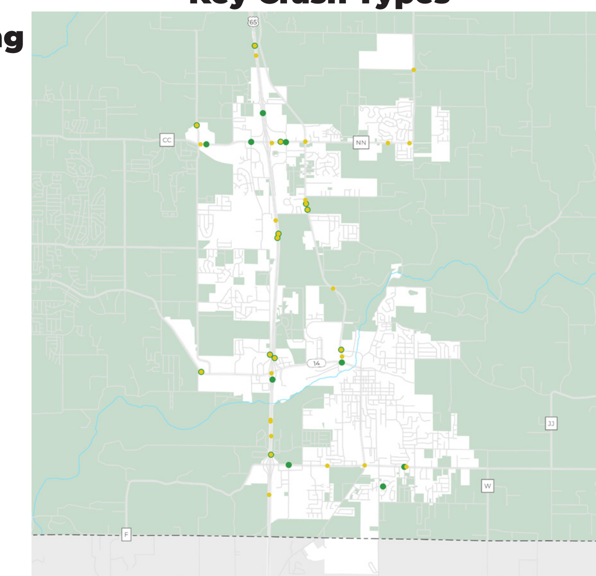
Fatal and Serious Injury Crashes



Fatal Crash Locations

Serious Injury Crash Locations

Key Crash Types



Aggressive Driving

Lane Departure

Republic

2020 POPULATION
18,750
LANE MILES
292
2023 VEHICLE MILES TRAVELED
443,003

Severity	Number
Property Damage Only	1,097
Minor Injuries	297
Serious Injuries	40
Fatal	7
Total	**1,441**

Location	Number Serious/ Fatal Crashes
Intersection	33
Segment	14

Type	Number Serious/ Fatal Crashes
Aggressive Driver	11
Bicycle	0
CMV	7
Cross Median	3
Distracted	6
Drowsy	0
Fixed-Object	9
Head-On	7
Horizontal Curve	8
Lane Departure	22
Motorcycle	3
Older Driver (65+)	8
Over Speed Limit	6
Pedestrian	2
Run-Off Road	6
Substance Impaired	5
Too Fast for Conditions	1
Unlicensed/ Improper License	10
Work Zone	0
Wrong-Way	0
Young Driver (15-20)	16

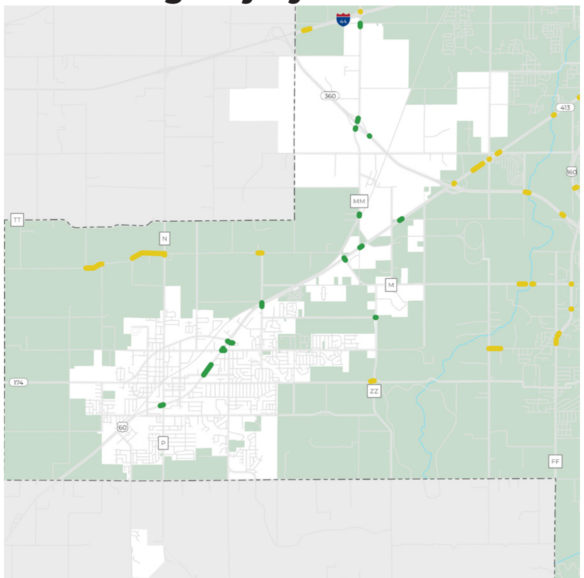
SYNOPSIS

Of the 22 lane departures in Republic between 2018 and 2022, 7 were head on collisions, 8 were fixed object, and 13 were at intersections. Of the aggressive drivers, 6 were lane departures, 6 were young drivers, and 7 were at intersections.

Republic has over twice as many intersection crashes as segment crashes. When reviewing which countermeasures to deploy, intersection treatments should receive attention. High crash intersection locations along US 60 include:

- 60/174 – 5
- 60/Hines – 3
- 60/Harrison - 3

High Injury Network

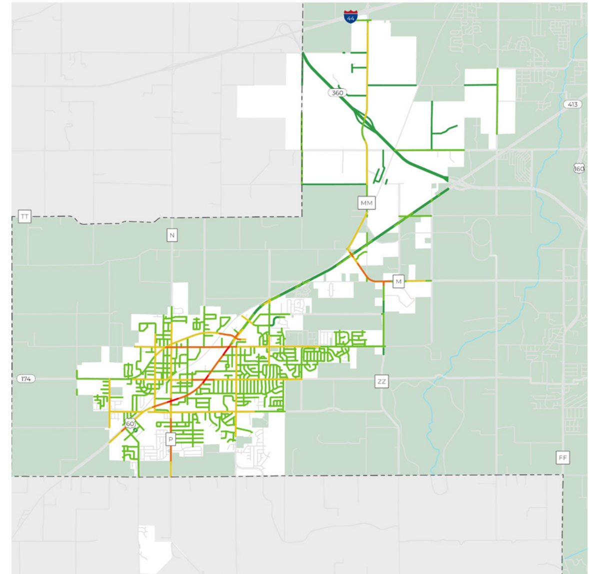


- Local High Injury Network
- Regional High Injury Network

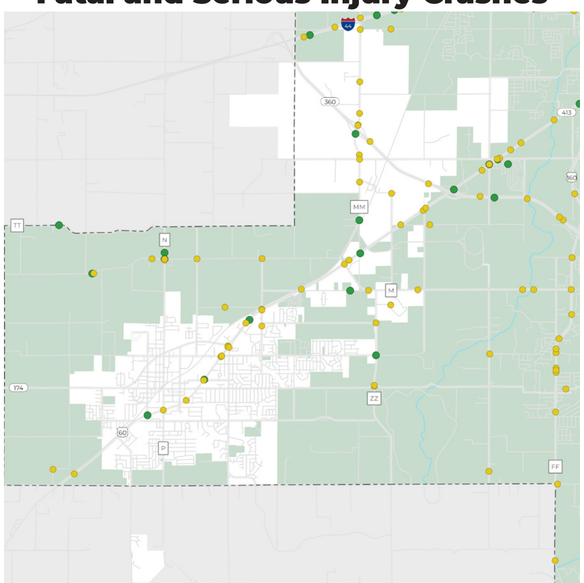
Risk Index

Risk Index

- 0.0-1.50
- 1.51-2.50
- 2.51-3.50
- 3.51-5.0
- 5.01-7.0



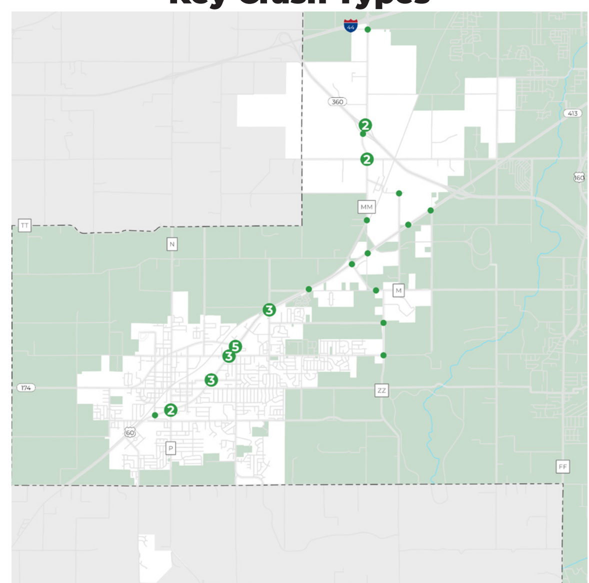
Fatal and Serious Injury Crashes



- Fatal Crash Locations
- Serious Injury Crash Locations

Key Crash Types

Intersection Crashes



Springfield

2020 POPULATION
169,176
LANE MILES
2,165
2023 VEHICLE MILES TRAVELED
5,011,242

SYNOPSIS

In Springfield, North National has a cluster of bicycle crashes, as does Kearney. Thirteen bicycle crashes were in dark conditions (11 with streetlights and 2 without).

Pedestrian crashes trend on Kearney, Chestnut, Grand, Glenstone, especially around the Glenstone and Kearney intersection, and in mid-town around Chestnut, Government Plaza, and Central/Drury. Over half (54) pedestrian crashes were in the dark with streetlights on, 11 with streetlights off, and the remaining during the day.

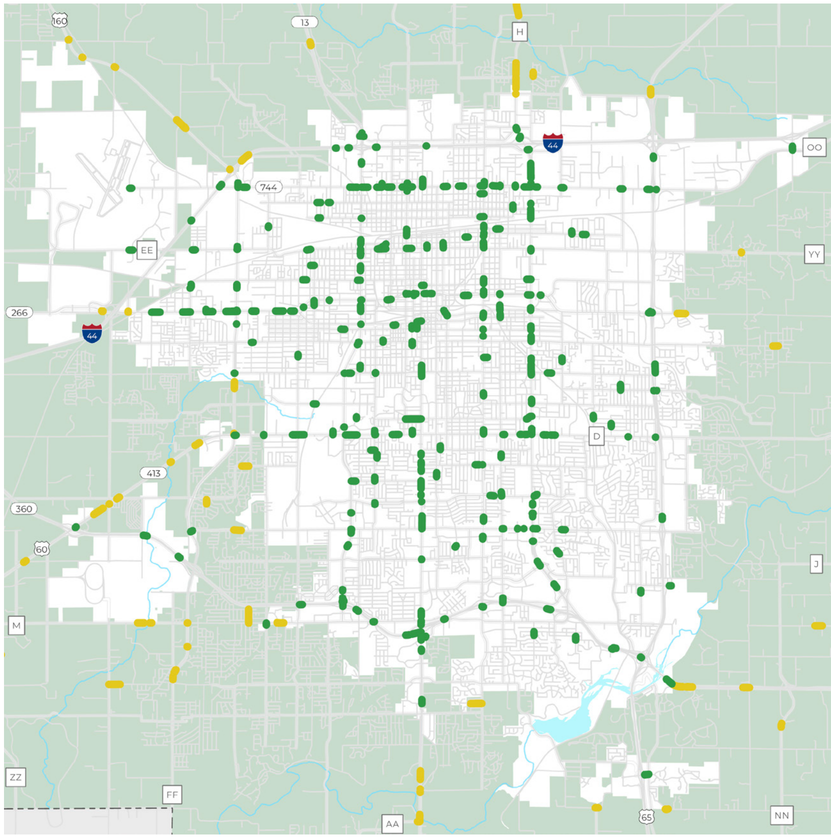
Severity	Number
Property Damage Only	12,762
Minor Injuries	8,032
Serious Injuries	619
Fatal	112
Total	**21,525**

Location	Number Serious/ Fatal Crashes
Intersection	485
Segment	246

Motorcycle Crash Class	Number Serious/ Fatal Crashes
Out of Control	53
Left-Turn	45
Left-Turn Right-Angle Collision	25
Right Angle	20
Rear End	18
Passing	12
Head-On	10
Other	20
Total	203

Type	Number Serious/ Fatal Crashes
Aggressive Driver	203
Bicycle	27
CMV	57
Cross Median	13
Distracted	58
Drowsy	14
Fixed-Object	213
Head-On	49
Horizontal Curve	67
Lane Departure	280
Motorcycle	203
Older Driver (65+)	118
Over Speed Limit	97
Pedestrian	91
Run-Off Road	165
Substance Impaired	80
Too Fast for Conditions	63
Unlicensed/ Improper License	224
Work Zone	4
Wrong-Way	2
Young Driver (15-20)	126

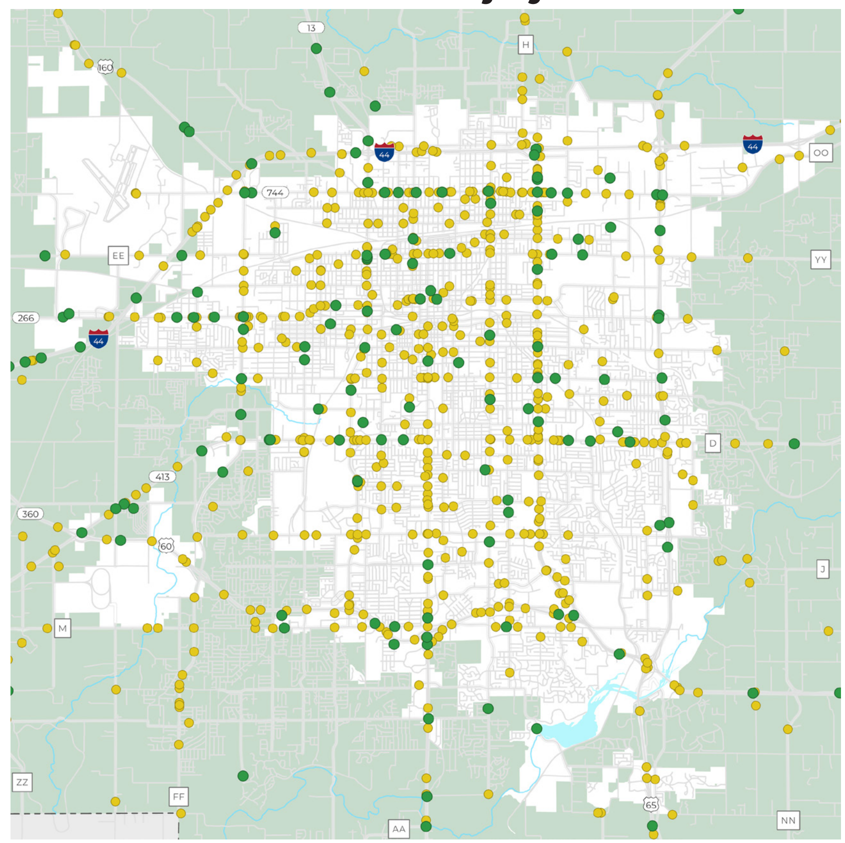
High Injury Network



Local High Injury Network

Regional High Injury Network

Fatal and Serious Injury Crashes

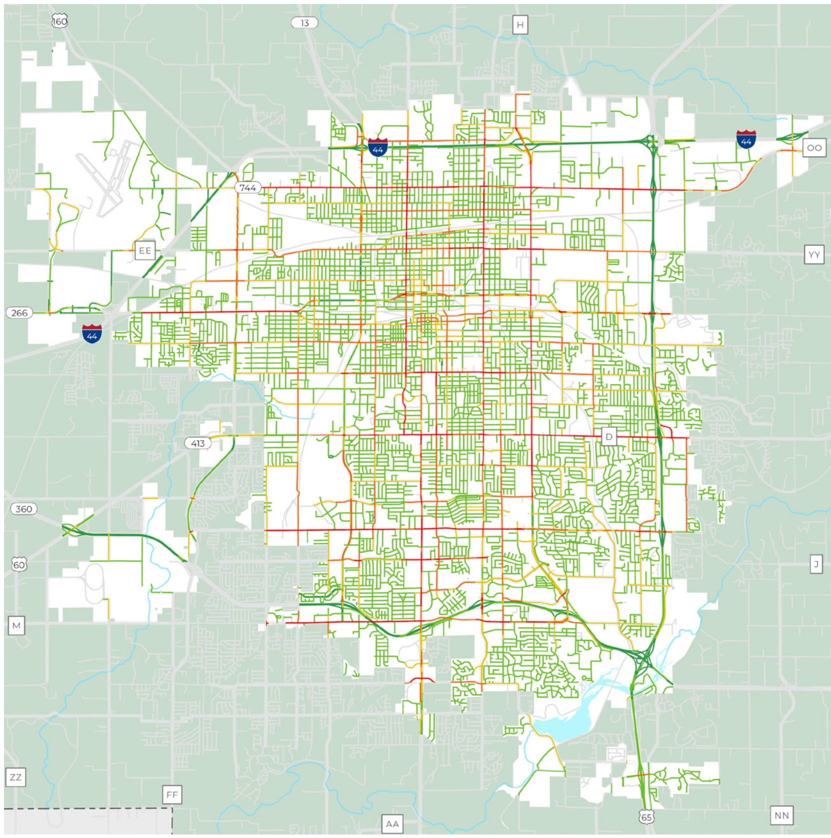


Fatal Crash Locations

Serious Injury Crash Locations

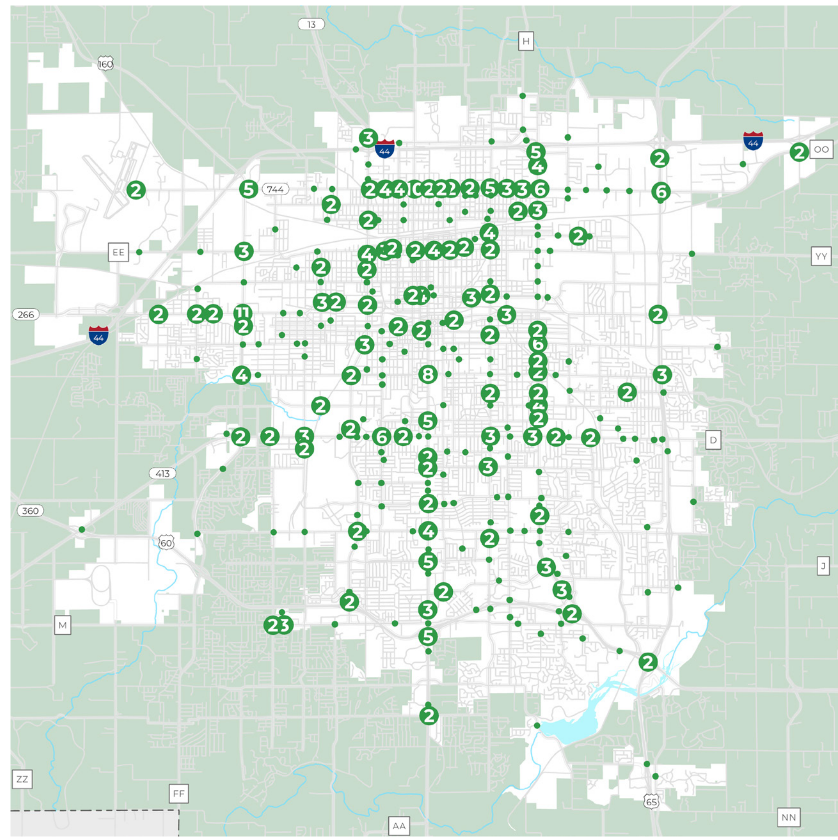
Springfield, continued

Risk Index



Risk Index
- 0.0-1.50
- 1.51-2.50
- 2.51-3.50
- 3.51-5.0
- 5.01-7.0

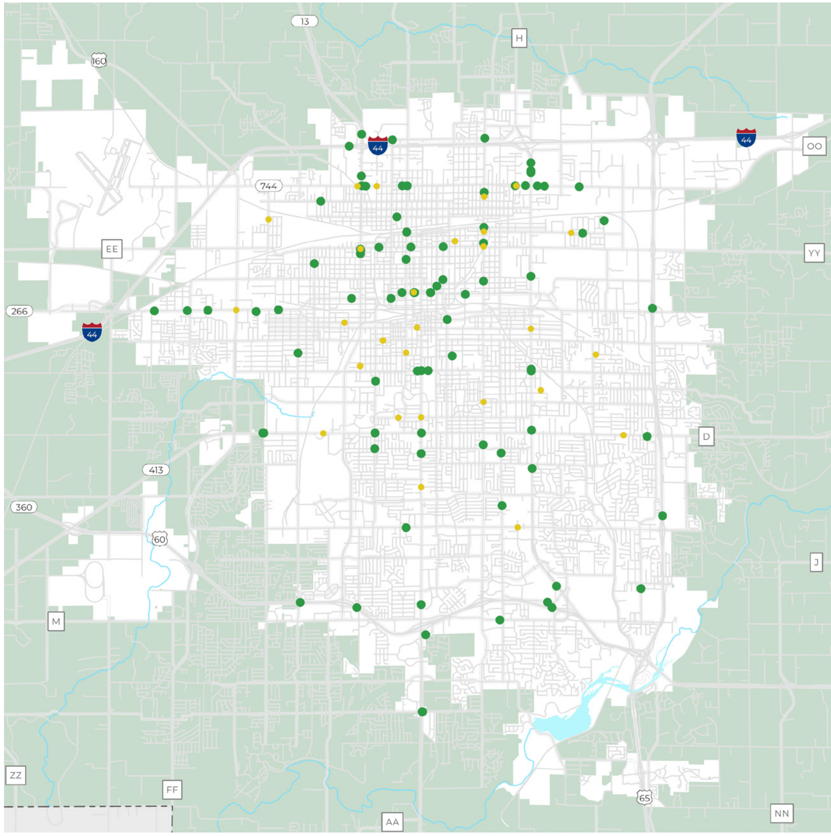
Intersection Crashes



Intersection clusters include West Bypass and Chestnut (11), Kearney and Grant (10), Campbell and Grand (8).

Intersection Crashes

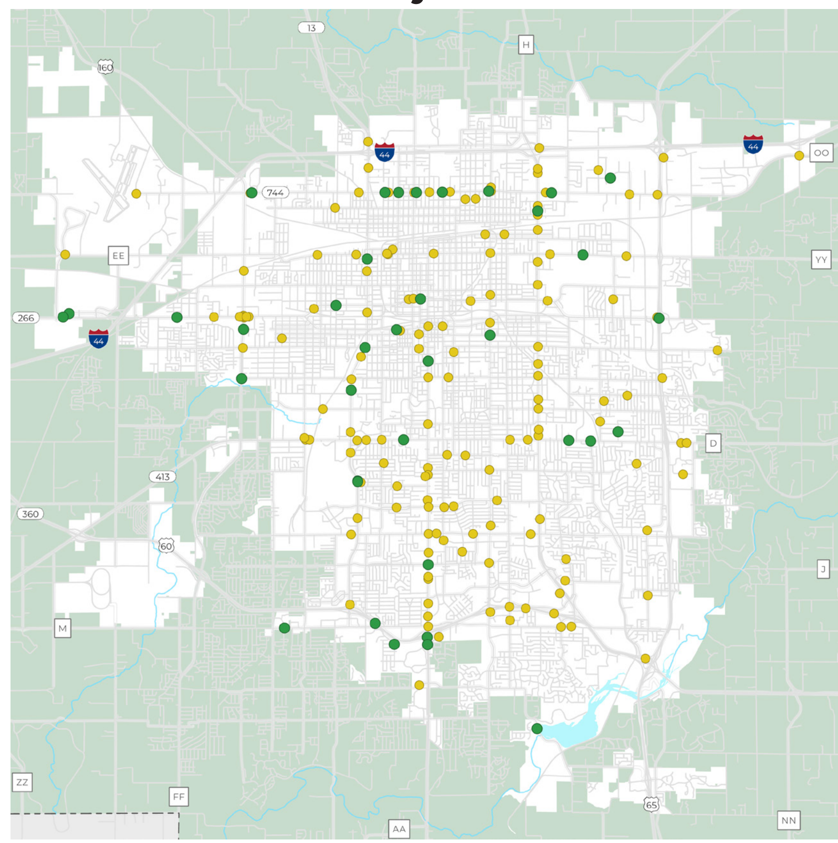
Bicycle/Pedestrian KSIs



Pedestrian Crashes

Bicycle Crashes

Motorcycle KSIs



Motorcycle crashes appear arterial based – especially south Campbell, mid-town Kearney, Glenstone between Sunshine and Cherry and Glenstone between Commercial and I-44. Another hot spot is around Chestnut and West Bypass. Of the 37 that were fatal, most were on Kearney or south Campbell.

Fatal Crash Locations

Serious Injury Crash Locations

Strafford

2020 POPULATION
2,561
LANE MILES
79
2023 VEHICLE MILES TRAVELED
264,159

Severity	Number
Property Damage Only	397
Minor Injuries	81
Serious Injuries	6
Fatal	1
Total	**485**

Location	Number Serious/ Fatal Crashes
Intersection	2
Segment	5

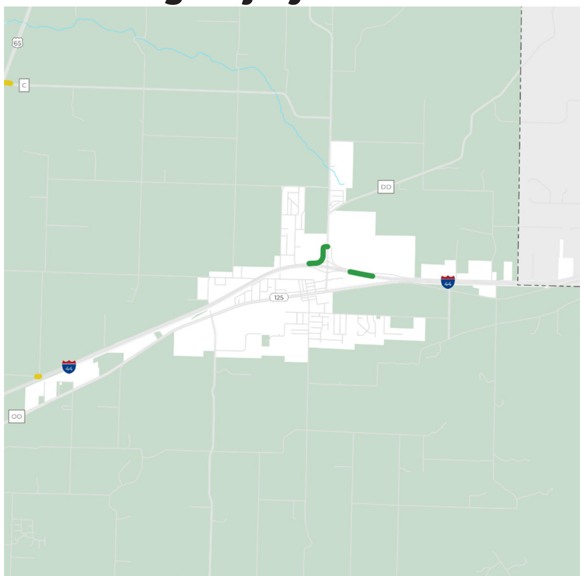
Type	Number Serious/ Fatal Crashes
Aggressive Driver	3
Bicycle	0
CMV	3
Cross Median	1
Distracted	0
Drowsy	0
Fixed-Object	2
Head-On	2
Horizontal Curve	1
Lane Departure	7
Motorcycle	2
Older Driver (65+)	3
Over Speed Limit	1
Pedestrian	0
Run-Off Road	2
Substance Impaired	1
Too Fast for Conditions	0
Unlicensed/ Improper License	1
Work Zone	0
Wrong-Way	0
Young Driver (15-20)	1

SYNOPSIS

Though Strafford had few serious injury crashes and just one fatal crash between 2018 and 2022, some patterns still emerge.

With I-44, there are more segment crashes than intersection crashes. Then, lane departure crashes are among the most prevalent involving type. Several of the lane departure crashes involved commercial motor vehicles. Strafford has multiple businesses that involve and support tractor-trailer vehicles. It is important that road improvements addressing safety provide accommodations for these large vehicles, while at the same time ensuring that roadway designs support safe speeds and pedestrian- and bicycle-scaled improvements.

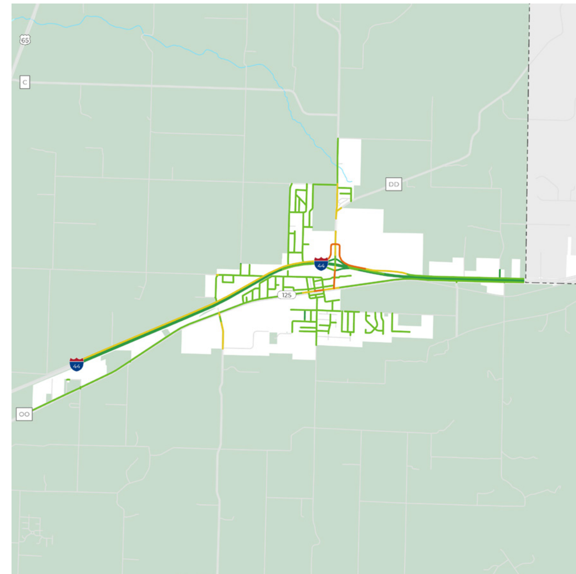
High Injury Network



Local High Injury Network

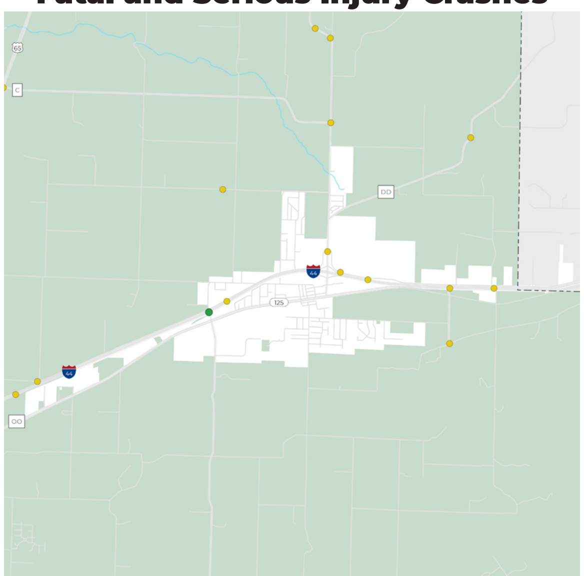
Regional High Injury Network

Risk Index



Risk Index
- 0.0-1.50
- 1.51-2.50
- 2.51-3.50
- 3.51-5.0
- 5.01-7.0

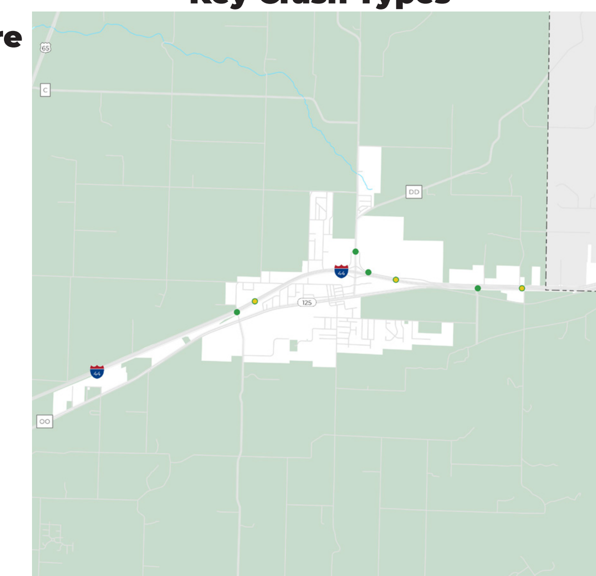
Fatal and Serious Injury Crashes



Fatal Crash Locations

Serious Injury Crash Locations

Key Crash Types



Lane Departure

Commercial Motor Vehicle

Willard

2020 POPULATION
6,344
LANE MILES
105
2023 VEHICLE MILES TRAVELED
99,509

Severity	Number
Property Damage Only	297
Minor Injuries	63
Serious Injuries	14
Fatal	0
Total	**374**

Location	Number Serious/ Fatal Crashes
Intersection	9
Segment	5

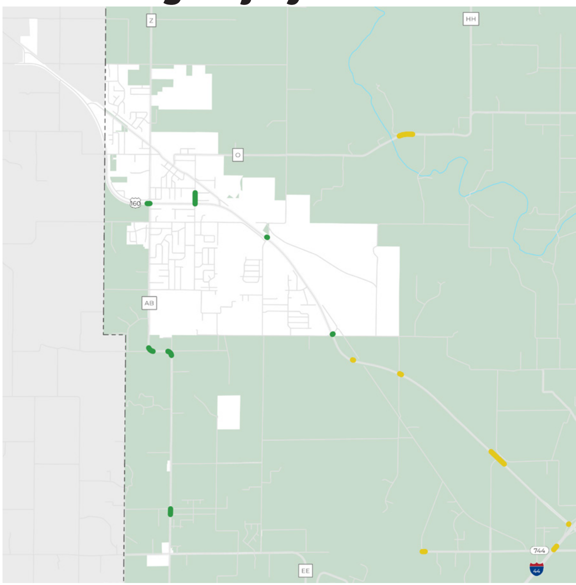
Type	Number Serious/ Fatal Crashes
Aggressive Driver	7
Bicycle	0
CMV	3
Cross Median	0
Distracted	2
Drowsy	1
Fixed-Object	7
Head-On	1
Horizontal Curve	4
Lane Departure	9
Motorcycle	4
Older Driver (65+)	5
Over Speed Limit	2
Pedestrian	1
Run-Off Road	3
Substance Impaired	0
Too Fast for Conditions	2
Unlicensed/ Improper License	4
Work Zone	0
Wrong-Way	0
Young Driver (15-20)	2

SYNOPSIS

While there were not any fatal crashes, many of the serious injury crashes in Willard between 2018 and 2022 involve aggressive driving. These crashes are also involve horizontal curves, lane departures, and fixed objects. This is another example of the need for the safe systems approach, where a behavior-based situation has led to conflicts with existing infrastructure.

Several of these combination crashes line up at the same location, providing further evidence for Route AB on the Tier 1 project list.

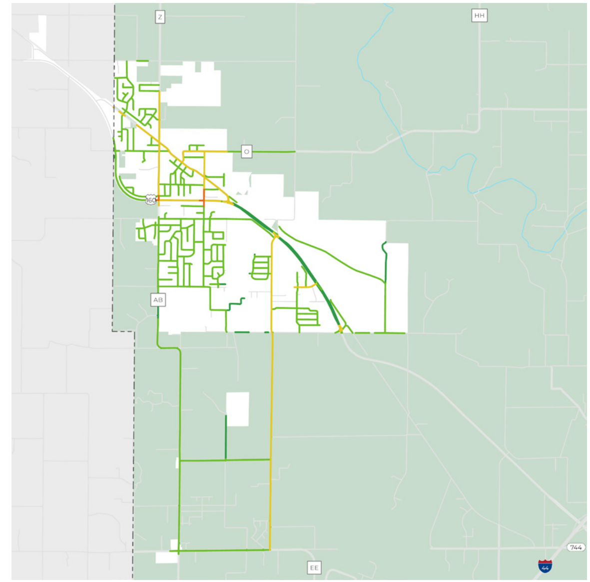
High Injury Network



Local High Injury Network

Regional High Injury Network

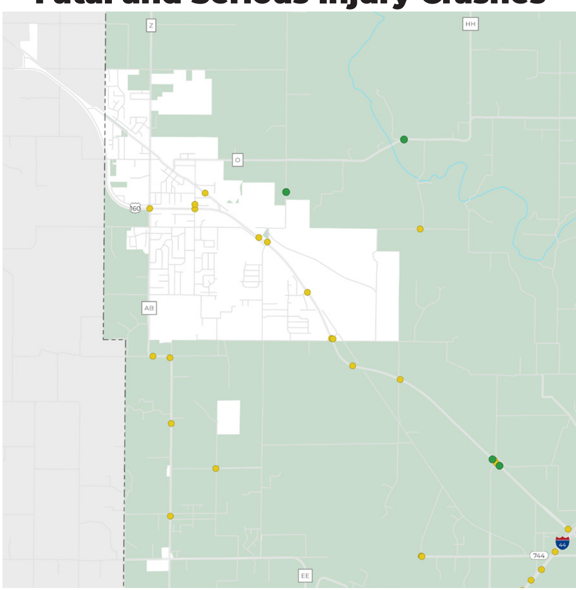
Risk Index



Risk Index

- 0.0-1.50
- 1.51-2.50
- 2.51-3.50
- 3.51-5.0
- 5.01-7.0

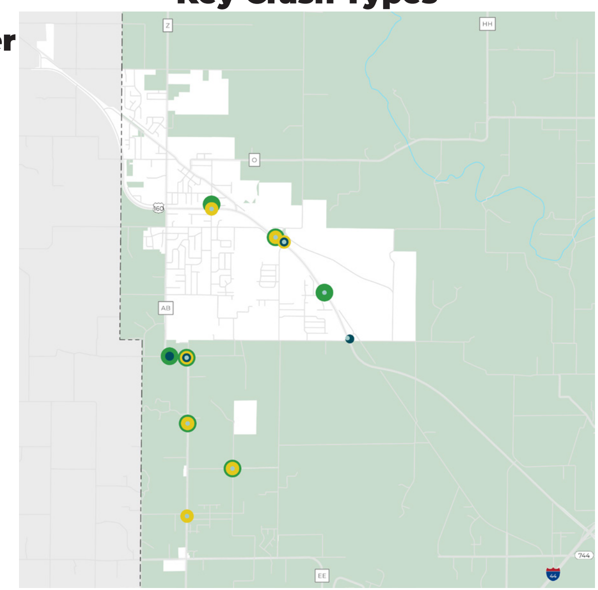
Fatal and Serious Injury Crashes



Fatal Crash Locations

Serious Injury Crash Locations

Key Crash Types



Aggressive Driver

Fixed Object

Horizontal Curve

Lane Departure

Christian

2020 POPULATION
88,842 (entire county)
LANE MILES
1,087 (inside OTO)
2023 VEHICLE MILES TRAVELED
1,232,923 (inside OTO)

Severity	Number
Property Damage Only	768
Minor Injuries	278
Serious Injuries	44
Fatal	5
Total	**1,095**

Location	Number Serious/ Fatal Crashes
Intersection	13
Segment	28

Type	Number Serious/ Fatal Crashes
Aggressive Driver	19
Bicycle	0
CMV	6
Cross Median	0
Distracted	7
Drowsy	2
Fixed-Object	26
Head-On	8
Horizontal Curve	23
Lane Departure	37
Motorcycle	7
Older Driver (65+)	6
Over Speed Limit	1
Pedestrian	0
Run-Off Road	23
Substance Impaired	8
Too Fast for Conditions	16
Unlicensed/ Improper License	10
Work Zone	0
Wrong-Way	0
Young Driver (15-20)	7

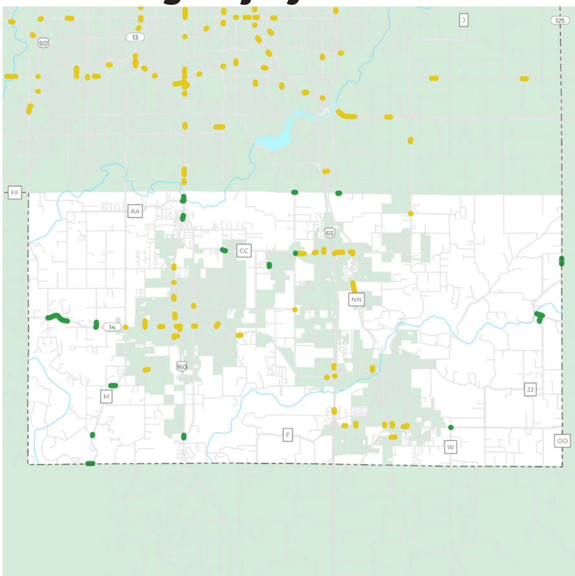
SYNOPSIS

Between 2018 and 2022, unincorporated Christian County, inside the OTO boundary, had 44 serious injury crashes and 5 fatal crashes.

There were twice as many segment crashes as intersection crashes. This is evidenced by the 37 lane departure crashes which often involved horizontal curves and fixed objects.

Other often cited crash factors include aggressive drivers and driving too fast for conditions.

High Injury Network



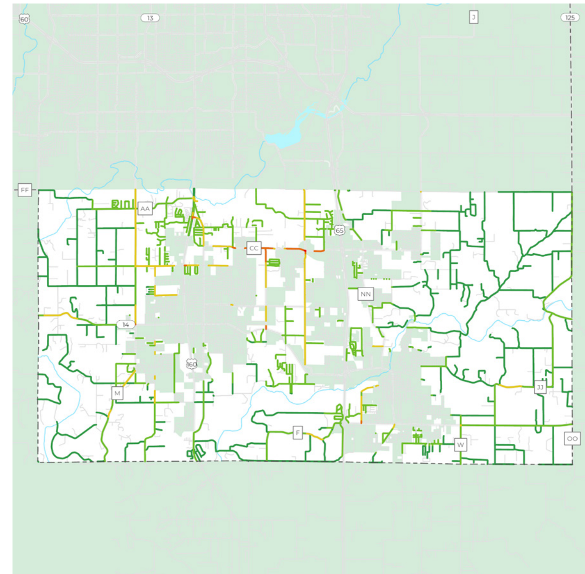
Local High Injury Network

Regional High Injury Network

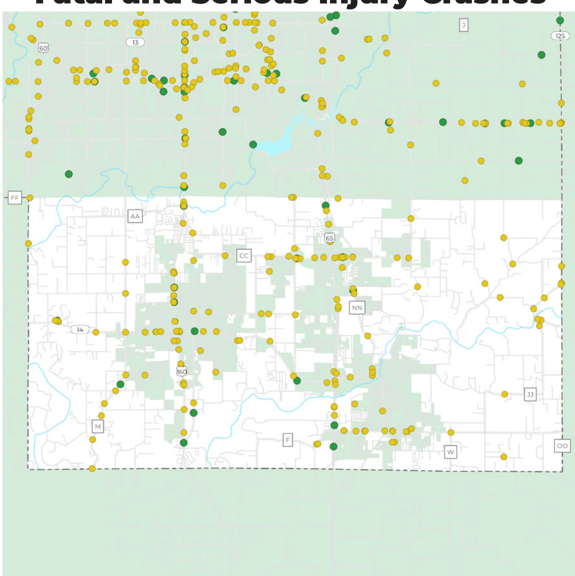
Risk Index

Risk Index

- 0.0-1.50
- 1.51-2.50
- 2.51-3.50
- 3.51-5.0
- 5.01-7.0



Fatal and Serious Injury Crashes



Fatal Crash Locations

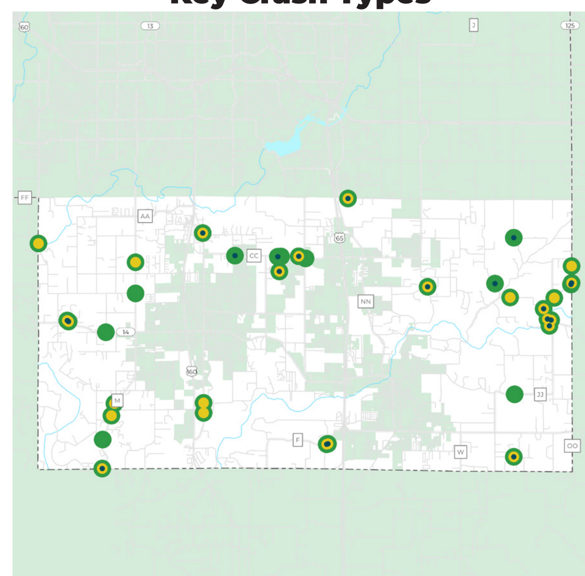
Serious Injury Crash Locations

Key Crash Types

Lane Departure

Fixed Object

Horizontal Curve



Greene

2020 POPULATION
298,915 (entire county)
LANE MILES
4,424 (inside OTO)
2023 VEHICLE MILES TRAVELED
8,042,692 (inside OTO)

Severity	Number
Property Damage Only	2.509
Minor Injuries	837
Serious Injuries	122
Fatal	42
Total	**3,510**

Location	Number Serious/ Fatal Crashes
Intersection	51
Segment	90

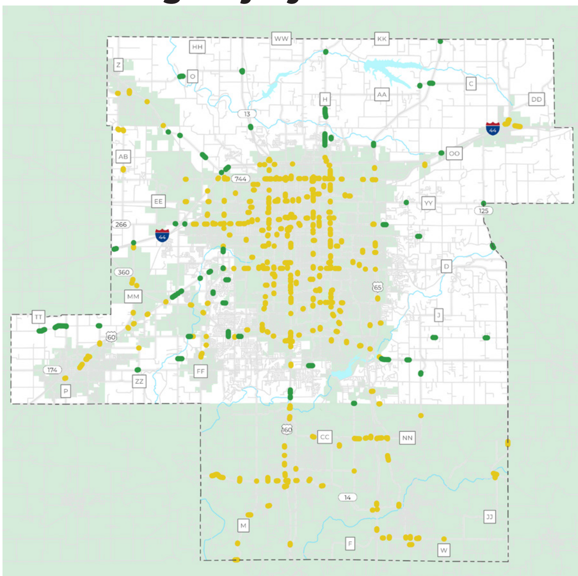
Type	Number Serious/ Fatal Crashes
Aggressive Driver	53
Bicycle	2
CMV	16
Cross Median	4
Distracted	32
Drowsy	3
Fixed-Object	77
Head-On	10
Horizontal Curve	35
Lane Departure	116
Motorcycle	28
Older Driver (65+)	24
Over Speed Limit	14
Pedestrian	12
Run-Off Road	64
Substance Impaired	19
Too Fast for Conditions	21
Unlicensed/ Improper License	38
Work Zone	0
Wrong-Way	0
Young Driver (15-20)	22

SYNOPSIS

Similar to Christian County, Greene County had nearly twice as many segment crashes as intersection crashes. The unincorporated portion of Greene County, inside the OTO area, had 122 serious injury crashes and 42 fatal crashes. These fatal crashes took place along higher speed routes.

As with other communities in the region, the majority of crashes involved lane departure and a fixed object. Run-off road was also prevalent. These often line up with lane departure, but a lane departure may not leave the physical roadway.

High Injury Network



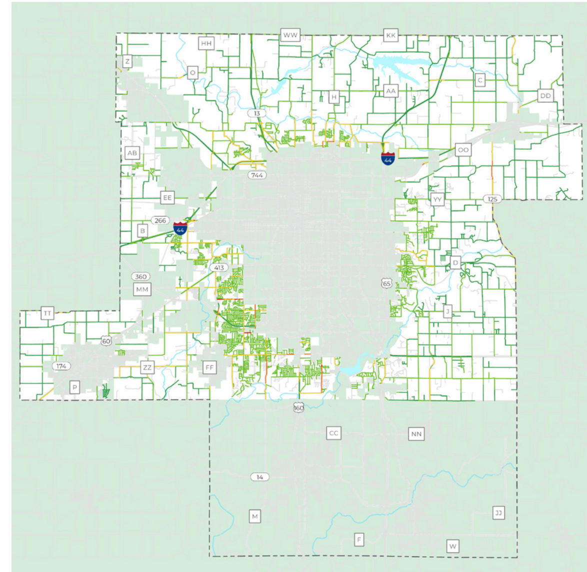
Local High Injury Network

Regional High Injury Network

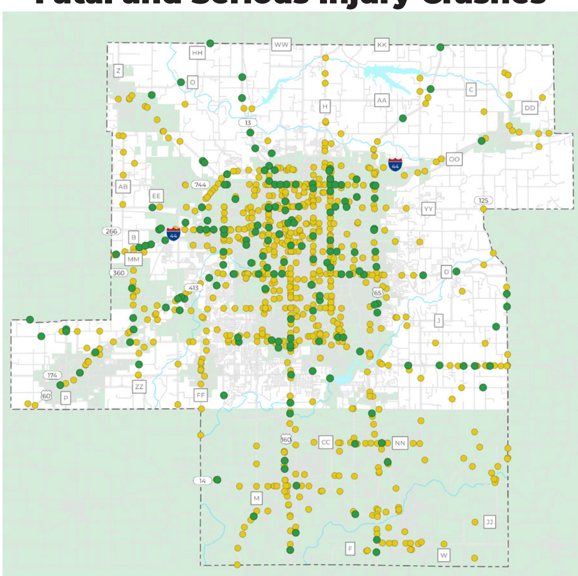
Risk Index

Risk Index

- 0.0-1.50
- 1.51-2.50
- 2.51-3.50
- 3.51-5.0
- 5.01-7.0



Fatal and Serious Injury Crashes



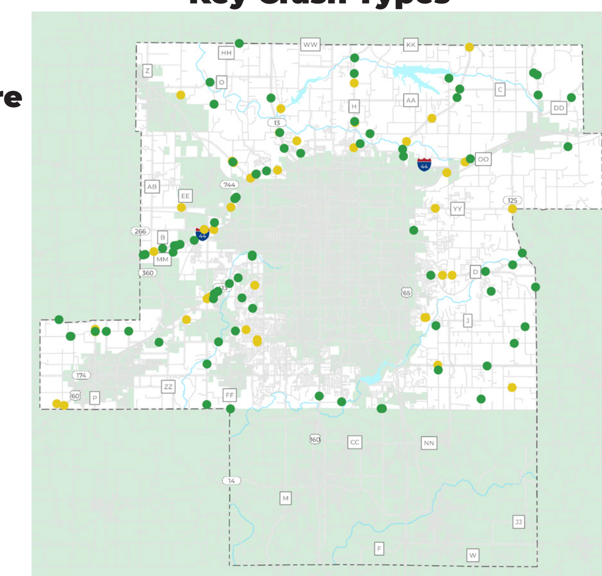
Fatal Crash Locations

Serious Injury Crash Locations

Key Crash Types

Fixed Object

Lane Departure



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7. Next Steps

Looking Forward

Updates, Progress Monitoring, and Resources

PROGRESS AND TRANSPARENCY

The OTO has set a goal of zero fatalities by 2040 and zero serious injuries by 2050.

