2019

Salt River Pima-Maricopa Indian Community

Tribal Transportation Safety Plan

May 2019

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Final Report

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1. Introduction

The Salt River Pima-Maricopa Indian Community (SRPMIC) is a sovereign Tribe located on the east side of the Phoenix metropolitan area. It is bordered by the cities of Mesa and Tempe to the south, Scottsdale to the west and north, the town of Fountain Hills and the Fort McDowell Indian Reservation to the north, as well as unincorporated Maricopa County and the Tonto National Forest to the east. The Community is a member of the Maricopa Association of Governments (MAG), the municipal and intergovernmental planning agency for Maricopa County and the Phoenix metropolitan area. **Figure 1** shows the SRPMIC in its regional context.

Background Information

SRPMIC initiated the development of a Tribal Transportation Safety Plan (TTSP). As described by the Federal Highway Administration (FHWA), the TTSP is a tool to identify and address transportation risk factors that have a potential of leading to serious injury or death.

To the extent possible, the TTSP is data-driven to identify transportation safety issues, emphasis areas, strategies, and countermeasures and to set priorities.

Development of the TTSP involves meeting with key stakeholders. These stakeholders include those who deal with injury prevention, public safety, transportation, and education to promote a comprehensive approach to addressing the safety needs of all stakeholders, and to organize the efforts of stakeholders to more effectively reduce risk.

The TTSP will identify costs and potential funding sources for recommendations. The TTSP will be consistent with the Arizona Strategic Highway Safety Plan (SHSP).

TTSP Objectives

Objectives for this TTSP are:

- Review historical transportation safety data (5-year crash history)
- Establish a vision for SRPMIC transportation safety
- Engage SRPMIC safety partners and resources
- Identify SRPMIC critical safety emphasis areas
- Develop strategies to address the emphasis areas
- Identify and prioritize specific projects for implementation
- Solicit public input on safety issues, needs, and recommended strategies and projects

Study Area Location

Figure 2 shows the TTSP study area is the SRPMIC Reservation as well as the roadways that are maintained by SRPMIC, as well as those maintained by ADOT, MCDOT, and City of Scottsdale.

Figure 1. SRPMIC Vicinity Map

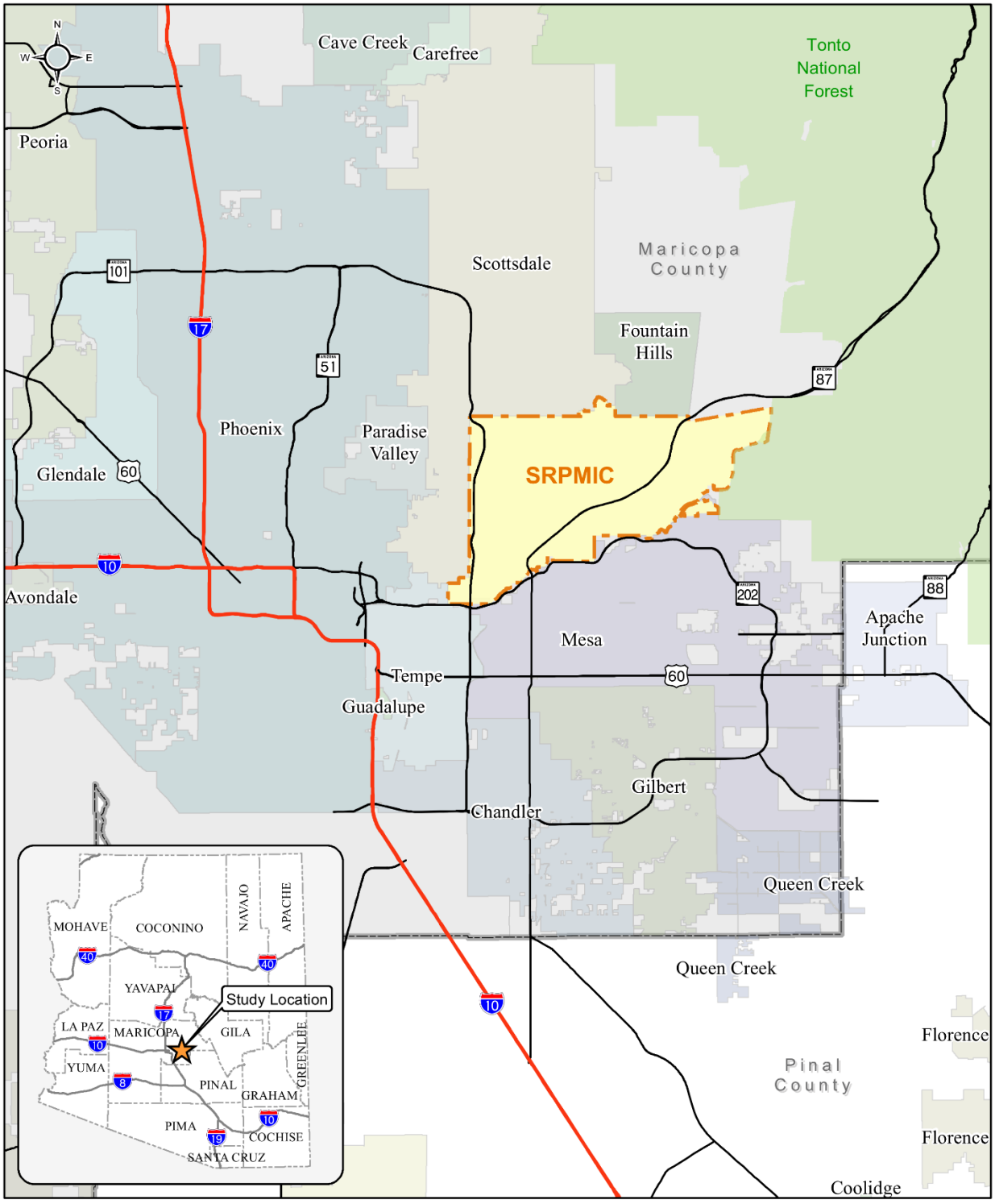