Reporting Structure

The OTO Technical Planning Committee will be charged with monitoring progress toward this goal annually, with a report made to the OTO Board of Directors.

Metrics

The following metrics will be used to monitor progress toward the goal of zero. Data will be provided for both the previous reporting year, and a prior 5-year rolling average.

Number of Fatalities

Rate of Fatalities per 100 Million VMT

Number of Serious Injuries

Rate of Serious Injuries per 100 Million VMT

Number of Fatal and Serious Injury Crashes involving Pedestrians and Cyclists

UPDATING THE SAFETY ACTION PLAN

The Plan will be updated at least every five year. If a significant trend or obvious safety needs arises, the Plan may be amended to include this specific information.

RESOURCES FOR OTO MEMBERS OTO

Members can work with OTO to further analyze areas of safety concern using data available through OTO and MoDOT, including crash reports and traffic information.

Show Me Zero Website

This is the website for MoDOT's Safety Plan and includes a link to a dashboard with a multitude of crash statistics.

https://www.savemolives.com/mcrs/show-me-zero

SAFER

SAFER stands for Safety Assessment for Every Roadway. This is a tool developed by MoDOT to facilitate discussions of safety during project development, utilizing the Safe System Approach. This is useful for other agencies to use as well.

https://epg.modot.org/index.php/907.9_Safety_Assessment_For_Every_Roadway_(SAFER)

MoDOT Vulnerable Road User Report

MoDOT worked with the University of Missouri-Columbia to develop a safety assessment for vulnerable road users. A copy is available through MoDOT or OTO.

Self-Certification

Grant Eligibility

When applying for Safe Streets and Roads for All Implementation Funding, an eligible safety action plan is required. It is the intent that this plan should meet these requirements for the OTO region and OTO members.

Eight components are used to determine whether an action plan is considered eligible for SS4A. The following two conditions must be met:

Questions 2, 7, and 9 can be answered YES; and

At least 4 of the 6 remaining Questions 1, 2, 4, 5, 6, and 8 can be answered YES.

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

The OTO Board of Directors makes this commitment with the adoption of this plan and accompanying resolution.

Relevant Document and Page Numbers

Destination Safe Streets - Page 3 (Resolution)

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

At the August 16, 2023 Technical Planning Committee, and Advisory Committee was appointed to guide the development of the Plan. With Adoption of this Plan, the Technical Planning Committee will be charged with the plan's implementation and monitoring.

Relevant Document and Page Numbers

August 16, 2023 OTO Technical

Planning Committee Minutes - Page 4

Destination Safe Streets - Page 3 (Resolution)

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 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 roadway features or specific safety needs of relevant road users); and,

A geospatial identification (geographic or locational data using maps) of higher risk locations.

YES

Existing conditions and trends are found in the Introduction, Safety Analysis, and Prioritization Sections, with additional detail provided in the Appendices.

Crash locations are shown in maps and described in the Introduction, Safety Analysis, Prioritization, and Community Profile Sections.

The High Injury Network and a systemic safety analysis are provided in the Safety Analysis Section, as well as the Appendices.

The systemic safety analysis included in the Safety Analysis Section includes and evaluation of high risk roadway features specific to the OTO region and provides a map of the resulting risk assessment and determined index.

Relevant Document and Page Numbers

Destination Safe Streets

Introduction, Pages 7-16

Safety Analysis, Pages 35-50

Prioritization, Pages 63-112

Community Profiles, Pages 113-136

High Injury Network, Pages 40-41

Systemic Safety Analysis, Pages 42-45

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

Multiple opportunities were provided for engagement by the public. Several events were held in conjunction with other business booths, also providing private sector engagement. This is detailed in the Engagement Section.

Engagement informed the list of projects for prioritization, as well as the prioritization process. Recommendations through the policy analysis and additional strategies found in the Policy Analysis Section were also informed by public engagement.

The Advisory Team consisted of area member agencies, Missouri State University, and the Missouri Department of Transportation. Discussion from the Advisory Team was also shared with the Technical Planning Committee and the Board of Directors at various meetings throughout the process.

The match for the SS4A Grant Award was also shared by each member jurisdiction based on population.

Relevant Document and Page Numbers

Destination Safe Streets
Engagement, Pages 17-34

May 18, 2023 OTO Board of Directors Minutes - Pages 4 and 5

August 16, 2023 OTO Technical Planning Committee Minutes - Page 4

October 18, 2023 OTO Technical Planning Committee Minutes - Page 4

February 21, 2024 OTO Technical Planning Committee Minutes - Page 3

March 21, 2024 OTO Board of Directors Minutes - Page 3

April 17, 2024 OTO Technical Planning Committee Minutes - Page 5

June 26, 2024 OTO Technical Planning Committee Minutes - Page 4

August 21, 2024 OTO Technical Planning Committee Minutes - Page 5

September 19, 2024 OTO Board of Directors Minutes - Page 6

October 16, 2024 OTO Technical Planning Committee Minutes - Page TBD

November 21, 2024 OTO Board of Directors Minutes - Page TBD

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

OTO contracted with an Equity Engagement Consultant to guide the outreach and engagement process, ensuring non-traditional participants were included in the planning process. As seen with the demographic results in Survey One, respondents were more diverse than the regional population as a whole.

Underserved communities were identified using OTO's Equity Index tool and this was supplemented with the Climate and Economic Justice Screening Tool during project prioritization.

Relevant Document and Page Numbers

Destination Safe Streets

Engagement, Pages 17-34

Prioritization, Pages 63-112

Appendix B - Survey One Summary

Appendix C - Engagement Report

Appendices D, D-3, D-4, and D-5

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

The Policy Analysis Section focuses on policy and process assessment of OTO's member jurisdictions, while providing recommendations for OTO and members to implement. Additional strategies are also included to further support implementation.

Relevant Document and Page Numbers

Destination Safe Streets

Policy Analysis, Pages 51-62

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

This is described in the Safety Analysis Section, as well as the Prioritization and Implementation Section, with further detail provided in Appendices D, D-3, D-4, and D-5.

Relevant Document and Page Numbers

Destination Safe Streets

Safety Analysis, Pages 35-50

Prioritization, Pages 63-112

Appendices D, D-3, D-4, D-5

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

The Next Steps Section describes how progress will be monitored and the resolution includes a statement that the plan will be monitored and the Technical Planning Committee will be that reporting group.

The plan is available on the OTO website at https://www.OzarksTransportation.org/SS4A.

Relevant Document and Page Numbers

Destination Safe Streets

Next Steps, Page 138

9 ACTION PLAN DATE

Was the action plan finalized or last updated between the dates provided in the Notice of Funding Availability?

The OTO Safety Action Plan, Destination Safe Streets, was adopted on January 16, 2024.

This report was prepared in cooperation with the USDOT, including FHWA and FTA, as well as the Missouri Department of Transportation. The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the Missouri Highways and Transportation Commission, the Federal Highway Administration or the Federal Transit Administration.

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www.OzarksTransportation.org

DESTINATION SAFE STREETS
OTO Safety Action Plan

Appendix A
Safety Toolkit

Ozarks Transportation Organization (OTO) Safety Toolkit

Ways to reduce crashes and keep our communities safe

Sources: U.S. Department of Transportation Federal Highway Administration, National Highway Traffic Safety Administration, NACTO, Caltrans

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Introduction

Ensuring safety within local transportation systems is paramount for the well-being of all road users, including cyclists, drivers, pedestrians, and wheelchair users. The OTO Safety Toolkit provides crucial insights and actionable strategies to enhance transportation safety and accessibility. This guide highlights the importance of targeted interventions to address specific safety challenges and reduce risks effectively. Implementing evidence-based countermeasures can significantly improve the safety and inclusivity of transportation networks, fostering a more secure environment for everyone in the community.

Legend

TARGETED USER

Vehicle

Bicycle

Pedestrian

Wheelchair

COST

$$$$	Less than $100k
$$$$	$100k - $500k
$$$$	$500k - $1M
$$$$	$1M+

SYSTEMIC APPLICATIONS

S Appropriate for Systemic Applications

Table of Contents

Automated Enforcement

PURPOSE

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.

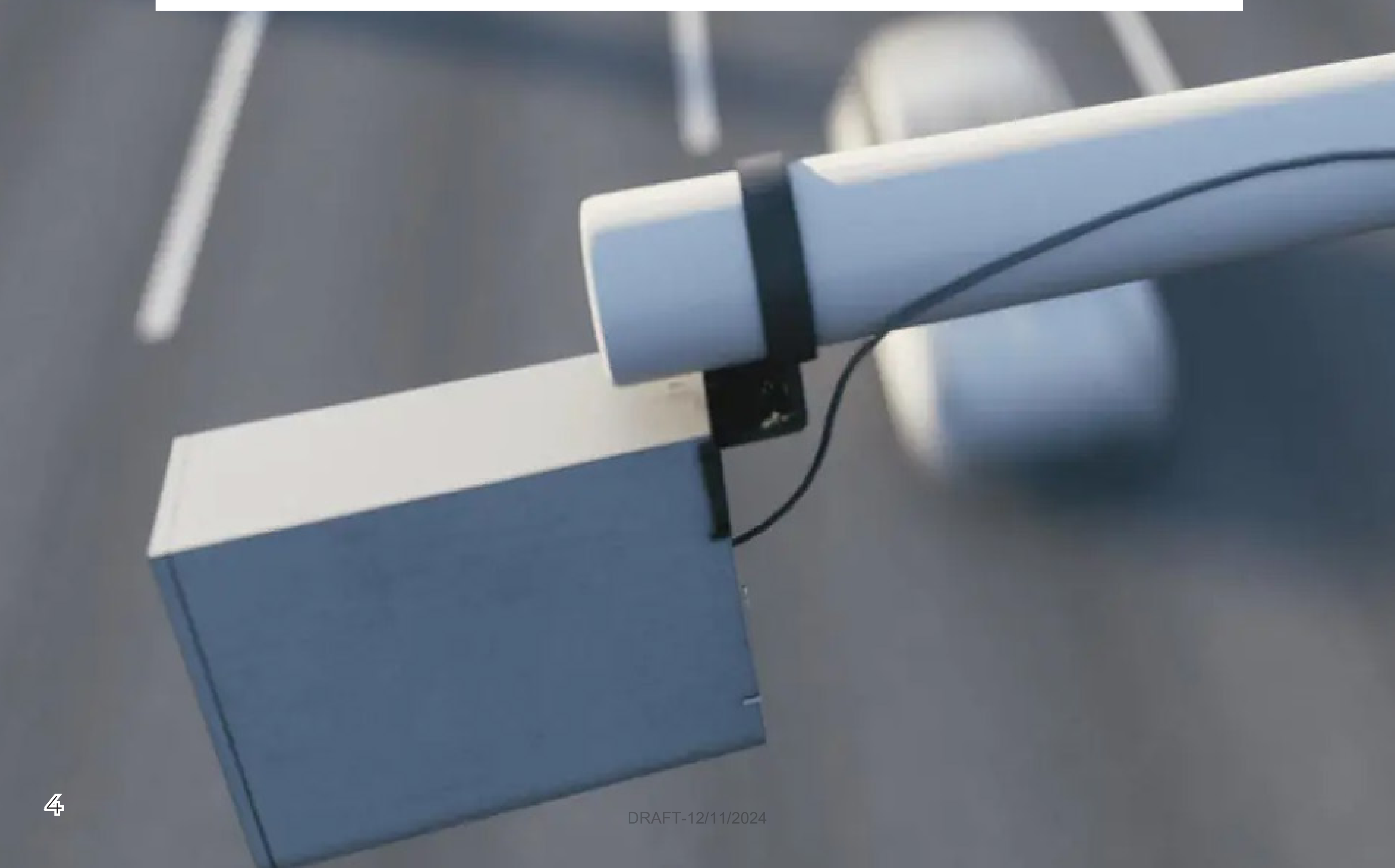
DESCRIPTION

SSCs use speed measurement devices to detect speeding and capture photographic or video evidence of vehicles that are violating a set speed threshold.

APPLICABLE LOCATIONS

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).

The applicability of SSCs in Missouri is subject to local ordinance. For state owned roadways, guidance is found in the MoDOT Engineering Policy Guide (EPG) 950 Automated Traffic Enforcement.



SAFETY BENEFITS

Fixed units can reduce crashes on urban principal arterials up to 54% for all crashes and 47% for injury crashes.

Point-to-point (P2P) units can reduce crashes on urban expressways, freeways, and principal arterials up to 37% for fatal and injury crashes.

Mobile units can reduce crashes on urban principal arterials up to 20% for fatal and injury crashes.

In New York City, fixed units reduced speeding in school zones up to 63% during school hours.

SSCs can produce a crash reduction upstream and downstream, thus generating a spillover effect.

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DESIGN CONSIDERATIONS

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.

MORE INFORMATION

Bicycle Lanes

PURPOSE

Aligns with the Safe Systems Approach principle of recognizing human vulnerability and separates users in space.

DESCRIPTION

Bicycle facilities can mitigate or prevent interactions, conflicts, and crashes between bicyclists and motor vehicles, and create a network of safer roadways for bicycling.

APPLICABLE LOCATIONS

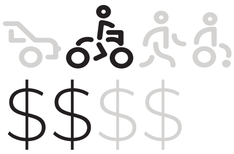
New roads/existing roads through modifications. Bicycle facilities can be appropriate within various roadway contexts however, roadway context determines the appropriate facility type and design.

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

Bicycle lane additions can reduce crashes up to 49% for total crashes on urban 4-lane undivided collectors and local roads

30% reduction for total crashes on urban 2-lane undivided collectors and local roads



DESIGN GUIDANCE 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.

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.

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.

MORE INFORMATION

Corridor Access Management

PURPOSE

Thoughtful access management along a corridor can simultaneously enhance safety for all modes, facilitate walking and biking, and reduce trip delay and congestion.

DESCRIPTION

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.
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.
- 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.

APPLICABLE LOCATIONS

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.

SAFETY BENEFITS

Reducing driveway density 5-23% reduction in total crashes along 2-lane rural roads

25-31% reduction in fatal and injury crashes along urban/suburban arterials.

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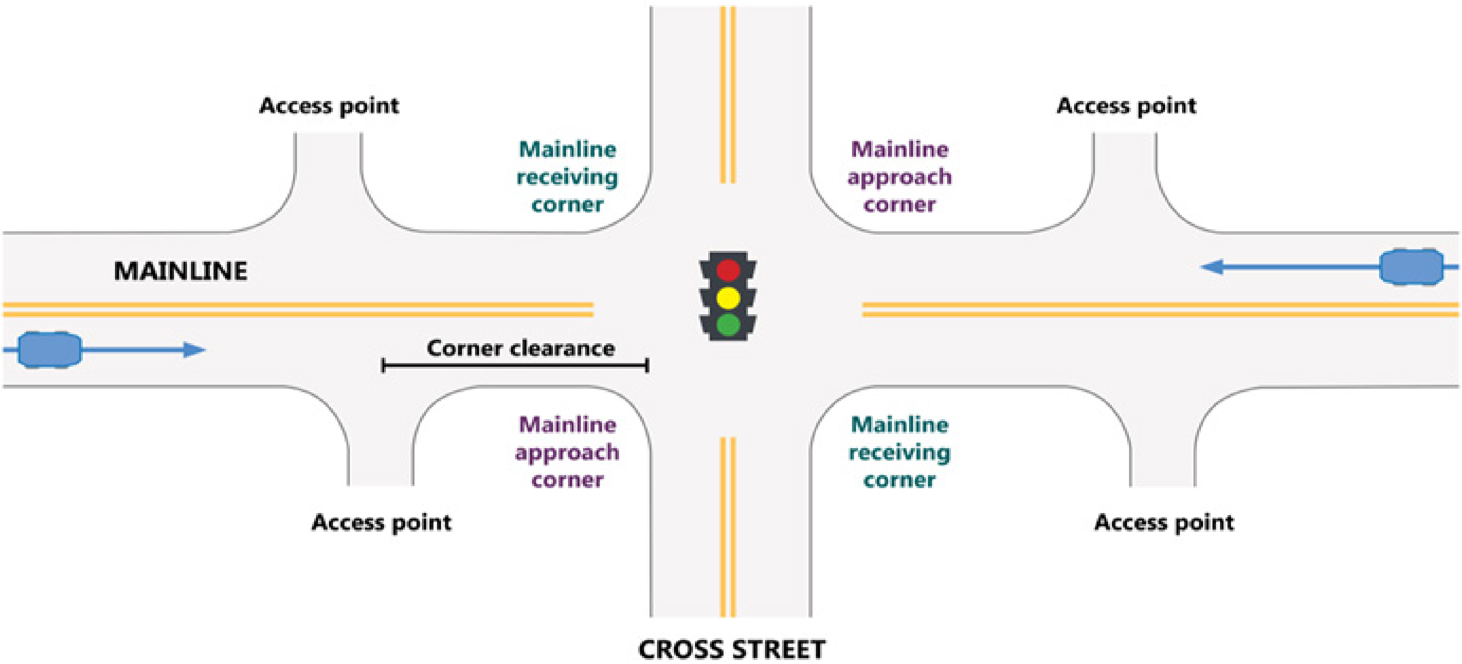
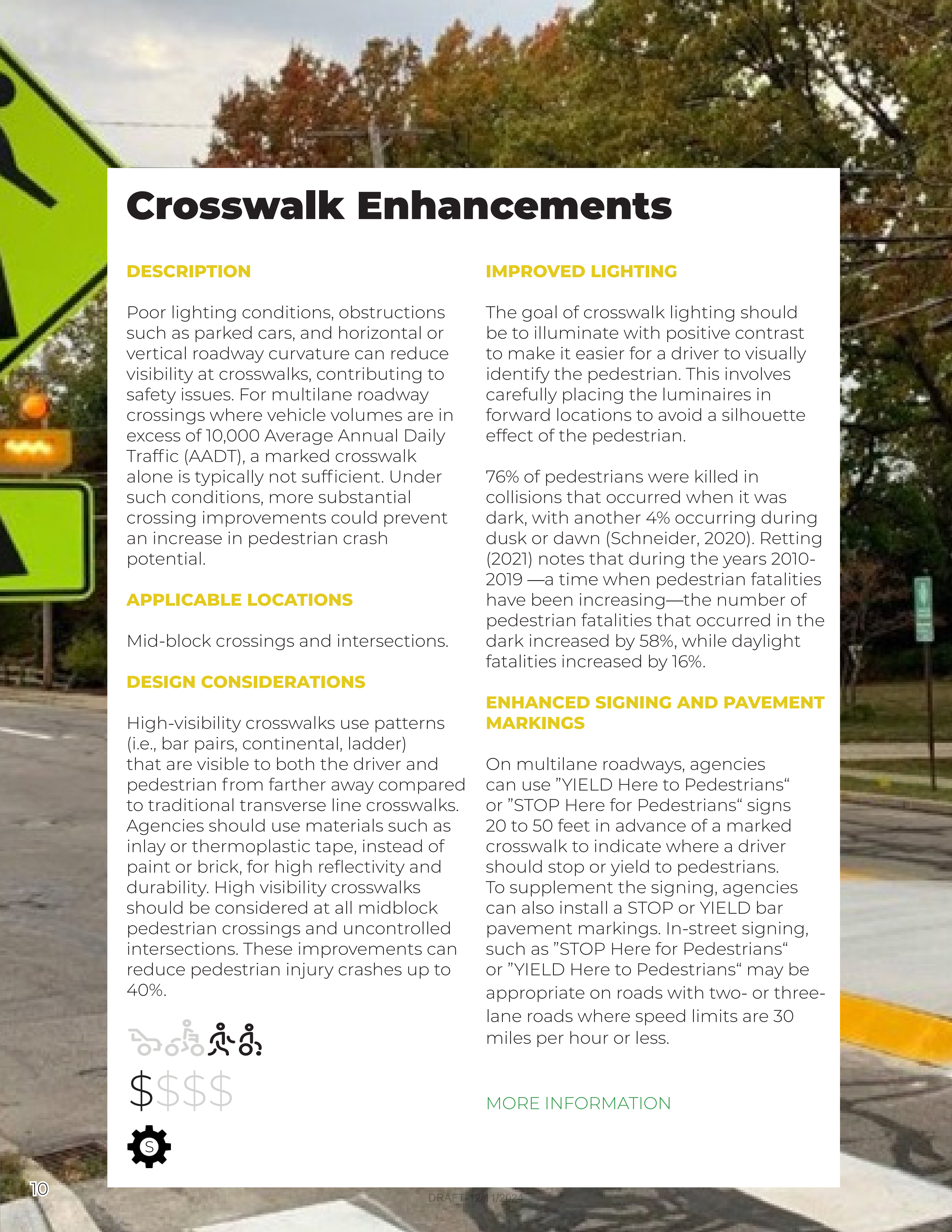
MORE INFORMATION



Access point
Mainline receiving corner
Mainline approach corner
Access point
MAINLINE
Corner clearance
Mainline approach corner
Mainline receiving corner
Access point
Access point
CROSS STREET



Crosswalk Enhancements

DESCRIPTION

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.

APPLICABLE LOCATIONS

Mid-block crossings and intersections.

DESIGN CONSIDERATIONS

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. Agencies should use materials such as inlay or thermoplastic tape, instead of paint or brick, for high reflectivity and durability. High visibility crosswalks should be considered at all midblock pedestrian crossings and uncontrolled intersections. These improvements can reduce pedestrian injury crashes up to 40%.

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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.

76% of pedestrians were killed in collisions that occurred when it was dark, with another 4% occurring during dusk or dawn (Schneider, 2020). Retting (2021) notes that during the years 2010-2019 —a time when pedestrian fatalities have been increasing—the number of pedestrian fatalities that occurred in the dark increased by 58%, while daylight fatalities increased by 16%.

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. To supplement the signing, agencies can also install a STOP or YIELD bar 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.

MORE INFORMATION

Curb Extensions

PURPOSE

Curb extensions visually and physically narrow the roadway, creating safer and shorter crossings for pedestrians while increasing the available space for street furniture, benches, plantings, and street trees

DESCRIPTION

Curb extensions involves extending the curb into the street, decreasing roadway space and increasing pedestrian space.

APPLICABLE LOCATIONS

Curb extensions may be implemented on downtown, neighborhood, and residential streets, large and small.

Mid-block curb extensions, known as pinchpoints or chokers, which may include cut-throughs for bicyclists.

Curb extensions used as gateways to minor streets known as neckdowns.

Offset curb extensions that force vehicles to move laterally, known as chicanes.

Curb extensions at bus (or transit) stops, also known as bus bulbs.

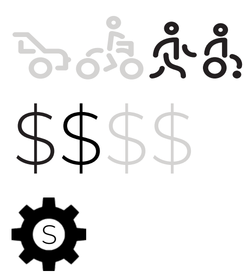
SAFETY BENEFITS

Curb extensions decrease the overall width of the roadway and can serve as a visual cue to drivers that they are entering a neighborhood street or area.

Curb extensions increase the overall visibility of pedestrians by aligning them with the parking lane and reducing the crossing distance for pedestrians, creating more time for preferential treatments such as leading pedestrian interval and transit signal priority.

Used as a bus bulb, curb extensions may improve bus travel times by reducing the amount of time a bus takes to merge with traffic after boarding. Bus bulbs also help to prevent motorists from double parking in the bus stop.

Curb extensions tighten intersection curb radii and encourage slower turning speeds.



DESIGN CONSIDERATIONS

Where application of a curb extension adversely impacts drainage, curb extensions may be designed as edge islands with a 1–2-foot gap from the curb or a trench drain.

Installation of curb extensions may require moving a fire hydrant to maintain adequate curbside access in case of a fire. In such cases, a curb extension may incur additional expense or be reoriented to avoid conflict with the hydrant.

Generally, curb extensions should be designed to be 1-2 feet less than the space provided by the adjacent parking lane.

MORE INFORMATION

Curve Improvements

PURPOSE

Curve improvements aim to enhance road safety by addressing issues that can lead to crashes on curved road segments. Improving the design and visibility of curves helps drivers navigate them more safely, reducing the risk of run-off-road crashes, head-on collisions, and other curve-related crashes.

DESCRIPTION

Curve improvements encompass various measures, including geometric design enhancements, increased signage, improved pavement markings, and the addition of safety features like guardrails and rumble strips. Geometric enhancements might involve adjusting the curve radius, superelevation, and widening the lanes or shoulders to provide more room for maneuvering. Increased signage and pavement markings make curves more visible and provide advance warning to drivers, while guardrails and rumble strips help prevent vehicles from leaving the roadway.

APPLICABLE LOCATIONS

Curve improvements are particularly beneficial on rural roads with sharp or poorly visible curves, urban areas with high traffic volumes, and roadways with a history of curve-related crashes. They are also effective in areas with challenging weather conditions that can reduce visibility and traction, making curves more dangerous.

SAFETY BENEFITS

Curve improvements can significantly reduce the incidence and severity of crashes. Enhancements such as better signage and markings can decrease crash rates by up to 30%, while geometric improvements can lead to a reduction in crashes by up to 50%. Implementing these measures improves overall road safety by ensuring drivers can navigate curves more safely and effectively.

MORE INFORMATION

Dedicated Left- and Right-Turn Lanes at Intersections

PURPOSE

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.

DESCRIPTION

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.

APPLICABLE LOCATIONS

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 .

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.

SAFETY BENEFITS

Left-Turn Lanes saw a 28-48% reduction in total crashes. Right-Turn Lanes saw a 14-26% reduction in total crashes.

MORE INFORMATION

Dilemma Zone Detection

PURPOSE

The dilemma zone, where drivers may be unsure whether to stop or proceed during a yellow traffic signal, can significantly increase the risk of accidents at signalized intersections. This uncertainty can lead to rear-end collisions, red-light running, and other types of intersection-related crashes.

Dilemma Zone Detection systems are designed to enhance driver decision-making and improve safety by detecting vehicles approaching an intersection and adjusting the signal timing to mitigate the risks associated with the dilemma zone.

DESCRIPTION

Dilemma Zone Detection systems use advanced sensor technology, such as radar or inductive loop detectors, to monitor vehicle speed and location as they approach an intersection. When a vehicle is detected within the dilemma zone, the system can extend the green signal phase or provide an early warning to drivers about an impending signal change.

This proactive approach helps reduce the occurrence of abrupt stops or dangerous accelerations.

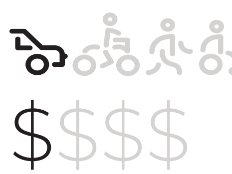
APPLICABLE LOCATIONS

Dilemma Zone Detection systems are particularly effective at intersections with high-speed approaches, typically where speed limits exceed 35 miles per hour.

They are also useful in areas with a high incidence of red-light running or where the timing of traffic signals has been identified as a contributing factor to crashes. Transportation agencies should assess the specific traffic conditions and crash history at each intersection to determine the suitability of Dilemma Zone Detection systems.

SAFETY BENEFITS

Dilemma Zone Detection systems can reduce red-light running and rear-end collisions by up to 39%. They also improve overall intersection safety by optimizing signal timing to account for the varying speeds and behaviors of approaching vehicles.



MORE INFORMATION

Dynamic Speed Monitoring Display

PURPOSE

Dynamic Speed Monitoring Display (DSMD) signs actively manage vehicle speeds through real-time feedback to drivers. By measuring the speed of approaching vehicles and displaying this information on dynamic message displays, DSMD signs encourage drivers to adjust their speed to comply with posted speed limits, ultimately reducing the risk of accidents and improving overall traffic safety.

DESCRIPTION

DSMD signs are advanced traffic control devices that utilize Intelligent Transportation System (ITS) technology. These signs incorporate radar sensors to measure the speed of oncoming vehicles and then relay this information to drivers via dynamic message displays. Positioned alongside standard static regulatory speed limit signs, DSMD signs provide drivers with real-time feedback about their current speed compared to the posted speed limit. This interactive approach aims to encourage drivers to adhere to speed limits and promote safer driving behavior, particularly in areas where speed limits change, such as speed reduction transition zones.Dynamic signs can be used to alert other street users of approaching transit vehicles, and to regulate turns and other movements that are prohibited when transit vehicles are approaching.

APPLICABLE LOCATIONS

DSMD signs are applicable in various locations where managing vehicle speeds is crucial for road safety. These signs are particularly effective in speed reduction transition zones, where speed limits change from higher to lower speeds, such as rural highways entering urbanized areas. Additionally, DSMD signs can be beneficial in residential neighborhoods, school zones, work zones, and areas with high pedestrian activity. They are also useful on roads with frequent speed limit changes, curves, or hazardous conditions, where maintaining appropriate speeds is essential for preventing accidents.

SAFETY BENEFITS

By providing real-time feedback to drivers about their vehicle's speed compared to the posted speed limit, DSMD signs encourage drivers to adjust their speed accordingly, promoting compliance with speed limits and reducing the risk of accidents. These signs are particularly effective in speed transition zones and areas with changing road conditions, where maintaining appropriate speeds is critical for road safety. Additionally, DSMD signs enhance driver awareness and promote safer driving behaviors, contributing to overall improvements in traffic safety on both rural and urban roads.

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MORE INFORMATION

Enhanced Delineation

PURPOSE

Enhanced delineation improves the visibility of road features and boundaries, especially under low visibility conditions such as nighttime, fog, or heavy rain. This can be achieved through various measures like wider edge lines, reflective markers, and improved signage to provide better guidance for drivers, reduce lane departure incidents, and enhance overall road safety.

DESCRIPTION

Enhanced delineation can include increasing the width of edge lines, using reflective pavement markers, installing larger and more reflective signs, and marking high-visibility crosswalks. Wider edge lines, for example, increase visibility and help drivers maintain lane discipline. Reflective pavement markers provide visual and tactile feedback, especially useful at night and in adverse weather conditions. Improved signage ensures critical warnings and guidance are visible from greater distances, while high-visibility crosswalks make pedestrian crossings more noticeable to drivers.

APPLICABLE LOCATIONS

These measures are particularly effective on rural roads where street lighting is minimal, curvy roads needing better navigation aids, high-speed roadways, and intersections or pedestrian crossings requiring enhanced visibility to protect pedestrians and reduce vehicle-pedestrian conflicts.

SAFETY BENEFITS

Enhanced delineation significantly improves road safety by providing clearer guidance and reducing lane departure incidents. For instance, wider edge lines can reduce total crashes by up to 15% and fatal or injury crashes by up to 30%. Reflective pavement markers can decrease nighttime crashes by up to 40%, while improved signage and delineators enhance driver awareness and reaction times, leading to fewer crashes.

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MORE INFORMATION

High Friction Surface Treatments

PURPOSE

High Friction Surface Treatments (HFST) are applied to road surfaces to significantly improve pavement friction and enhance vehicle traction, especially in areas prone to skidding and slipping. These treatments are designed to reduce crashes, particularly on curves, ramps, intersections, and areas with steep grades.

DESCRIPTION

HFST involves applying a layer of high-quality, durable aggregate to the road surface using a strong polymer binder. This creates a textured surface with significantly higher friction than standard pavement. The treatment is particularly effective in locations where vehicles are prone to losing control due to sharp turns, wet conditions, or high traffic volumes.

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APPLICABLE LOCATIONS

Curves: Where vehicles are more likely to skid due to the change in direction.

Intersections: Where stopping distances are crucial, and vehicles often need to brake suddenly.

Steep grades: Where vehicles can lose control due to gravity and wet conditions.

Pedestrian crossings: To enhance safety for pedestrians by ensuring vehicles can stop more quickly.

SAFETY BENEFITS

Studies have shown that HFST can reduce total crashes by up to 52% and wet weather crashes by up to 83%. By providing enhanced friction, these treatments help reduce the risk of run-off-road incidents, rear-end collisions, and intersection-related crashes.

MORE INFORMATION

Improved Right Turn Angle

PURPOSE

Improving the right turn angle at intersections aims to enhance safety and efficiency for vehicles making right turns. By optimizing the turn angle, drivers can maintain better control and visibility, reducing the likelihood of collisions and near-misses with other vehicles, pedestrians, and cyclists.

DESCRIPTION

Improving the right turn angle involves redesigning the intersection geometry to create a sharper, more perpendicular right turn rather than a sweeping, high-speed turn. This can be achieved by adjusting the curb radius, implementing curb extensions, or adding channelization islands. The goal is to reduce the speed of turning vehicles, improve sightlines, and encourage drivers to make safer, more deliberate turns.

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APPLICABLE LOCATIONS

Enhanced right turn angles are beneficial at:

- Urban intersections: Where pedestrian and bicycle activity is high, and slower vehicle speeds improve safety.
- Suburban and rural intersections: Where right turn speeds are typically higher, increasing the risk of run-off-road crashes.
- High-crash intersections: Locations with a history of right-turn-related collisions.

SAFETY BENEFITS

Improving the right turn angle can significantly reduce crash rates at intersections. Sharper turn angles force drivers to slow down, improving reaction times and reducing the severity of collisions. Enhanced turn geometry also improves sightlines, making it easier for drivers to see oncoming traffic, pedestrians, and cyclists. Research indicates that improving the right turn angle can reduce right-turn-related crashes by up to 50%.

MORE INFORMATION

Intersection Conflict Warning System

PURPOSE

An Intersection Conflict Warning System (ICWS) enhances intersection safety by providing real-time alerts to drivers about potential conflicts with other vehicles. These systems are particularly useful in reducing crashes at intersections, especially where visibility is limited or where high-speed approaches are common.

DESCRIPTION

ICWS uses a combination of sensors, signs, and communication technology to monitor traffic movements and alert drivers to potential conflicts. The system detects vehicles approaching or within the intersection and activates warning signs to alert drivers of cross-traffic. The alerts can be visual (flashing lights or digital message signs) and sometimes auditory, depending on the system design. This increased awareness helps drivers make safer decisions when approaching or navigating intersections.

APPLICABLE LOCATIONS

ICWS is particularly effective at rural intersections with limited visibility, intersections with high-speed approaches, and locations with a history of angle or side-impact collisions. They are also beneficial in areas where traffic volumes are unpredictable or where traditional traffic control measures (like traffic signals) may not be feasible or sufficient.

SAFETY BENEFITS

ICWS can significantly reduce the incidence of intersection-related crashes by improving driver awareness and reaction times. Studies have shown that these systems can reduce total crashes at treated intersections by up to 30%, with notable decreases in severe crashes, such as right-angle collisions. By alerting drivers to potential conflicts, ICWS enhances decision-making and reduces the likelihood of crashes.

MORE INFORMATION

Leading Pedestrian Interval

PURPOSE

Leading pedestrian intervals (LPI) allow pedestrians to better establish their presence in the crosswalk before vehicles have priority to turn right or left.

DESCRIPTION

A leading pedestrian interval gives pedestrians the opportunity to enter the crosswalk at an intersection 3-7 seconds before vehicles are given a green indication.

For more information: https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/fhwasa19040.pdf

APPLICABLE LOCATIONS

Several cities across the U.S. have decided to install LPIs across systems of signalized intersections to improve pedestrian safety.

Agencies prioritize the intersections in places where there are lots of crashes, high pedestrian crossing volumes, and vulnerable populations.

They may be especially useful at one-way streets or at T-intersections.

SAFETY BENEFITS

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

Leading pedestrian intervals can create a 13% reduction in pedestrian-vehicle crashes at intersections

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MORE INFORMATION


BEER WINE
Norwood
MARKET
5070
ATM
Little Armenia
Hollywood

Median

PURPOSE

Provides separation between opposing vehicle travel lanes, supports improved safety and traffic flow, and creates space for landscaping or visual enhancements.

DESCRIPTION

Area between opposing lanes of traffic, excluding turn lanes. Can be defined by pavement markings, raised medians, or islands.

APPLICABLE LOCATIONS

Mid-block crossings, multilane intersections, and areas near transit stops or other pedestrian-focused sites

SAFETY BENEFITS

46% reduction in pedestrian crashes (median with marked crosswalk)

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MORE INFORMATION

Pedestrian Hybrid Beacon

PURPOSE

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.

DESCRIPTION

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.

APPLICABLE LOCATIONS

New Roads/Existing roads through modifications

SAFETY BENEFITS

Nearly 74% of pedestrian fatalities occur at non-intersection locations, and vehicle speeds are often a major contributing factor. Pedestrian hybrid beacons also allow motorists to proceed once the pedestrian has cleared their side of the travel lane(s), reducing vehicle delay. 55% reduction in pedestrian crashes, 29% reduction in total crashes, and 15% reduction in serious injury and fatal crashes.

DESIGN GUIDANCE CONSIDERATIONS

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. If PHBs are not already familiar to a community, agencies should conduct appropriate education and outreach as part of implementation.

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MORE INFORMATION

Pedestrian Refuge Island

PURPOSE

Provides a protected area for pedestrians crossing a road.

DESCRIPTION

A raised median island with a refuge area intended for pedestrians.

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APPLICABLE LOCATIONS

Mid-block crossings, multilane intersections, and areas near transit stops or other pedestrian-focused sites.

SAFETY BENEFITS

56% reduction in pedestrian crashes (Median with Marked Crosswalk)

MORE INFORMATION

Permissive to Protected Left-Turn Signal Phase

PURPOSE

Permissive left turns, where drivers must yield to oncoming traffic and pedestrians, can create safety concerns due to the complexity and judgment required by drivers. Converting permissive left turns to protected left turns, where left-turn movements have a dedicated signal phase without conflicting traffic or pedestrian movements, can enhance safety and reduce collision risks.

DESCRIPTION

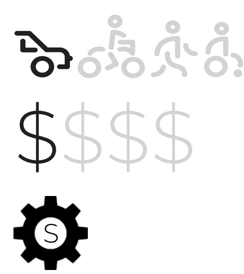
Protected left turn phases are implemented through dedicated signal displays, such as a green arrow, indicating that left-turning vehicles have the exclusive right of way. This approach eliminates conflicts with oncoming vehicles and crossing pedestrians during the left-turn movement, thereby reducing the likelihood of crashes.

APPLICABLE LOCATIONS

Protected left turns are particularly beneficial at intersections with high traffic volumes, frequent left-turning movements, or a history of left-turn-related collisions. They are also effective in areas with complex intersection geometries or significant pedestrian activity. Transportation agencies should evaluate traffic conditions, collision history, and intersection layout to determine the need for protected left-turn phases.

SAFETY BENEFITS

Protected left turn phases can significantly reduce the risk of collisions involving left-turning vehicles. Research indicates that converting permissive left turns to protected left turns can reduce left-turn crashes by approximately 50% and improve overall intersection safety.



MORE INFORMATION

Rectangular Rapid Flashing Beacon (RRFB)

PURPOSE

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.

DESCRIPTION

RRFBs consist of two, rectangular-shaped yellow indications, each with a light-emitting diode (LED)-array-based light source. RRFBs flash with an alternating high frequency when activated to enhance conspicuity of pedestrians at the crossing to drivers.

APPLICABLE LOCATIONS

The RRFB is applicable to many types of pedestrian crossings but is particularly effective at multi-lane crossings with speed limits less than 40 miles per hour. Research suggests RRFBs can result in motorist yielding rates as high at 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. RRFBs can also accompany school or trail crossing warning signs. Agencies should consult the Manual on Uniform Traffic Control Devices (MUTCD) for more information.

SAFETY BENEFITS

RRFBs can reduce crashes up to 47% for pedestrian crashes. RRFBs can increase motorist yielding rates up to 98%.

MORE INFORMATION

Reduced Left-Turn Conflict Intersections

PURPOSE

These intersections simplify decision-making for drivers and minimize the potential for higher severity crash types, such as head-on and angle.

DESCRIPTION

Reduced left-turn conflict intersections are geometric designs that alter how left-turn movements occur.

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 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.

APPLICABLE LOCATIONS

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.

The MUT is an excellent choice for intersections with heavy through traffic and moderate left-turn volumes.

SAFETY BENEFITS

Studies have shown that installing an RCUT can result in a 30% increase in throughput and a 40% reduction in network intersection travel time.

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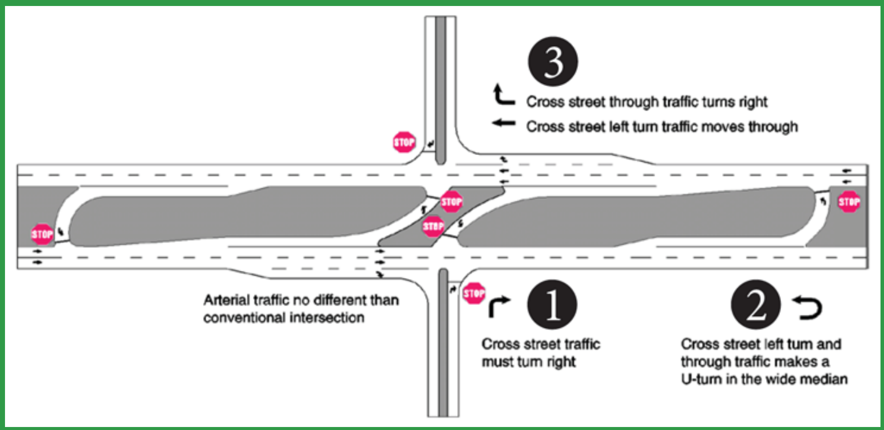
MORE INFORMATION



Retroreflective Backplates

PURPOSE

Backplates with retroreflective borders improve the visibility of the illuminated face of the signal. 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.

DESCRIPTION

Backplates added to a traffic signal head introduce 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.

APPLICABLE LOCATIONS

The most efficient means of implementing this proven safety countermeasure is to adopt it as a standard treatment for signalized intersections across a jurisdiction or State.

SAFETY BENEFITS

15% reduction in total crashes

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MORE INFORMATION

Road Diet

PURPOSE

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. They may be a low-cost way to reduce an overbuilt street that suggests high speeds to drivers and provide more space for walking, bicycling, and for drivers who need to park their vehicles.

DESCRIPTION

A Road Diet typically involves decreasing the number of lanes in a roadway. This can be achieved by adding sidewalks, cycle lanes, center turn lanes, or otherwise decreasing the number of car lanes.

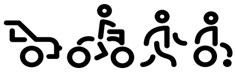
APPLICABLE LOCATIONS

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.

SAFETY BENEFITS

4-lane to 3-lane road diet conversions can have a 19-47% reduction in total crashes. 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.



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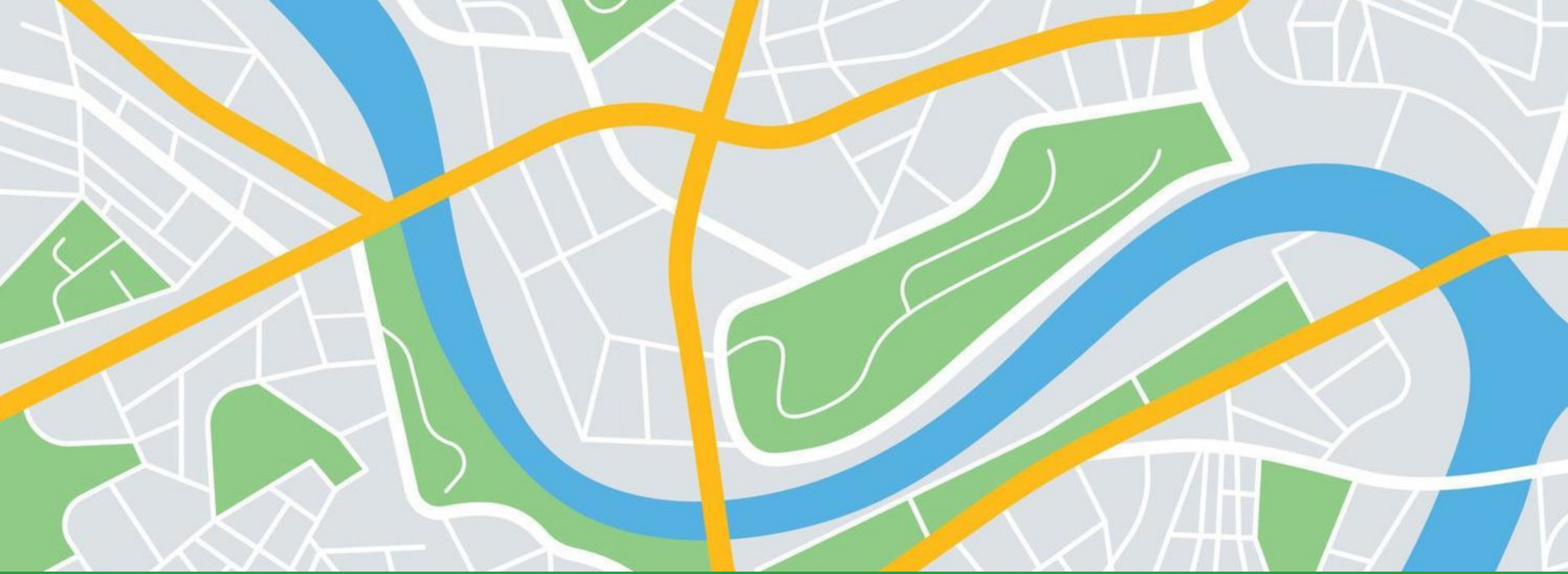
MORE INFORMATION



Road Safety Audit

PURPOSE

A Road Safety Audit (RSA) is a proactive safety management tool designed to identify and address potential road safety issues in existing or planned road projects. Conducted by an independent, multidisciplinary team, RSAs aim to enhance road safety by providing recommendations for improvements before crashes occur.

DESCRIPTION

RSAs involve a systematic examination of road safety aspects, focusing on factors such as road design, traffic flow, signage, and environmental conditions. The process includes data collection, field reviews during different times and conditions, and analysis to pinpoint areas of concern. The findings are compiled into a report with recommendations for safety improvements. Follow-up actions involve implementing these recommendations and monitoring their effectiveness over time.

APPLICABLE LOCATIONS

RSAs can be conducted at any stage of a road project's lifecycle, including planning and design phases, during construction, or on existing roads. They are particularly useful for high-risk areas such as intersections, school zones, and locations with a history of frequent or severe crashes.

SAFETY BENEFITS

RSAs significantly improve road safety by proactively identifying and mitigating hazards. Implementing RSA recommendations can reduce crash rates by up to 60%, identifying cost-effective safety improvements that can be quickly implemented to prevent crashes and save lives.

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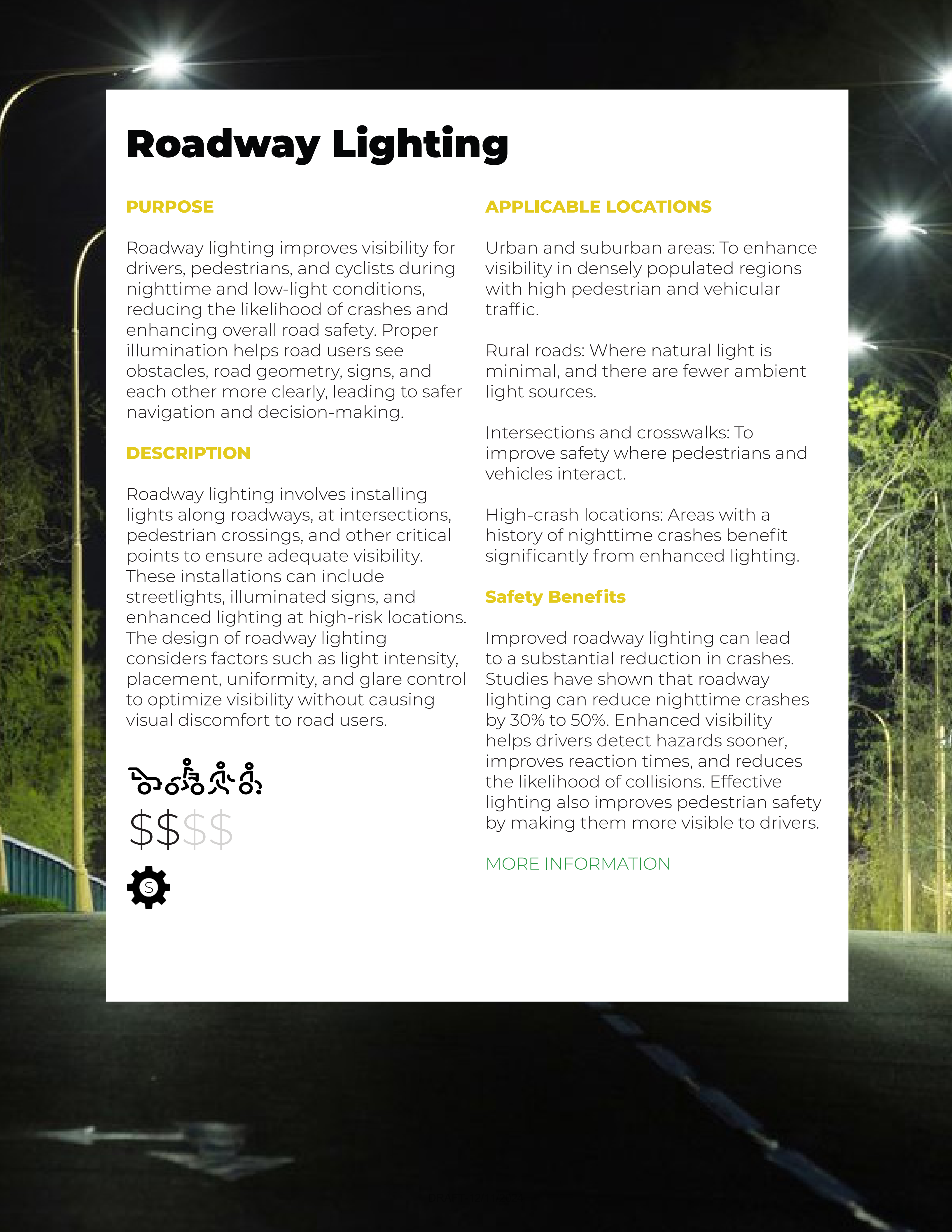
MORE INFORMATION



Roadway Lighting

PURPOSE

Roadway lighting improves visibility for drivers, pedestrians, and cyclists during nighttime and low-light conditions, reducing the likelihood of crashes and enhancing overall road safety. Proper illumination helps road users see obstacles, road geometry, signs, and each other more clearly, leading to safer navigation and decision-making.

DESCRIPTION

Roadway lighting involves installing lights along roadways, at intersections, pedestrian crossings, and other critical points to ensure adequate visibility. These installations can include streetlights, illuminated signs, and enhanced lighting at high-risk locations. The design of roadway lighting considers factors such as light intensity, placement, uniformity, and glare control to optimize visibility without causing visual discomfort to road users.

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APPLICABLE LOCATIONS

Urban and suburban areas: To enhance visibility in densely populated regions with high pedestrian and vehicular traffic.

Rural roads: Where natural light is minimal, and there are fewer ambient light sources.

Intersections and crosswalks: To improve safety where pedestrians and vehicles interact.

High-crash locations: Areas with a history of nighttime crashes benefit significantly from enhanced lighting.

Safety Benefits

Improved roadway lighting can lead to a substantial reduction in crashes. Studies have shown that roadway lighting can reduce nighttime crashes by 30% to 50%. Enhanced visibility helps drivers detect hazards sooner, improves reaction times, and reduces the likelihood of collisions. Effective lighting also improves pedestrian safety by making them more visible to drivers.

MORE INFORMATION

Roundabouts

PURPOSE

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.

DESCRIPTION

The modern roundabout is an intersection with a circular configuration that safely and efficiently moves traffic.

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APPLICABLE LOCATIONS

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.

SAFETY BENEFITS

Roundabouts are not only a safer type of intersection; they are also efficient at 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.

MORE INFORMATION

Rumble Strips

PURPOSE

Rumble strips are designed to alert inattentive drivers through vibration and sound when they depart from their travel lane. These safety features can prevent roadway departure crashes, including run-off-road and head-on collisions. There are three main types of rumble strips: shoulder rumble strips, centerline rumble strips, and transverse rumble strips.

DESCRIPTION

Shoulder Rumble Strips: Installed on the shoulder of the roadway to alert drivers when they are leaving the travel lane. These are typically found on rural highways.

Centerline Rumble Strips: Placed along the centerline of two-lane roads to reduce head-on collisions and opposite-direction sideswipe crashes.

Transverse Rumble Strips: Installed across the travel lane to alert drivers of upcoming changes in the road, such as stop signs, toll booths, or sharp curves.

APPLICABLE LOCATIONS

Rumble strips are particularly effective in:

Rural highways: Where there is a higher risk of run-off-road crashes.

Two-lane roads: Where head-on collisions and opposite-direction sideswipe crashes are a concern.

Approaches to intersections: To alert drivers of an upcoming stop or change in road conditions.

High-speed roadways: Where driver inattention or drowsiness is a significant concern.

SAFETY BENEFITS

Shoulder Rumble Strips can reduce run-off-road crashes by 29-51%.
Centerline Rumble Strips: Can reduce head-on collisions and opposite-direction sideswipe crashes by 44-64%.
Transverse Rumble Strips: Effectively reduce vehicle speeds and improve driver awareness at critical points on the road.

MORE INFORMATION

Shared Use Path

PURPOSE

Shared use paths provide a safe, dedicated space for non-motorized users, such as pedestrians, cyclists, and other forms of micromobility. These paths are designed to separate non-motorized traffic from motor vehicle traffic, reducing conflicts and enhancing safety and accessibility for all users.

DESCRIPTION

A shared use path is a type of infrastructure that is physically separated from motor vehicle traffic by an open space or barrier. These paths are typically at least 10 feet wide to accommodate two-way travel and are used by a variety of non-motorized users, including pedestrians, bicyclists, and skaters. Shared use paths can be located along natural corridors, such as rivers and rail lines, or within urban areas to connect parks, schools, and neighborhoods.

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APPLICABLE LOCATIONS

Shared use paths are suitable for various locations, including urban, suburban, and rural areas. They are particularly effective in:

- Recreational areas, parks, and greenways.
- Corridors with limited space for separate pedestrian and bicycle facilities.
- Routes connecting key community destinations, such as schools, libraries, and shopping areas.
- Areas with high pedestrian and bicycle traffic.

SAFETY BENEFITS

Shared use paths can significantly improve safety by reducing the number of conflict points between motor vehicles and non-motorized users. Research indicates that shared use paths can reduce crashes involving non-motorized users by up to 60%. These paths also encourage active transportation, contributing to public health and reducing traffic congestion.

MORE INFORMATION

Sidewalks

PURPOSE

Defined space for pedestrians.

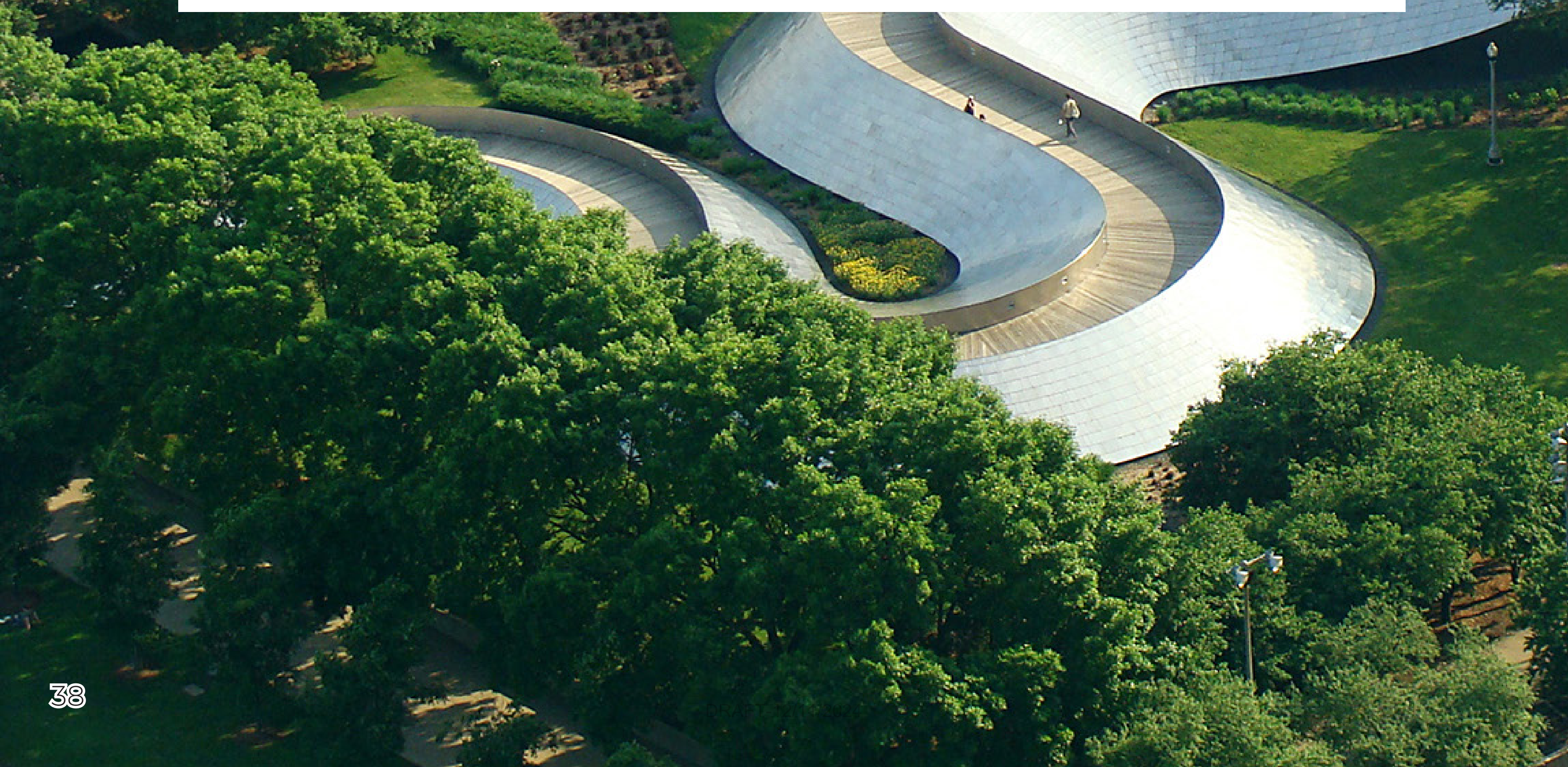
DESCRIPTION

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.

APPLICABLE LOCATIONS

Well-designed 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.

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.



SAFETY BENEFITS

With more than 6,200 pedestrian fatalities and 75,000 pedestrian injuries occurring in roadway crashes annually, it is important for transportation agencies to improve conditions and safety for pedestrians and to integrate sidewalks more fully into the transportation system. Research shows people living in low-income communities are less likely to encounter sidewalks and other pedestrian-friendly features.

Sidewalks can lead to a 65-89% reduction in crashes involving pedestrians walking along roadways.

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MORE INFORMATION

Signage

PURPOSE

Signs serve a crucial purpose in ensuring the safe and efficient movement of people and vehicles. They provide vital information regarding directions, speed limits, hazards, and regulations, aiding navigation and decision-making for drivers, pedestrians, and cyclists alike. By communicating standardized symbols and messages, signs help to establish order and predictability on roads, highways, railways, and waterways, reducing the risk of accidents and promoting smoother traffic flow. Whether indicating a sharp curve ahead or directing travelers to the nearest exit, the purpose of signs in transportation is ultimately to foster a safer, more organized, and user-friendly environment.

DESCRIPTION

Regulatory signs include those used to communicate required or prohibited movements. Flashing beacons can be used to enhance overhead and other regulatory signage, indicating to drivers and other users when the transit lane is in force. Overhead signs above transit lanes and transitways alert drivers and other street users by placing critical information about lane use in a prominent location. Dynamic signs can be used to alert other street users of approaching transit vehicles, and to regulate turns and other movements that are prohibited when transit vehicles are approaching.

APPLICABLE LOCATIONS

Signage finds application in various settings including highways, roads, and streets. They are often particularly important near intersections and busy areas.

SAFETY BENEFITS

A number of types of signs have been shown to provide safety benefits. For instance, advance yield signs have been shown to be effective in decreasing rear end and sideswipe crashes. Fluorescent curve signs have been shown to reduce crashes during nighttime and at non-intersections.

MORE INFORMATION


Primary School
0.1 MI.
1 MIN.
City Park
2.0 MI.
15 MIN.
Rail Trail
3.0 MI.
20 MIN.

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

PURPOSE

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.

DESCRIPTION

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.

APPLICABLE LOCATIONS

Stop-controlled intersections.

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.

MORE INFORMATION

Vertical Deflections

PURPOSE

Vertical deflections are traffic calming measures designed to reduce vehicle speeds and enhance safety for all road users. These measures include raised intersections, raised crosswalks, speed cushions, and speed tables. Vertical deflections force drivers to slow down, thereby reducing the likelihood and severity of crashes, especially in areas with high pedestrian activity.

DESCRIPTION

Raised Intersections: Entire intersections are elevated to the level of the sidewalk, creating a flat, raised surface that forces vehicles to slow down while also providing a safer crossing environment for pedestrians.

Raised Crosswalks: Pedestrian crossings are elevated above the roadway surface, making pedestrians more visible to drivers and encouraging vehicles to reduce speed as they approach.

Speed Cushions: Rounded, raised areas placed across the roadway, with cutouts for larger vehicles, that reduce vehicle speeds to around 15-20 mph.

Speed Tables: Longer and flatter than speed humps, speed tables can accommodate vehicles at slightly higher speeds (25-30 mph) and are often used in conjunction with pedestrian crossings.

APPLICABLE LOCATIONS

Residential areas: To control speeds and improve safety in neighborhoods.

School zones: To protect children by slowing down traffic near schools.

Urban areas with high pedestrian activity: To enhance pedestrian safety and comfort.

Roadways with documented speeding issues: To address and mitigate speed-related safety concerns.

SAFETY BENEFITS

Vertical deflections are effective in reducing vehicle speeds, which directly contributes to improved safety. Research shows that these measures can reduce crashes by 30-50%. Specifically, speed humps can reduce speeds by approximately 20-25%, and raised crosswalks and intersections can significantly improve pedestrian safety by increasing driver awareness and reducing speeds at critical crossing points.

MORE INFORMATION

Yellow Change Intervals

PURPOSE

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.

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DESCRIPTION

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.

APPLICABLE LOCATIONS

Signalized intersections

SAFETY BENEFITS

36-50% reduction in red light running
8-14% reduction in total crashes
12% reduction in injury crashes

MORE INFORMATION

List of Acronyms

SSC	-Speed Safety Camera
P2P	-Point-to-Point type of speed safety camera
AADT	-Average Annual Daily Traffic
DSMD	-Dynamic speed Monitoring Display
HFST	-High Friction Surface Treatment
ICWS	-Intersection Conflict Warning System
LPI	-Leading Pedestrian Interval
PHB	-Pedestrian Hybrid Beacon
RRFB	-Rectangular Rapid Flashing Beacon
RCUT	-Restricted Crossing U-Turn
MUT	-Median U-Turn
RSA	-Road Safety Audit

Appendix B

Survey One Summary

Survey Analysis

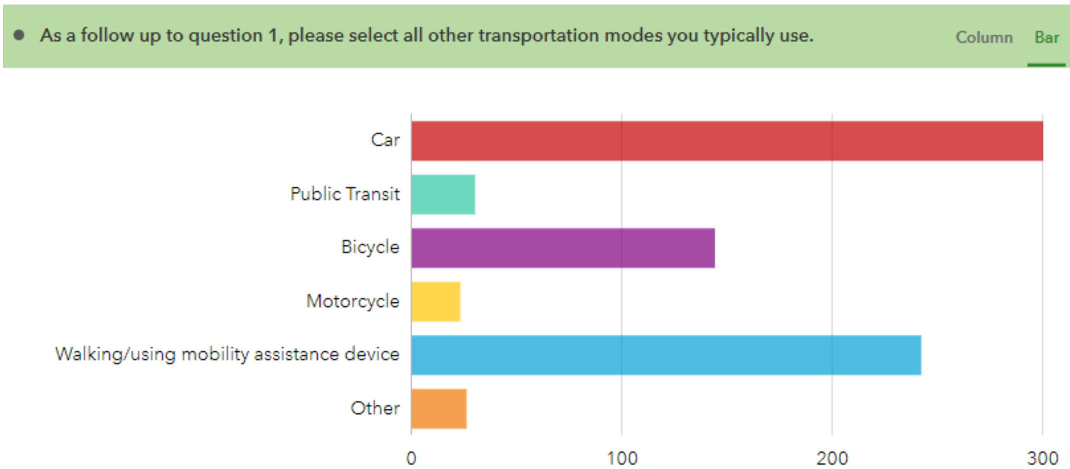
March 2024

Mobility Patterns

Modal Breakdown

The purpose of this question is to understand how area residents currently travel throughout the region.

90% of respondents' primary transportation mode is a car, 4% walking, 3% transit, and 2% bicycling. While cars remain the primary transportation mode of respondents, 34% noted that they also walk, 20% noted that they also use a bicycle, 4% use transit, and 3% use a motorcycle.

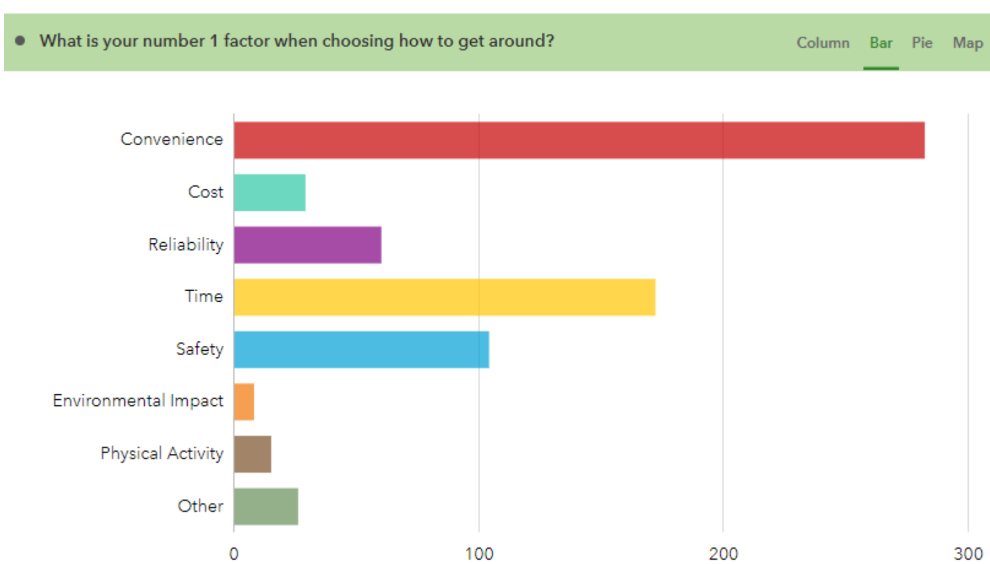


Factors Involved in Getting Around

The purpose of this question is to understand why people get around the way they do, and what the reason is that they use their primary mode of transportation.

The top three factors influencing mode choice are convenience, time, and safety. Cost and reliability were moderate factors. Environmental impact and physical activity were not significant factors, accounting for only 1-2% each.

With cars being the primary mode of transportation and convenience being the top factor involved with mode choice, people feel that it is easiest to get around the region by car.



Mobility Patterns

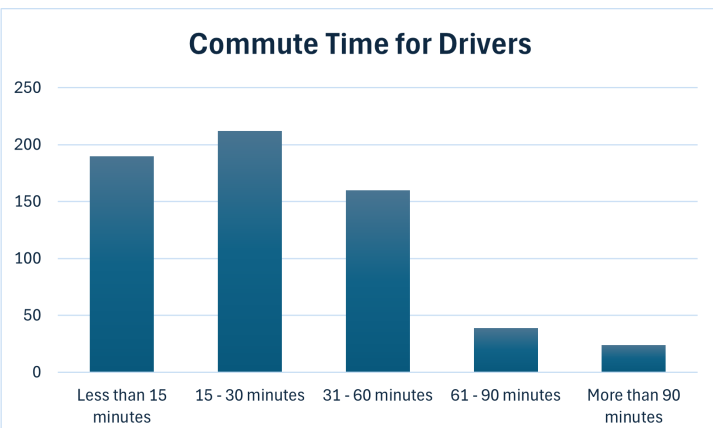
Commute Times and Trends

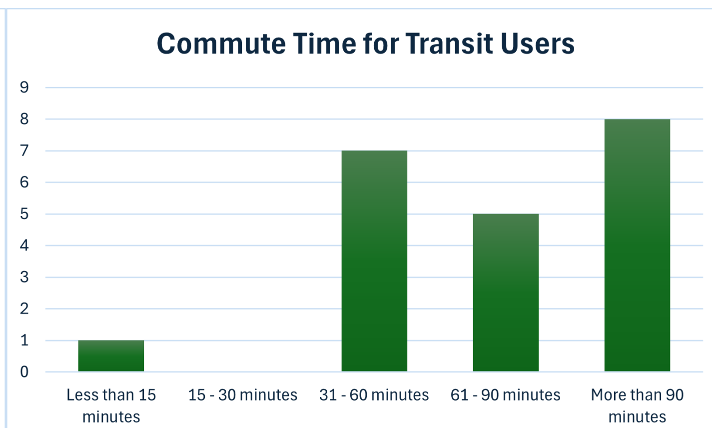
This question aims to identify how long it takes people to get to and from work each day, and whether they make any stops along the way.

About 80% of respondents have a total round trip commute time of under one hour, split fairly evenly between under 15 minutes, 15-30 minutes, and 30-60 minutes, while 7% had a commute time of 60-90 minutes and 5% of more than 90 minutes.
Additionally, about 28% of commutes involve at least one additional stop or detour, whether that may be to pick someone else up or drop someone else off, such as a child, elderly adult, or carpool passenger.

Commute Times by Mode

Breaking this data down to determine how long it takes a transit user to get to and from work versus how long it takes someone who drives a car to get to and from work is an important key to explore service metrics and potential disadvantages within the community.

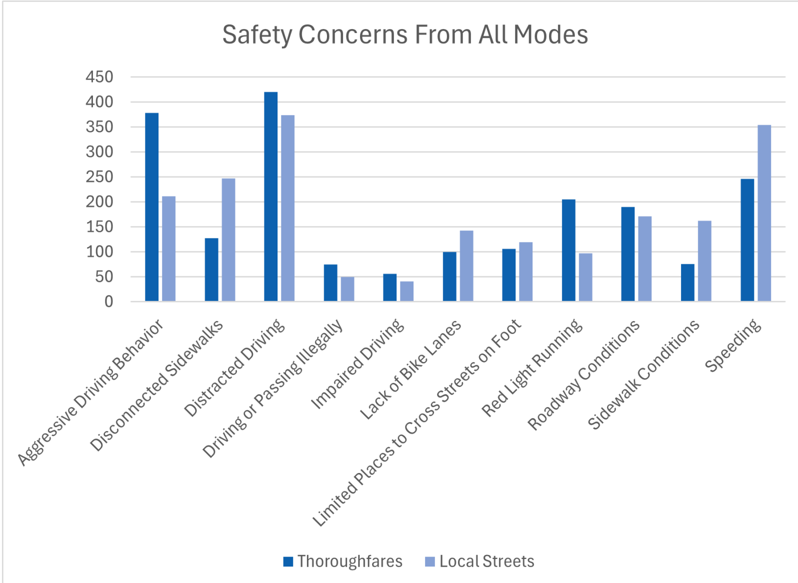




It takes public transit users significantly longer to get to and from work than it does for people who drive a car. The overwhelming majority of respondents who drive to work have a round trip commute time of under one hour, and most respondents who use transit indicated it takes 30 - 90+ minutes to get to and from work. This higher commute time can put transit users at a disadvantage, especially if they do not have any other reasonable options to get around, as they have to spend more of their day commuting and have less time to themselves.

Long transit trip times also discourage more people from using transit, which can increase the number of people who drive a car, thus increasing traffic, pollution, and noise levels.

Overall Safety Concerns on Major Thoroughfares vs Local Streets



There are both similarities and differences between safety concerns noted on major thoroughfares and local neighborhood streets. Top concerns for both were distracted driving. Aggressive driving and speeding were also major concerns for both, but aggressive driving was the 2nd-highest concern on major thoroughfares but was only the 4th-highest concern on local neighborhood streets, while speeding was the 2nd-highest concern on local neighborhood streets at 50% but only 35% noted it as a concern on major thoroughfares.

There were more pedestrian and bike-related safety concerns on local neighborhood streets than there were on major thoroughfares. Disconnected sidewalks were the 3rd-highest concern on local neighborhood streets, with 35% of respondents noting it as a concern, while roughly half noted it as a concern on major thoroughfares. Additionally, lack of bike lanes, limited places to cross streets on foot, and sidewalk conditions all had more selections on local neighborhood streets than they did on major thoroughfares.

This demonstrates that there may be more people walking and biking on local neighborhood streets, thus more people noticing poor walking and biking conditions. At first glance, it might be assumed that there are better walking and biking conditions on major thoroughfares, but this result may be simply because there are fewer people walking and biking along major thoroughfares and therefore fewer people noticing poor conditions. It could also suggest that walking and biking conditions are poor enough that many don't even attempt to walk or bike on major thoroughfares and avoid them entirely. This may also be a reason why speeding is more of a concern on local streets, because the presence of more pedestrians and bicyclists makes it a bigger concern.

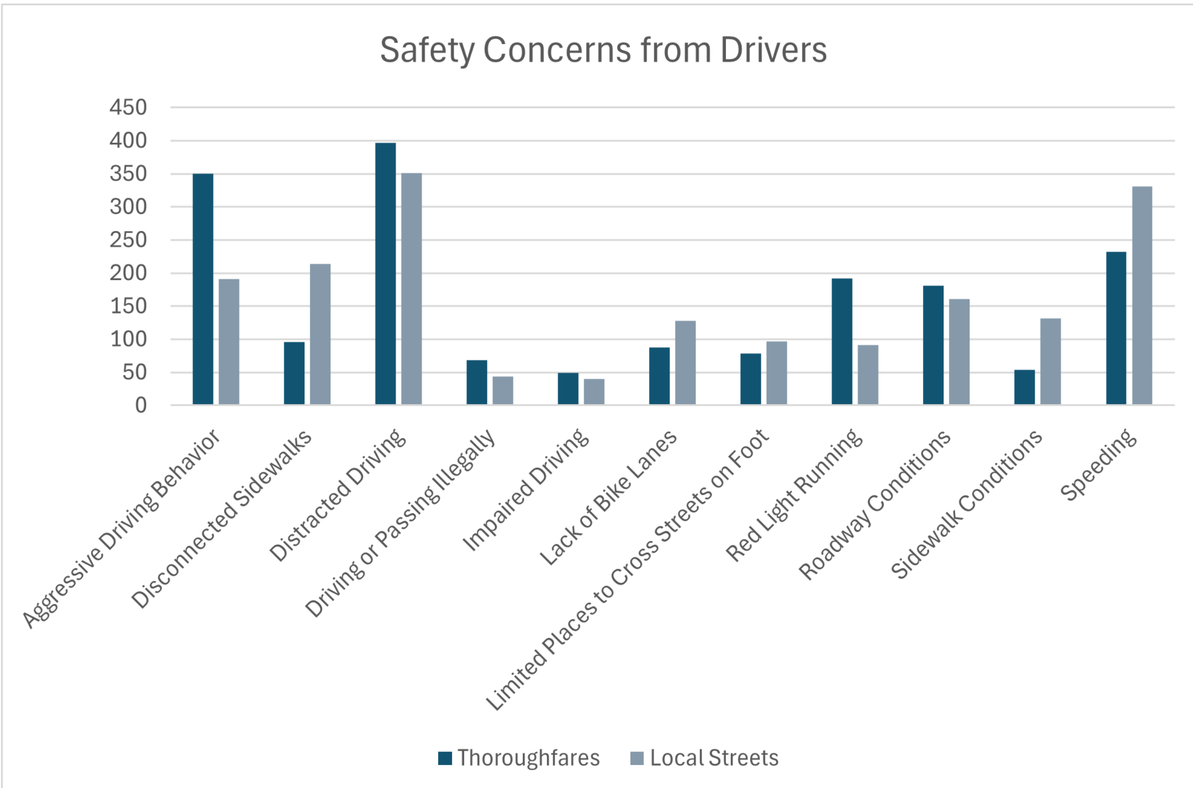
Included below is an additional analysis of these safety concerns by transportation mode to identify differences in perceived safety issues that may be covered up if a modal breakdown is not included.

Safety Concerns & Issues

Safety Concerns on Major Thoroughfares vs Local Streets by Mode

Breaking down respondents' noted safety concerns based on each respondent's primary mode of transportation identifies key differences in the perception of safety for people who travel via different modes of transportation.

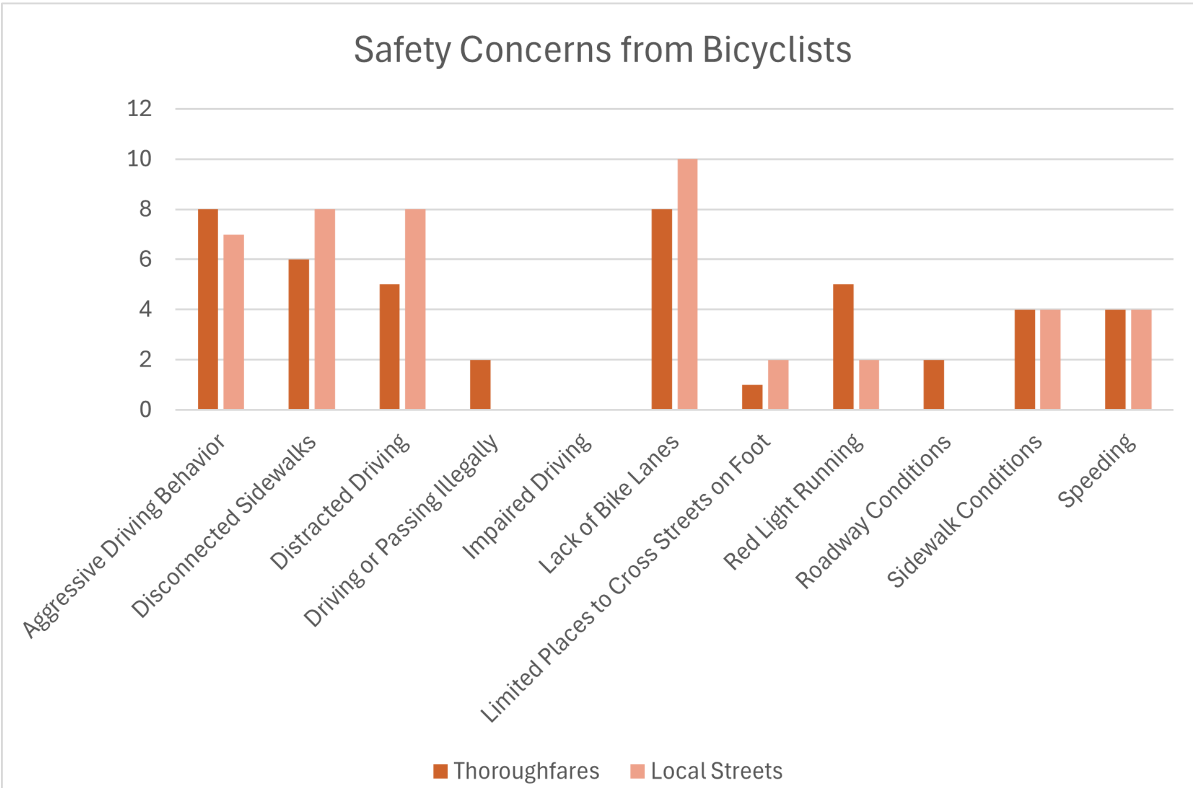
Safety Concerns from Drivers



The top three concerns noted by drivers were aggressive driving, distracted driving, and speeding. Disconnected sidewalks were also a larger concern on local neighborhood streets, again signifying a potential increase of pedestrian activity on local streets versus major thoroughfares.

Generally, drivers noted safety concerns that are easily observable from a driver's perspective, that is, dangerous actions of other drivers. That may also explain why some concerns such as roadway conditions are of more importance to drivers than sidewalk conditions.

Safety Concerns from Bicyclists



Bicyclists' top three concerns were a lack of bike lanes, aggressive driving, and disconnected. Disconnected sidewalks and distracted driving were also noted as a larger concern on local neighborhood streets.

As the primary user of bike lanes, bicyclists notice when safe and separated facilities do not exist. Additionally, bicyclists are more impacted when separated cycling infrastructure is not present on a roadway. Bicyclists may also be susceptible to disconnected sidewalks.

Since bicyclists have very limited physical protections when biking and interacting with vehicles, it is also understandable why both aggressive driving and distracted driving are of high concern, since these can put bicyclists at higher risk of being struck by a driver and leading to severe injury and death. A protected bike network can help to both improve safety and comfortability for bicyclists but also encourage more people to bike because it is safer and more comfortable.

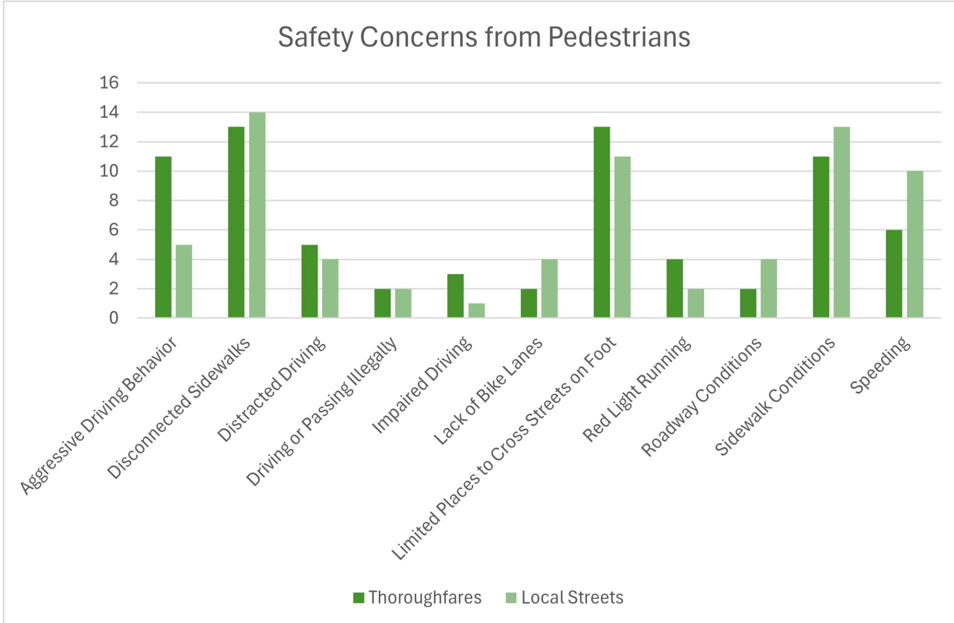
Safety Concerns & Issues

Safety Concerns from Pedestrians and Public Transit Users

Pedestrians and public transit users both had very similar safety concerns.

Disconnected sidewalks, limited places to cross streets on foot, and sidewalk conditions were both groups' top three safety concerns.

This similarity is likely since most transit users are also pedestrians as they walk to and from bus stops.



Of note, transit users' top concern on major thoroughfares is limited places to cross streets on foot.

As many bus routes run along major thoroughfares, transit users have difficulty crossing these major roads when walking between the bus stop and their trip origin or destination.

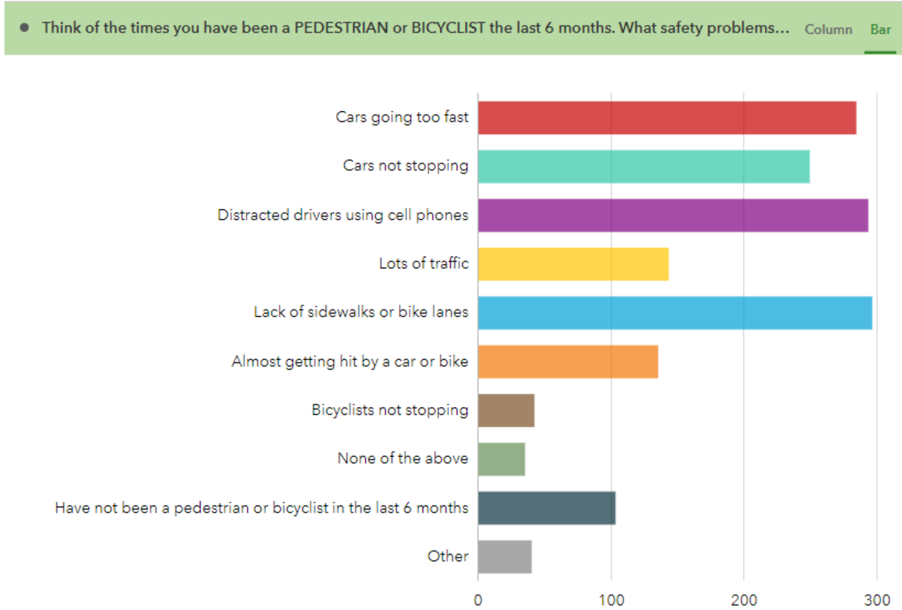
Overall, respondents noted safety concerns that are most applicable to their primary mode of transportation. For example, pedestrians concerned about sidewalks and crossing streets, bicyclists concerned about bike lanes, and drivers concerned about distracted driving, aggressive driving, and speeding, and generally less concerned with bike and pedestrian-related infrastructure and safety concerns, since drivers either do not notice issues with bike and pedestrian infrastructure since they are inside a vehicle instead, or just because it feels like it doesn't affect them.

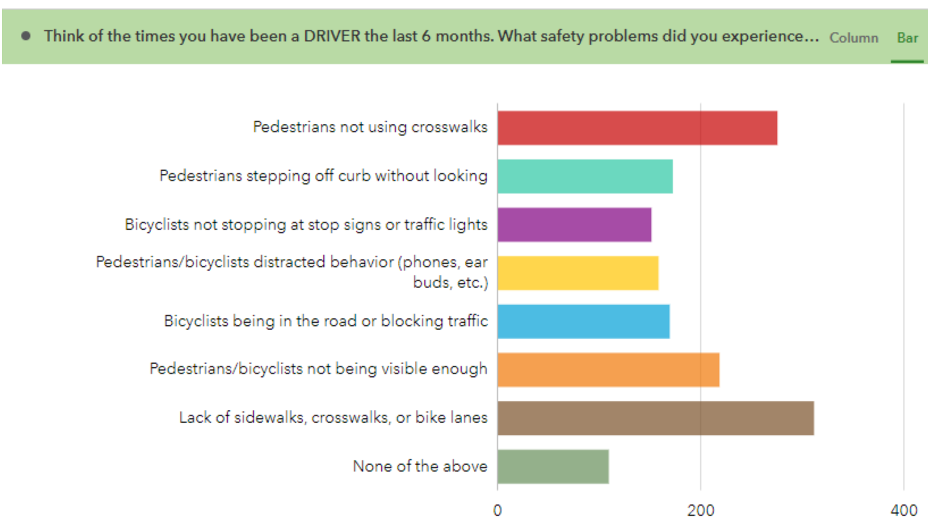
Safety Concerns & Issues

Observed Safety Problems

This question identifies what safety problems people have seen or experienced when using the transportation network.

Top safety problems noted as pedestrians and bicyclists include cars going too fast, cars not stopping, distracted driving, and a lack of sidewalks. Each were noted by at least 35% of participants.





Top safety problems noted as drivers were a lack of sidewalks, crosswalks, or bike lanes (44%), pedestrians not using crosswalks (39%), and pedestrians/bicyclists not being visible enough (31%).

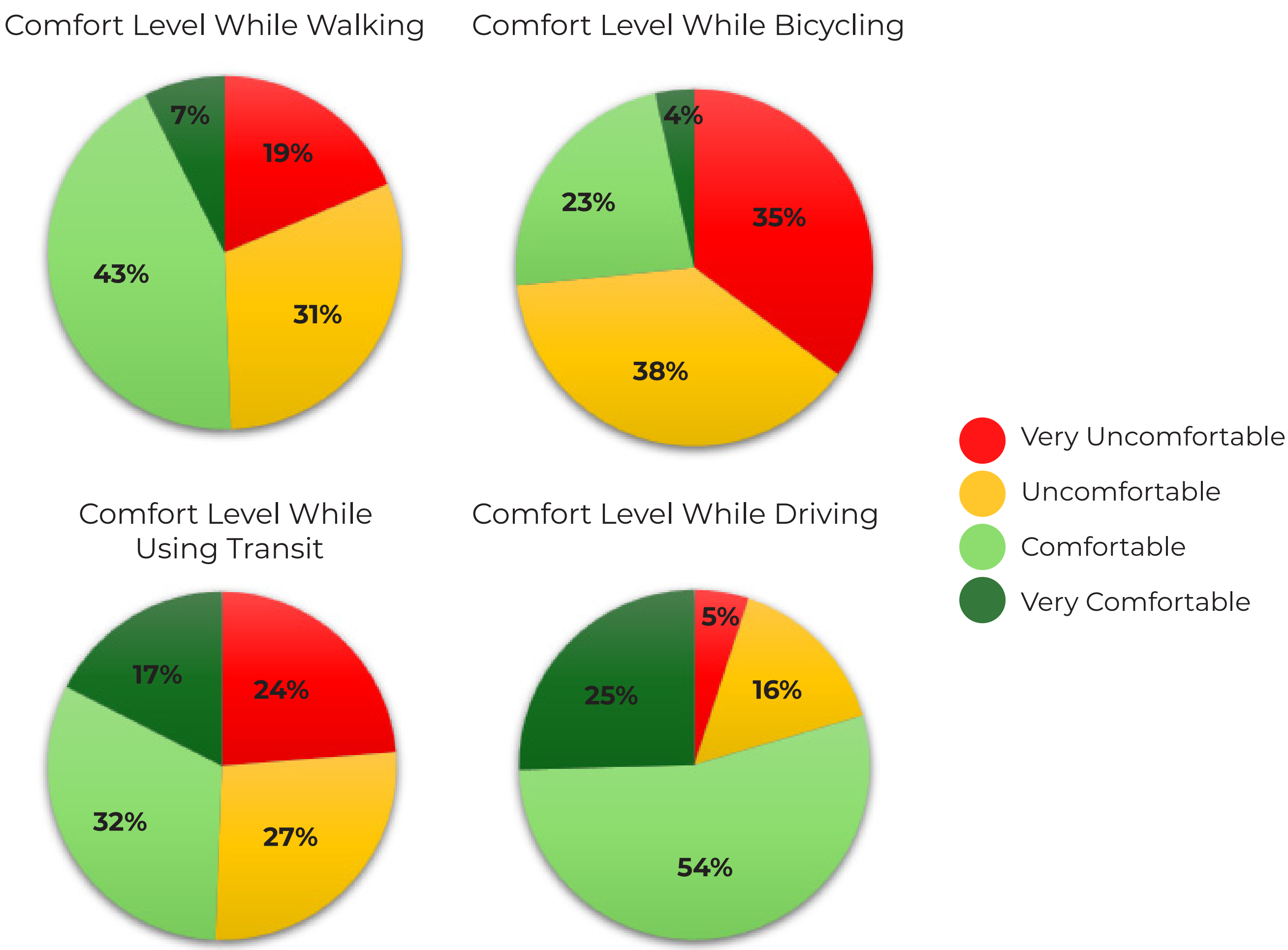
Other selection options each had 20-25% of respondents select them, including pedestrians stepping off curb without looking, bicyclists not stopping at stop signs/traffic lights, pedestrians/bicyclists distracted behavior, and bicyclists being in the road or blocking traffic.

The most frequently selected concerns and observations in this question suggest that drivers have noticed and recognized that there is often not sufficient bike and pedestrian infrastructure in place, and that it is not the fault of the person walking or biking. For example, pedestrians not using crosswalks and bikes being in the road or blocking traffic are both results that stem from a lack of sidewalks, crosswalks, or bike lanes, which was the most frequently selected concern in this question. A pedestrian might not use a crosswalk because there aren't enough crosswalks conveniently located for pedestrians, and a bicyclist might be in the road because they are provided with no other options.

Comfortability by Mode

This question aims to breakdown how comfortable or uncomfortable people are when traveling by different modes, in part to gauge both perceived and actual safety levels by mode.

50% of people who walk said they are comfortable or very comfortable and 50% are uncomfortable or very uncomfortable while walking.
74% of people who bike said that that are either uncomfortable or very uncomfortable when biking.
80% of people who drive said that they are comfortable or very comfortable when driving.
74% of people who use a motorcycle are either uncomfortable or very uncomfortable.
50% of people who use transit are uncomfortable, and 50% are comfortable.
60% of people who use rideshares are comfortable.



Respondents are most comfortable when driving, split about 50/50 when walking or taking transit, and are least comfortable when bicycling. Road users not in a car are generally more vulnerable than those in a vehicle, as they lack physical protections that vehicle occupants have, and have both a lower perceived level of safety and actual level of safety. That is, road users not in a car both feel more unsafe and are more unsafe. Our transportation infrastructure must be designed in a way that not only makes people feel safer, but actually makes them safer as well.

Safety Concerns & Issues

Factors to Increase Safety for All Road Users

Respondents were asked to rank the importance of five statements in an effort to determine what safety improvement strategies are both preferred by the public as well as which ones they believe are most effective.

The order of these statements is listed below, with the top statement having the highest average ranking in terms of importance.

Improve safe streets design to design roads that support all road users, including drivers, pedestrians, bicyclists, and transit. *(4.11/5)*

Promote safe speeds and reduce drive speeds to reduce injury severity for all road users. *(3.2/5)*

Support communities to plan for safe streets and public areas. *(3.08/5)*

Expand awareness of safe walking, biking, and rolling. *(2.69/5)*

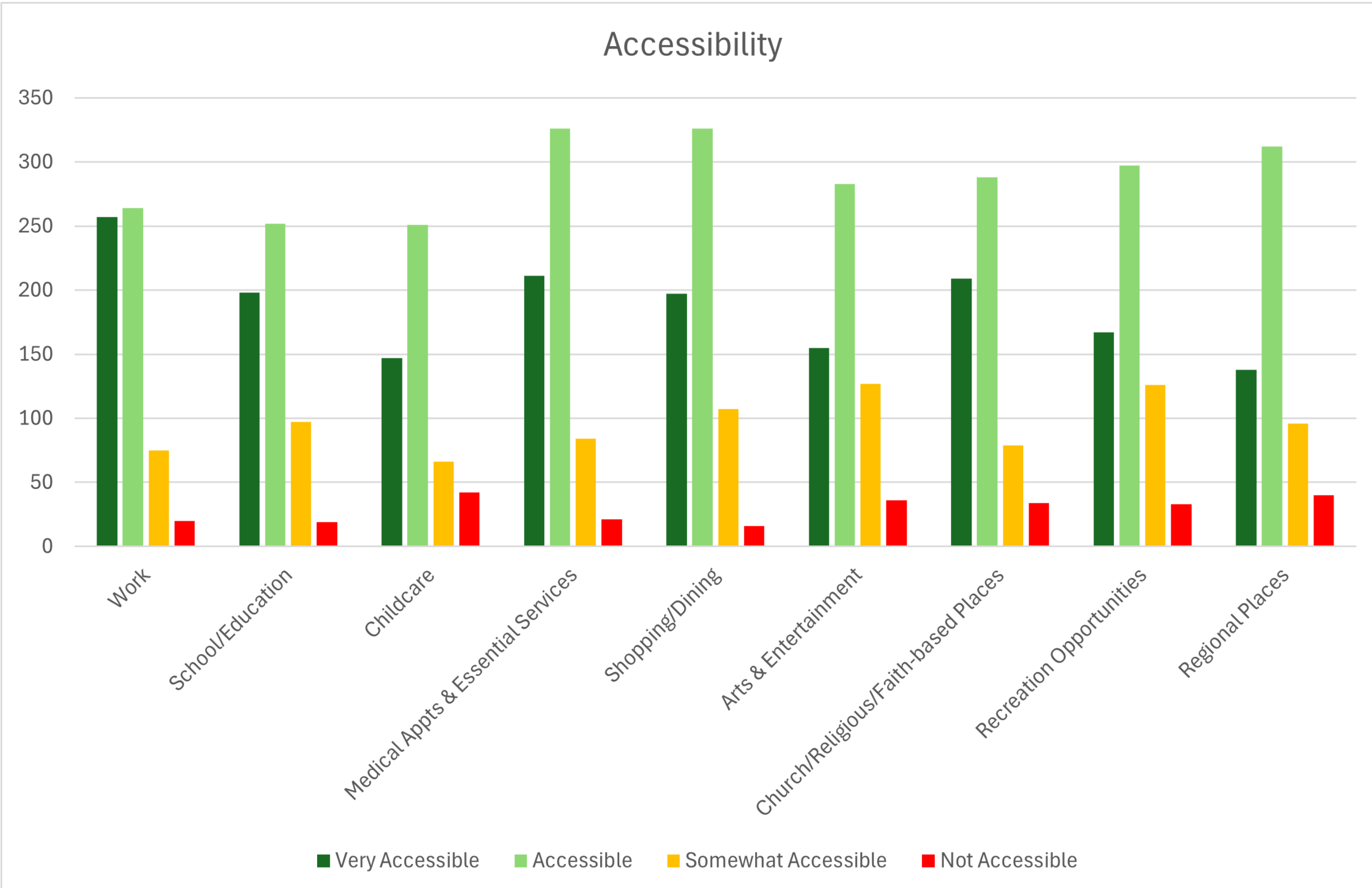
Provide physical and emotional care to crash survivors and their families. *(1.93/5)*

Respondents indicated a preference for design and infrastructure changes to improve safety more than awareness and public relations campaigns to reduce speeds.

This demonstrates that the community is aware that the way our transportation network is designed is the key component of determining safety and aspects like driver behavior. Infrastructure that safely and comfortably includes all road users will likely have a more impactful outcome of improving safety than solely trying to better educate people on safety practices without also including infrastructure changes.

Accessibility of Destinations via Primary Mode of Transportation

The purpose of this question is to understand how accessible different community aspects are to residents, and what perceived levels of accessibility are.



Respondents generally noted that most destinations were accessible or very accessible via their primary mode of transportation. Some destinations that saw slightly higher selections of “Somewhat Accessible” or “Not Accessible” were Arts & Entertainment, Recreation Opportunities, and Childcare. Places like Work, Medical Appts & Essential Services, and Shopping/Dining generally were considered as more accessible by respondents.

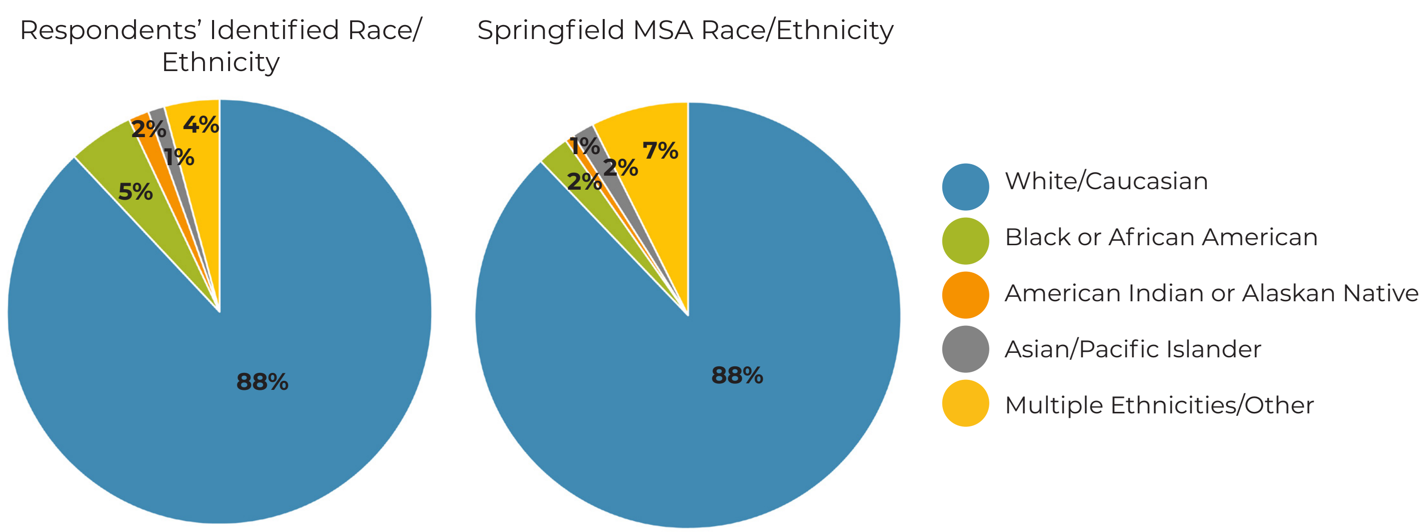
Since cars are the primary mode of transportation in the region and most people are traveling by car, this is likely why there is a high overall perception of accessibility to destinations within the region.

Demographic Information

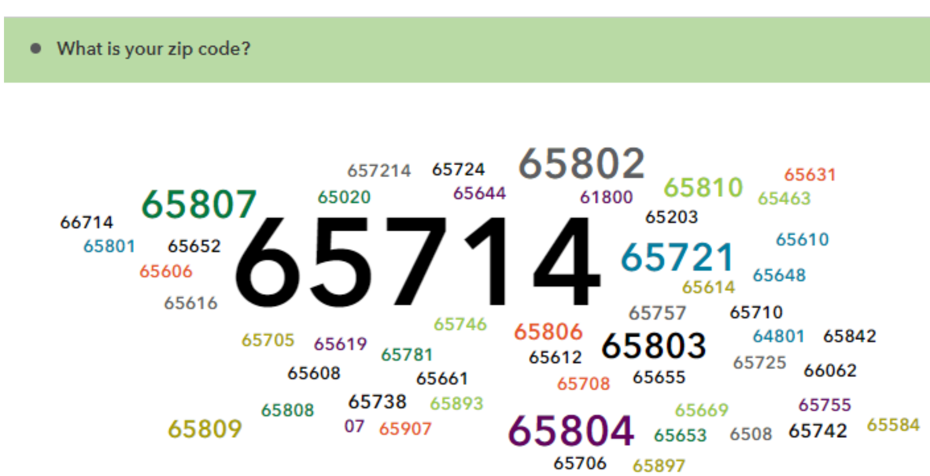
A combined 3/4 of respondents are over the age of 35, something of note to understand that the younger population groups may be underrepresented in the survey sample size. Keeping in mind that some respondents preferred not to answer some demographic questions, about 49% of respondents were female and 45% were male.

About 92% of respondents own or otherwise have reliable to a vehicle, while 8% do not. Approximately 6% of households in the Springfield metro area do not have access to a reliable vehicle, per the 2022 American Community Survey.

Not including those who declined to respond, about 88% identified as White/Caucasian, 5% as Black or African American, 2% as American Indian or Alaskan Native, 1% as Asian/Pacific Islander, and 4% identified with multiple ethnicities or other. These results are roughly in line with the Springfield metro area as a whole as provided by the 2020 US Census, and a comparison is shown in the pie charts below.



Most respondents live in the 65714 zip code (Nixa). While this may show overrepresentation of Nixa residents, it is also important to note that Springfield is split between several zip codes.



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Appendix C
Engagement Summary

TO BE INCLUDED ONCE RECEIVED

Appendix D
Implementation Plan Summary

The Implementation Plan items included in Appendix D-1 through D-5 were produced by OTO's Safety Engineering Consultant. References in the Summary Report may reference Appendices with Letters different than those found in this plan. Here is a guide for those changes:

Implementation Plan Appendix Letter	OTO Appendix Letter
Appendix A (Safety Toolkit)	Appendix A
Appendix B (Policy Process)	Appendix D-1
Appendix C (Systemic Safety Analysis)	Appendix D-2
Appendix D (Project Prioritization)	Appendix D-3
Appendix E (Implementation Matrix)	Appendix D-5
Appendix F (Tier 1 Projects)	Appendix D-4

Destination Safe Streets – Implementation Framework

Prepared By: Lochmueller Group

For: Ozarks Transportation Organization (OTO)

September 2024

TABLE OF CONTENTS

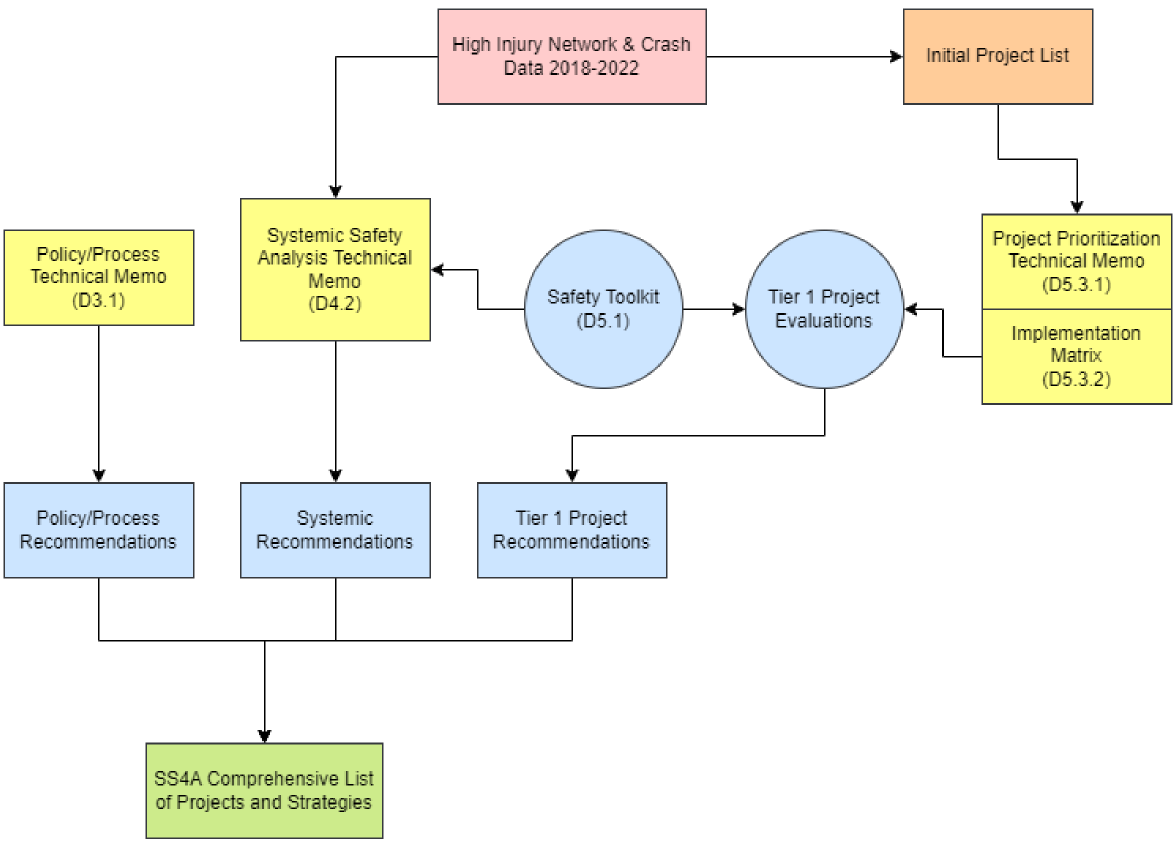
LIST OF APPENDICES

INTRODUCTION

The Ozarks Transportation Organization (OTO) Safety Action Plan, “Destination Safe Streets”, is a commitment to reducing fatal and serious injury crashes and improving roadway safety for all users. The Destination Safe Streets Implementation Plan is a collection of projects and strategies, based in the Safe System Approach and developed through a data-driven approach. This implementation framework organizes and describes the various elements of the Implementation Plan including:

- Safety Toolkit
- Projects and Strategies
    - Policy/Process Evaluation
    - Systemic Projects
    - Site-Specific Projects
- Safe Streets and Roads for All (SS4A) Comprehensive List of Projects and Strategies

The Implementation Plan is one component of the Destination Safe Streets Safety Action Plan. Together with other components such as engagement and collaboration, equity considerations, safety analysis, and Advisory Committee guidance, Destination Safe Streets will be a comprehensive, strategic, and actionable plan that prioritizes roadway safety for all users.



SAFETY TOOLKIT

Implementing evidence-based countermeasures can significantly improve the safety and inclusivity of transportation networks, fostering a more secure environment for everyone in the community. The Safety Toolkit (Appendix A) provides a list of proven safety countermeasures that can be implemented throughout the region to improve safety for all roadway users. For each safety countermeasure, general guidance is provided and includes the purpose and a description of the countermeasure, applicable locations, expected safety benefits, and additional design considerations. Guidance for each safety countermeasure also includes targeted users (vehicles, bicycles, pedestrians, wheelchair users) and a planning level cost estimate. Safety countermeasures that are appropriate for systemic applications are noted. Finally, links to related research and national best practices are provided where appropriate.

PROJECTS AND STRATEGIES

The Destination Safe Streets projects and strategies were developed in three categories: policy/process recommendations, systemic projects, and site-specific projects. Together, these recommendations constitute the SS4A Comprehensive List of Projects and Strategies as defined and required by the SS4A grant program.

Policy/Process Evaluation

New and/or updated policies, procedures, and programs are important strategies to improve safety outcomes for all users throughout the region. Following an assessment of existing policies and procedures, policy and program recommendations are tailored to specific needs within OTO while also considering national best practices. Each recommended strategy is a starting point from which municipalities can begin working, along with their partners, to adjust and implement policies. The evaluation process is documented in the Policy/Process Technical Memo (Appendix B).

Systemic Project Evaluation

The purpose of the systemic safety analysis is to evaluate the risk of roadway characteristics, identify locations with the greatest risk of fatal and serious injuries, and to develop systemic safety countermeasures to improve safety outcomes throughout the network. The systemic safety analysis includes the development of risk factors based on fatal and serious injury crashes at high injury analysis locations, the identification of high-risk roadway features, and a regional risk assessment and risk index score for all roadways. To mitigate the effects of high-risk features along roadways throughout the OTO region, a systemic application of safety countermeasures is listed to mitigate risk and address the most frequently occurring fatal and serious injury crash types. The evaluation process is documented in the Systemic Safety Analysis Technical Memo (Appendix C).

Site-Specific Evaluation

Initial Project List

The site-specific evaluation begins with the initial project list of over 200 project locations. The initial project list was developed from the following sources:

- Unfunded STIP safety priority locations
- High Injury Network (HIN) locations
- Locations identified by OTO member agencies
- Locations identified by the public via the survey and public meetings

Prioritization Process

The prioritization process is outlined in the Project Prioritization Technical Memo (Appendix D). The project prioritization process assigns all 202 project locations with data elements and prioritization criteria. Prioritization criteria were developed with guidance from the Advisory Committee and OTO. Each prioritization criterion was assigned a point value to reflect the relative importance of the criterion. For each project location, a priority score was calculated to serve as the quantitative element of the prioritization process with higher priority scores representing projects with higher quantitative priority.

Table 1 - Project Prioritization Criteria

Prioritization Criteria	***Ranking***	***Measurement***	***Point Value Assigned***
Number KSI Crashes	#1	If greater than the mean (≥5)	6 pts
High Injury Network (HIN)	#2	If yes	5 pts
Number Fatal Injuries	#3	If greater than the mean (≥1)	4 pts
Number Serious Injuries	#4	If greater than the mean (≥5)	3 pts
STIP Priority	#5	If yes	2 pts
Public Input	#6	If yes	1 pt

In addition to the quantitative evaluation, a qualitative component was also incorporated into the prioritization process. OTO and the Advisory Committee intended to identify a set of priority project locations that represent diversity by reviewing the following qualitative elements for each project location:

- Disadvantaged communities
- Urban and rural locations
- Roadway segments and intersections
- Pedestrian and bicycle improvements
- OTO member agencies

The result of the prioritization process is the Implementation Matrix, encompassing all tiered projects.

Implementation Matrix

The Implementation Matrix (Appendix E) is the prioritized and tiered project list. All 202 project locations are placed into one of three tiers based on the results of the prioritization process and guidance from the Advisory Committee.

Table 2 - Implementation Matrix Data Elements

Element	Description
Project Location	Description of project location
Location Type	Segment, intersection, or bicycle/pedestrian
System (State/Local)	Roadway owned/maintained by the State or Local agency
HIN	Located on the High Injury Network (yes/no)
CEJST Disadvantaged	Located within a disadvantaged community (yes/no)
Municipality (Geographic)	Municipality project is located
Urban Rural	Located in Urban or Rural area
STIP Priority	Identified from the STIP priority list (yes/no)
Timeframe	Timeframe to develop and implement improvements (short/mid/long)
Public Input	Identified from public input (yes/no)
Local Agency Input	Identified by OTO member agency (yes/no)
Number of KSI Crashes	Number of KSI crashes at location (2018-2022)
Number of Fatal Injuries	Number of fatal injuries at location (2018-2022)
Number of Serious Injuries	Number of serious injuries at location (2018-2022)
KSI	Number of KSI crashes prioritization criteria point value (6/0)
HIN	HIN prioritization criteria point value (5/0)
Fatal Injuries	Number of fatal injuries prioritization criteria point value (4/0)
Serious Injuries	Number of serious injuries prioritization criteria point value (3/0)
STIP Priority	STIP prioritization criteria point value (2/0)
Public Input	Public input prioritization criteria point value (1/0)
Priority Score	Total priority score (0-21)
Tier	Priority tier (0/1/2)

Tier 0 Projects

Tier 0 projects are locations that earn a high priority score and have already been studied for future safety improvements. All of these projects are on the State system under Missouri Department of Transportation (MoDOT) jurisdiction. Because these locations have been identified and studied by MoDOT for improvements, they are not considered high priority for action by OTO or its member agencies. There are 10 Tier 0 project locations.

Tier 1 Projects

Tier 1 projects are locations with the highest safety priority in the OTO region. Tier 1 projects were identified through the prioritization process and collectively represent the OTO member agencies, disadvantaged communities, and a mix of urban and rural locations, state and local routes, segments and intersections, and pedestrian/bicycle improvement needs. Tier 1 projects were further evaluated to assess existing roadway characteristics and crash history to developed location specific safety countermeasures. The 21 Tier 1 projects and associated recommendations are documented in the Tier 1 Project Recommendations Technical Memo (Appendix F).

Tier 2 Projects

Tier 2 projects are the remaining locations found in the Implementation Matrix and were evaluated through the prioritization process. While not determined to be high priority locations, Tier 2 projects merit inclusion in the Implementation Matrix and can be subject to future project development if funding becomes available and/or local priorities change. There are 171 Tier 2 projects, categorized as secondary priorities.

SS4A COMPREHENSIVE LIST OF PROJECTS AND STRATEGIES

The SS4A Comprehensive List of Projects and Strategies are identified and detailed in previous sections of the Implementation Plan and are summarized below. The SS4A Comprehensive List of Projects and Strategies satisfies the requirements of the SS4A grant program[1] and represents the immediate priorities in the OTO region to address the safety problems throughout the region.

Site-Specific Projects (Tier 1 Locations)
MO-13/Kansas Expressway (Evergreen St to Division St)
MO-13/Kansas Expressway (Division St to Chestnut Ex)
MO-13 (Norton Rd to Route WW)
MO-13 and Division St Intersection
Route 14 (14th St to Route W)
Route 125 (Route D to US 60)
Kearney St and National Ave Intersection
US 160 and Farm Road 123 Intersection
US 160 (Route 14 to OTO Boundary)
Route AB (US 160 to Route EE)
Route CC (US 160 to US 65)
Route FF (Republic Rd to Weaver Rd)
Glenstone Ave (Valley Water Mill Rd to Evergreen St)
Grant Ave (College St to Kearney St)
Tracker Rd (Nicholas Rd to US 160)
National Ave (Chestnut Ex to Kearney St)
Grand St (Kansas Ex to Glenstone Ave)
Division St (Kansas Ex to Sherman Ave)
Sunshine St (Kansas Ex to Campbell Ave)
Hines St (Oakwood Ave to Route ZZ)
S Campbell Ave (Battlefield St to Republic Rd)

**Tier 0 and Tier 2 projects are found in the Implementation Matrix*

[1] SS4A Self-Certification Eligibility Worksheet, last updated February 20, 2024.

Systemic Projects (High-Risk Locations)
Grant Avenue
Battlefield Street
Chestnut Expressway
Division Street
Glenstone Avenue
Kearney Street
MO-14 (Nixa and Ozark)
National Avenue
Republic Street
S Campbell Avenue
Sunshine Street
US-61 (Republic)

Systemic Projects (High-Risk Roadway Features)		Risk Factor
Intersection Type	Signalized Intersection	6.1
Functional Class	Minor Arterial	1.8
	Principal Arterial	1.8
Shoulder Type	Aggregate	4.8
	Asphalt	1.2
	Curb and Gutter	1.4
	Earth	1.6
Shoulder Width	1ft	2.3
	2ft	1.5
	3ft	1.1
	4ft	1.5
Number of Lanes	3 lanes	2.1
	4 lanes	1.8
Median Access Control	Undivided	1.4
Horizontal Curvature	Class 4	1.5
Multimodal Activity	Yes, within ¼ mile of multimodal facility	1.2
Area Type	Urban	1.1
MoDOT Roadway Type	3 Lane Section	1.4
	5 Lane Section	1.5
	Expressway	1.1
	Two Lane	1.2

**More information on appropriate countermeasures are found in the Systemic Safety Analysis Technical Memo.*

Policy Recommendations
Develop or update ADA Transition Plans (when required by the public entity)
Adopt a Complete Streets policy
Develop guidance to utilize OTO's Social Equity Index data
Develop guidance to utilize OTO's crash and High Injury Network data
Establish Safe Routes to School programs in combination with developing a toolbox of traffic calming strategies for school zones
Partner with law enforcement agencies for targeted enforcement efforts
Utilize transportation educational campaign materials provided by USDOT

Appendix D-1
Policy Process

MEMO

To: Natasha Longpine, OTO

From: Lochmueller Group

Date: September 26, 2024

Subject: OTO Safety Action Plan Policy and Process Review

Introduction

The Ozarks Transportation Organization (OTO) Safety Action Plan will include a diverse set of recommendations to comprehensively address roadway safety and reduce fatal and serious injury crashes in the region. New and/or updated policies, procedures, and programs are important strategies to improve safety outcomes for all users throughout the region. Following an assessment of existing policies and procedures, policy and program recommendations are tailored to specific needs within OTO while also considering national best practices. Each recommended strategy is a starting point from which municipalities can begin working, along with their partners, to adjust and implement policies.

Assessment of Policies & Processes

OTO member agencies were surveyed to determine if each has "a policy, plan, guideline, standard, or other formalized process that addresses" the topics identified in Table 1. Examples of formalized documentation include project selection procedures, design guidelines, speed management policies, and performance management processes.

The 15 topics identified in Table 1 are related to vulnerable road users (VRU) and transportation safety, and it is not required that agencies have or adopt policies addressing each. Rather, the assessment is to collectively gauge policy and procedural influence on safety decision-making across the metropolitan planning area.

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TABLE 1. POLICY AND PROCESS ASSESSMENT TOPICS

TOPIC	DESCRIPTION A policy, plan, guideline, standard, or other formalized process that addresses:
ADA Transition Plan	Pedestrian infrastructure improvements with respect to Americans with Disabilities Act (ADA) compliance
Complete Streets	Roadway design for all users
Educational Campaigns	Educational efforts regarding unsafe driving behavior and/or awareness of vulnerable road users
Equity	Funding dedication specifically for roadway safety projects in underserved and disadvantaged areas
Funding	Funding dedication specifically for roadway safety; vulnerable road users, etc.
Land Development	Incorporation of roadway safety and/or multimodal access standards into development review process for new developments
Narrow Lanes	Roadway lane widths (could be part of Complete Streets policy)
Performance Management	The annual tracking of fatal and serious injury crashes and safety projects; annual public updates; an entity to review fatal/serious injury crashes
Project Selection	Improvement project prioritization based on proven safety countermeasures and/or safety for vulnerable road users
Roundabout Pedestrian Crossings	Pedestrian crossings at roundabouts
Safe Routes to School (SRTS)	Partnering with school districts to develop Safe Routes to School programs
School Zones	Traffic calming strategies and deployments in school zones
Speed Limits	Consistent speed limits are set on similar roadways throughout the region
Speed Management	A means for residents to formally request speed humps/bumps/cushions, signage, or other traffic calming features to reduce vehicle speeds
Traffic Operations	Levels of Service (LOS) along urban/high-pedestrian corridors

Table 2 summarizes the responses from all nine OTO members, categorizing each as yes, no, or partial.

If a member has a formalized policy, it was assigned the “yes” designation. If a member does not have a formalized policy, or one could not be readily identified, it was assigned “no” designation. If a member has a tangentially related policy, it was assigned a “partial” designation, and descriptions of the five “partial” designations are as follows:

- *Roundabout Pedestrian Crossings* – Greene County noted that pedestrian crossing incorporation at roundabouts is determined by the project designer and that, in most cases, Greene County does not desire additional or large amounts of right-of-way to accommodate pedestrian crossings at roundabouts.
- *Speed Management* – Ozark utilizes a form for traffic sign installations and replacements, which represents one aspect of a comprehensive speed management program.
- *SRTS* – Springfield has dedicated manuals for school crossings, but they do not incorporate all aspects of a SRTS program.
- *Educational Campaigns* – Springfield's Public Works Department has a focused pedestrian safety program called "SGF Yields" but the program does not cover additional aspects of roadway safety.
- *Educational Campaigns* – The Republic Police Department engages in sharing roadway safety tips with the public through social media but does not maintain a policy formalizing such efforts.

TABLE 2: POLICIES IDENTIFIED BY OTO MEMBERS

TOPIC	OTO Member Agency								
	County		City						
	Christian	Greene	Battlefield	Nixa	Ozark	Republic	Springfield	Strafford	Willard
ADA Transition Plan	No	Yes	No	No	Yes	Yes	Yes	No	No
Complete Streets	No	No	Yes	No	No	No	Yes	No	No
Educational Campaigns	No	No	No	No	No	Partial	Partial	No	No
Equity	No	No	No	No	No	No	No	No	No
Funding	No	Yes	No	Yes	Yes	Yes	Yes	No	No
Land Development	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Narrow Lanes	Yes	Yes	No	No	No	Yes	No	No	No
Performance Management	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Project Selection	No	Yes	No	Yes	No	Yes	No	No	No
Roundabout Pedestrian Crossings	No	Partial	No	No	No	No	No	No	No
Safer Routes to School (SRTS)	No	Yes	No	No	No	No	Partial	No	No
School Zones	Yes	No	No	No	No	No	Yes	No	No
Speed Limits	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Speed Management	No	No	No	No	Partial	Yes	Yes	No	No
Traffic Operations	No	No	No	No	No	No	No	No	No

The information gleaned from the OTO member policy and process assessment was utilized to identify opportunities to affect and improve roadway safety for all users.

Topics by Emphasis Areas

Guided by the policy and process assessment and public engagement activities, the 15 topics were grouped into seven emphasis areas. Collectively, the emphasis area topics form the seven identified policy and process recommendations to improve roadway safety for all users throughout the OTO region. Resources are identified for each topic to support and guide the implementation of the identified recommendations.

Americans with Disabilities Act (ADA) Compliance

The Americans with Disabilities Act (ADA) is a federal civil rights law that prohibits discrimination against people with disabilities in everyday activities, and it guarantees that people with disabilities have the same opportunities as everyone else to enjoy employment opportunities, purchase goods and services, and participate in state and local government programs[1].

Furthermore, the updated Public Right of Way Accessibility Guidelines (PROWAG) were finalized on August 8, 2023. Identifying and inventorying accessibility barriers and non-compliances that exist within a transportation network enable agencies to prioritize and incorporate needed improvements into projects.

ADA Transition Plan

An effective means to document such needs is with an ADA Transition Plan[2], which is required for agencies with 50 or more employees and solidifies a community's effort to improve accessibility. A plan also acts as a tool to assess, document, and monitor locations for ADA compliance.

The FHWA provides comprehensive guidance and resources for communities to address ADA compliance when undergoing roadway and transportation projects, and a guide to best management practices for ADA Transition Plans is available for use.

RECOMMENDATION #1

Develop or update ADA Transition Plans (when required by the public entity).

The 2023 update to PROWAG is an ideal trigger to update, or implement, transition plans where they are required to be established. To aid in the development or update of a transition plan, FHWA provides an overview and self-evaluation basics for agencies. FHWA also recommends suggests the City of Rancho Cordova transition plan as an example document.

Complete Streets

A variety of safety concerns regarding bicyclists and pedestrians were noted in the public survey for OTO residents, and Complete Streets is a holistic approach to roadway planning and design, encompassing all types of road users (pedestrians, bicyclists, motorists, and transit users of all ages and abilities) and encouraging safety and inclusion.

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[1] https://www.ada.gov/topics/intro-to-ada/
[2] https://highways.dot.gov/civil-rights/programs/ada/ada-transition-plans-memoranda

Complete Streets

Smart Growth America and the National Complete Streets Coalition identify a Complete Streets Policy Framework, which lists ten ideal elements of a policy establishing including a vision and commitment, addressing all projects and phases, allowing only for clear exceptions, adopting excellent design guidance, and creating a plan for implementation. The Elements of a Complete Streets Policy are explored and explained in further detail to help communities develop and/or implement policies and practices.

OTO hosts a Complete Streets Toolbox to assist member communities to consider the safety aspects for all users during the project development process.

Land Development

Established and adopted policies can ensure the consistent incorporation of VRU accommodations as communities develop. The 2019 document titled Lessons Learned in Implementation of Pedestrian-Oriented Zoning Provisions provides useful information, community references, and catalysts for implementing zoning changes.

The promotion of pedestrian and bicycle supportive development is also addressed in FHWA's 2016 report titled Noteworthy Local Policies That Support Safe and Complete Pedestrian and Bicycle Networks.

Narrow Lanes

The narrowing of roadway travel lanes is a common consideration of a Complete Street. Accordingly, lane narrowing is covered in the Complete Streets resources identified.

Roundabout Pedestrian Crossings

Accommodating pedestrians safely within roundabouts can be challenging. FHWA offers a summary brochure that highlights key elements for pedestrian, and bicycle, accommodation in addition to educational resources.

Enhancing pedestrian experiences at roundabouts is also the topic of a 2023 Minnesota research study, which articulates the associated challenges, relevant case studies, and recommended design guidance to better assimilate pedestrians in the roundabout setting.

Traffic Operations

In urban and high-pedestrian volume corridors, vehicular traffic and pedestrians must operate harmoniously. One mode cannot prevent the other from operating safety and effectively. Considering level of service for pedestrians is a means to support the interactions between the two.

In addition to the Complete Streets resources for designing roadways for all users, Sacramento's Best Practices for Pedestrian Master Planning and Design touches on level of service from the pedestrian's perspective. It identifies a Pedestrian Level of Service tool that can be used to measure impacts to walkability, which can inform vehicular operational decision during project development.

RECOMMENDATION #2

Adopt a Complete Streets policy.

Complete Streets policies imbed VRU considerations into transportation project development, which can improve safety for all users, including motor vehicles. Furthermore, Complete Streets policies can encompass multiple topics, including vehicular speeds. In addition to the resources above for developing a policy, steps to adopting a strong Complete Streets Policy are available to guide implementation. Example local policies for consideration are identified by FHWA in a 2016 technical report, which includes reference to the Delaware Valley Regional Planning Commission's Pedestrian and Bicycle Friendly Policies, Practices and Ordinances.

Data-based Decision-making

Comprehensive data and information are necessities for making sound transportation investments. Understanding and utilizing the available data and information brings the decision-making process full circle.

Equity

Disadvantaged communities have been underserved and overburdened. Identifying such communities and understanding the relevant data is foundational in order to address inequities in communities and improve roadway safety for all users. Prioritizing new and additional funding for projects in these areas is a means to improve roadway safety for the underserved. Using a community's equity data and information, multiple resources are available for integrating equity into procedures.

FHWA's "Integrating Equity into Transportation Planning" article is informative, summarizes the USDOT Equity Action Plan, and identifies additional resources. The Victoria Transport Institute offers comprehensive guidance titled "Evaluating Transportation Equity" to analyze equity and best incorporate equity during the decision-making process. The Mobility Equity Framework (How to Make Transportation Work for People) provides similar useful and informative guidance.

Funding

Targeted funding is a key strategy to address inequities in communities regarding roadway safety for all users. Many funding programs instituted under the 2021 Infrastructure Investment and Jobs Act (IIJA) focus on, or at a minimum incorporate, equity in transportation. Similarly, agencies or municipalities can designate funding that prioritizes or incorporates equity. "Generating and Prioritizing Funding for Active Transportation" highlights a case study example of such a measure, where the Los Angeles County transportation agency passed a sales tax increase that focused on prioritizing equity, and other measures, for improvements via funding guidelines.

Performance Management

Performance management is the process by which safety targets are monitored over time to assess the outcomes of projects. Safety projects should go under regular evaluations to assess safety performance by tracking the number and rate of fatalities, number and rate of serious injuries, and number of non-motorized fatalities and serious injuries. The following resources provide guidance for communities to employ performance management processes in efficient and beneficial ways.

The FHWA maintains a Transportation Performance Management (TPM) website that contains a wealth of information, which is supplemented by the TPM Toolbox. Additional resources for incorporating performance management into the planning process are the Transportation Safety Planning and the Zero Deaths Vision technical report and the Safety Performance Management Target Setting Communication Plan and Toolkit.

Project Selection

With competing interests and entities, project selection needs to be rooted in priorities. Once defined, a prioritization can be developed to objectively support transportation decision-making.

Modern Project Prioritization for Transportation Investments offers a well-rounded assessment of and recommendations for prioritizing transportation projects overall, including scoring objectives and recommended evaluation criteria. Focusing on VRUs, the Vision Zero Network identifies five key steps to develop a robust and equity-centered prioritization process, which aligns nicely with the intent of the Safe Streets and Roads for All (SS4A) program and the safety action planning process.

The National Center for Safe Routes to School also identifies a process for safety-based prioritization of schools for Safe Routes to School (SRTS) infrastructure projects, which is applicable to the SRTS emphasis area.

RECOMMENDATION #3

Develop guidance to utilize OTO's Social Equity Index data.

As evidenced by the Data-based Decision-making topics above, data and information are necessities for making sound transportation investments. The OTO website contains the publicly available Social Equity Index, which is an incredible source of both quantitative and graphical information based on census data. The website explains the "why" and the "how" of the Index; however, the missing question to be answered is "What can I do with this information?"

It is recommended that brief guidance be developed that would be utilized by member agencies. The guidance would outline what information can be accessed, how to understand and interpret the information, and how can I utilize the information to prioritize projects and/or seek targeted funding.

RECOMMENDATION #4

Develop guidance to utilize OTO's crash and High Injury Network (HIN) data.

As evidenced by the Data-based Decision-making topics above, data and information are necessities for making sound transportation investments. The OTO webpage for Destination Safe Streets contains the publicly available High Injury Network (HIN) Analysis interactive map. As part of the SS4A Safety Action Plan, there is an expectation that the HIN will be updated at future intervals.

To make this data more understandable and therefore informative to both member agencies and the public, it is recommended that a basic guidance document be developed to supplement the interactive map. In addition to fully defining legend elements, the concept of a HIN segment and risk should be explained. For decision-makers, the guidance should outline how the HIN information can be appropriately utilized (not misinterpreted) to prioritize project decisions and to support funding efforts.

Safe Routes to School (SRTS)

Safe Routes to School (SRTS)

SRTS programs encourage walking and biking to and from schools with an emphasis on safety. SRTS programs are required to have a designated coordinator and typically include safety education for students, targeted traffic enforcement, encouragement activities such as Walk to School Day or "walking school buses," and can incorporate infrastructure improvements to slow vehicular traffic near schools or provide contiguous sidewalk connections. Additionally, the intent is to embed safety knowledge and mindfulness into the young minds of students.

The Safe Routes Partnership is a national non-profit organization that serves as a resource for understanding and developing SRTS programs. The Safe Routes to School Online Guide is a similar resource useful information.

School Zones

A school zone is a unique location that often accommodates high pedestrian, bicycle, vehicular, and bus traffic daily during short windows in time. Understanding this setting, with respect to each individual school layout, is important to determining traffic calming needs and other opportunities. Guidance for understanding the environment around the school is offered by the SRTS Guide.

Although not a SRTS program, the City of Markham (near Toronto, Canada) is currently developing a School Zone Safety Guide to improve safety for all road users in the vicinity of its schools. Although the guide is not yet complete, the objectives are comprehensive, and the results will ultimately include policy improvements, engineering measures, and education and outreach recommendations.

From the vehicular perspective, traffic calming strategies can increase safety for students in school zones and also for the walking public at any appropriate location. Traffic calming treatments are intended to reduce vehicle speed and encourage more deliberate driving behavior. Basic examples of traffic calming measures include speed bumps, crosswalks, and high visibility crosswalks.

RECOMMENDATION #5

Establish Safe Routes to School (SRTS) programs in combination with developing a toolbox of traffic calming strategies for school zones.

OTO members can partner with their school districts to develop and implement SRTS programs. The Online Guide provides 8 Steps to Creating a SRTS Program, which outlines starting a program from scratch through evaluating and improving the established program.

Combining educational elements with engineering treatments can holistically lead to a safer environment for all road users, and providing a customized traffic calming toolbox for the OTO region would offer a menu of options for consideration that could steer consistency across school zones. However, the measures identified in a toolbox could be applied to any appropriate non-school location to impact driver behaviors. FHWA's Traffic Calming ePrimer is a detailed resource that includes a toolbox of traffic calming measures, and the Urban Street Design Guide includes easy-to-understand graphics of a variety of speed reduction mechanisms to inform toolbox development.

Vehicular Speeds

Law enforcement and engineering measures can be effective tools to mitigate dangerous driving behaviors such as aggressive driving, distracted driving, and speeding – the top three safety concerns received from the project's public engagement activities.

Speed Limits

As shown in Table 2, most members have a formalized policy or process for determining speed limits, which ensures consistency within a jurisdiction.

Speed Management

Multiple traffic calming measures are noted throughout the resources in this document, and the Speed Enforcement Program Guidelines identify a variety of countermeasures and strategies that can be deployed to manage traffic speeds. However, identifying locations where such measures need to be applied is not as straightforward.

Although vehicular speed data and crash history can be easily collected, perspectives and perceptions can vary between users (pedestrians, vehicles, bicyclists), between residents and passers-by, and between other variants of transportation network users. Offering a mechanism to obtain the public's requests to manage speed can supplement speed data or help pinpoint locations where speed data should be analyzed.

RECOMMENDATION #6

Partner with law enforcement agencies to implement targeted enforcement efforts.

OTO members can collaborate closely with local law enforcement agencies to identify areas or specific locations for targeted enforcement efforts. Available information to consider when determining target locations includes the HIN locations, crash history, speed study information, and locations of public concern, specifically the speeding locations identified through the interactive public survey conducted for the Destination Safe Street safety action plan.

Public Educational Campaigns

Communicating with community members about on-going efforts and initiatives is an effective means to directly, or indirectly, educate citizens about transportation safety matters. U.S Department of Transportation (USDOT) agencies maintain a wide variety of educational campaign materials that are intended to be used by local agencies and other entities. Information often includes facts, social media posts, graphics (multiple languages), and video/audio advertisements.

Educational Campaigns

The National Highway Traffic Safety Administration (NHTSA) Communication Resources webpage offers a plethora of safety marketing tools for use by partner organizations and highway safety professionals. Similarly, the Federal Motor Carrier Safety Administration (FMCSA) offers All Our Roads, Our Safety campaign resources related to commercial motor vehicles.

RECOMMENDATION #7

Utilize transportation educational campaign materials provided by USDOT.

It is recommended that OTO and its members use the campaign materials offered by USDOT for frequent and routines messaging of transportation safety topics.

Summary of Recommendations

These recommendations are the result of analyzing the policies and processes identified by member agencies, as well public survey results. Categorized by emphasis area, the policy and process recommendations offer opportunities to implement best practices for safe streets. Since OTO is a regional transportation planning organization without local policy making authority, some policy and process recommendations would require member action. Policy and process recommendations are shown in Table 3 and include the entity that would be responsible for implementation.

TABLE 3: POLICY AND PROCESS RECOMMENDATIONS

Emphasis Area	Recommended Strategy	Responsibility
ADA Compliance	#1 – Develop or update ADA Transition Plans (when required by the public entity)	Members
Complete Streets	#2 – Adopt a Complete Streets policy	Members
Data-based Decision-making	#3 – Develop guidance to utilize OTO's Social Equity Index data	OTO
Data-based Decision-making	#4 – Develop guidance to utilize OTO's crash and High Injury Network data	OTO
Safe Routes to School	#5 – Establish Safe Routes to School programs in combination with developing a toolbox of traffic calming strategies for school zones	Members/OTO
Vehicular Speeds	#6 – Partner with law enforcement agencies to implement targeted enforcement efforts	Members
Public Educational Campaigns	#7 – Utilize transportation educational campaign materials provided by USDOT.	Members/OTO

Document Reference	Source	Web Address
Americans with Disabilities Act (ADA) Compliance		
Public Right of Way Accessibility Guidelines (PROWAG)	Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way	https://www.federalregister.gov/documents/2023/08/08/2023-16149/accessibility-guidelines-for-pedestrian-facilities-in-the-public-right-of-way
Comprehensive guidance and resources	FHWA ADA Resources	https://highways.dot.gov/civil-rights/programs/ada/resources
Guide to best management practices	ADA Transition Plans: A Guide to Best Management Practices	https://www.fhwa.dot.gov/indiv/docs/ada_transition_plans_report.pdf
Overview	Federal-aid Essentials: Americans with Disabilities Act Transition Plans	https://highways.dot.gov/sites/fhwa.dot.gov/files/32transitionplans.pdf
Self-evaluation basics	Federal-aid Essentials: Americans with Disabilities Act Self-evaluation Basics	https://highways.dot.gov/sites/fhwa.dot.gov/files/33self%20evaluation.pdf
City of Rancho Cordova transition plan	City of Rancho Cordova Americans with Disabilities Action Transition Plan (FHWA example)	https://www.scribd.com/document/21193230/City-of-Rancho-Cordova-ADA-Transition-Plan-Final
Complete Streets		
Complete Streets Policy Framework	Complete Streets Policy Framework	https://smartgrowthamerica.org/resources/elements-complete-streets-policy/
Elements of a Complete Streets Policy	The Elements of a Complete Streets Policy	https://smartgrowthamerica.org/wp-content/uploads/2018/02/CS-Policy-Elements.pdf
Complete Streets Toolbox	OTO's Complete Streets Toolbox	https://www.ozarkstransportation.org/our-resources/planning-tools/cstools
Lessons Learned in Implementation of Pedestrian-Oriented Zoning Provisions	Lessons Learned in Implementation of Pedestrian-Oriented Zoning Provisions: A Research Brief	https://p3rc.uic.edu/wp-content/uploads/sites/561/2020/02/PAPRN_brief_and_profiles508v2Sept5.pdf
Noteworthy Local Policies That Support Safe and Complete Pedestrian and Bicycle Networks	FHWA Technical Report: Noteworthy Local Policies that Support Safety and Complete Pedestrian and Bicycle Networks	https://safety.fhwa.dot.gov/ped_bike/tools_solve/docs/fhwasa17006-Final.pdf
Summary brochure	FHWA Roundabouts with Pedestrians & Bicycles - A Safe Choice for Everyone	https://safety.fhwa.dot.gov/intersection/roundabouts/fhwasa15016.pdf
Enhancing pedestrian experiences at roundabouts	Enhancing Pedestrian Experiences at Roundabouts	https://mntransportationresearch.org/2023/04/18/enhancing-pedestrian-experiences-at-roundabouts/
Best Practices for Pedestrian Master Planning and Design	Best Practices for Pedestrian Master Planning and Design	https://nacto.org/docs/usdg/best_practices_ped_master_planning_design_sacramento.pdf
Steps to adopting a strong Complete Streets Policy	Adopting a Strong Complete Streets Policy	https://smartgrowthamerica.org/program/national-complete-streets-coalition/policy-atlas/policy-development/
Example local policies	FHWA Technical Report: Noteworthy Local Policies that Support Safety and Complete Pedestrian and Bicycle Networks	https://safety.fhwa.dot.gov/ped_bike/tools_solve/docs/fhwasa17006-Final.pdf
Pedestrian and Bicycle Friendly Policies, Practices and Ordinances	Delaware Valley Regional Planning Commission: Pedestrian and Bicycle Friendly Policies, Practices, and Ordinances (Chapter 5)	https://www.dvrpc.org/reports/11019.pdf
Data-based Decision-making		
Equity Action Plan	Equity Action Plan 2023 Update	https://www.transportation.gov/sites/dot.gov/files/2023-12/2023%20update%20to%20the%20DOT%20Equity%20Action%20Plan.pdf
Evaluating Transportation Equity	Evaluating Transportation Equity Guidance for Incorporating Distributional Impacts in Transport Planning	https://www.vtpi.org/equity.pdf
Mobility Equity Framework	Mobility Equity Framework - How to Make Transportation Work for People	https://greenlining.org/wp-content/uploads/2019/01/MobilityEquityFramework_8.5x11_v_GLI_Print_Endnotes-march-2018.pdf
Generating and Prioritizing Funding for Active Transportation	Generating and Prioritizing Funding for Active Transportation	https://www.saferoutespartnership.org/sites/default/files/resource_files/generating_and_prioritizing_funding_for_active_transportation.pdf
Transportation Performance management (TPM) website	Transportation Performance management	https://www.fhwa.dot.gov/tpm/
TPM Toolbox	TPM Toolbox	https://www.tpmtools.org/
Transportation Safety Planning and the Zero Deaths Vision	Transportation Safety Planning and the Zero Deaths Vision: A Guide for Metropolitan Planning Organizations and Local Communities	https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/MPOLocalSafetyPlanGuide_508compliant.pdf
Communication Plans and Toolkit	FHWA Safety Performance Management Target Setting - Communication Plan and Toolkit	https://safety.fhwa.dot.gov/hsip/spm/fhwasa18006/docs/fhwasa18006.pdf
Modern Project Prioritization for Transportation Investments	Modern Project Prioritization for Transportation Investments	https://files.library.northwestern.edu/transportation/online/unrestricted/repository/2021/Noyce_ProjectPrioritization_Report_CTEDD-REM.pdf
Vision Zero Network	Developing a Robust Vision Aero Prioritization Process	https://visionzeronetwork.org/developing-a-robust-vision-zero-prioritization-process/
National Center for Safe Routes to School	Safety-based prioritization of schools for Safe Routes to School infrastructure projects: A process for transportation professionals	https://www.pedbikeinfo.org/pdf/SRTSstate_SafetyBasedPrioritization.PDF
Social Equity Index	OTO's Social Equity Index	https://experience.arcgis.com/experience/bac0937f5e4a48878381f493aaad7988/
High Injury Network (HIN) Analysis	OTO's High Injury Network Analysis, 2018-2022 Fatal & Serious Injury	https://experience.arcgis.com/experience/2eba59388e6544ca85faee092fd20745/
Safe Routes to School (SRTS)		
Safe Routes Partnership	Safe Routes Partnership	https://www.saferoutespartnership.org/
Safe Routes to School Online Guide	Welcome to the Safe Routes to School Online Guide	http://guide.saferoutesinfo.org/index.cfm
Understanding the environment around the school	SRTS Guide: Around the School	http://guide.saferoutesinfo.org/engineering/the_school_zone.cfm
School Zone Safety Guide	City of Markham - School Zone Safety Guide	https://yourvoicemarkham.ca/school-zone-safety-guide?tool=map
8 Steps to Creating a SRTS Program	Steps to Creating a Safe Routes to School Program	http://guide.saferoutesinfo.org/steps/index.cfm
Traffic Calming ePrimer	FHWA Traffic Calming ePrimer	https://highways.dot.gov/safety/speed-management/traffic-calming-eprimer
Speed reduction mechanisms	NACTO Urban Street Design Guide	https://nacto.org/publication/urban-street-design-guide/design-controls/design-speed/speed-reduction-mechanisms/
Vehicular Speeds		
Speed Enforcement Program Guidelines	NHTSA Speed Enforcement Program Guidelines	https://safety.fhwa.dot.gov/speedmgt/ref_mats/fhwasa1304/resources/Speed%20Enforcement%20Program%20Guidelines.pdf
Public Educational Campaigns		
Communication Resources	NHTSA Traffic Safety Marketing Communication Resources	https://www.trafficsafetymarketing.gov/
All Our Roads, Our Safety	FMCSA All Our Roads, Our Safety Campaigns	https://www.fmcsa.dot.gov/ourroads/all-our-roads-our-safety-campaigns

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Appendix D-2
Systemic Safety Analysis

MEMO

To: OTO

From: Lochmueller Group

Date: June 18, 2024

Subject: OTO Safety Action Plan – Safety Analysis (FINAL)

Systemic Safety Analysis

A systemic approach to safety includes developing countermeasures at locations with the greatest risk of fatal and serious injury crashes. A systemic safety analysis is a data-driven, multi-step process that includes identifying and evaluating risk factors, identifying locations with the greatest risk, and selecting appropriate countermeasures to mitigate risk and improve safety outcomes. Different from a typical network screening methodology that relies on observed crash history to identify high crash locations, such as a high injury network, a systemic safety analysis identifies high-risk roadway features throughout the network to identify locations with the greatest risk. The purpose of the systemic safety analysis is to evaluate the risk of roadway characteristics, identify locations with the greatest risk of fatal and serious injuries, and to develop systemic safety countermeasures to improve safety outcomes throughout the network.

Note: The identification of risk factors does not mean that a certain roadway feature contributes or causes fatal or serious injury crashes. Rather, risk factors are simply used to identify common features of roadways on which fatal and serious injury crashes occur in order to identify other roadways with similar risk.

Data

All data for this project was acquired and provided by OTO. Historic crashes included 5-year data from 2018 through 2022, originally sourced from MoDOT. Crash data was enriched by OTO to include roadway characteristics, demographics, and other contextual details. Roadway characteristic data was originally sourced from MoDOT; some roadway characteristic data are only available for roadways on the state system.

Definitions

- **Risk** – exposure to a crash that results in a fatal or serious injury.
- **Killed or Seriously Injured (KSI)** – any crash that results in a fatal or serious injury.
- **Risk Factor** – roadway characteristic or other contextual feature that increases risk of a KSI crash; risk factors are ratios based on the percentage of KSI crashes and roadway length (or other appropriate roadway measure).
- **High Injury Analysis Location** – developed by OTO, these 40 locations are a subset of the high injury network that experience a high number of KSI crashes and collectively illustrate various roadway types, roadway characteristics, and member jurisdictions throughout the OTO region.

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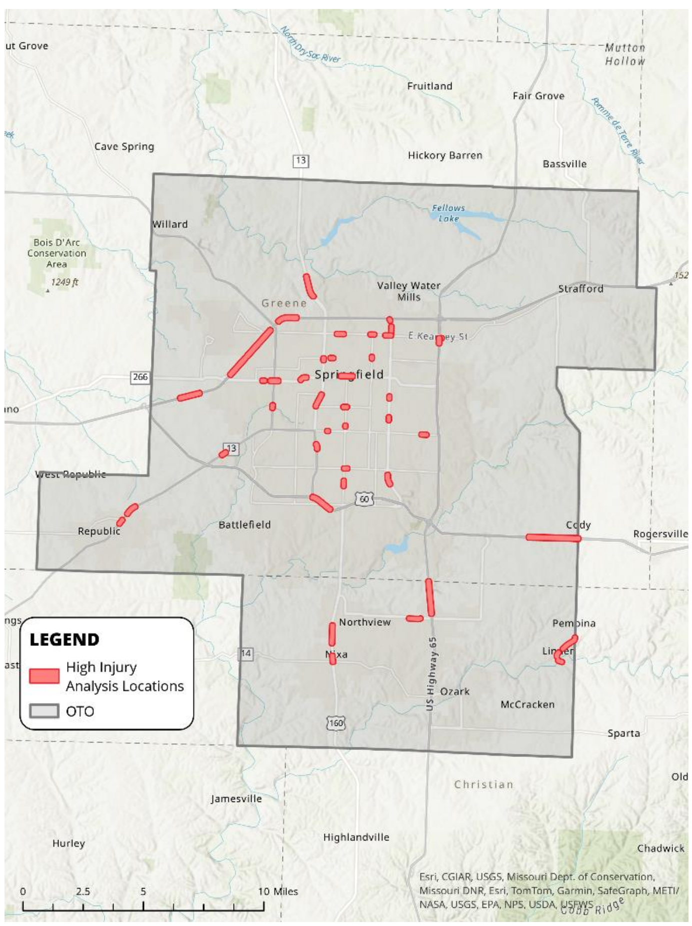
- **High-Risk (Roadway) Feature** – roadway features with a risk factor greater than one are considered a high-risk roadway feature.
- **Risk Index** – a composite index that combines includes all high-risk roadway features in a single index score that can be mapped and visualized to assess overall risk throughout the network.

Risk Factors

Methodology

To focus the analysis on high-risk roadway features that contribute to Killed or Serious Injury (KSI) crashes, OTO identified 40 high injury analysis locations. The high injury analysis locations are all located on the high injury network, experience a high number of KSI crashes, and collectively illustrate various roadway types, roadway characteristics, and member jurisdictions throughout the OTO region. ***Only KSI crashes at high injury analysis locations were used to determine risk factors.*** From 2018-2022, there were 269 KSI crashes within the high injury analysis locations, representing about 25% of all KSI crashes in the OTO region. The high injury analysis locations are shown in Figure 1.

FIGURE 1: HIGH INJURY ANALYSIS LOCATIONS



Ten roadway characteristics were selected and included in the development of risk factors. For each roadway characteristic, the percentage of KSI crashes was compared to the percentage of roadway length or other roadway measure to determine the risk factor for that characteristic. Roadway features with risk factors above one have a higher-than-average risk and are considered a high-risk roadway feature. The ten roadway characteristics include:

- Intersection Type
- Functional Classification
- Number of Lanes
- Shoulder Type
- Shoulder Width
- Access Control
- Horizontal Curvature
- Roadway Type
- Area Type
- Multimodal Activity

$$\textbf{Risk Factor} = \frac{\textbf{Percent of KSI Crashes}}{\textbf{Percent of Roadway Length}}$$

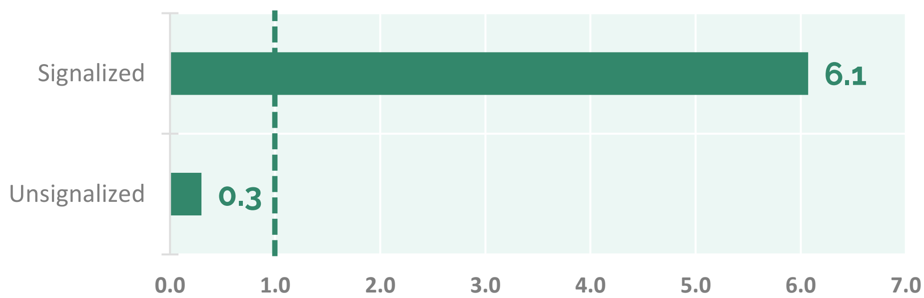
For example, if 30% of KSI crashes occurred along 20% of roadways (length) with a given feature, the risk factor calculation is 30%/20% for a risk factor of 1.5. In this example, roadways with the given risk feature have 1.5 times the expected number of KSI crashes.

Once risk factors were calculated for each of the roadway features, an index scoring system was created. The index scoring system was used to create a risk index and determine the highest risk locations to include in the application of systemic countermeasures. More information on the risk index is found in the Regional Risk Assessment.

Intersection Type

Signalized intersections have a greater percentage of KSI crashes relative to the percentage of all intersections. With a risk factor of 6.1, signalized intersections have 6.1 times the average number of KSI crashes.

FIGURE 2: INTERSECTION TYPE RISK FACTORS

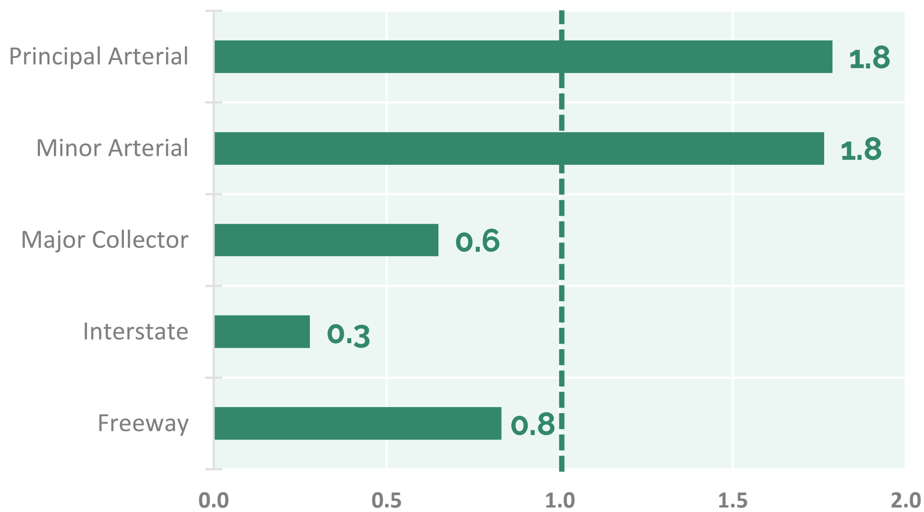


Intersection Type	Percent of KSI Crashes	Percent of Intersections	Risk Factor
Signalized Intersection	73.7%	12.2%	**6.1**
Unsignalized Intersection	26.3%	87.8%	0.3

Functional Classification

Minor arterials and major arterials both have risk factors of 1.8. No other functional classification has a risk factor greater than one. Functional classes such as local and minor collector were not included in the high injury analysis locations and therefore not included in the risk factor analysis.

FIGURE 3: FUNCTIONAL CLASSIFICATION RISK FACTORS

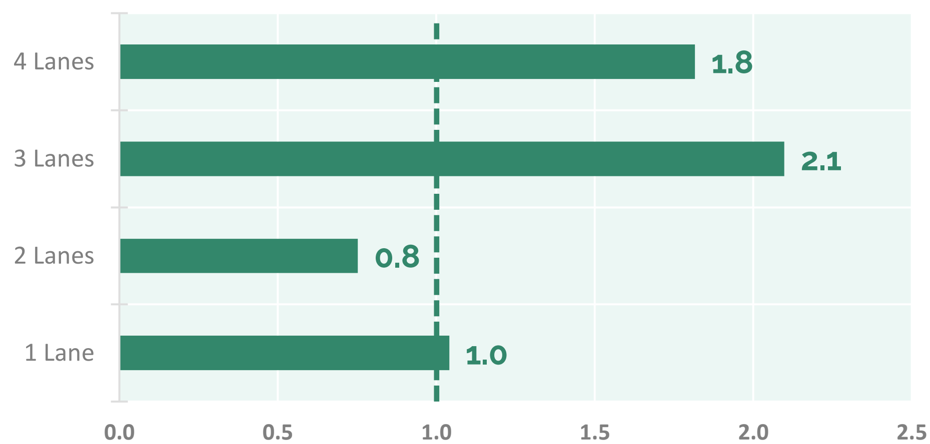


Functional Class	Percent of KSI Crashes	Percent of Roadway Length	Risk Factor
Freeway	39.4%	47.3%	0.8
Interstate	4.7%	16.8%	0.3
Major Collector	4.5%	7.0%	0.6
Minor Arterial	16.5%	9.3%	**1.8**
Principal Arterial	35.5%	19.6%	**1.8**

Number of Lanes

Roadways with a high number of lanes are more likely to have a higher percentage of KSI crashes relative to roadway length. The number of lanes represent the directional total. Both 3- and 4-lane roadway configurations are considered high-risk features with risk factors greater than 1 (2.1 and 1.8 respectively).

FIGURE 4: NUMBER OF LANES RISK FACTORS

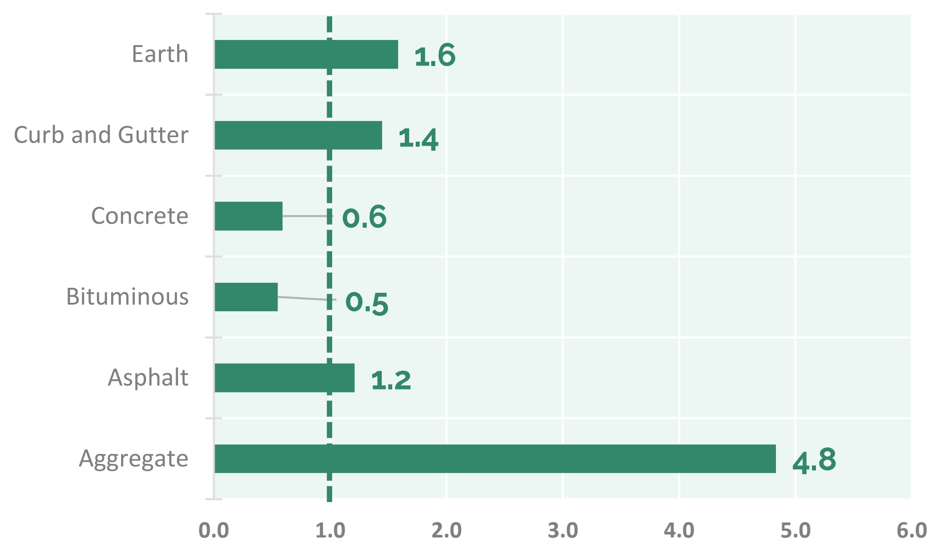


Number of Lanes	Percent of KSI Crashes	Percent of Roadway Length	Risk Factor
1 lane	19.3%	18.5%	1.0
2 lanes	50.5%	67.0%	0.8
3 lanes	30.0%	14.3%	**2.1**
4 lanes	0.3%	0.2%	**1.8**

Shoulder Type

For the purpose of this risk analysis, similar shoulder types were grouped together to establish a smaller number of similar shoulder types. Aggregate shoulder types have the highest risk factor but are present in just 1% of roadways. Earth, curb and gutter, and asphalt are each considered high-risk features with risk factors greater than one.

FIGURE 5: SHOULDER TYPE RISK FACTORS

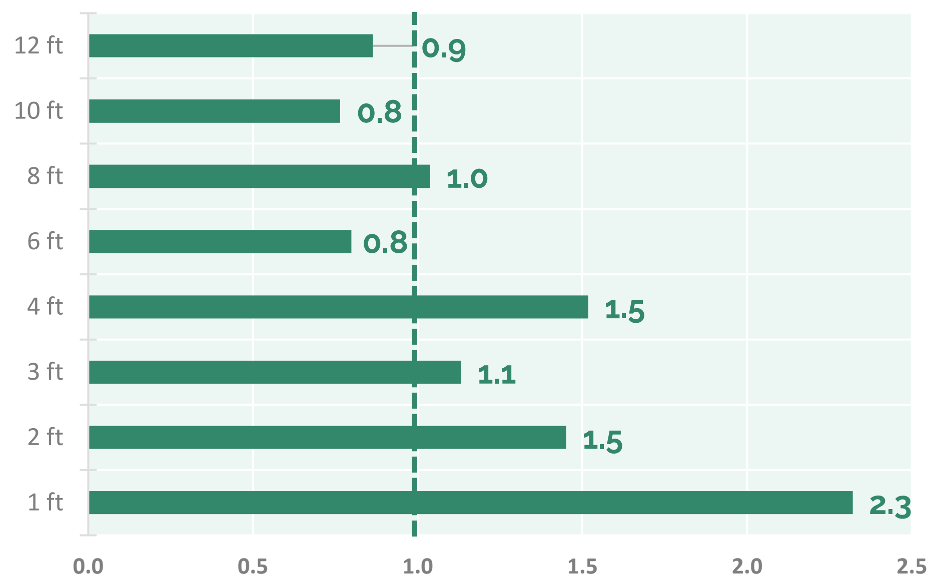


Shoulder Type	Percent of KSI Crashes	Percent of Roadway Length	Risk Factor
Aggregate	4.8%	1.0%	**4.8**
Asphalt	25.7%	21.2%	**1.2**
Bituminous	24.5%	44.7%	0.5
Concrete	2.6%	4.4%	0.6
Curb and Gutter	32.7%	22.6%	**1.4**
Earth	9.7%	6.1%	**1.6**

Shoulder Width

Shoulder widths range from one foot to twelve feet. Narrower shoulder widths of four feet and under are considered high-risk features with risk factors greater than one. Roadways with one-foot shoulders have the highest risk factor of 2.3.

FIGURE 6: SHOULDER WIDTH RISK FACTORS

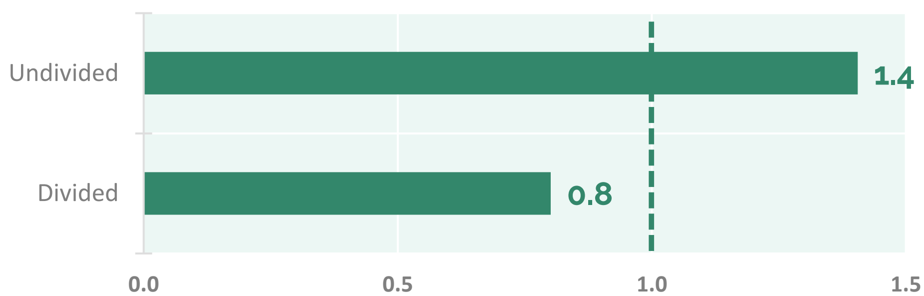


Shoulder Width	Percent of KSI Crashes	Percent of Roadway Length	Risk Factor
1ft	6.6%	2.8%	**2.3**
2ft	20.1%	13.9%	**1.5**
3ft	17.8%	15.7%	**1.1**
4ft	3.5%	2.3%	**1.5**
6ft	2.4%	3.0%	0.8
8ft	6.8%	6.6%	1.0
10ft	41.2%	53.9%	0.8
12ft	1.6%	1.8%	0.9

Median Access Control

Median access control refers to the presence of a center median and if the roadway is considered a divided roadway. Undivided roadways experience a higher share of KSI crashes and are considered a high-risk feature with a risk factor of 1.4.

FIGURE 7: MEDIAN ACCESS CONTROL RISK FACTORS



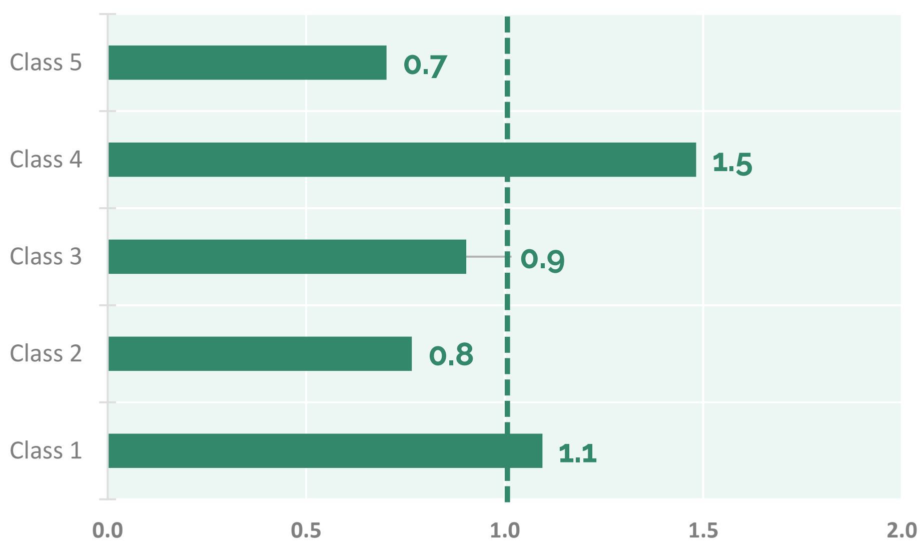
Median Access Control	Percent of KSI Crashes	Percent of Roadway Length	Risk Factor
Divided	53.7%	67.1%	0.8
Undivided	46.3%	32.9%	**1.4**

Horizontal Curvature

To assess horizontal curvature, curves within the high injury analysis locations were classified by quantile class to create five classes with an approximately equal number of curves. Curves classes range from class 1 which includes curves with the highest radii to class 5 which includes the lowest radii (sharpest curves are class 5).

Nationally, roadway curves are present in around 25% of all fatal crashes and curves generally experience more crashes than straight roadway segments. Curve classes 1-3 each have a risk factor near one, while class 4 curves experience a greater percentage of KSI crashes with a risk factor of 1.5. Class 5 curves experience a lower share of KSI crashes with a risk factor of just 0.7 even though it could be assumed that a sharper curve would experience more serious crashes. This could be due to the analysis being focused on the high injury analysis locations or that sharper curves cause drivers to significantly reduce speed and therefore reduce the risk of a serious injury crash.

FIGURE 8: HORIZONTAL CURVATURE RISK FACTORS



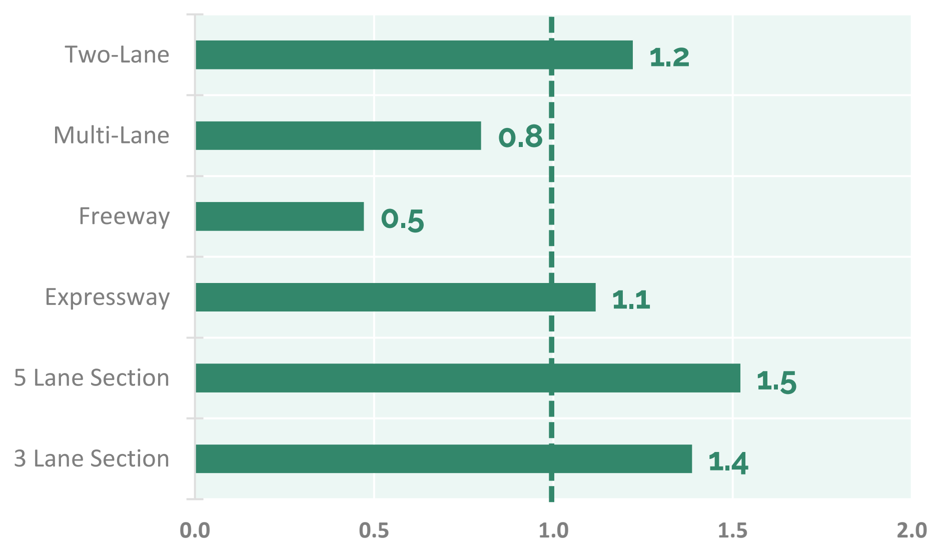
Curve Class	Percent of KSI Crashes	Percent of Curves	Risk Factor
Class 1	20.4%	18.6%	1.1
Class 2	14.3%	18.6%	0.8
Class 3	18.4%	20.3%	0.9
Class 4	32.7%	22.0%	**1.5**
Class 5	14.3%	20.3%	0.7

Roadway Type

Roadway types are categories of roadway as defined by MoDOT. Roadway type categories may combine other risk features such as access control, number of lanes, lane width, and/or shoulder types.

Most likely an outlier due to the analysis looking exclusively at the high injury analysis locations, one-way roadways have a risk factor of 12.0. This is far outside the range seen by other roadway types and is also based on less than 1% of roadway length being of this type. Both 3-lane and 5-lane sections have higher percentages of KSI crashes with risk factors of 1.4 and 1.5, respectively. 2-lane roadway types also experience a higher percentage of KSI crashes with a risk factor of 1.2.

FIGURE 9: ROADWAY TYPE RISK FACTORS



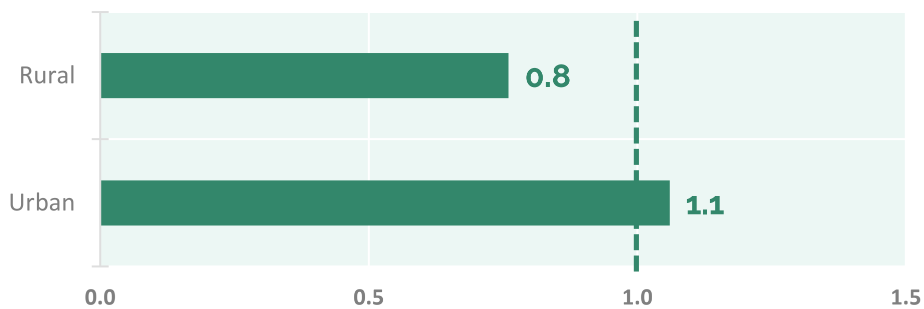
*Risk factor for one-way roadway type is not shown on chart and is not included in the risk index.

Roadway Type	Percent of KSI Crashes	Percent of Roadway Length	Risk Factor
3-Lane Section	3.7%	2.7%	**1.4**
5-Lane Section	27.5%	18.1%	**1.5**
Expressway	37.9%	33.9%	**1.1**
Freeway	12.3%	26.0%	0.5
Multi-Lane	4.5%	5.6%	0.8
One-Way	2.2%	0.2%	12.0
Two-Lane	11.9%	9.7%	**1.2**

Area Type

Area type refers to whether the location of the roadway or crash is within the Springfield, MO urbanized area. Roadways within the urban area have a higher percentage of KSI crashes with a risk factor of 1.1.

FIGURE 10: AREA TYPE RISK FACTORS

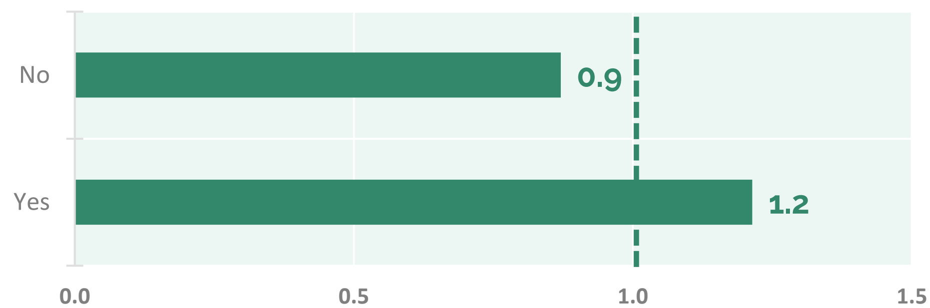


Area Type	Percent of KSI Crashes	Percent of Roadway Length	Risk Factor
Urban	84.8%	80.0%	**1.1**
Rural	15.2%	20.0%	0.8

Multimodal Activity

Multimodal activity refers to proximity to a dedicated bicycle or pedestrian facility such as a trail, trailhead, greenway, or bike route. Proximity to a multimodal facility considers the risk of vulnerable road users (VRUs) and the likelihood of vulnerable road users experiencing a serious injury as a result of a crash with a vehicle. Conflicts between VRUs and vehicles are more likely to occur in locations with greater bicyclist and pedestrian activity. Roadways within ¼ of a dedicated multimodal facility experience a higher percentage of KSI crashes with a risk factor of 1.2.

FIGURE 11: MULTIMODAL ACTIVITY RISK FACTORS



Multimodal Activity	Percent of KSI Crashes	Percent of Roadway Length	Risk Factor
Yes	45.7%	37.7%	**1.2**
No	54.3%	62.3%	0.9

Regional Risk Assessment

Roadway features were selected and evaluated for the development of risk factors based on KSI crashes observed at OTO high injury analysis locations. To determine risk throughout the entire OTO regional network, risk factors were used to develop a risk index scoring system that was applied to the regional roadway network. The scoring system follows the process outlined in the Federal Highway Administration's (FHWA) "Systemic Safety Project Selection Tool". Roadway features that were found to have risk factors greater than one are considered high-risk features and are therefore included in the composite risk index.

The score for each high-risk feature is based on a confidence metric (KSI crash overrepresentation) and the total share of KSI crashes. High-risk features with a confidence of 10% or more AND a percent of KSI crashes of 30% or more are given a score of 1. High-risk features that do not meet both of these conditions are given a score of 0.5. The risk index scoring is shown in Table 1. The scores for all high-risk features are summed to create the risk index.

The results of the regional risk assessment (risk index) are shown in the maps in Figure 12, Figure 13, Figure 14, Figure 15, and Figure 16 where higher risk index means more high-risk features and/or more significant high-risk features. The risk index illustrates roadways with high-risk features based on the risk profile of the high injury analysis locations and helps identify locations at which to deploy a systemic application of safety countermeasures aimed at mitigating the risk of serious and fatal injury crashes. Corridors with higher risk index scores include:

- Grant Avenue
- National Avenue
- Glenstone Avenue
- S Campbell Avenue
- Kearney Street
- Division Street
- Chestnut Expressway
- Sunshine Street
- Battlefield Street
- Republic Street
- MO-14 (Nixa and Ozark)
- US-60 (Republic)

Table 1: High-Risk Feature Scoring

Roadway Characteristic	High-Risk Feature	Risk Factor	Percent of KSI Crashes	Confidence	Score
Intersection Type	Signalized Intersection	6.1	73.7%	61.6%	1
Functional Class	Minor Arterial	1.8	16.5%	7.1%	0.5
	Principal Arterial	1.8	35.0%	15.4%	1
Shoulder Type	Aggregate	4.8	4.8%	3.8%	0.5
	Asphalt	1.2	25.7%	4.5%	0.5
	Curb and Gutter	1.4	32.7%	10.1%	1
	Earth	1.6	9.7%	3.6%	0.5
Shoulder Width	1ft	2.3	6.6%	3.7%	0.5
	2ft	1.5	20.1%	6.3%	0.5
	3ft	1.1	17.8%	2.1%	0.5
	4ft	1.5	3.5%	1.2%	0.5
Number of Lanes	3 lanes	2.1	30.0%	15.7%	1
	4 lanes	1.8	0.3%	0.1%	0.5
Undivided	Undivided	1.4	46.3%	13.3%	1
Horizontal Curvature	Class 4	1.5	32.7%	10.6%	1
Multimodal Activity	Yes	1.2	45.7%	8.1%	0.5
Area Type	Urban	1.1	84.8%	4.8%	0.5
Roadway Type	3 Lane Section	1.4	3.7%	1.0%	0.5
	5 Lane Section	1.5	27.5%	9.4%	0.5
	Expressway	1.1	37.9%	4.0%	0.5
	Two Lane	1.2	11.90%	2.2%	0.5

FIGURE 12: RISK INDEX, OTO

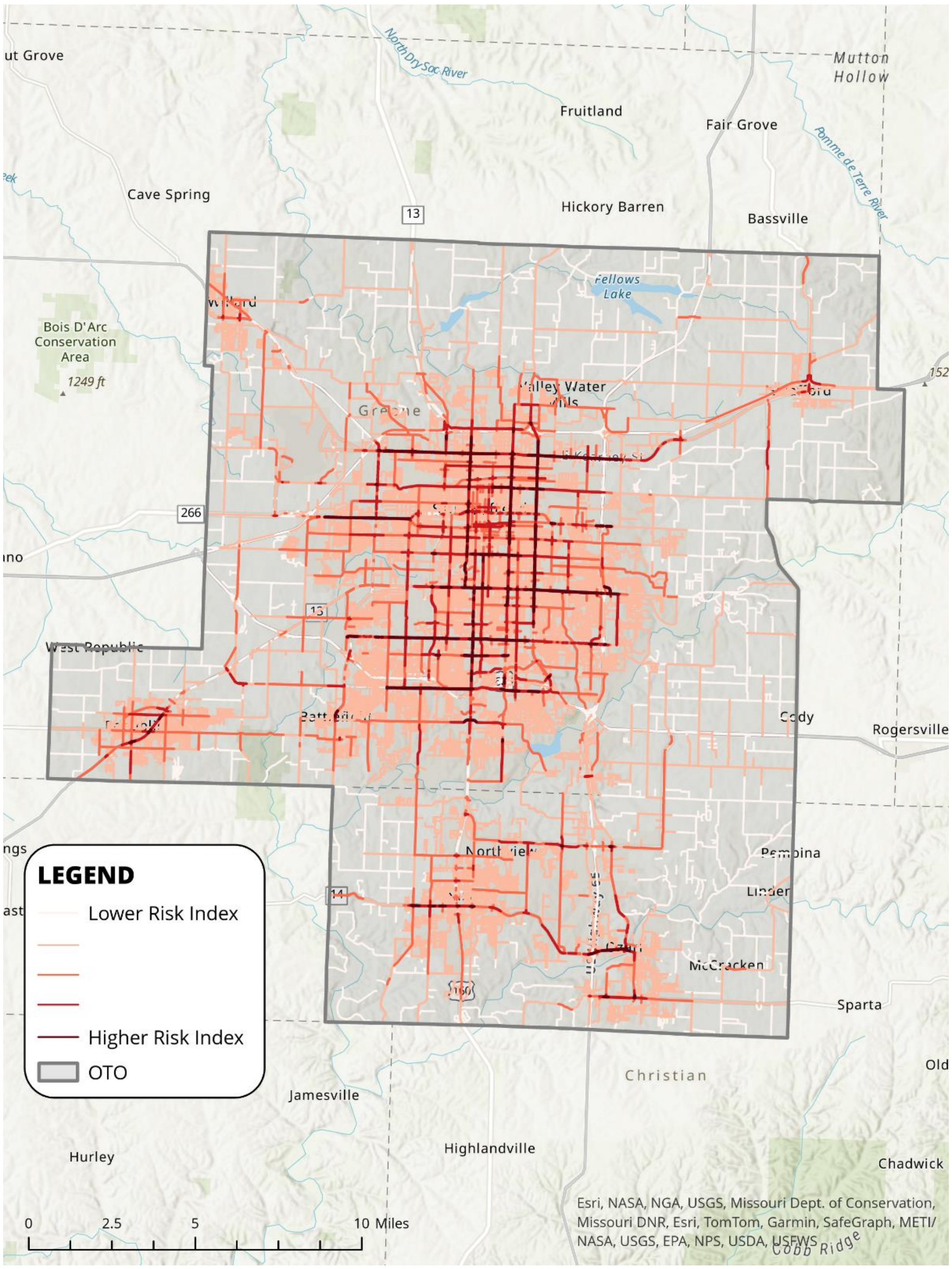


FIGURE 13: RISK INDEX, SPRINGFIELD

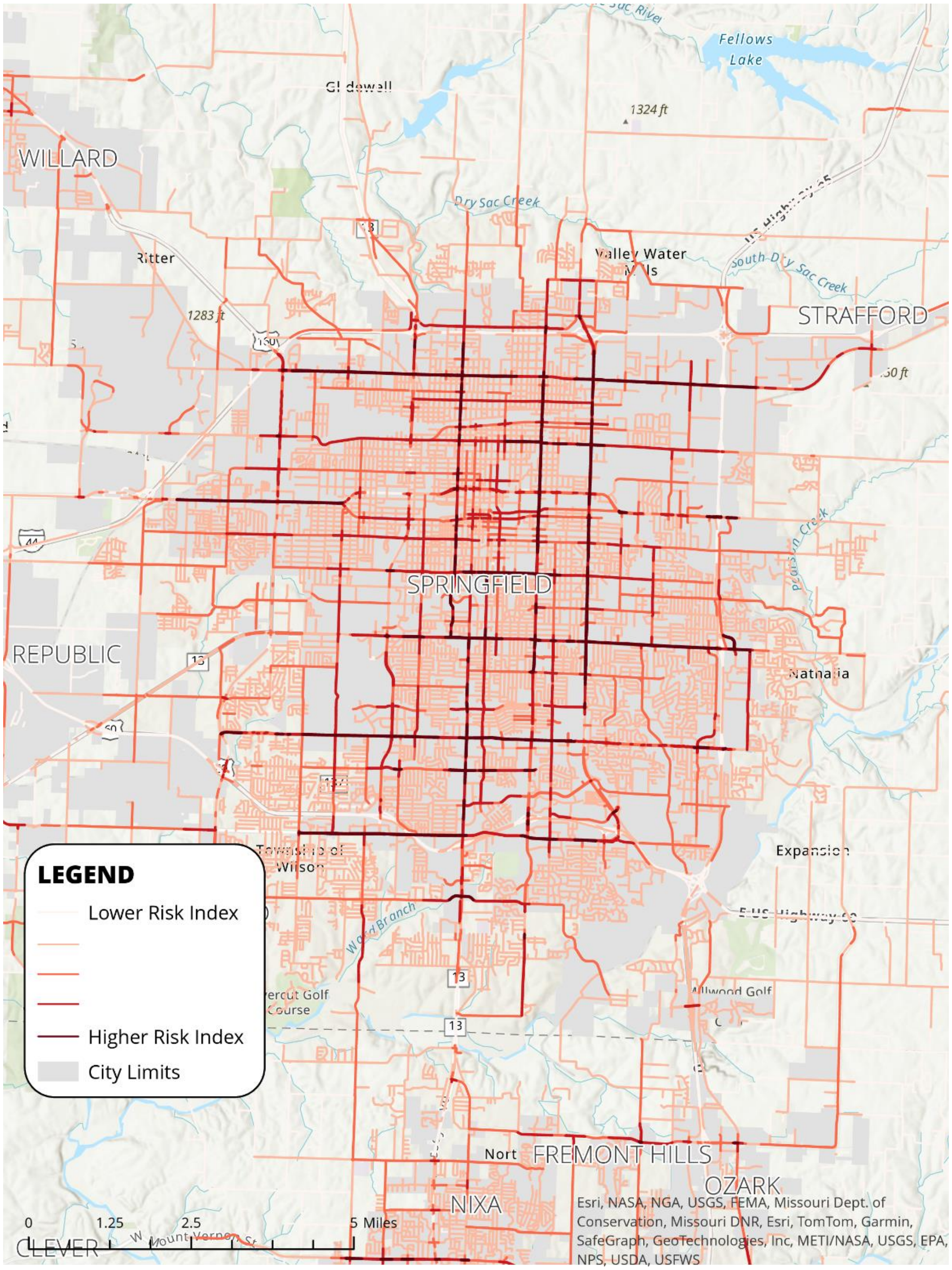


FIGURE 14: RISK INDEX, NIXA

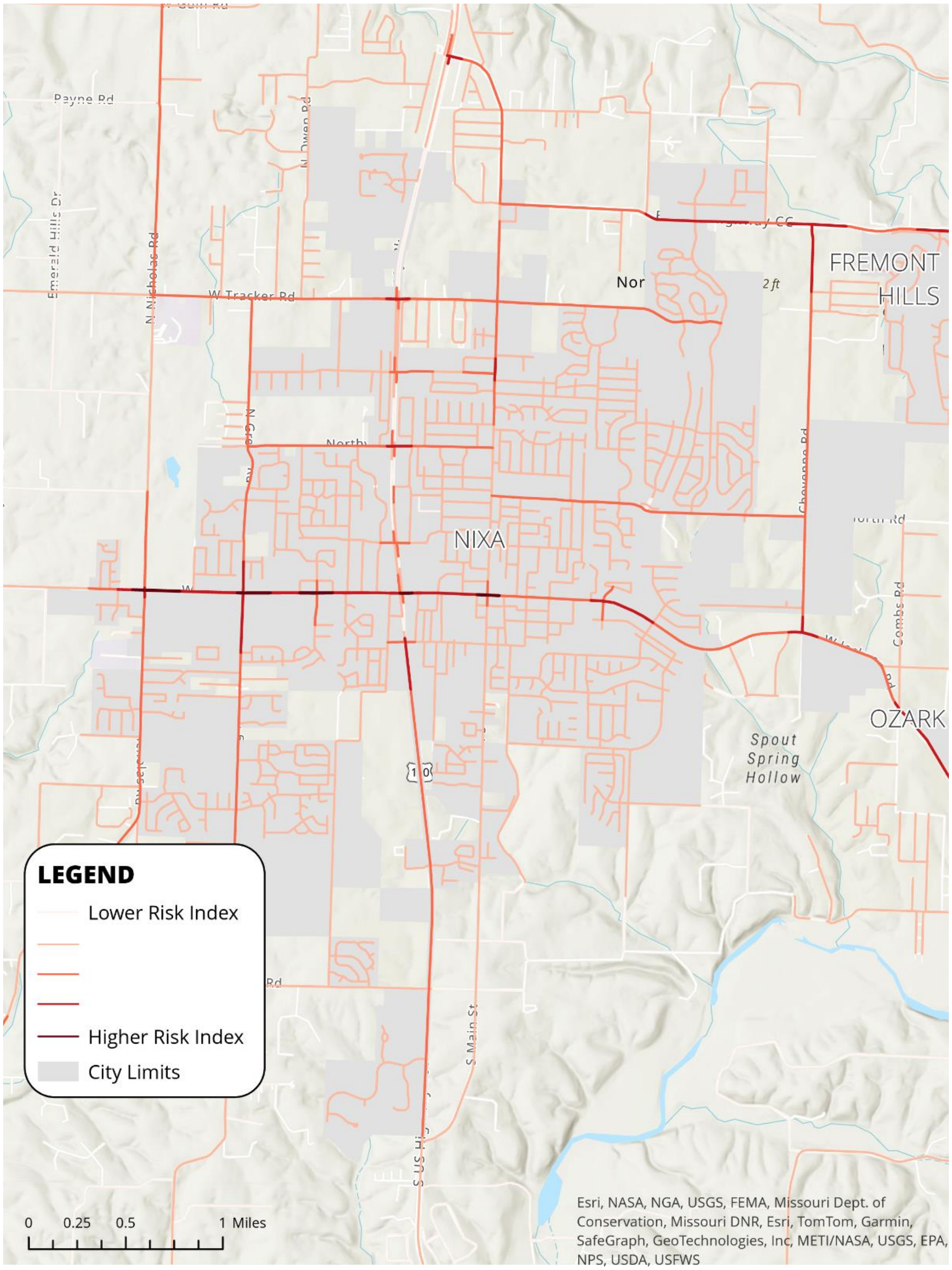


FIGURE 15: RISK INDEX, OZARK

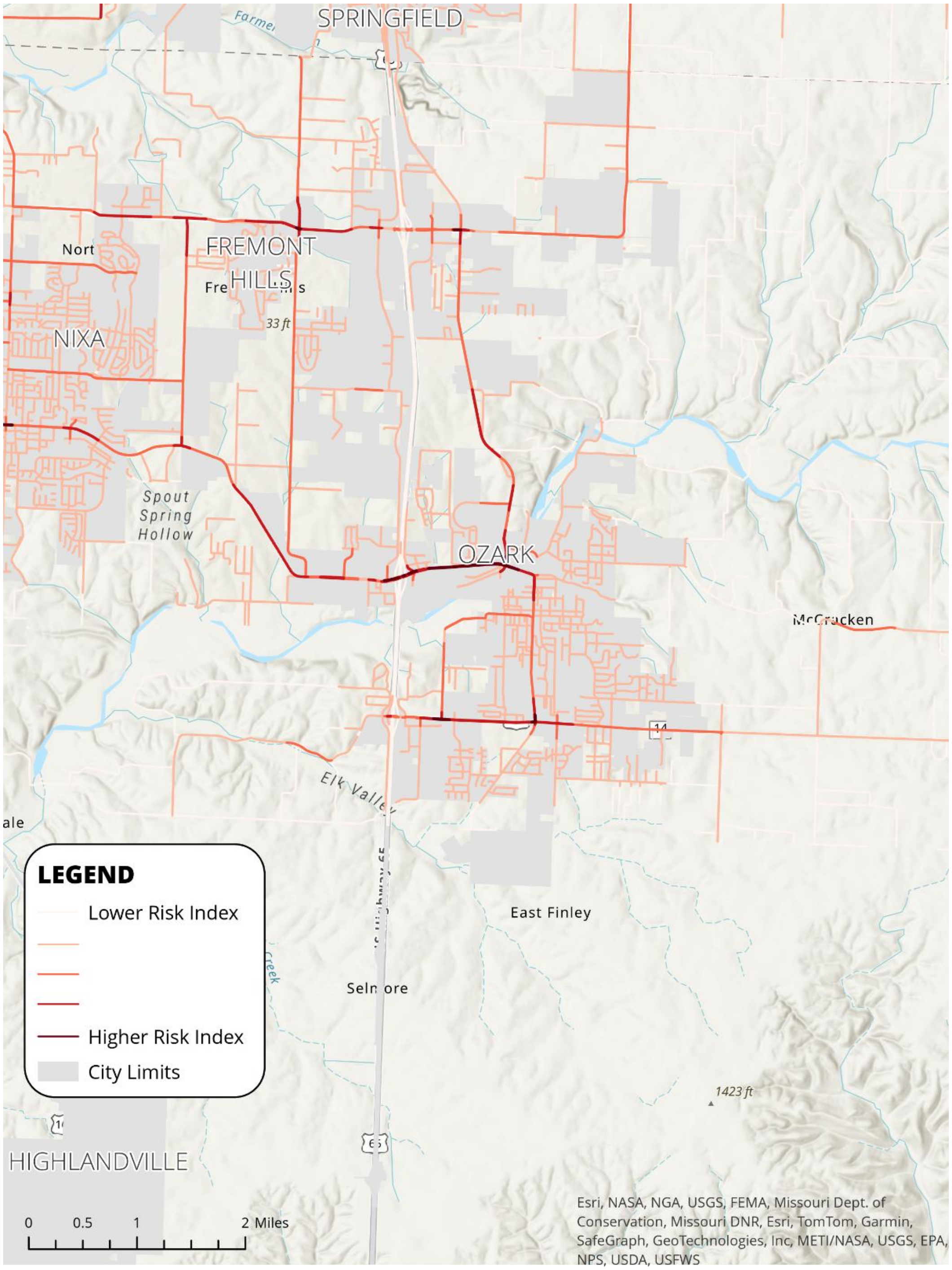
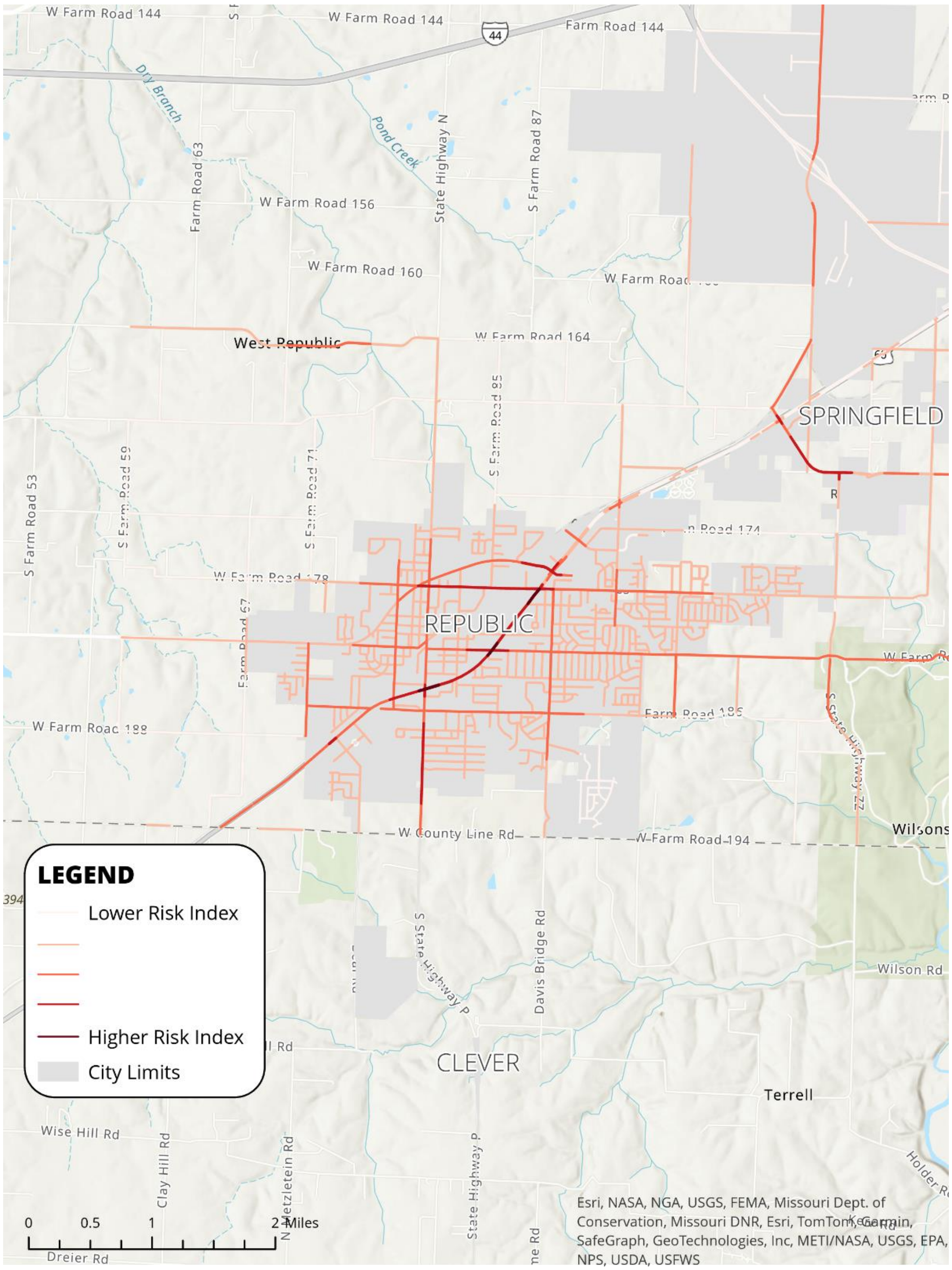


FIGURE 16: HIGH-RISK NETWORK, REPUBLIC



Systemic Strategies

To mitigate the effects of high-risk features along roadways throughout the OTO region, a systemic application of safety countermeasures is recommended. Each of the high-risk roadway features established in the risk factor analysis is listed along with the most frequently occurring crash types resulting in fatal and/or serious injuries. Finally, a set of recommended strategies is listed to mitigate risk and address the most frequently occurring KSI crash types. Recommended systemic strategies are shown in

Table 2. Table 3 lists the mitigated high-risk features for each systemic strategy. All recommended strategies are proven safety countermeasures and consider risk factors and prevailing crash types. Each recommendation is linked to a source for more information on effectiveness, applicability, and/or other considerations.

Table 2: Recommended Systemic Strategies

Roadway Characteristic	High-Risk Feature	Top KSI Crash Types	Recommended Systemic Strategies
Intersection Type	Signalized Intersection	Left Turn (34%) Left Turn Right Angle (12%) Out of Control (11%) Head On (11%) Pedestrian/Bicyclist (11%)	Retroreflective Backplates Roundabouts Yellow Change Intervals Leading Pedestrian Intervals Crosswalk Enhancements Pedestrian Refuge Islands Permissive to Protected Left Turn Improved Channelized Right Turn Angle Dilemma Zone Detection Left Turn Offset Improvement
Functional Class	Minor/Principal Arterial	Out of Control (18%) Left Turn (16%) Pedestrian/Bicyclist (14%) Rear End (12%) Right Angle (11%)	Road Diets Corridor Access Management Dilemma Zone Detection Median Barriers Sidewalks Shared Use Paths Left or Right Turn
Shoulder Type	Aggregate	Left Turn Right Angle (23%) Left Turn (23%) Pedestrian/Bicyclist (23%)	Enhanced Delineation Curve Improvements High Friction Surface Treatment
	Asphalt	Out of Control (26%) Rear End (21%)	Enhanced Delineation Curve Improvements High Friction Surface Treatment Rumble Strips
	Curb and Gutter	Out of Control (17%) Left Turn (17%) Pedestrian/Bicyclist (16%)	Enhanced Delineation Bicycle Lanes Pedestrian Hybrid Beacons (PHBs) Rectangular Rapid Flashing Beacons (RRFBs)
	Earth	Out of Control (28%) Pedestrian/Bicyclist (15%) Head On (13%)	Enhanced Delineation Curve Improvements Shared Use Paths
Shoulder Width	1ft – 4ft	Out of Control (26%) Left Turn (14%) Pedestrian/Bicyclist (13%) Right Angle (11%)	Enhanced Delineation Curve Improvements Rumble Strips High Friction Surface Treatment

Roadway Characteristic	High-Risk Feature	Top KSI Crash Types	Recommended Systemic Strategies
Number of Lanes	3+ lanes	Out of Control (17%) Pedestrian/Bicyclist (15%) Left Turn (15%) Rear End (14%)	Road Diets Corridor Access Management Median Barriers Sidewalks Shared Use Paths
Undivided	Undivided	Out of Control (26%) Pedestrian/Bicyclist (13%) Left Turn (12%) Right Angle (12%) Head On (10%)	Enhanced Delineation Rumble Strips High Friction Surface Treatment Intersection Conflict Warning
Horizontal Curvature	Class 4	Out of Control (31%) Left Turn (19%) Rear End (13%)	Enhanced Delineation Curve Improvements Rumble Strips High Friction Surface Treatment Guardrail, Clear Zone
Multimodal Activity	Yes	Out of Control (26%) Pedestrian/Bicyclist (14%) Right Angle (14%) Left Turn (12%)	Road Diets Corridor Access Management Dynamic Speed Displays Intersection Conflict Warning Shared Use Paths Pedestrian Refuge Islands Sidewalks Yellow Change Intervals Leading Pedestrian Intervals Crosswalk Enhancements Pedestrian Hybrid Beacons (PHBs) Rectangular Rapid Flashing Beacons (RRFBs) Roadway Lighting
Area Type	Urban	Out of Control (25%) Pedestrian/Bicyclist (14%) Left Turn (13%) Right Angle (11%) Rear End (11%)	Road Diets Corridor Access Management Sidewalks Shared Use Paths Pedestrian Refuge Islands Permissive to Protected Left Turn Pedestrian Hybrid Beacons (PHBs) Rectangular Rapid Flashing Beacons (RRFBs) Roadway Lighting

Roadway Characteristic	High-Risk Feature	Top KSI Crash Types	Recommended Systemic Strategies
Roadway Type	Two-Lane	Out of Control (38%) Pedestrian/Bicyclist (11%) Right Angle (10%)	Enhanced Delineation Curve Improvements Rumble Strips High Friction Surface Treatment Intersection Conflict Warning Dynamic Speed Displays Guardrail, Clear Zone Pedestrian Hybrid Beacons (PHBs)
	3-Lane Section	Out of Control (31%) Pedestrian/Bicyclist (17%) Right Angle (12%) Left Turn (12%)	Road Diets Corridor Access Management Dilemma Zone Detection Median Barriers Sidewalks Shared Use Paths Pedestrian Refuge Islands Permissive to Protected Left Turn Pedestrian Hybrid Beacons (PHBs)
	5-Lane Section	Left Turn (20%) Pedestrian/Bicyclist (16%) Out of Control (12%)	Road Diets Corridor Access Management Dilemma Zone Detection Median Barriers Sidewalks Shared Use Paths Pedestrian Refuge Islands Permissive to Protected Left Turn Rectangular Rapid Flashing Beacons (RRFBs)
	Expressway	Out of Control (26%) Rear End (14%) Left Turn (14%) Right Angle (14%)	Wider Edge Lines Dynamic Speed Displays Intersection Conflict Warning Roadway Lighting Median Barriers High Friction Surface Treatment

Table 3: Mitigated High-Risk Features

Recommended Systemic Strategies	Mitigated High-Risk Features
Bicycle Lanes	Curb and Gutter Shoulder Types
Corridor Access Management	3+ lanes 3-Lane Sections 5-Lane Sections Minor/Principal Arterials Multimodal Activity Urban Areas
Crosswalk Enhancements	Multimodal Activity Signalized Intersections
Curve Improvements	1ft – 4ft Shoulder Widths Aggregate Shoulder Types Asphalt Shoulder Types Earth Shoulder Types Class 4 Curves Two-Lane Sections
Dilemma Zone Detection	3-Lane Sections 5-Lane Sections Minor/Principal Arterials Signalized Intersections
Dynamic Speed Displays	Expressways Two-Lane Sections Multimodal Activity
Enhanced Delineation	1ft – 4ft Shoulder Widths Aggregate Shoulder Types Asphalt Shoulder Types Curb and Gutter Shoulder Types Earth Shoulder Types Class 4 Curves Two-Lane Sections Undivided Roadways
Guardrail, Clear Zone	Class 4 Curves Two-Lane Sections
High Friction Surface Treatment	1ft – 4ft Shoulder Widths Aggregate Shoulder Types Asphalt Shoulder Types Class 4 Curves Expressways Two-Lane Sections Undivided Roadways
Improved Channelized Right Turn Angle	Signalized Intersections

Recommended Systemic Strategies	Mitigated High-Risk Features
Intersection Conflict Warning	Multimodal Activity Expressways Two-Lane Sections Undivided Roadways
Leading Pedestrian Intervals	Multimodal Activity Signalized Intersections
Left or Right Turn	Minor/Principal Arterials
Left Turn Offset Improvement	Signalized Intersections
Median Barriers	3+ lanes 3-Lane Sections 5-Lane Sections Expressways Minor/Principal Arterials
Pedestrian Hybrid Beacons (PHBs)	Curb and Gutter Shoulder Types Multimodal Activity Two-Lane Sections 3-Lane Sections Urban Areas
Pedestrian Refuge Islands	3-Lane Sections 5-Lane Sections Multimodal Activity Signalized Intersections Urban Areas
Permissive to Protected Left Turn	3-Lane Sections 5-Lane Sections Signalized Intersections Urban Areas
Rectangular Rapid Flashing Beacons (RRFBs)	Curb and Gutter Shoulder Types Multimodal Activity 5-Lane Sections Urban Areas
Retroreflective Backplates	Signalized Intersections
Road Diets	3+ lanes 3-Lane Sections 5-Lane Sections Minor/Principal Arterials Multimodal Activity Urban Areas
Roadway Lighting	Expressways Multimodal Activity Urban Areas

Recommended Systemic Strategies	Mitigated High-Risk Features
Roundabouts	Signalized Intersections
Rumble Strips	1ft – 4ft Shoulder Widths Asphalt Shoulder Types Class 4 Curves Two-Lane Sections Undivided Roadways
Shared Use Paths	Earth Shoulder Types 3+ lanes 3-Lane Sections 5-Lane Sections Minor/Principal Arterials Multimodal Activity Urban Areas
Sidewalks	3+ lanes 3-Lane Sections 5-Lane Sections Minor/Principal Arterials Multimodal Activity Urban Areas
Wider Edge Lines	Expressways
Yellow Change Intervals	Multimodal Activity Signalized Intersections

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Appendix D-3
Project Prioritization

MEMO

To: Ozarks Transportation Organization (OTO)

From: Lochmueller Group

Date: August 30, 2024

Subject: Project Prioritization Technical Memo

PRIORITIZATION PROCESS

An initial project list was developed to identify locations of safety needs in the region. In accordance with the Advisory Committee's guidance, evaluation criteria were developed and ranked to quantify priorities. The projects were quantitatively scored and qualitatively evaluated to classify each into one of three priority Tiers.

The culmination of this prioritization process is documented in the Implementation Matrix, and its contents are summarized in Table 1.

Table 1. Implementation Matrix Information

Data Elements per Project Location	
Project Location	Public Input*
Location Type	Local Agency Input
System (State vs Local)	Number KSI Crashes*
High Injury Network (HIN)*	Number Fatal Injuries*
CEJST Disadvantaged Community	Number Serious Injuries*
Municipality (Geographic)	Point Values^
Urban/Rural	Priority Score
STIP Priority*	Tier (Priority)
Timeframe	
**Prioritization criterion*	*^Assigned to each prioritization criterion*

Project List

A list of 202 project locations was developed and is a compilation from the following sources:

- Segments and locations identified on the high injury network (HIN)
- Locations of safety concern identified by the OTO member agencies
- Safety-related projects identified as STIP Priorities in the OTO region
- Locations most frequently identified by the public via the survey and meetings

The data elements identified in Table 1 were populated for each project to inform the prioritization process. The Point Values, Priority Score, and Tier (Priority) were calculated and determined later in the prioritization process.

Quantitative Evaluation

Prioritization Criteria Development

OTO and the Advisory Committee collaboratively identified six criteria to evaluate the project list and ranked the criteria in order of importance. A measurement was identified for each prioritization criterion and an associated point value. The prioritization criteria information is summarized in Table 2.

Table 2. Prioritization Criteria

Prioritization Criteria	Ranking	Measurement	Point Value Assigned
Number KSI Crashes	#1	If greater than the mean (≥5)	6 pts
High Injury Network (HIN)	#2	If yes	5 pts
Number Fatal Injuries	#3	If greater than the mean (≥1)	4 pts
Number Serious Injuries	#4	If greater than the mean (≥5)	3 pts
STIP Priority	#5	If yes	2 pts
Public Input	#6	If yes	1 pt

Priority Scoring

Using project locations-specific data, point values were assigned for each project location in accordance with Table 2, and the assigned point values were summed to determine a Priority Score for each project location. All point values and priority scores are listed in the Implementation Matrix, and the priority scores served as the based for quantitative comparison of the project locations.

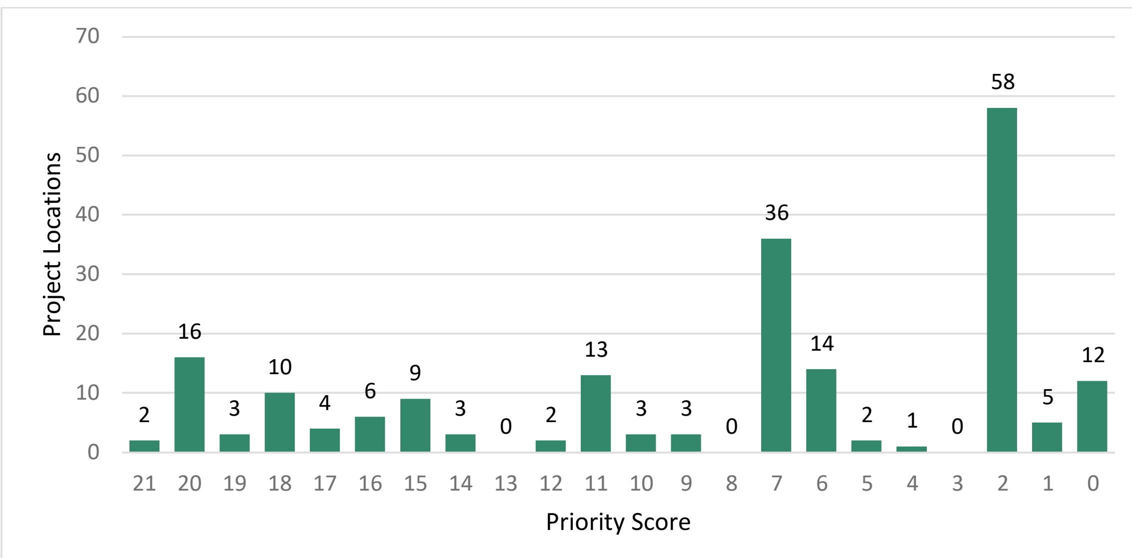
An example Priority Score calculation is outlined in Table 3.

Table 3. Example Priority Score Calculation

Evaluation Criterion	Project Data	Metric Met	Assigned Point Value
Number KSI Crashes	5	Yes	6
High Injury Network (HIN)	Yes	Yes	5
Number Fatal Injuries	1	Yes	4
Number Serious Injuries	4	No	0
STIP Priority	Yes	Yes	2
Public Input	No	No	0
		Priority Score	***17***

High priority scores represent higher quantitative priority, and low priority scores represent lower quantitative priority. 21 is the highest priority score to be obtained, and 0 is the lowest. The priority score distribution of the 202 project locations is displayed in Figure 1.

Figure 1. Priority Score Distribution



Qualitative Evaluation

The project locations were further evaluated to better focus future efforts and resources toward a strategically identified set of projects focused on member agencies.

OTO and Advisory Committee intended to identify a set of priority project location that represent diversity in:

- Disadvantaged communities
- Urban and rural locations
- Roadway segments and intersections
- Pedestrian and bicycle improvements
- OTO member agencies

81% of project locations are on the State system and therefore under the Missouri Department of Transportation's (MoDOT) jurisdiction, which is a member of the Advisory Committee. These locations are representative of safety needs in the region, often traverse municipal boundaries, and affect all users. However, a state transportation agency cannot directly apply for SS4A funding, and identifying project locations under the jurisdiction of member agencies was a goal of OTO and the Advisory Committee.

Furthermore, multiple project locations on the state system have already been studied and/or identified for initial project development and were not considered as priorities for action, with respect to the Safety Action Plan.

Priority Project Location Identification

The 202 project locations were quantified by Priority Score and qualitatively evaluated in collaboration with the Advisory Committee. The project locations were categorized into one of the following three Tiers, as indicated in the Implementation Matrix.

Tier 0 – 10 Project Locations

These ten project locations are under the Missouri Department of Transportation's jurisdiction and have already been studied and/or identified for initial project development; however, each has safety merit with respect to the comprehensive safety analysis process for the region. Accordingly, these are categorized as Tier 0 project locations.

Tier 1 – 21 Project Locations

The Tier 1 project locations represent the **top safety priorities** in the OTO region. The Tier 1 project locations collectively represent the OTO member agencies, disadvantaged communities, and a mix of urban and rural locations, state and local routes, segments and intersections, and pedestrian/bicycle improvement needs. For each Tier 1 project location, an evaluation of existing conditions and crash history was performed and a set of safety countermeasure recommendations was developed to illustrate potential safety improvements at each Tier 1 location.

Tier 2 – 171 Project Locations

The remaining 171 projects have safety merit, as documented by the project data and Priority Scores, and are important elements of the comprehensive safety analysis process and action plan. Tier 2 project locations can be subject to future project development if funding becomes available and/or local priorities change Accordingly, they are collectively categorized in Tier 2 as secondary priorities.

IMPLEMENTATION MATRIX

The Implementation Matrix lists all 202 project locations and incorporates all data elements listed in Table 1, including the resulting priority as categorized by Tier.

Timeframes are specifically identified for each project. It is important to note that timeframes are not indicative of urgency, which is represented by the prioritization process results. Rather, timeframe is estimated to represent the duration to develop and implement a construction project (of undefined scope) at the location. Timeframes are estimated to fall into the following three categories.

- Short-term
    - Signal improvements, signing, pedestrian crossings, and sidewalks/trails
- Mid-term
    - Intersection improvements, roundabouts, corridor improvements, CSS solutions,
- Long-term
    - Capacity improvements, widening, interchanges, and overpasses

Appendix D-4
Tier 1 Project Recommendations

MEMO

To: Ozarks Transportation Organization

From: Lochmueller Group

Date: September 27, 2024

Subject: OTO Safety Action Plan – Tier 1 Project Evaluations

INTRODUCTION

As part of the comprehensive project list and project prioritization process, 21 tier 1 project locations were identified as the top safety needs throughout the OTO region. This technical memorandum evaluates each of the tier 1 projects and provides recommended safety countermeasures that can address the safety needs of each location.

For each tier 1 project evaluation, an existing conditions overview is provided to illustrate key roadway characteristics such as the number of lanes, daily traffic volumes, speed limits, intersections, pedestrian and bicycle facilities, and adjacent land uses. A crash history (2018-2022) is also provided, detailing the type and severity of crashes at each tier 1 project location. Since tier 1 project locations were identified from the project prioritization process, key items from the prioritization process are shown for each location, including whether the location is on the high injury network (HIN), whether the project is in a disadvantaged community (CEJST), the total number of killed or serious injury (KSI) crashes, and the total priority score. For all data elements used in the prioritization process, see the Implementation Matrix.

Recommendations

Safety countermeasures are recommended based on the context of the location as well as the identified safety problem. In some cases, countermeasures are best implemented together while in other cases, countermeasures reflect options to implement based on funds available, time-frame, or other agency priorities. For each recommendation, additional context and information is provided.

- **Purpose**: The purpose of the recommended safety countermeasure is to address the observed safety need.
- **Benefit**: The expected safety benefits based on national statistics found in FHWA's Proven Safety Countermeasure initiative.
- **Time-frame**: The time-frame to implement a countermeasure based on cost and complexity.
- **Right-of-Way (ROW)**: The expectation that a countermeasure will require additional ROW.
- **Planning Level Cost**: The per unit construction cost of a countermeasure.
- **Quantity**: The unit quantity of a countermeasure recommended at the project location.
- **Estimated Cost**: The estimated cost to construct a countermeasure at the project location.
- **Baseline Estimated Total Cost**: Sum of estimated costs for each countermeasure. This is the baseline construction total not including design, environmental review, ROW, utility coordination, maintenance of traffic, or contingency.

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TIER 1 PROJECT EVALUATIONS

MO-13/Kansas Expressway (Evergreen St to Division St)

Existing Conditions

MO-13/Kansas Expressway from Evergreen Street to Division Street is a 1.5-mile principal arterial/freeway in Springfield, MO. There are two through lanes in each direction and a center median south of Kearney Street and a center turn lane north of Kearney Street. Average daily vehicle traffic is around 25,000 – 30,000 vehicles per day. Sidewalks are disconnected and crossings appear challenging. There are no dedicated bicycle facilities.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Pedestrian	2	5	0	7
Rear end	1	62	96	159
Left turn	1	13	14	28
Out of control	1	12	41	54
Right turn right angle collision	1	6	10	17
Head on	1	5	8	14
Right angle	0	22	22	44
Left turn right angle collision	0	21	12	33
Pedalcycle	0	7	1	8
Passing	0	3	22	25
Sideswipe	0	3	3	6
Right turn	0	2	4	6
Fixed object	0	2	1	3
Other	0	1	2	3
Dual lefts collide	0	1	2	3
Avoiding	0	1	1	2
Changing lane	0	0	2	2
Debris	0	0	1	1
U - turn	0	0	1	1
Total	***7***	***166***	***243***	***416***

Project Prioritization

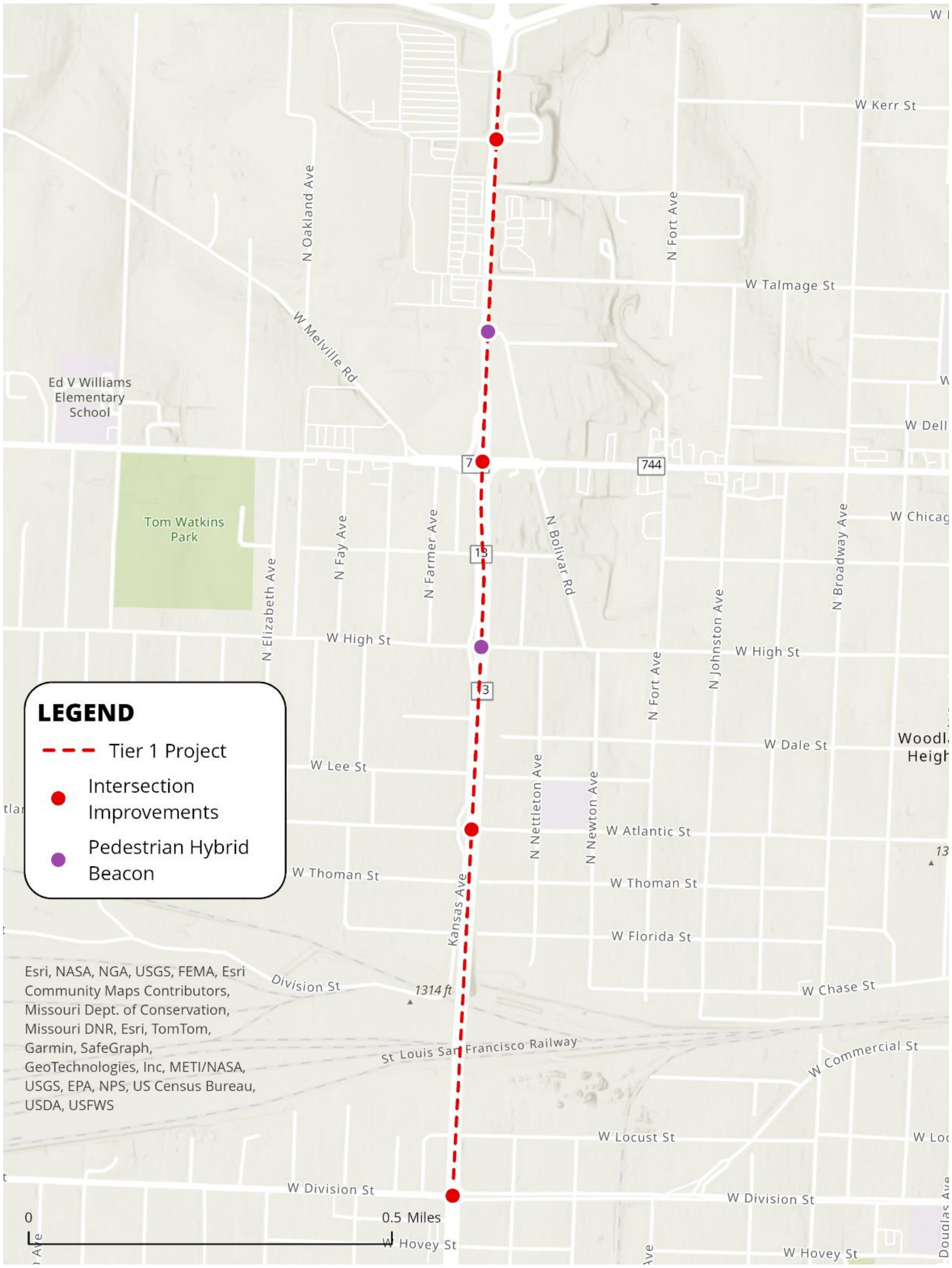
System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
State	Yes	Yes	Springfield	Urban	Yes	Yes	No	7	21

Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Sidewalks	Reduce pedestrian crashes	65%-89% reduction in pedestrian crashes	Short-term	No	1.3 miles	$370,000 per mile	$481,000
Pedestrian Hybrid Beacons (PHBs)	Reduce pedestrian crashes Reduce vehicle speeds	55% reduction in pedestrian crashes	Short-term	No	2 crossings*	$120,000 each	$240,000
Crosswalk Enhancements	Reduce pedestrian crashes Reduce vehicle speeds	40% reduction in pedestrian crashes	Short-term	No	4 intersections	$25,000 per intersection	$100,000
Pedestrian Refuge Islands	Reduce pedestrian crashes Reduce vehicle speeds	56% reduction in pedestrian crashes	Mid-term	No	8 islands	$115,000 per island	$920,000
Dilemma Zone Detection	Reduce rear end and right-angle crashes	39% reduction in KSI crashes at intersections	Short-term	No	4 signalized intersections	$60,000 per intersection	$240,000
Signal Heads with Retroreflective Backplates	Reduce rear end and right-angle crashes	15% reduction in total crashes	Short-term	No	56 signals	$3,000 per signal	$168,000
Permissive to Protected Left Turn Phase	Reduce left turn and right-angle crashes	--	Short-term	No	4 signalized intersections	$5,000 per intersection	$20,000
Improved Right Turn Angles	Reduce pedestrian crashes Reduce vehicle speeds	--	Mid-term	Yes	8 right turns	$400,000 per right turn	$3,200,000
Corridor Access Management	Reduce pedestrian, rear end, and right-angle crashes	25%-31% reduction in KSI crashes	Long-term	Yes	1.3 miles	--	--
BASELINE ESTIMATED TOTAL							**$5,400,000**

**PHB crossings at High Street and Bolivar Road*

FIGURE 1 - MO-13/KANSAS EXPRESSWAY (EVERGREEN ST TO DIVISION ST)



MO-13/Kansas Expressway (Division St to Chestnut Ex)

Existing Conditions

MO-13/Kansas Expressway from Division Street to Chestnut Expressway is a 0.8-mile divided freeway in Springfield, MO. There are two through lanes in each direction, eight-foot-wide shoulders, and a center median and the speed limit is 40mph. Average daily vehicle traffic is around 15,000 – 20,000 vehicles per day. There are signalized intersections at Division Street, Nicholas Street, and the Chestnut Expressway. There are no sidewalks between Division Street and Nicholas Street; sidewalks are present on the east side south of Nicholas Street. Crossings on foot appear challenging with no dedicated crossings or crosswalks except for those at the signalized intersections. There are no dedicated bicycle facilities, but shared lanes markings are present along Nicholas St. Land use is primarily residential with nearby community features such as Nicholas Park and York Elementary School.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Out of control	3	9	19	31
Pedestrian	2	3	0	5
Left turn right angle collision	1	16	11	28
Left turn	1	8	10	19
Head on	1	6	1	8
Pedalcycle	1	2	1	4
Rear end	0	41	52	93
Right angle	0	24	16	40
Right turn right angle collision	0	4	2	6
Passing	0	2	13	15
Avoiding	0	1	0	1
Other	0	0	3	3
Changing lane	0	0	2	2
Sideswipe	0	0	1	1
Fixed object	0	0	1	1
U - turn	0	0	1	1
Dual lefts collide	0	0	1	1
Total	***9***	***116***	***134***	***259***

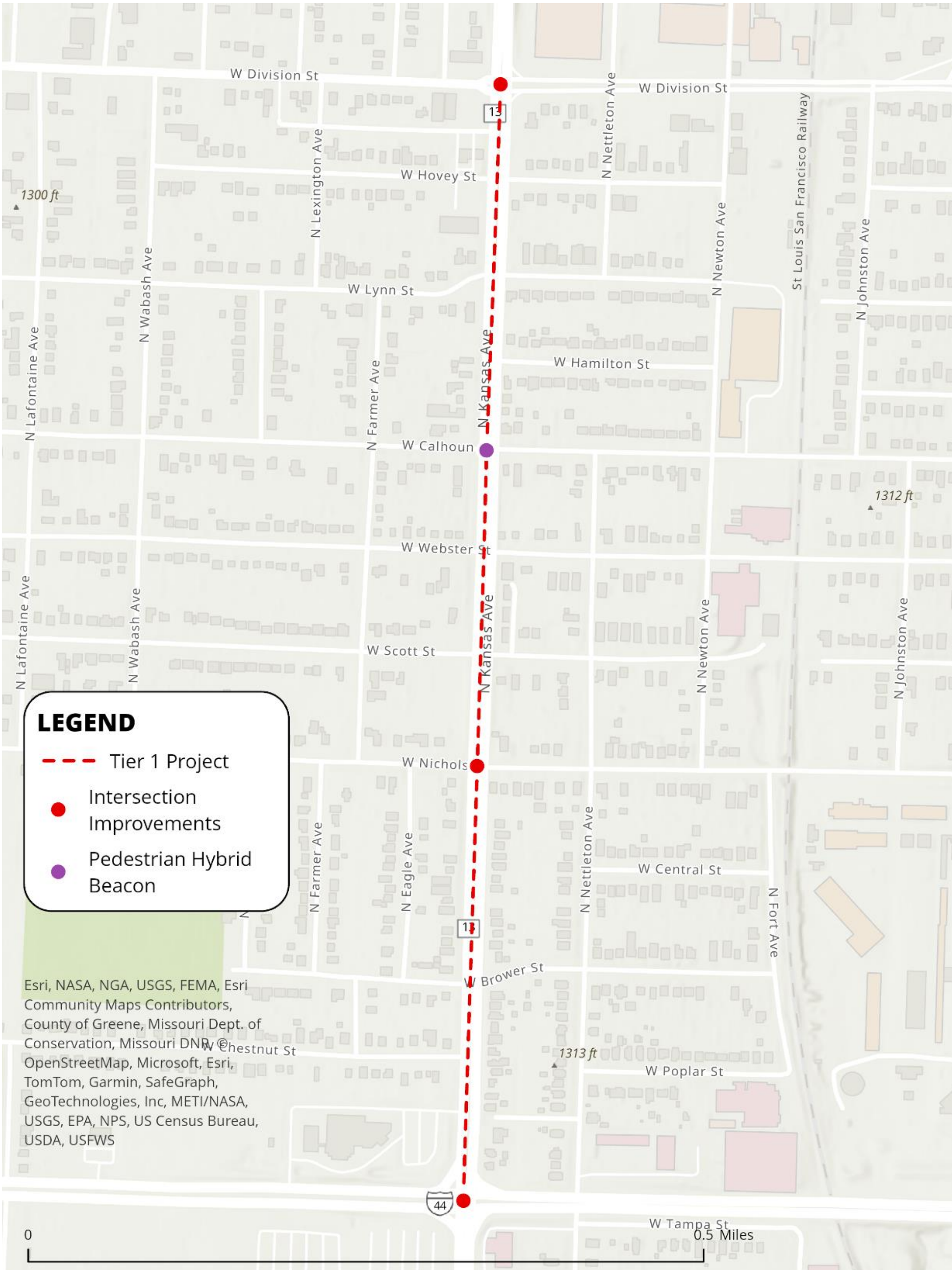
Project Prioritization

System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
State	Yes	Yes	Springfield	Urban	Yes	No	No	9	20

Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Sidewalks	Reduce pedestrian crashes	65%-89% reduction in pedestrian crashes	Short-term	No	1 mile	$370,000 per mile	$370,000
Pedestrian Hybrid Beacons (PHBs)	Reduce pedestrian crashes Reduce vehicle speeds	55% reduction in pedestrian crashes	Short-term	No	1 crossing	$120,000 per unit	$120,000
Crosswalk Enhancements	Reduce pedestrian crashes Reduce vehicle speeds	40% reduction in pedestrian crashes	Short-term	No	3 intersections	$25,000 per intersection	$75,000
Pedestrian Refuge Islands	Reduce pedestrian crashes Reduce vehicle speeds	56% reduction in pedestrian crashes	Mid-term	No	6 islands	$115,000 per island	$690,000
Road Diet	Reduce vehicle speeds and out of control crashes Reduce pedestrian and pedalcycle crashes	19%-47% reduction in total crashes	Long-term	No	1.7 miles	$150,000 per mile	$255,000
BASELINE ESTIMATED TOTAL							**$1,500,000**

FIGURE 2 - MO-13/KANSAS EXPRESSWAY (DIVISION ST TO CHESTNUT EX)



MO-13 (Norton Rd to Route WW)

Existing Conditions

This section of MO-13 is a freeway that stretches nearly six miles and is two lanes in each direction separated by a grass median with ten-foot-wide paved shoulders on both sides. Average daily traffic is approximately 20,000 – 25,000 vehicles per day and the speed limit is 65mph. There is one signalized intersection at Norton Road and at-grade stop-controlled intersections at Farm Road 94, Farm Road 88, Little Sac River Road, Route O, and Route WW. Serving rural areas with little commercial or residential development, there are no dedicated bicycle or pedestrian facilities. The Fullbright Springs Greenway crosses the corridor at the Little Sac River near Farm Road 88 with a nearby trailhead on Farm Road 141.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Right angle	4	12	8	24
Out of control	4	6	36	46
Rear end	1	16	49	66
Left turn right angle collision	1	2	3	6
Pedestrian	1	0	0	1
Passing	0	5	19	24
Animal	0	5	8	13
Other	0	2	13	15
Left turn	0	2	0	2
Debris	0	0	9	9
Changing lane	0	0	3	3
Total	***11***	***50***	***148***	***209***

Project Prioritization

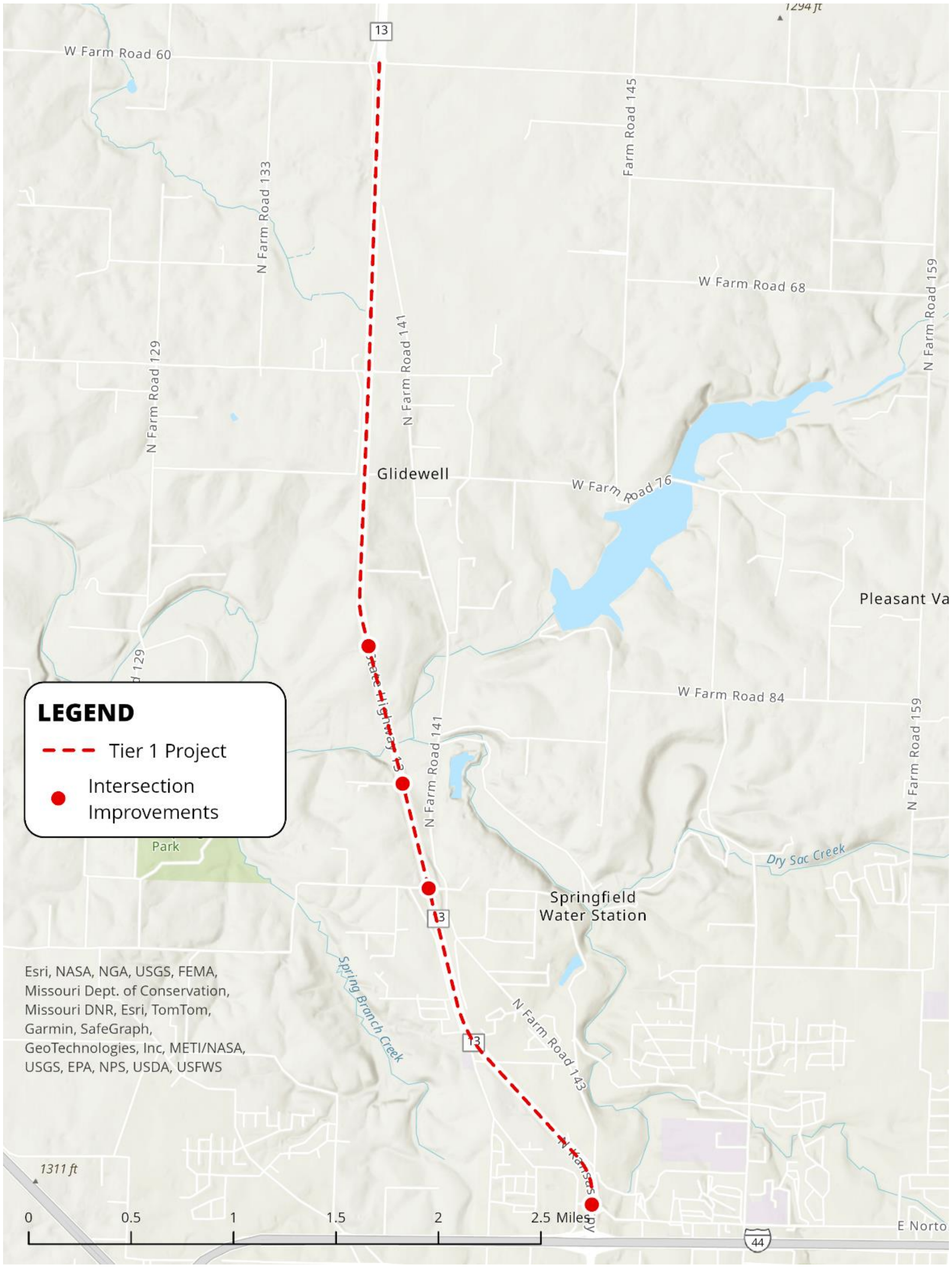
System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
State	Yes	Yes	Springfield	Rural	Yes	No	No	11	20

Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Intersection Conflict Warning Systems	Reduce right angle crashes	20%-30% reduction in KSI crashes at intersections	Short-term	No	4 intersections	$35,000 per intersection	$140,000
Lighting	Reduce crashes at intersections	28% reduction in injury crashes	Long-term	No	4 intersections	$30,000 per intersection	$120,000
Median barriers	Reduce out of control crashes	97% reduction in cross median crashes	Mid-term	No	5.9 miles	$525,000 per mile	$3,100,000
BASELINE ESTIMATED TOTAL							**$3,400,000**

Reduced Left Turn Conflict Intersections have been recently implemented at Route O and Route WW to reduce left turn and right-angle crashes; future evaluations should be performed when more data becomes available.

FIGURE 3 - MO-13/KANSAS EXPRESSWAY (NORTON RD TO ROUTE WW)



MO-13 and Division St Intersection

Existing Conditions

MO-13 is two through lanes with left and right turn lanes in both directions. Division Street is one through lane with left and right turn lanes in each direction. Right-turn lanes on northbound MO-13 and westbound Division Street are channelized slip lanes. Sidewalk connectivity is lacking at the intersection with missing connections along the south leg on MO-13 and west leg on Division Street.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Out of control	2	6	11	19
Pedestrian	2	1	0	3
Left turn right angle collision	1	4	1	6
Pedalcycle	1	2	0	3
Rear end	0	33	32	65
Right angle	0	7	8	15
Right turn right angle collision	0	2	1	3
Left turn	0	1	5	6
Head on	0	1	0	1
Passing	0	0	7	7
Other	0	0	2	2
Right turn	0	0	1	1
Dual lefts collide	0	0	1	1
Backing	0	0	1	1
Sideswipe	0	0	1	1
Total	***6***	***57***	***71***	***134***

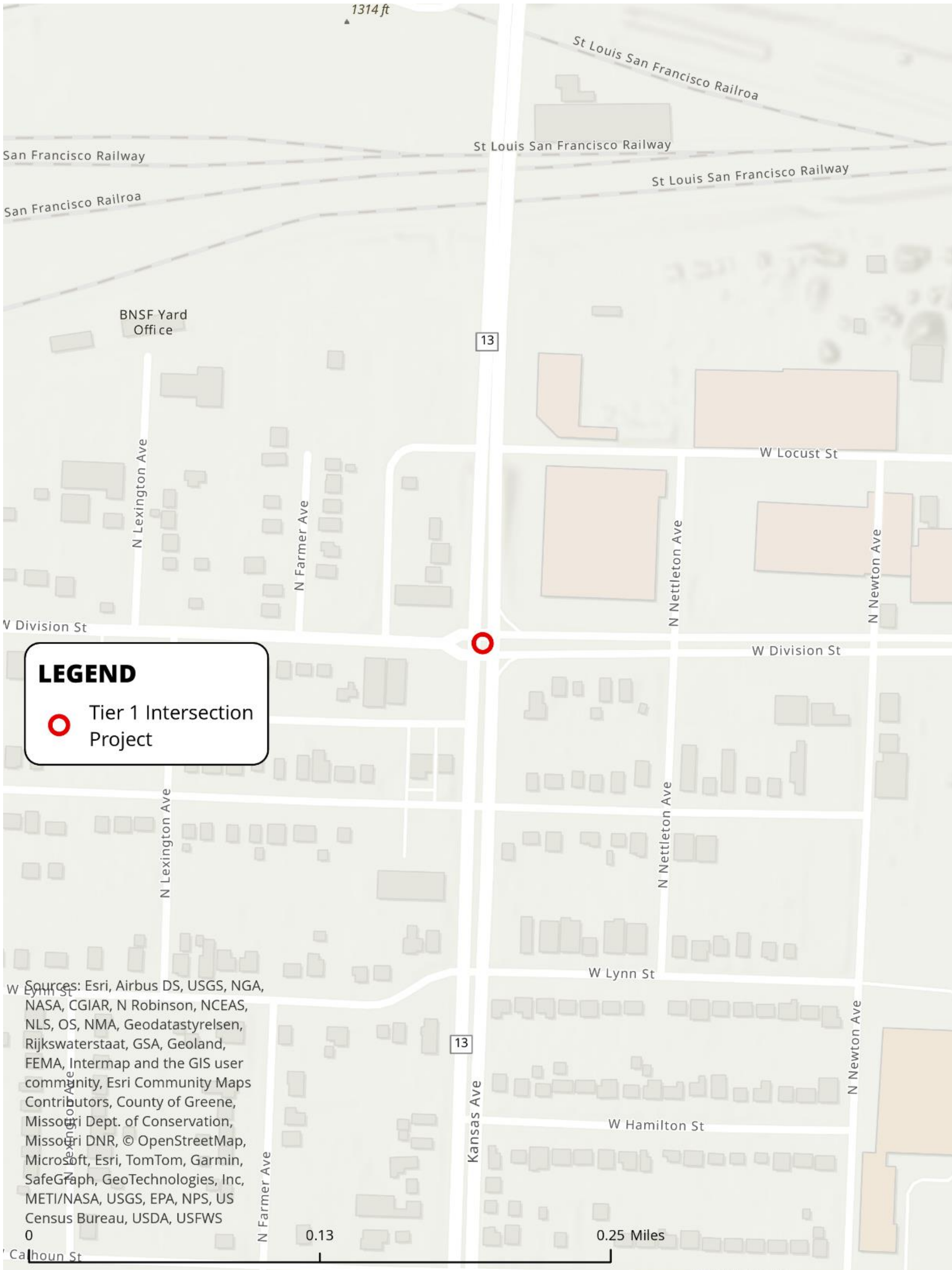
Project Prioritization

System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
State	Yes	Yes	Springfield	Urban	Yes	No	No	6	17

Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short-term	No	1 intersection	$25,000 per intersection	$25,000
Pedestrian Refuge Islands	Reduce pedestrian and out of control crashes	56% reduction in pedestrian crashes	Short-term	No	2 islands	$115,000 per island	$230,000
Dilemma Zone Detection	Reduce rear end and right angle crashes	39% reduction in KSI crashes at intersections	Short-term	No	1 intersection	$60,000 per intersection	$60,000
Signal Heads with Retroreflective Backplates	Reduce rear end and right angle crashes	15% reduction in total crashes	Short-term	No	13 signals	$3,000 per signal	$40,000
Permissive to Protected Left Turn Phase	Reduce left turn and right angle crashes	--	Short-term	No	1 intersection	$5,000 per intersection	$5,000
Improved Right Turn Angles	Reduce pedestrian crashes Reduce vehicle speeds	--	Mid-term	Yes	2 right turns	$400,000 per right turn	$800,000
BASELINE ESTIMATED TOTAL							**$1,200,000**

FIGURE 4 - MO-13 AND DIVISION ST INTERSECTION



Route 14 (14^{th} St to Route W)

Existing Conditions

Route 14 is a two-lane, rural, minor arterial, around 1-mile long, that serves approximately 5,000 – 10,000 vehicles per day. There are no signalized intersections; 14^{th} Street and Route W are side street stop-controlled intersections. The speed limit along the corridor is 45mph. There are no dedicated bicycle or pedestrian facilities, and the adjacent land uses include commercial, light industrial, and residential.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Rear end	1	8	12	21
Left turn right angle collision	0	2	2	4
Left turn	0	2	1	3
Out of control	0	2	1	3
Sideswipe	0	1	1	2
Right angle	0	1	0	1
Animal	0	0	2	2
Passing	0	0	1	1
Head on	0	0	1	1
Total	***1***	***16***	***21***	***38***

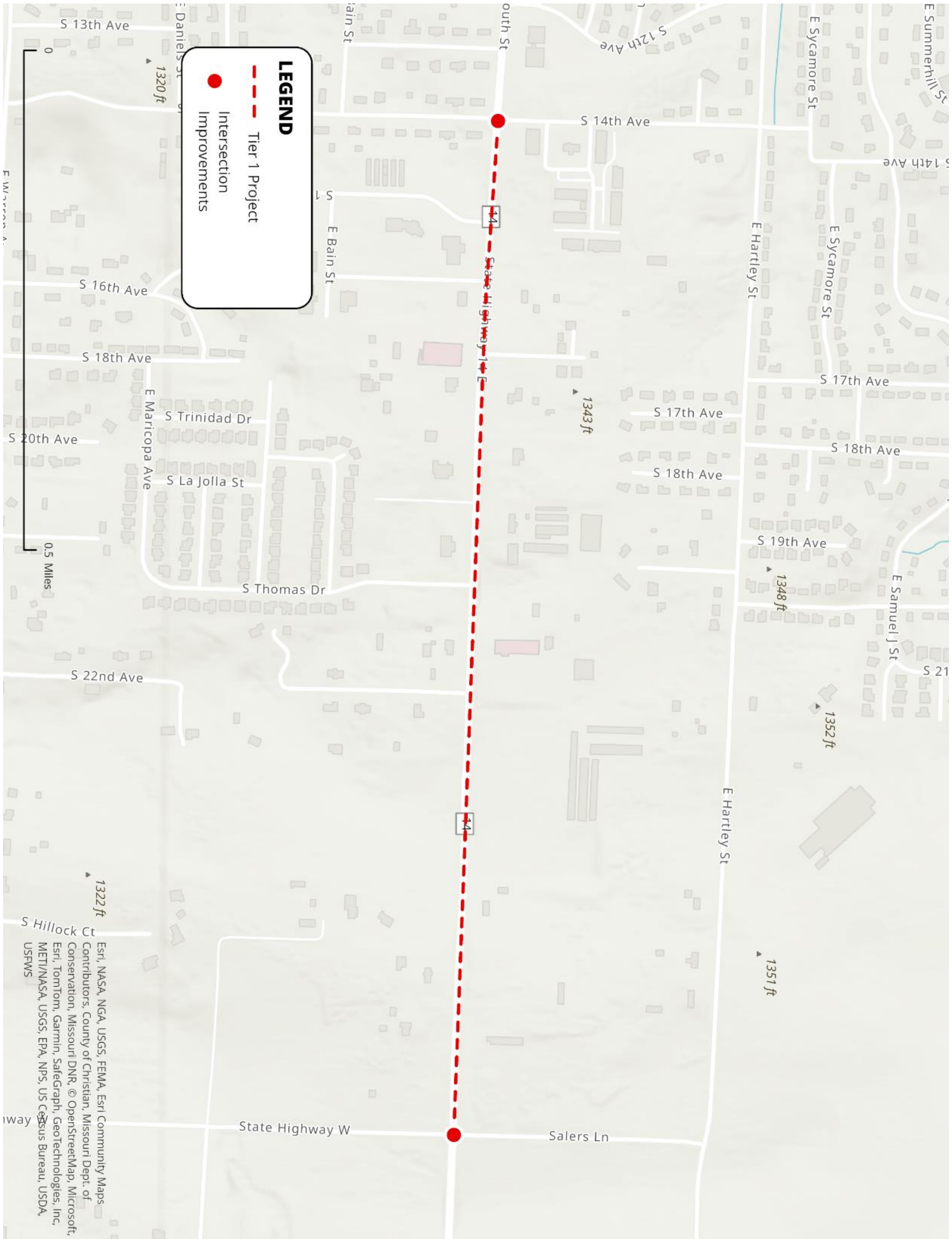
Project Prioritization

System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
State	Yes	No	Ozark	Rural	Yes	No	No	1	7

Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Intersection Conflict Warning Systems	Reduce right angle crashes	20%-30% reduction in KSI crashes at intersections	Short-term	No	2 intersections	$35,000 per intersection	$70,000
Lighting	Reduce crashes at intersections	28% reduction in injury crashes	Long-term	No	2 intersections	$30,000 per intersection	$60,000
Systemic Signing & Marking	Reduce rear end and intersection crashes	27% reduction in KSI crashes at rural intersections	Short-term	No	2 intersections	$15,000 per intersection	$30,000
BASELINE ESTIMATED TOTAL							**$160,000**

FIGURE 5 – ROUTE 14 (14TH ST TO ROUTE W)



Route 125 (Route D to US 60)

Existing Conditions

Route 125 is a two-lane, rural, minor arterial, 4.5 miles long, from Route D to US 60. The corridor carries approximately 5,000 vehicles per day. There are no shoulders or bicycle or pedestrian facilities. The speed limit along the corridor is 55mph. The signalized intersection at Route 125 and US 60 is being replaced by a grade separated interchange (completion scheduled for late 2024). There are no other signalized intersections along the corridor. The corridor primarily serves rural residential land uses.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Rear end	2	8	15	25
Out of control	1	5	9	15
Right angle	1	0	4	5
Pedestrian	1	0	0	1
Left turn right angle collision	0	3	5	8
Left turn	0	2	1	3
Passing	0	2	1	3
Right turn right angle collision	0	1	3	4
Head on	0	1	2	3
Pedalcycle	0	1	0	1
Avoiding	0	1	0	1
Other	0	0	1	1
Dual lefts collide	0	0	1	1
Animal	0	0	1	1
Backing	0	0	1	1
Right turn	0	0	1	1
Sideswipe	0	0	1	1
Total	***5***	***24***	***46***	***75***

Project Prioritization

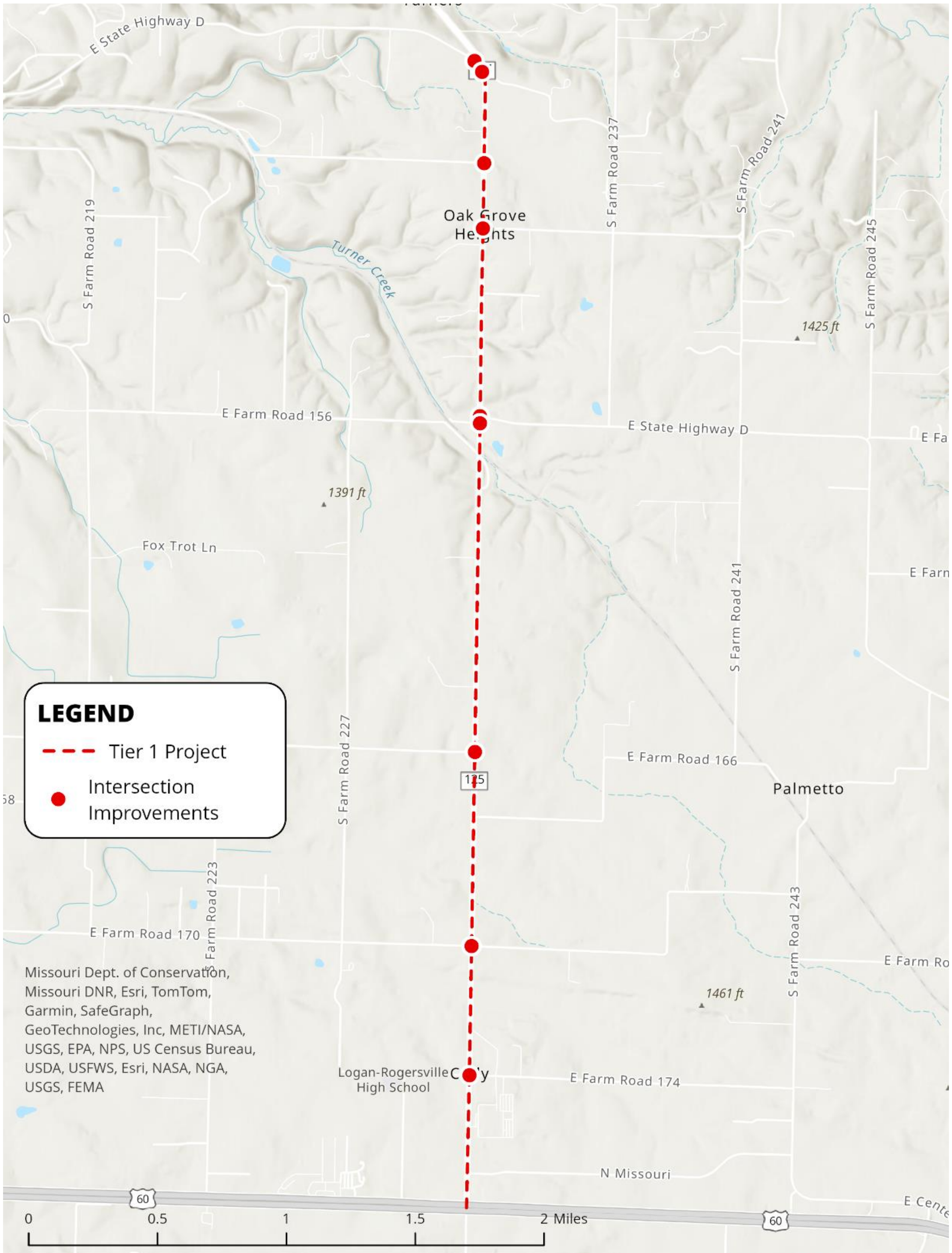
System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
State	No	No	Rogersville	Rural	Yes	No	No	5	12

Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Intersection Conflict Warning Systems	Reduce right angle crashes	20%-30% reduction in KSI crashes at intersections	Short-term	No	3 intersections*	$35,000 per intersection	$105,000
Lighting	Reduce crashes at intersections	28% reduction in injury crashes	Long-term	No	3 intersections*	$30,000 per intersection	$90,000
Systemic Signing & Marking	Reduce rear end and intersection crashes	27% reduction in KSI crashes at rural intersections	Short-term	No	9 intersections	$15,000 per intersection	$135,000
Rumble Strips	Reduce out of control crashes	13%-51% reduction in out of control crashes	Short-term	No	4.5 miles	$10,000 per mile	$45,000
BASELINE ESTIMATED TOTAL							**$375,000**

The new interchange at Route 125 and US 60 should be evaluated after completion once data become available.
**Farm Road 174, Farm Road 156, and Route D*

FIGURE 6 – ROUTE 125 (ROUTE D TO US 60)



Kearney St and National Ave Intersection

Existing Conditions

Kearney Street is two through lanes with left turn lanes in each direction. National Avenue is one through lane with left turn lanes in both directions and a right turn lane on the northbound approach. Kearney Street carries approximately 22,000 vehicles per day while National Avenue carries around 10,000 vehicles per day. Sidewalks are present on all approaches however, several objects (utility poles, signal poles, signal boxes, etc.) are located on the sidewalk. Crosswalks appear to be in poor condition with low visibility. There are no dedicated bicycle facilities.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Left turn	3	7	7	17
Head on	1	5	1	7
Out of control	1	1	4	6
Right angle	0	9	3	12
Rear end	0	6	17	23
Passing	0	2	4	6
Left turn right angle collision	0	1	2	3
Pedestrian	0	1	0	1
Total	***5***	***32***	***38***	***75***

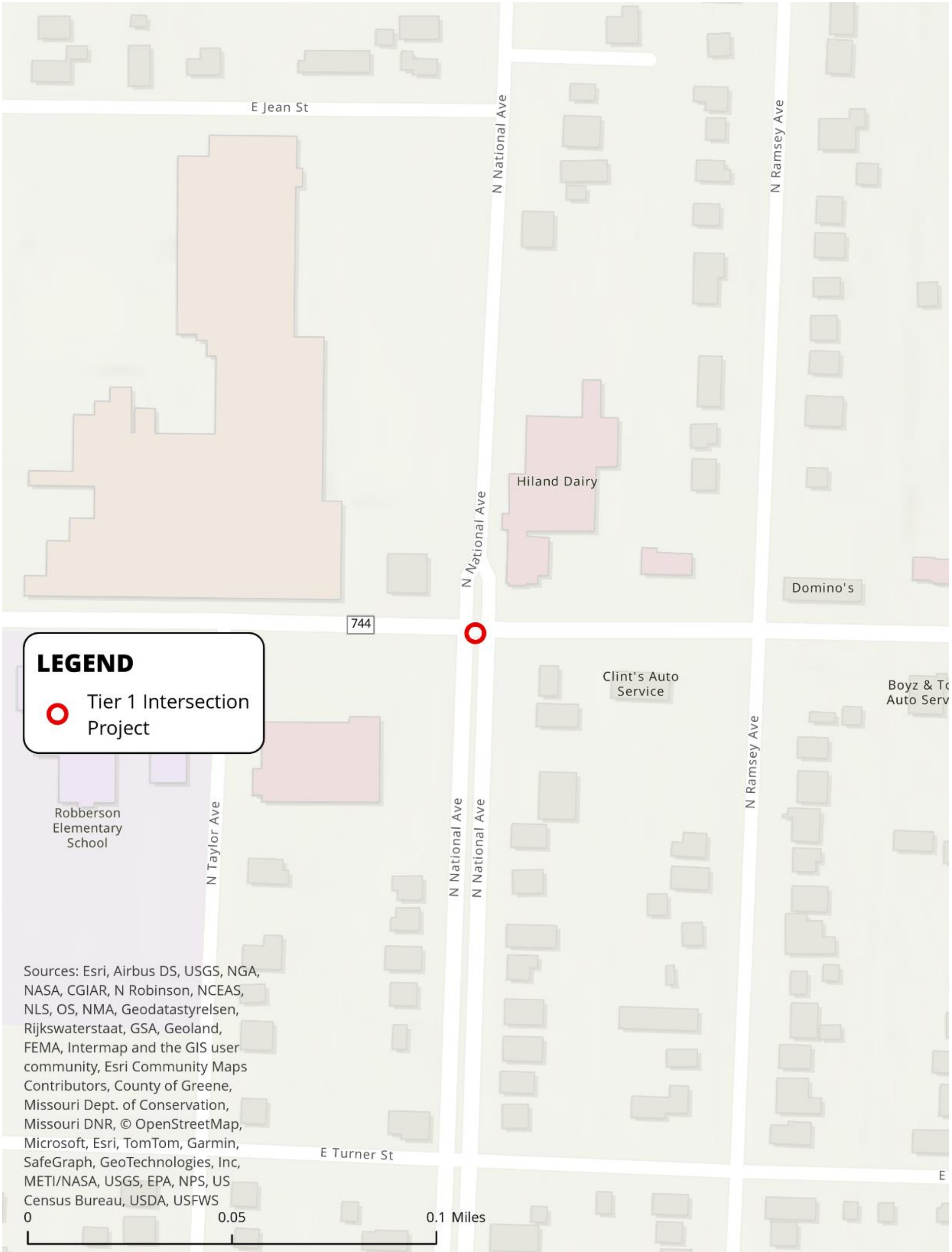
Project Prioritization

System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
State	Yes	Yes	Springfield	Urban	Yes	No	No	5	17

Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Permissive to Protected Left Turn Phase	Reduce left turn and head on crashes	--	Short-term	No	1 intersection	$5,000 per intersection	$5,000
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short-term	No	1 intersection	$25,000 per intersection	$25,000
Leading Pedestrian Interval	Reduce pedestrian crashes	13% reduction in pedestrian crashes	Short-term	No	1 intersection	$5,000 per intersection	$5,000
Pedestrian Refuge Islands	Reduce pedestrian and out of control crashes	56% reduction in pedestrian crashes	Short-term	No	2 islands	$115,000 per island	$230,000
Signal Heads with Retroreflective Backplates	Reduce rear end and right angle crashes	15% reduction in total crashes	Short-term	No	12 signals	$3,000 per signal	$36,000
Dilemma Zone Detection	Reduce left turn and right angle crashes	--	Short-term	No	1 intersection	$60,000 per intersection	$60,000
BASELINE ESTIMATED TOTAL							**$360,000**

FIGURE 7 – KEARNEY ST AND NATIONAL AVE INTERSECTION



US 160 and Farm Road 123 Intersection

Existing Conditions

Reduced Left Turn Conflict Intersection completed in 2021; not providing recommendations at this time.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Rear end	2	1	4	7
Head on	1	1	0	2
Left turn right angle collision	1	0	0	1
Pedalcycle	0	1	0	1
Out of control	0	0	3	3
Right angle	0	0	1	1
Total	***4***	***3***	***8***	***15***

Project Prioritization

System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
State	Yes	Yes		Rural	Yes	No	No	4	11

US 160 (Route 14 to OTO Boundary)

Existing Conditions

This section of US 160 is a principal arterial extending 3.6 miles from Route 14 in Nixa south to the OTO boundary. There is one through lane in each direction and ten-foot-wide paved shoulders. The speed limit is 60mph. US 160 at Route 14 and at South Street (reconstructed in 2021) are the only signalized intersections along the corridor. Other major intersections include left turn lanes at Sunrise Drive, Rosedale Road, Kelby Parkway, S Main Street, and Pawnee Road. The corridor carries approximately 5,000 vehicles per day.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Rear end	4	20	76	100
Left turn right angle collision	3	6	5	14
Out of control	2	7	17	26
Left turn	1	3	3	7
Sideswipe	1	1	0	2
Avoiding	1	1	0	2
Right angle	0	4	8	12
Head on	0	3	5	8
Animal	0	1	12	13
Right turn right angle collision	0	1	4	5
Passing	0	0	13	13
Debris	0	0	4	4
Other	0	0	3	3
Fixed object	0	0	2	2
Right turn	0	0	1	1
Changing lane	0	0	1	1
Total	***12***	***47***	***154***	***213***

Project Prioritization

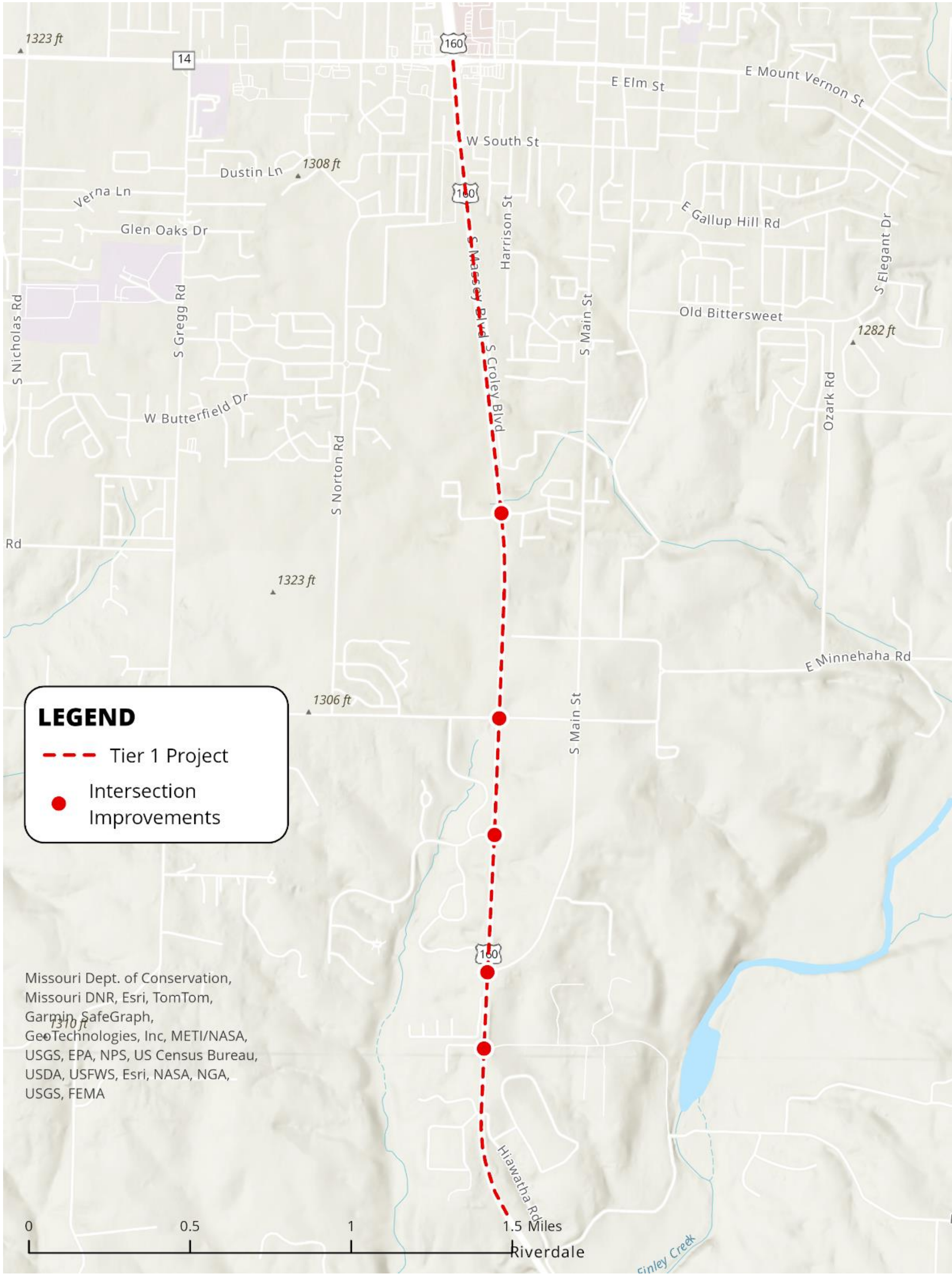
System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
State	Yes	No	Nixa	Rural	Yes	No	No	12	20

Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Intersection Conflict Warning Systems	Reduce right angle and rear end crashes	20%-30% reduction in KSI crashes at intersections	Short-term	No	5 intersections	$35,000 per intersection	$175,000
Lighting	Reduce crashes at intersections	28% reduction in injury crashes	Long-term	No	5 intersections	$30,000	$150,000
Systemic Signing & Marking	Reduce rear end and intersection crashes	27% reduction in KSI crashes at rural intersections	Short-term	No	5 intersections	$15,000 per intersection	$75,000
Rumble Strips	Reduce out of control crashes	13%-51% reduction in out of control crashes	Short-term	No	3.6 miles	$10,000 per mile	$36,000
Reduced Conflict Left Turn Intersections	Reduce left turn and right angle crashes	63% reduction in KSI crashes	Long-term	Yes	2 intersections*	$1,000,000 per intersection	$2,000,000
BASELINE ESTIMATED TOTAL							**$2,400,000**

**Rosedale Road and Main Street*

FIGURE 8 – US 160 (ROUTE 14 TO OTO BOUNDARY)



Route AB (US 160 to Route EE)

Existing Conditions

Route AB is a major collector with one lane in each direction and narrow shoulders stretching 4 miles from US 160 to Route AB. The route carries approximately 2,500 vehicles per day and has a speed limit of 55 mph. There is a signalized intersection at US 160 and a four-way stop controlled intersection at Route EE. Land use along the corridor is rural residential and agricultural with some suburban residential developments near US 160 in Willard, MO. There are no dedicated bicycle or pedestrian facilities.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Right angle	1	6	11	18
Out of control	1	5	14	20
Rear end	1	4	8	13
Sideswipe	1	0	1	2
Other	1	0	0	1
Left turn right angle collision	0	1	5	6
Avoiding	0	1	0	1
Animal	0	0	9	9
Left turn	0	0	4	4
Passing	0	0	3	3
Debris	0	0	1	1
U - turn	0	0	1	1
Head on	0	0	1	1
Total	***5***	***17***	***58***	***80***

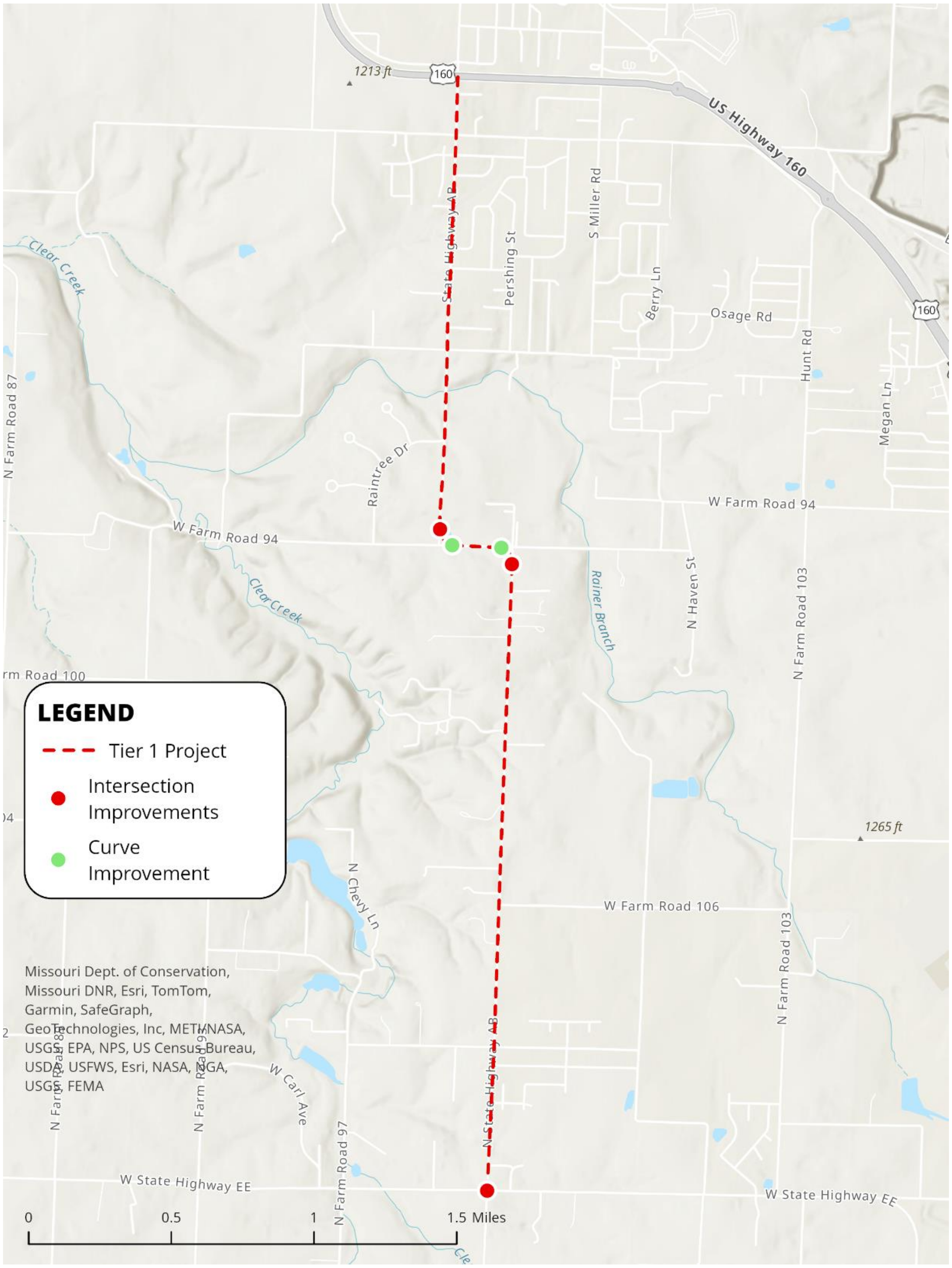
Project Prioritization

System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
State	No	No	Willard	Rural	Yes	No	No	5	11

Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Intersection Conflict Warning Systems	Reduce right angle and rear end crashes	20%-30% reduction in KSI crashes at intersections	Short-term	No	3 intersections	$35,000 per intersection	$105,000
Lighting	Reduce crashes at intersections	28% reduction in injury crashes	Long-term	No	3 intersections	$30,000 per intersection	$90,000
Systemic Signing & Marking	Reduce rear end and intersection crashes	27% reduction in KSI crashes at rural intersections	Short-term	No	3 intersections	$15,000 per intersection	$45,000
Rumble Strips	Reduce out of control crashes	13%-51% reduction in out of control crashes	Short-term	No	4 miles	$10,000 per mile	$40,000
Curve Improvements – Signs and markings	Reduce out of control crashes	--	Short-term	No	2 curves	$35,000 per curve	$70,000
Curve Improvements – Radius Improvement	Reduce out of control crashes	--	Long-term	Yes	2 curves	$1,500,000 per curve	$3,000,000
BASELINE ESTIMATED TOTAL							**$3,400,000**

FIGURE 9 – ROUTE AB (US 160 TO ROUTE EE)



Route CC (US 160 to US 65)

Existing Conditions

Route CC is a minor arterial, 4.5 miles long, from US 160 to US 65 spanning the communities of Nixa, Fremont Hills, and Ozark. The corridor is one lane in each direction with narrow shoulders and has a speed limit of 45 mph. Approximately 12,000 – 18,000 vehicles per day use the facility which provides access to various land uses such as suburban residential neighborhoods, commercial uses, and schools. Intersections at US 160, Cedar Street, Cheyenne Road, Fremont Road, and 22nd Street are signalized. The intersection at US 65 is a diverging diamond interchange (DDI) completed in 2016. There are sidewalks on the south side of Route CC between 22nd Street and US 65 and a 0.15-mile disconnected walkway/shared use path just west of Fremont Road.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Head on	4	5	3	12
Rear end	3	29	118	150
Out of control	2	16	25	43
Left turn right angle collision	1	4	14	19
Right angle	1	2	7	10
Left turn	0	9	18	27
Animal	0	2	4	6
Passing	0	1	22	23
Right turn right angle collision	0	1	12	13
Pedestrian	0	1	0	1
Sideswipe	0	0	6	6
Right turn	0	0	4	4
Changing lane	0	0	3	3
Debris	0	0	2	2
Other	0	0	2	2
Avoiding	0	0	1	1
Total	***11***	***70***	***241***	***322***

Project Prioritization

System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
State	Yes	No	Nixa Fremont Hills Ozark	Urban	Yes	No	No	11	20

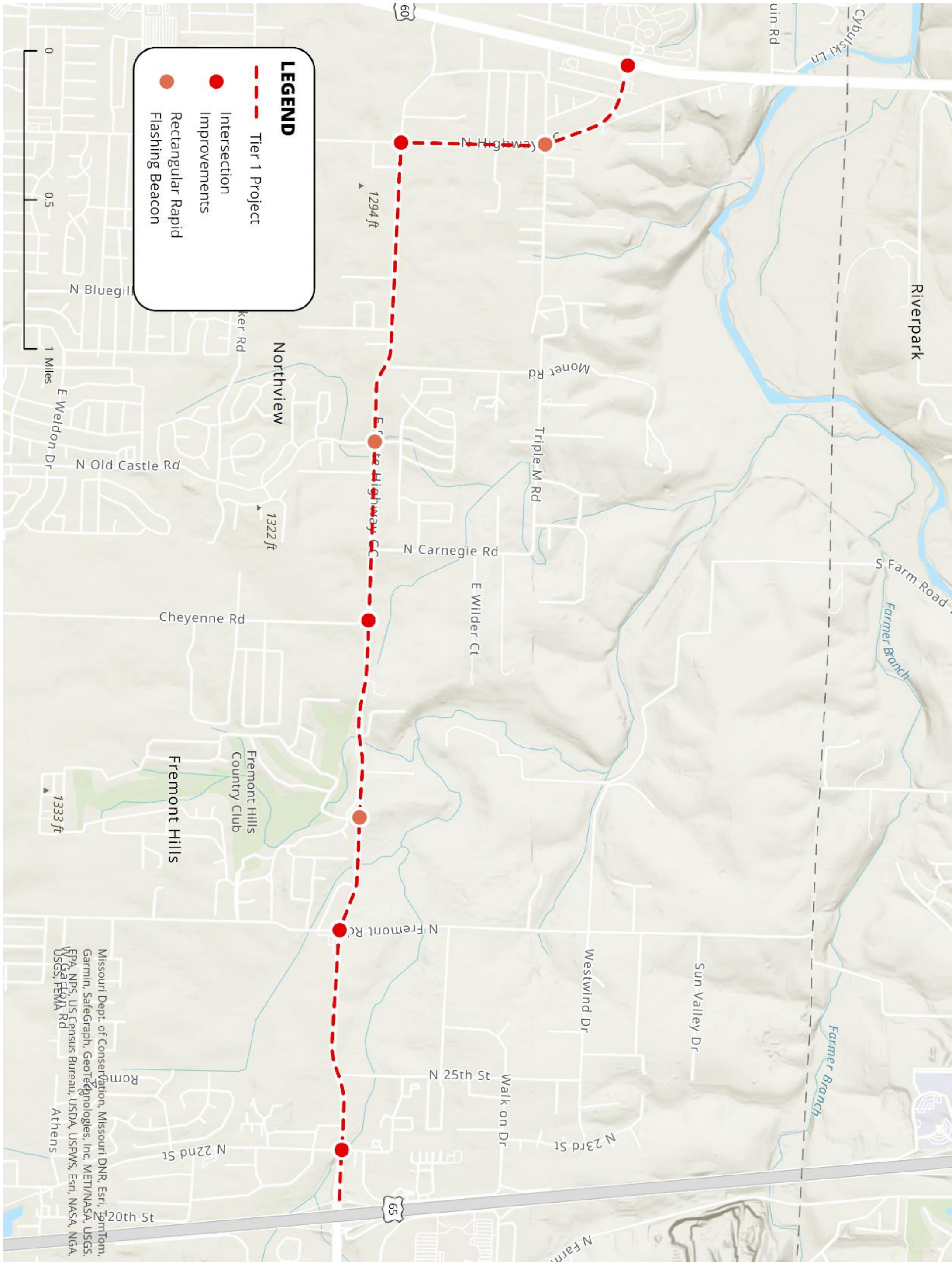
Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Shared Use Path	Reduce bicycle and pedestrian crashes	--	Mid-term	Yes	4.5 miles	$700,000 per mile	$3,150,000
Rectangular Rapid Flashing Beacons	Reduce pedestrian and speed related crashes	47% reduction in pedestrian crashes	Short-term	No	3 crossings*	$25,000 each	$75,000
Crosswalk Enhancements	Reduce pedestrian and speed related crashes	40% reduction in pedestrian crashes	Short-term	No	5 intersections	$25,000 per intersection	$125,000
BASELINE ESTIMATED TOTAL							**$3,400,000**

Project on STIP priority list to include sidewalk and trail improvements only

**Sycamore Street/Lindbergh Road, Old Castle Road, Rolling Hills Drive*

FIGURE 10 – ROUTE CC (US 160 TO US 65)



Route FF (Republic Rd to Weaver Rd)

Existing Conditions

Route FF is a 1-mile divided minor arterial with a grass median and two through lanes in each direction from Republic Road to Farm Road 123. South of Farm Road 123 to Weaver Road, Route FF is one through lane in each direction with a center turn lane. The corridor carries around 5,000 vehicles per day and the speed limit is 55 mph. The intersection at Republic Road is the only signalized intersection. Route FF is a signed bike route, but no dedicated facilities are available for bicyclists or pedestrians. Land uses in the area include suburban residential, commercial uses, schools, and a senior living community.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Right angle	2	5	9	16
Left turn	2	3	5	10
Out of control	1	2	4	7
Left turn right angle collision	1	0	3	4
Rear end	0	3	33	36
Head on	0	2	4	6
Other	0	1	0	1
Passing	0	0	5	5
Animal	0	0	5	5
Fixed object	0	0	2	2
Right turn	0	0	1	1
Right turn right angle collision	0	0	1	1
Total	***6***	***16***	***72***	***94***

Project Prioritization

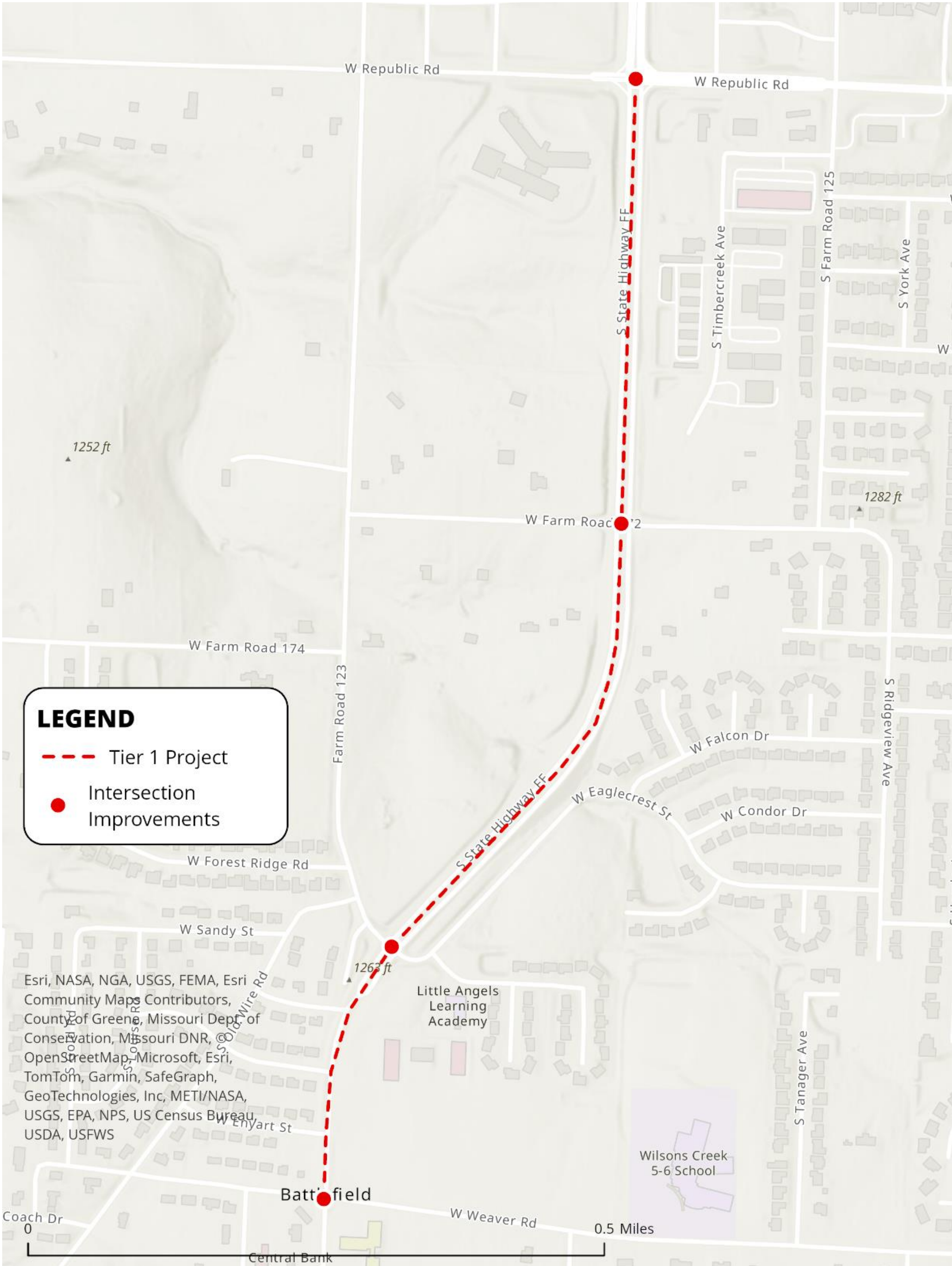
System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
State	Yes	No	Battlefield	Urban	Yes	No	No	6	16

Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Shared Use Path	Reduce bicycle and pedestrian crashes	--	Mid-term	Yes	1 mile	$700,000 per mile	$700,000
Rectangular Rapid Flashing Beacons	Reduce pedestrian and speed related crashes	47% reduction in pedestrian crashes	Short-term	No	2 crossings	$25,000 each	$50,000
Pedestrian Hybrid Beacons	Reduce pedestrian and speed related crashes	55% reduction in pedestrian crashes	Short-term	No	2 crossings	$120,000 each	$240,000
Crosswalk Enhancements	Reduce pedestrian and speed related crashes	40% reduction in pedestrian crashes	Short-term	No	4 intersections	$25,000 per intersections	$100,000
BASELINE ESTIMATED TOTAL							**$390,000**

Project on STIP priority list to include pedestrian improvements only

FIGURE 11 – ROUTE FF (REPUBLIC RD TO WEAVER RD)



Glenstone Ave (Valley Water Mill Rd to Evergreen St)

Existing Conditions

Glenstone Avenue is a principal arterial south of I-44 and a minor arterial north of I-44. The corridor is a 1.2-mile divided expressway with two through lanes in each direction from Evergreen Street to Mcclernon Street. From Mcclernon Street to Valley Water Mill Road, the corridor is one through lane in each direction with a center turn lane. Daily traffic varies from around 11,000 vehicles per day north of I-44 to nearly 24,000 vehicles per day south of I-44. Signalized intersections include Evergreen Street, I-44 on/off ramps, Mcclernon Street, and Valley Water Mill Road. There are no sidewalks south of I-44 and the sidewalks are disconnected north of I-44. There are no dedicated bicycle facilities. Land use is primarily commercial.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Left turn	5	22	22	49
Left turn right angle collision	3	14	14	31
Rear end	1	9	34	44
Pedestrian	1	2	0	3
Head on	0	9	2	11
Out of control	0	8	12	20
Right angle	0	5	9	14
Sideswipe	0	3	3	6
Other	0	2	1	3
Passing	0	1	12	13
U - turn	0	1	2	3
Right turn	0	1	1	2
Pedalcycle	0	1	0	1
Avoiding	0	1	0	1
Right turn right angle collision	0	0	5	5
Total	***10***	***79***	***117***	***206***

Project Prioritization

System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
State	Yes	Yes	Springfield	Urban	Yes	No	No	10	20

Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Sidewalks	Reduce pedestrian crashes	65%-89% reduction in pedestrian crashes	Short-term	No	2 miles	$370,000 per mile	$740,000
Permissive to Protected Left Turn Phase	Reduce left turn and head on crashes	--	Short-term	No	5 intersections	$5,000 per intersection	$25,000
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short-term	No	5 intersections	$25,000 per intersection	$125,000
Leading Pedestrian Interval	Reduce pedestrian crashes	13% reduction in pedestrian crashes	Short-term	No	5 intersections	$5,000 per intersection	$25,000
Pedestrian Refuge Islands	Reduce pedestrian and out of control crashes	56% reduction in pedestrian crashes	Mid-term	No	10 islands	$115,000 per island	$1,150,000
BASELINE ESTIMATED TOTAL							**$2,100,000**

Project on STIP priority list to include pedestrian improvements only

FIGURE 12 – GLENSTONE AVE (VALLEY WATER MILL RD TO EVERGREEN ST)

Grant Ave (College St to Kearney St)

Existing Conditions

Grant Avenue is a 2.2-mile minor arterial with one through lane in each direction with a center turn lane. The corridor runs from College Street in Downtown Springfield north to Kearney Street. Approximately 4,000 – 6,000 vehicles per day utilize the corridor. The speed limit is 30 mph. Signalized intersections along the corridor include College Street, Chestnut Expressway, Nicholas Street, Division Street, Commercial Street, Atlantic Street, High Street, and Kearney Street. Land uses are primarily residential with commercial uses at the major intersections. There are no bicycle facilities; sidewalks are present on both sides throughout the corridor except between Commercial Street and Chase Street where Grant Avenue goes under the railroad tracks.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Pedestrian	4	8	0	12
Out of control	4	4	36	44
Head on	3	7	5	15
Right angle	1	44	24	69
Left turn	1	20	18	39
Left turn right angle collision	1	12	8	21
Passing	1	4	7	12
Right turn right angle collision	1	1	6	8
Rear end	0	39	62	101
Pedalcycle	0	3	1	4
Other	0	2	1	3
Fixed object	0	1	8	9
Parking or parked car	0	1	5	6
Right turn	0	1	4	5
Sideswipe	0	0	4	4
Backing	0	0	3	3
Changing lane	0	0	1	1
Total	***16***	***147***	***193***	***356***

Project Prioritization

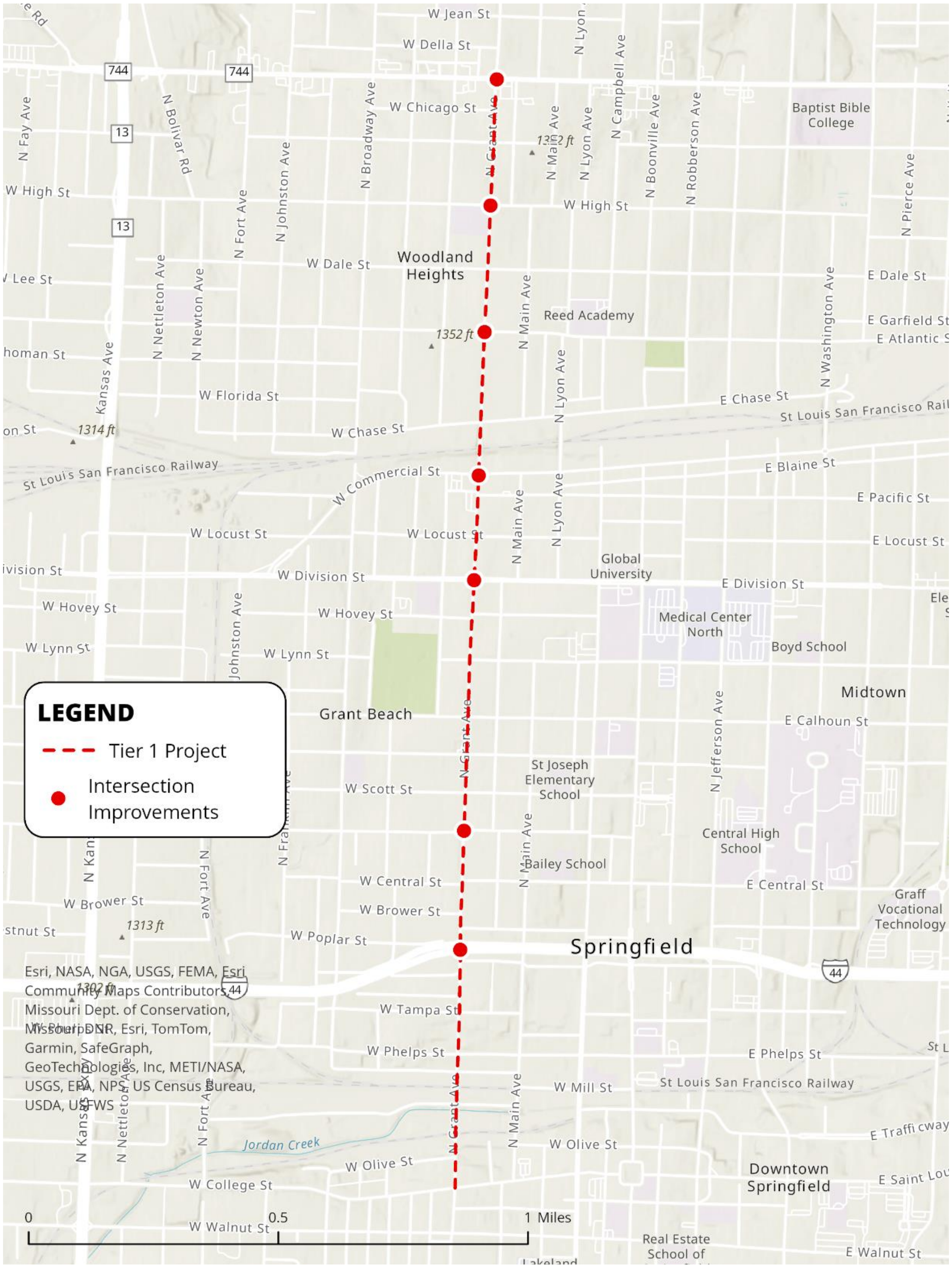
System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
Local	Yes	Yes	Springfield	Urban	No	Yes	No	16	19

Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Road Diet	Reduce pedestrian and bicycle crashes and vehicle speeds	--	Long-term	No	2.2 miles	$150,000 per mile	$330,000
Shared Use Path	Reduce bicycle and pedestrian crashes	--	Long-term	No	2.2 miles	$700,000 per mile	$1,540,000
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short-term	No	7 intersections	$25,000 per intersection	$175,000
BASELINE ESTIMATED TOTAL							**$2,100,000**

Countermeasures selected based on the continuation of the Grant Avenue Parkway Project.

FIGURE 13 – GRANT AVE (COLLEGE ST TO KEARNEY ST)



Tracker Rd (Nicholas Rd to US 160)

Existing Conditions

Tracker Road is a 1.3-mile major collector with one lane in each direction and narrow shoulders. The speed limit is 35 mph. The intersection at Nicholas Road is a four-way stop controlled intersection; Tracker Road and US 160 is a signalized intersection. There are no bicycle or pedestrian facilities. Land uses include rural residential and agricultural.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Left turn	4	7	2	13
Right angle	1	2	5	8
Rear end	0	2	12	14
Left turn right angle collision	0	1	5	6
Head on	0	1	4	5
Out of control	0	0	6	6
Sideswipe	0	0	3	3
Right turn right angle collision	0	0	1	1
Debris	0	0	1	1
Total	***5***	***13***	***39***	***57***

Project Prioritization

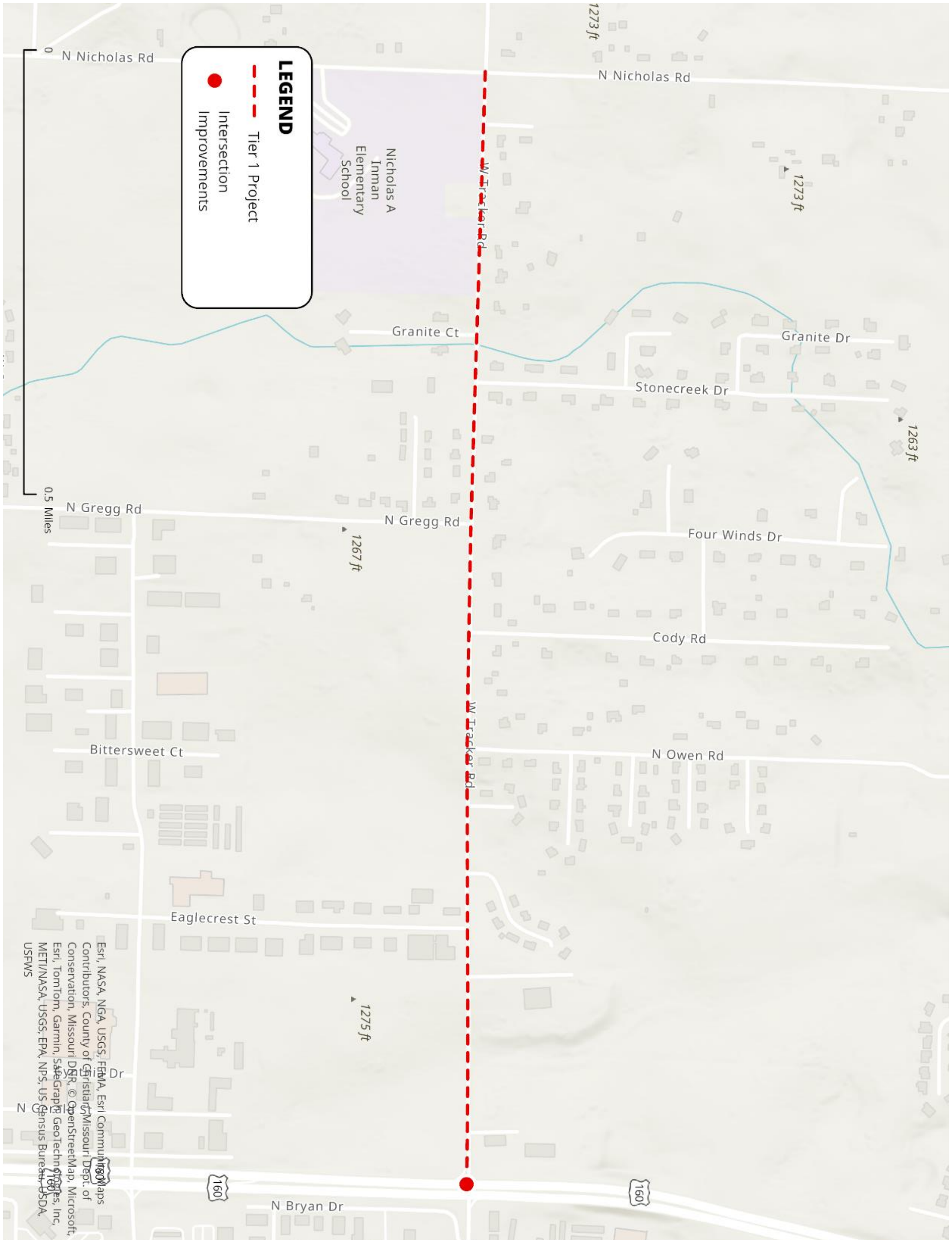
System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
Local	No	No	Nixa	Urban	No	Yes	Yes	5	10

Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Permissive to Protected Left Turn Phase	Reduce left turn and head on crashes	--	Short-term	No	1 intersection	$5,000 per intersection	$5,000
Signal Heads with Retroreflective Backplates	Reduce rear end and right-angle crashes	15% reduction in total crashes	Short-term	No	13 signals	$3,000 per signal	$39,000
Reduced Conflict Left Turn Intersections	Reduce left turn and right angle crashes	63% reduction in KSI crashes	Long-term	Yes	1 intersection	$1,000,000 per intersection	$1,000,000
BASELINE ESTIMATED TOTAL							**$1,100,000**

All KSI crashes occurred at the Tracker Road/US 160 intersection; countermeasures focused on intersection improvements

FIGURE 14 – TRACKER RD (NICHOLAS RD TO US 160)



National Ave (Chestnut Ex to Kearney St)

Existing Conditions

National Avenue is a 1.8-mile minor arterial with two through lanes in each direction with a center left turn lane. Average daily traffic volume is approximately 5,000 – 10,000 vehicles per day. The speed limit is 35 mph. Signalized intersections along the corridor include Chestnut Expressway, Central Street, Pythian Street, Division Street, Commercial Street, Dale Street, Turner Street, and Kearney Street. Well-connected sidewalks are present on both sides of the street. There are no bicycle facilities along the corridor but a connection to the Jordan Creek Greenway provides access to Silver Springs Park and Smith Park. Adjacent land uses are primarily residential.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Left turn	4	17	16	37
Out of control	3	11	22	36
Pedalcycle	3	4	0	7
Pedestrian	3	3	1	7
Rear end	2	28	32	62
Head on	2	11	6	19
Other	1	2	2	5
Right angle	0	40	32	72
Left turn right angle collision	0	8	9	17
Passing	0	6	27	33
Right turn right angle collision	0	4	5	9
Right turn	0	1	0	1
Fixed object	0	0	2	2
Backing	0	0	2	2
Changing lane	0	0	1	1
Sideswipe	0	0	1	1
Total	***18***	***135***	***158***	***311***

Project Prioritization

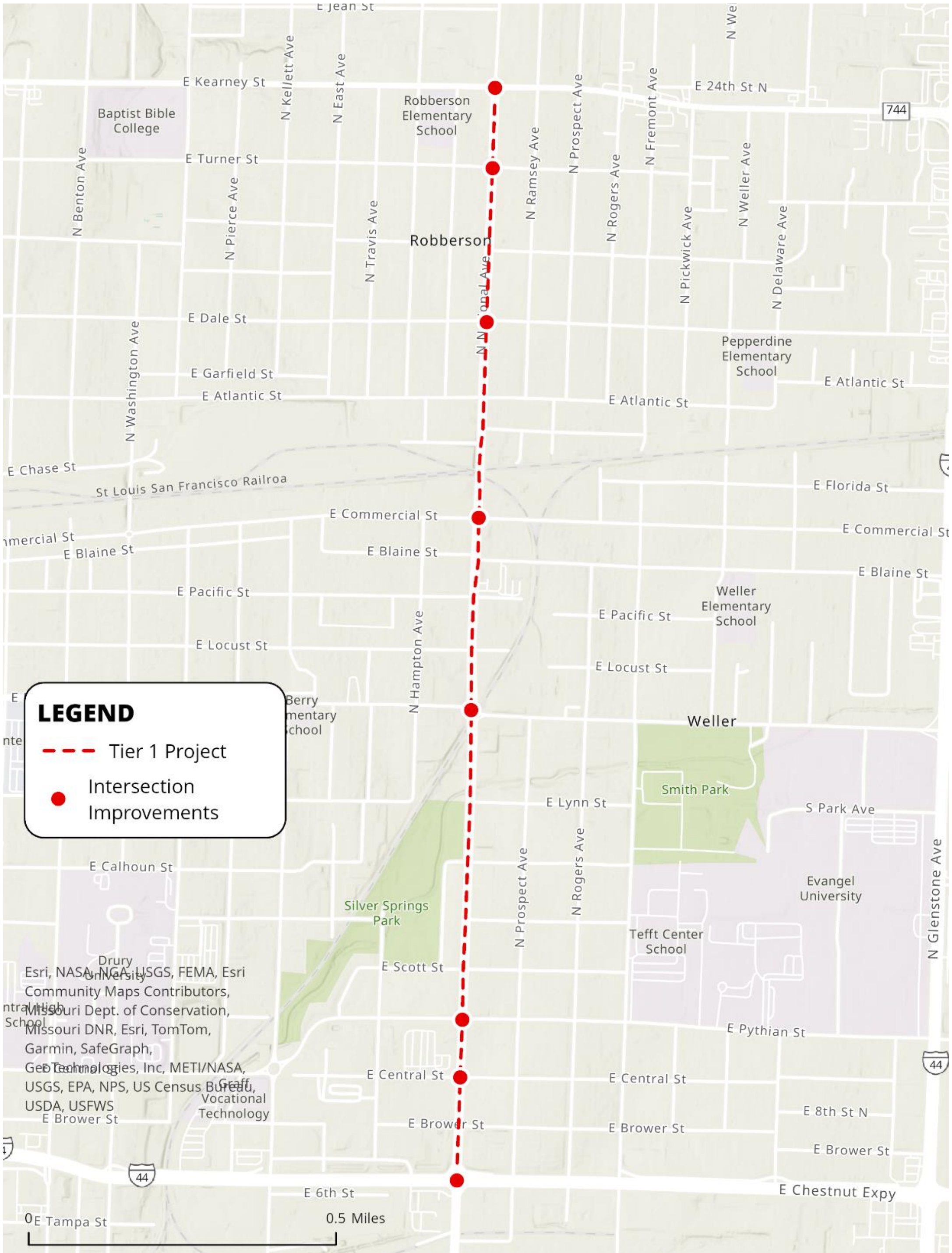
System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
Local	Yes	Yes	Springfield	Urban	No	No	No	18	18

Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Road Diet	Reduce fatal and serious injury crashes and vehicle speeds	--	Long-term	No	1.8 miles	$150,000 per mile	$270,000
Permissive to Protected Left Turn Phase	Reduce left turn and head on crashes	--	Short-term	No	8 intersections	$5,000 per intersection	$40,000
Bicycle Lanes – On-Street	Reduce bicycle crashes	30% - 49% reduction in total crashes	Mid-term	No	1.8 miles	$120,000 per mile	$216,000
Bicycle Lanes – Elevated Cycle Track	Reduce bicycle crashes	30% - 49% reduction in total crashes	Long-term	Yes	1.8 miles	$600,000 per mile	$1,080,000
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short-term	No	8 intersections	$25,000 per intersection	$200,000
Pedestrian Refuge Islands	Reduce pedestrian crashes Reduce vehicle speeds	56% reduction in pedestrian crashes	Mid-term	No	16 islands	$115,000 per island	$1,840,000
Leading Pedestrian Interval	Reduce pedestrian crashes	13% reduction in pedestrian crashes	Short-term	No	8 intersections	$5,000 per intersection	$40,000
BASELINE ESTIMATED TOTAL							**$2,600,000 - $3,500,000**

Baseline estimated total range reflects on-street bicycle lanes or an elevated cycle track.

FIGURE 15 – NATIONAL AVE (CHESTNUT EX TO KEARNEY ST)



Grand St (Kansas Ex to Glenstone Ave)

Existing Conditions

Grand Street is a 3-mile minor arterial with various roadway configurations. From the Kansas Expressway to National Avenue, there are two through lanes in each direction with a grassy median from the Kansas Expressway to Grant Avenue and a center turn lane from Grant Avenue to National Ave. From National Avenue to Glenstone Avenue, there is one through lane in each direction with a center turn lane. Signalized intersections along the corridor include Kansas Expressway, Fort Avenue, Grant Avenue, Campbell Avenue, South Avenue, Jefferson Avenue, Kimbrough Avenue, Holland Avenue, John Q. Hammond Parkway, King Avenue, National Avenue, Fremont Avenue, and Glenstone Avenue. The corridor carries around 8,000 vehicles per day west of National Avenue and around 4,000 vehicles per day to the west of National Avenue. There are sidewalks on both sides of the street but no bicycle facilities. Land uses include residential, some commercial, and schools such as Missouri State University.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Left turn	4	34	34	72
Out of control	4	16	56	76
Pedestrian	4	16	0	20
Rear end	1	55	115	171
Right angle	1	51	38	90
Left turn right angle collision	1	23	39	63
Head on	1	11	11	23
Other	1	0	0	1
Pedalcycle	0	13	0	13
Right turn right angle collision	0	7	9	16
Passing	0	5	33	38
Sideswipe	0	4	3	7
Avoiding	0	2	0	2
Parking or parked car	0	1	4	5
Backing	0	1	3	4
Dual lefts collide	0	1	2	3
Fixed object	0	1	2	3
Right turn	0	0	2	2
Changing lane	0	0	1	1
Total	***17***	***241***	***352***	***610***

Project Prioritization

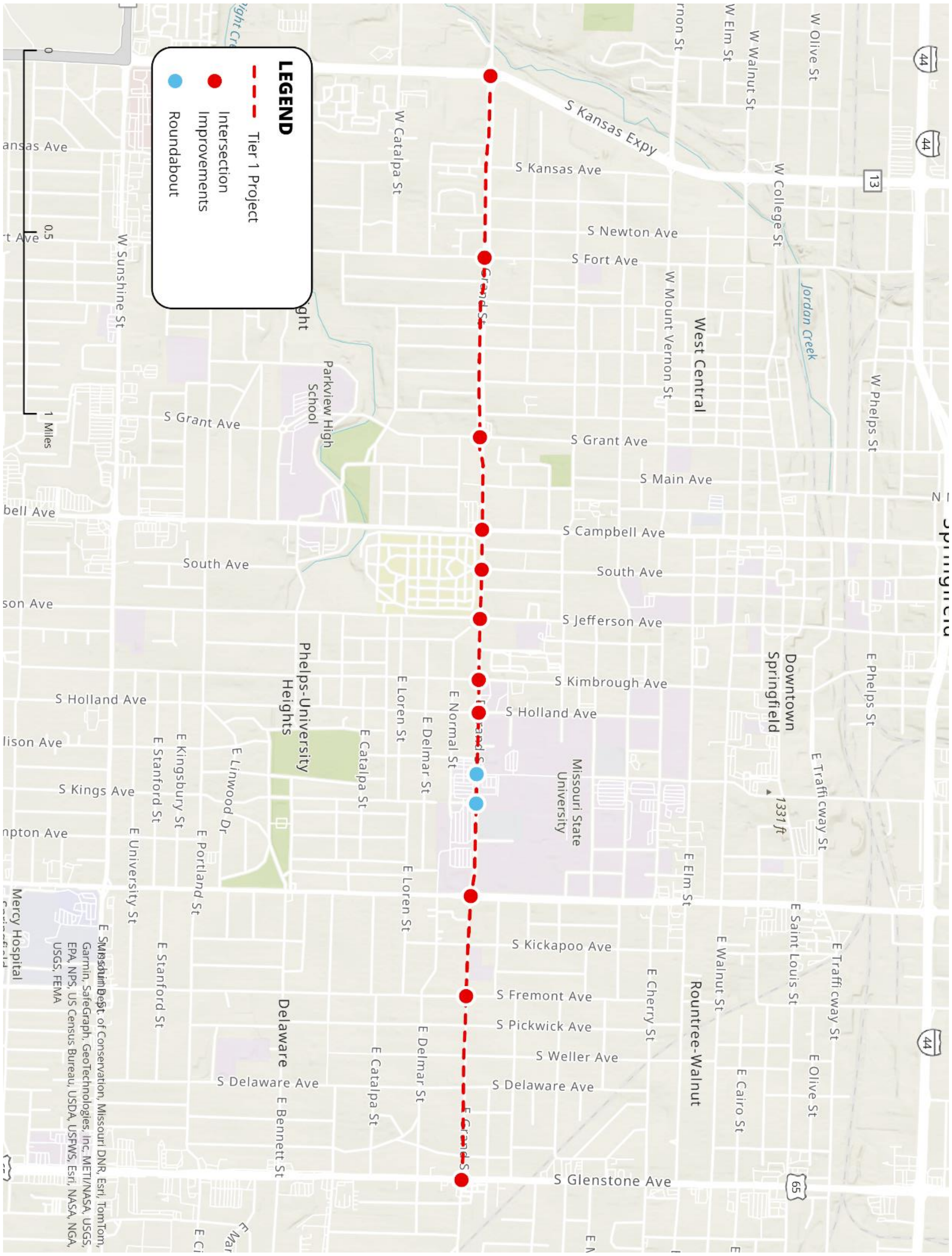
System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
Local	Yes	Yes	Springfield	Urban	No	No	No	17	18

Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Road Diet	Reduce fatal and serious injury crashes and vehicle speeds	--	Long-term	No	3 miles	$150,000 per mile	$450,000
Permissive to Protected Left Turn Phase	Reduce left turn and head on crashes	--	Short-term	No	13 intersections	$5,000 per intersection	$65,000
Bicycle Lanes – On-Street	Reduce bicycle crashes	30% - 49% reduction in total crashes	Mid-term	No	3 miles	$120,000 per mile	$360,000
Bicycle Lanes – Elevated Cycle Track	Reduce bicycle crashes	30% - 49% reduction in total crashes	Long-term	No	3 miles	$600,000 per mile	$1,800,000
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short-term	No	13 intersections	$25,000 per intersection	$325,000
Pedestrian Refuge Islands	Reduce pedestrian crashes Reduce vehicle speeds	56% reduction in pedestrian crashes	Mid-term	No	22 islands	$115,000 per island	$2,530,000
Leading Pedestrian Interval	Reduce pedestrian crashes	13% reduction in pedestrian crashes	Short-term	No	13 intersections	$5,000 per intersection	$65,000
Roundabouts	Reduce left turn crashes	82% reduction in fatal and serious injury crashes	Long-term	Yes	2 intersections*	$2,000,000 per intersection	$4,000,000
BASELINE ESTIMATED TOTAL							**$7,800,000 - $9,200,000**

**2 proposed roundabouts at John Q. Hammond Parkway and King Avenue*
Baseline estimated total range reflects on-street bicycle lanes or an elevated cycle track.

FIGURE 16 – GRAND ST (KANSAS EX TO GLENSTONE AVE)



Division St (Kansas Ex to Sherman Ave)

Existing Conditions

Division Street is a 1.7-mile minor arterial with one through lane in each direction with a center turn lane throughout much of the corridor. The corridor carries approximately 4,000 – 7,000 vehicles per day and the speed limit is 35 mph. Signalized intersections include the Kansas Expressway, Grant Avenue, Campbell Avenue, Boonville Avenue, Roberson Avenue, Benton Avenue, Washington Avenue, and Sherman Avenue. Sidewalks are well connected on both sides of the street; there is a mid-block pedestrian signal near Grant Avenue at Weaver Elementary school. There are a combination of painted bicycle lanes and shared lane markings from around Commercial Street to Washington Ave. Land uses are primarily residential, medical, and educational.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Out of control	7	5	12	24
Right angle	3	35	31	69
Pedestrian	3	9	0	12
Rear end	1	29	55	85
Left turn	1	5	8	14
Pedalcycle	1	3	0	4
Left turn right angle collision	0	9	7	16
Right turn right angle collision	0	4	5	9
Head on	0	2	2	4
Passing	0	1	8	9
Other	0	1	3	4
Avoiding	0	1	0	1
Sideswipe	0	0	3	3
Right turn	0	0	2	2
Changing lane	0	0	1	1
Dual lefts collide	0	0	1	1
U - turn	0	0	1	1
Fixed object	0	0	1	1
Backing	0	0	1	1
Total	***16***	***104***	***141***	***261***

Project Prioritization

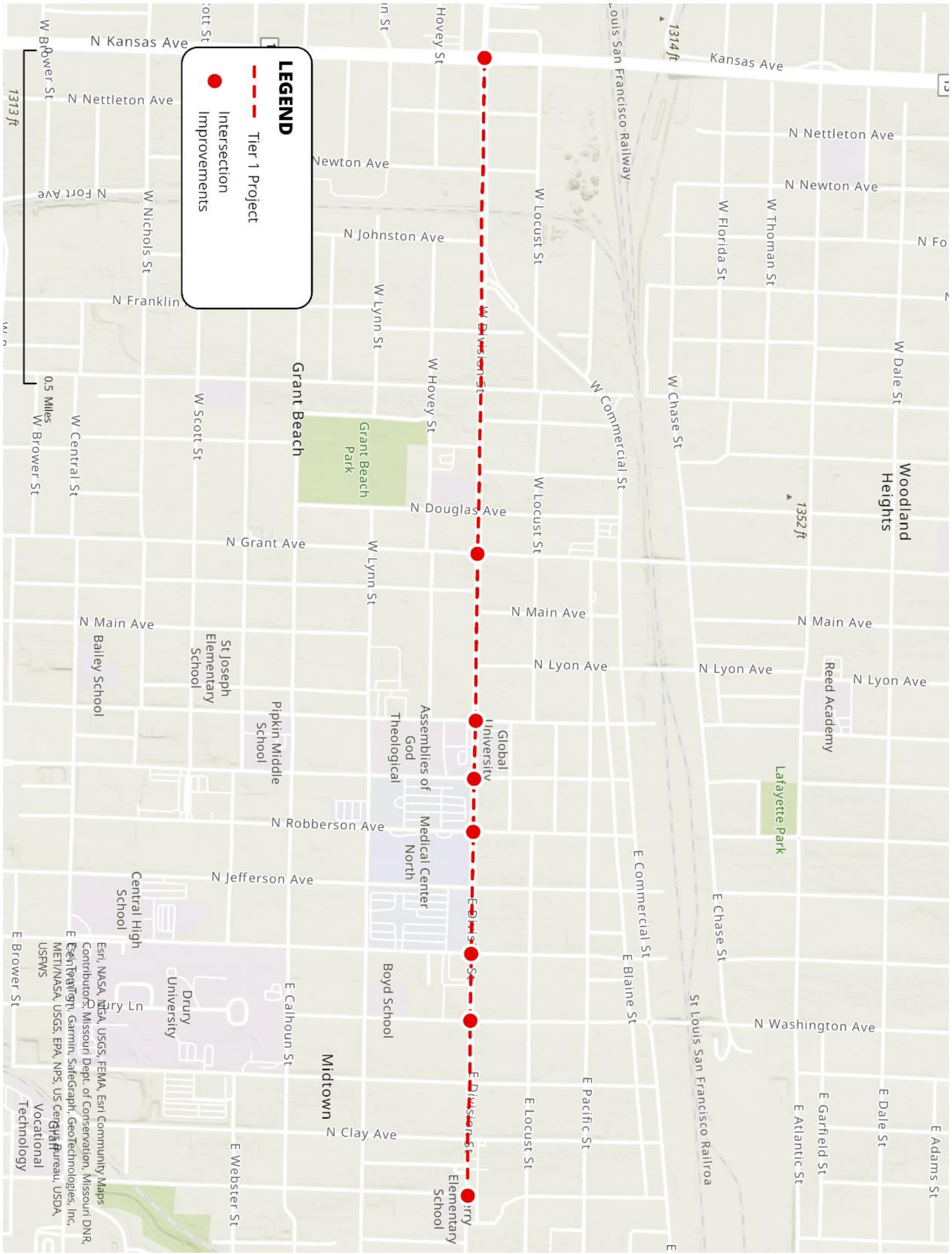
System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
Local	Yes	Yes	Springfield	Urban	No	No	No	16	18

Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Road Diet	Reduce fatal and serious injury crashes and vehicle speeds	--	Long-term	No	1.7 miles	$150,000 per mile	$255,000
Permissive to Protected Left Turn Phase	Reduce left turn and head on crashes	--	Short-term	No	8 intersections	$5,000 per intersection	$40,000
Bicycle Lanes – On-Street	Reduce bicycle crashes	30% - 49% reduction in total crashes	Mid-term	No	1.7 miles	$120,000 per mile	$204,000
Bicycle Lanes – Elevated Cycle Track	Reduce bicycle crashes	30% - 49% reduction in total crashes	Long-term	No	1.7 miles	$600,000 per mile	$1,020,000
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short-term	No	8 intersections	$25,000 per intersection	$200,000
Pedestrian Refuge Islands	Reduce pedestrian crashes Reduce vehicle speeds	56% reduction in pedestrian crashes	Short-term	No	16 islands	$115,000 per island	$1,840,000
Leading Pedestrian Interval	Reduce pedestrian crashes	13% reduction in pedestrian crashes	Short-term	No	8 intersections	$5,000 per intersection	$40,000
BASELINE ESTIMATED TOTAL							**$2,600,000 - $3,400,000**

Baseline estimated total range reflects on-street bicycle lanes or an elevated cycle track.

FIGURE 17 – DIVISION ST (KANSAS EX TO SHERMAN AVE)



Sunshine St (Kansas Ex to Campbell Ave)

Existing Conditions

Sunshine Street is a 1.3-mile principal arterial with two through lanes in each direction with a center turn lane. The corridor carries around 12,000 – 15,000 vehicles per day and the speed limit is 40 mph. There are signalized intersections at the Kansas Expressway, Fort Avenue, Grant Avenue, and Campbell Avenue. There are some sidewalks, but connectivity is lacking, and pedestrian crossings are also lacking. There are no bicycle facilities along the corridor. Land use is primarily commercial.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Right angle	3	16	9	28
Pedestrian	3	1	0	4
Left turn	2	14	15	31
Out of control	2	8	13	23
Rear end	1	53	68	122
Left turn right angle collision	1	22	25	48
Head on	1	17	5	23
Passing	1	4	17	22
Fixed object	1	0	1	2
Right turn right angle collision	0	4	8	12
Changing lane	0	2	4	6
Dual lefts collide	0	2	0	2
U - turn	0	2	0	2
Right turn	0	1	4	5
Other	0	1	3	4
Sideswipe	0	0	2	2
Parking or parked car	0	0	1	1
Total	***15***	***147***	***175***	***337***

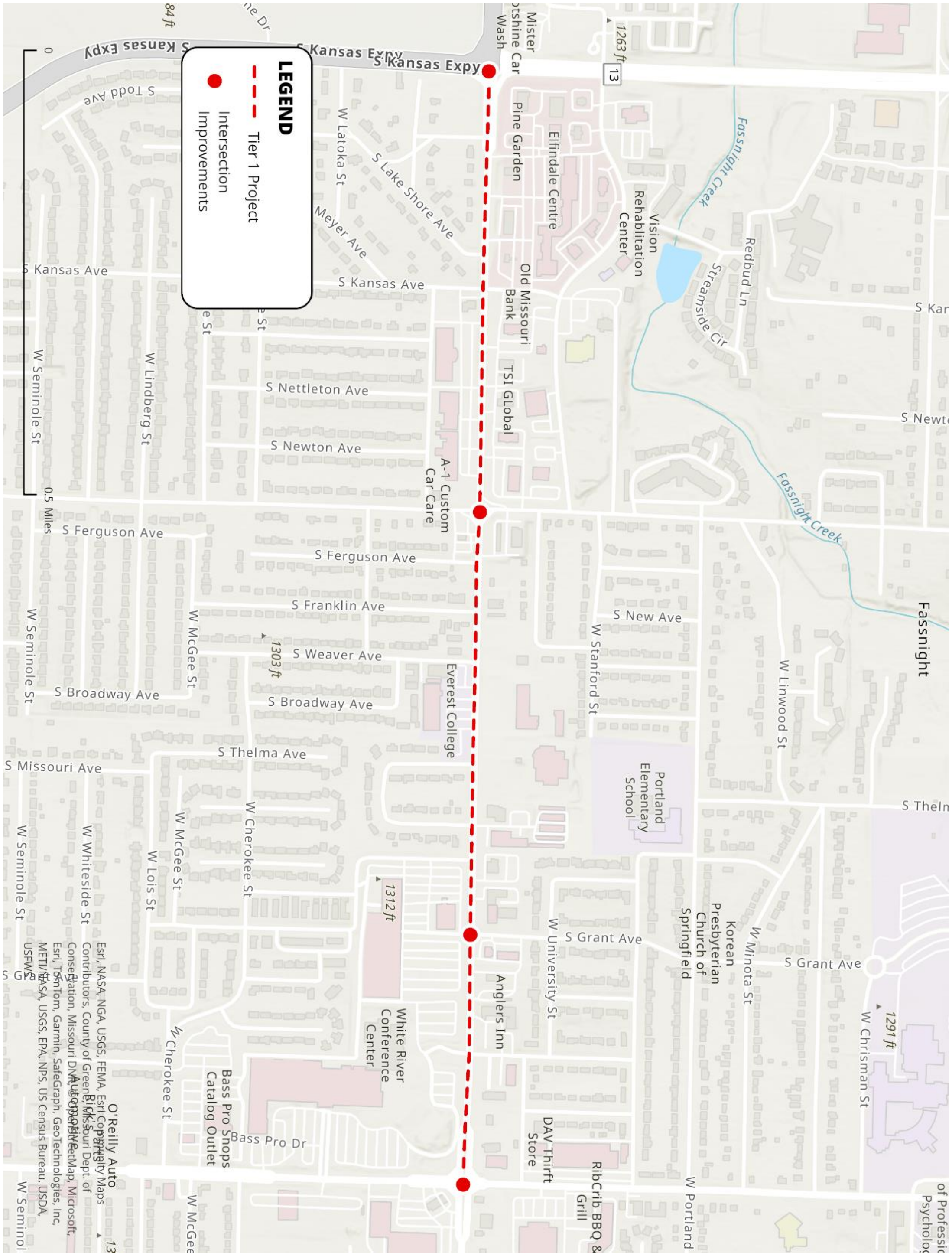
Project Prioritization

System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
Local	Yes	Yes	Springfield	Urban	No	No	No	15	18

Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Road Diet	Reduce fatal and serious injury crashes and vehicle speeds	--	Long-term	No	1.3 miles	$150,000 per mile	$195,000
Medians	Reduce out of control crashes	97% reduction in cross median crashes	Long-term	No	1.3 miles	$1,600,000 per mile	$2,100,000
Permissive to Protected Left Turn Phase	Reduce left turn and head on crashes	--	Short-term	No	4 intersections	$5,000 per intersection	$20,000
Signal Heads with Retroreflective Backplates	Reduce rear end and right-angle crashes	15% reduction in total crashes	Short-term	No	55 signals	$3,000 per signal	$275,000
Sidewalks	Reduce pedestrian crashes	65%-89% reduction in pedestrian crashes	Short-term	Yes	1.3 miles	$370,000 per mile	$481,000
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short-term	No	4 intersections	$25,000 per intersection	$100,000
Pedestrian Refuge Islands	Reduce pedestrian crashes Reduce vehicle speeds	56% reduction in pedestrian crashes	Short-term	No	8 islands	$115,000 per island	$920,000
Leading Pedestrian Interval	Reduce pedestrian crashes	13% reduction in pedestrian crashes	Short-term	No	4 intersections	$5,000 per intersection	$20,000
Corridor Access Management	Reduce pedestrian, rear end, and right-angle crashes	25%-31% reduction in KSI crashes	Long-term	Yes	-	-	-
BASELINE ESTIMATED TOTAL							**$4,100,000**

FIGURE 18 – SUNSHINE ST (KANSAS EX TO CAMPBELL AVE)



Hines St (Oakwood Ave to Route ZZ)

Existing Conditions

Hines Street is a 1.8-mile major collector with one through lane in each direction and no shoulders. The street carries around 1,000 – 2,000 vehicles per day and the speed limit is 30mph. Major intersections include four-way stop controlled intersections at Oakwood Avenue and Route ZZ. There is a short section of sidewalk between Lincoln Avenue and Franklin Avenue but otherwise the corridor lacks sidewalks and bicycle facilities. Land use is primarily suburban residential with some undeveloped agricultural land.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Right angle	1	1	6	8
Out of control	0	2	2	4
Rear end	0	1	2	3
Head on	0	1	1	2
Other	0	1	0	1
Left turn right angle collision	0	1	0	1
Left turn	0	0	2	2
Avoiding	0	0	1	1
Total	***1***	***7***	***14***	***22***

Project Prioritization

System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
Local	No	Yes	Republic	Urban	No	No	Yes	1	4

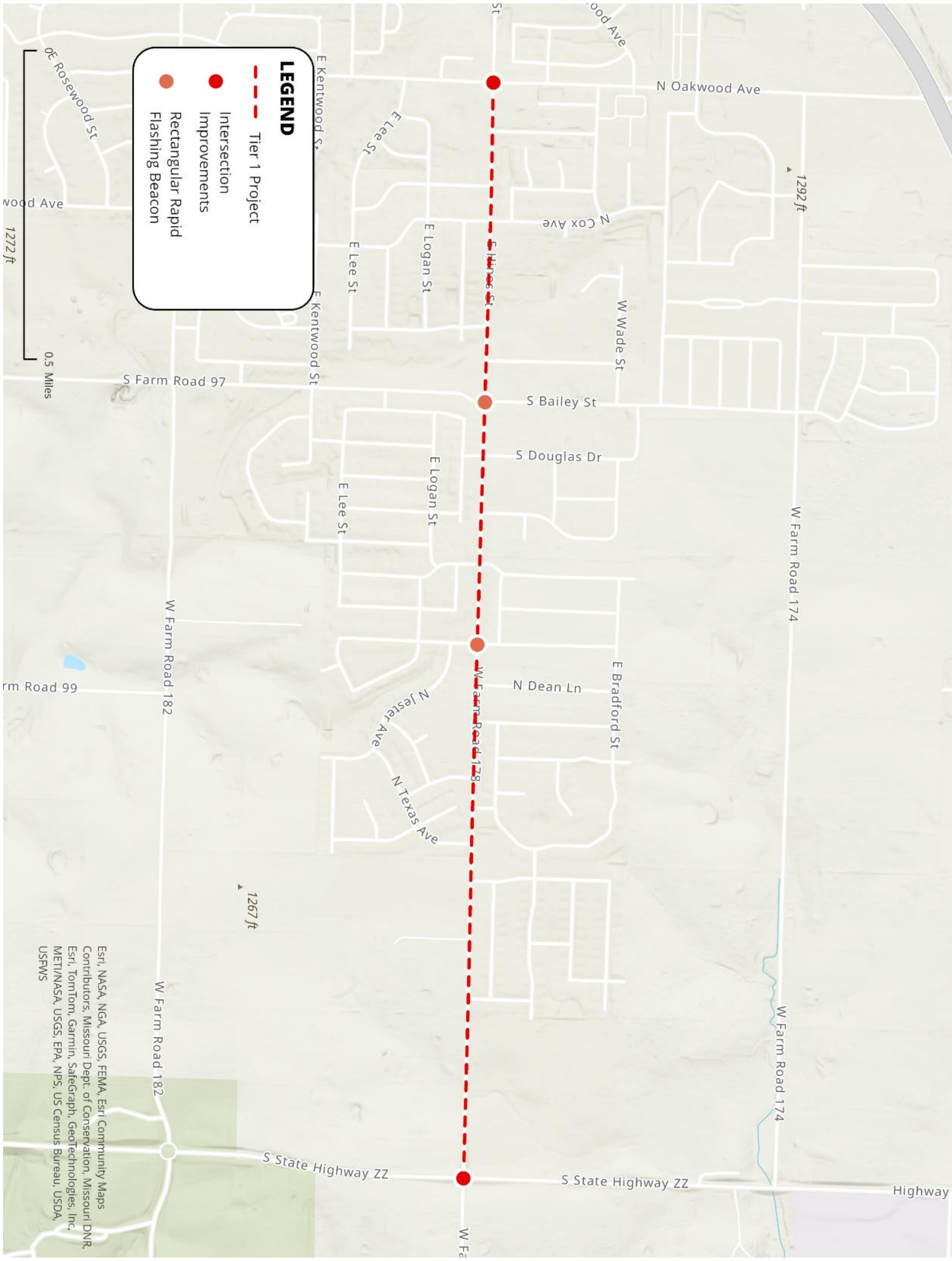
Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Sidewalks	Reduce bicycle and pedestrian crashes	65%-89% reduction in pedestrian crashes	Short-term	Yes	1.3 miles (one side only)	$370,000 per mile	$481,000
Shared Use Path	Reduce bicycle and pedestrian crashes	--	Long-term	Yes	1.3 miles	$700,000 per mile	$910,000
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short-term	No	2 intersections	$25,000 per intersection	$50,000
Rectangular Rapid Flashing Beacons	Reduce pedestrian and speed related crashes	47% reduction in pedestrian crashes	Short-term	No	2 mid-block crossings*	$25,000 each	$50,000
BASELINE ESTIMATED TOTAL							**$580,000 – $1,000,000**

**RRFBs proposed at Bailey Street/Farm Road 97 and Glenwood Avenue*

Baseline estimated total range reflects a 5-foot sidewalk or a 10-foot shared use path on one side of the street only

FIGURE 19 – HINES ST (OAKWOOD AVE TO ROUTE ZZ)



S Campbell Ave (Battlefield St to Republic Rd)

Existing Conditions

Campbell Avenue is a 1.5-mile principal arterial with two through lanes in each direction and a center left turn lane. The corridor carries approximately 20,000 vehicles per day and the speed limit is 40 mph. There are signalized intersections at Battlefield Street, Walnut Lawn Street, Westview Street/Primrose Street, and Republic Road. Sidewalks are disconnected and pedestrian crossings are inconvenient. There are no bicycle facilities. Land uses along the corridor are primarily commercial.

Crash History (2018-2022)

Crash Type	KSI	Minor Injury	PDO	Total
Left turn	9	32	42	83
Passing	3	5	28	36
Left turn right angle collision	2	66	44	112
Right angle	1	29	22	52
Head on	1	18	7	26
Out of control	1	13	30	44
Pedestrian	1	4	1	6
Rear end	0	118	145	263
Changing lane	0	3	5	8
Right turn right angle collision	0	2	6	8
Right turn	0	1	5	6
Other	0	1	3	4
Pedalcycle	0	1	2	3
U - turn	0	1	1	2
Avoiding	0	1	1	2
Sideswipe	0	0	3	3
Fixed object	0	0	2	2
Parking or parked car	0	0	1	1
Total	***18***	***295***	***348***	***661***

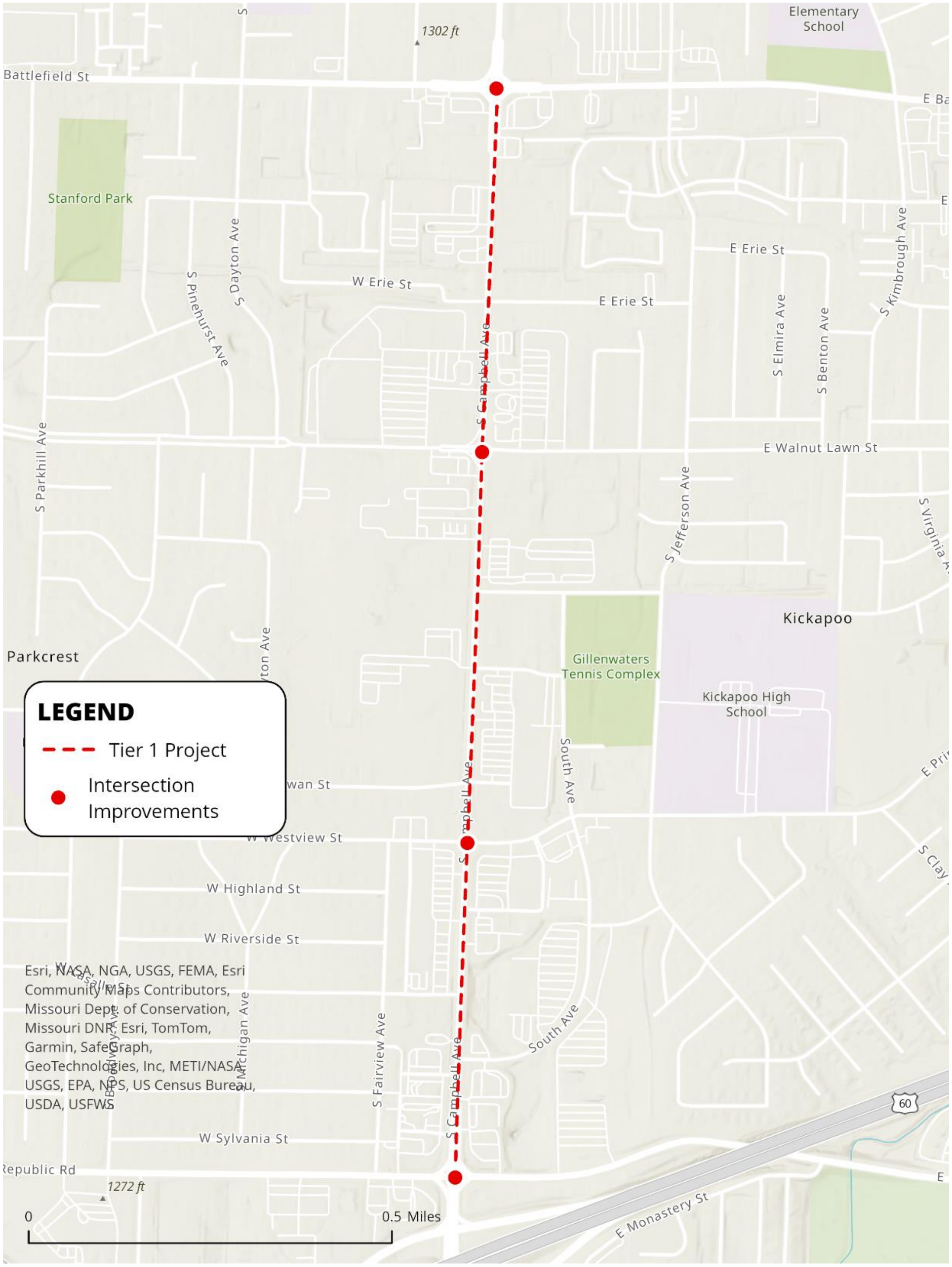
Project Prioritization

System	HIN	CEJST	Municipality	Area Type	STIP Priority	Public Input	Local Input	KSI Crashes	Priority Score
Local	Yes	Yes	Springfield	Urban	No	No	Yes	18	18

Recommendations

Countermeasure	Purpose	Benefit	Timeframe	ROW	Quantity	Planning Level Cost	Estimated Cost
Dilemma Zone Detection	Reduce rear end and right-angle crashes	39% reduction in KSI crashes at intersections	Short-term	No	4 intersections	$60,000 per intersection	$240,000
Signal Heads with Retroreflective Backplates	Reduce rear end and right-angle crashes	15% reduction in total crashes	Short-term	No	56 signals	$3,000 per signal	$168,000
Permissive to Protected Left Turn Phase	Reduce left turn and right-angle crashes	--	Short-term	No	4 intersections	$5,000 per intersection	$20,000
Improved Right Turn Angles	Reduce pedestrian crashes Reduce vehicle speeds	--	Mid-term	Yes	12 right turns	$400,000 per right turn	$4,800,000
Medians	Reduce out of control and head on crashes	97% reduction in cross median crashes	Long-term	No	1.5 miles	$1,600,000 per mile	$2,400,000
Sidewalks	Reduce pedestrian crashes	65%-89% reduction in pedestrian crashes	Short-term	No	1.3 miles	$370,000 per mile	$481,000
Crosswalk Enhancements	Reduce pedestrian and out of control crashes	40% reduction in pedestrian crashes	Short-term	No	4 intersections	$25,000 per intersection	$100,000
Corridor Access Management	Reduce pedestrian, rear end, and right-angle crashes	25%-31% reduction in KSI crashes	Long-term	Yes	--	--	--
BASELINE ESTIMATED TOTAL							**$8,200,000**

FIGURE 20 – S CAMPBELL AVE (BATTLEFIELD ST TO REPUBLIC RD)



COSTS AND ASSUMPTIONS

Countermeasure	Cost	Unit	Note/Assumptions
Automated Enforcement	$100,000	Intersection	
Bicycle Lanes (elevated Cycle Track)	$600,000	Mile	Does not include curb ramps, adjust to grade items, signal timing, bike signals
Bicycle Lanes (On Road)	$120,000	Mile	Does not include curb ramps, reconstructed curb, adjust to grade items, signal timing, bike signals; both sides of street
Crosswalk Enhancements	$25,000	Intersection	Assume restriping of crosswalk, 240’; does not include adding signage
Curve Improvements (Horizontal Radius Improvement)	$1,500,000	Curve	
Curve Improvements (Curve Warning)	$35,000	Curve	
Dilemma Zone Detection	$60,000	Intersection	
Dynamic Speed Monitoring Systems	$20,000	Each	per display
Improved Right Turn Angle	$400,000	Right Turn	Assume reconstruction of the corner radius
Intersection Conflict Warning Systems	$35,000	Intersection	
Leading Pedestrian Intervals	$5,000	Intersection	Assume ped signal heads already present
Medians	$1,600,000	Mile	Assume no widening at 9' wide with Curb and 24" gutter
Medians - Cable Barrier	$525,000	Mile	Assume no widening /only the cost of adding cable barrier on one side
Pedestrian Refuge Island	$115,000	Island	Assume 2 curb ramps; island 8’ by 40’
PHBs	$120,000	UNIT	Includes power, conduit, and signals
Protected Left Turns	$5,000	Intersection	
Reduced Left-Turn Conflict Intersections	$1,000,000	Intersection	
Road Diets	$150,000	Mile	
Roadway Lighting - corridor	$480,000	Mile	Assume ~275' spacing and $12K EA on each side of road
Roadway Lighting - intersection	$30,000	Intersection	Assume 4 lights per intersection
Roundabouts	$2,000,000	Intersection	
RRFBs	$25,000	Each	Assume crosswalk and curb ramps excluded / includes both sides of road
Rumble Strips	$10,000	Mile	Assume shoulder on 1 side and no centerline
Shared Use Paths	$700,000	Mile	Assume 10' wide and no unusual site conditions
Sidewalks	$370,000	Mile	Assumes 5' wide and no unusual site conditions
Signage	$1,000	Each	Assume a standard road sign
Signal Heads with Retroreflective Backplates	$3,000	Signal	Assume the existing conduit can be used
Systemic Application at Stop Intersections	$15,000	Intersection	
Yellow Change Intervals	$5,000	Intersection	

Appendix D-5
Implementation Matrix

The Implementation Matrix is a spreadsheet of all Tier 0, Tier 1, and Tier 2 projects with their accompanying evaluation factors and location characteristics. This spreadsheet is available online at:

https://www.ozarkstransportation.org/uploads/documents/Appendix-E-Implementation-Matrix.xlsx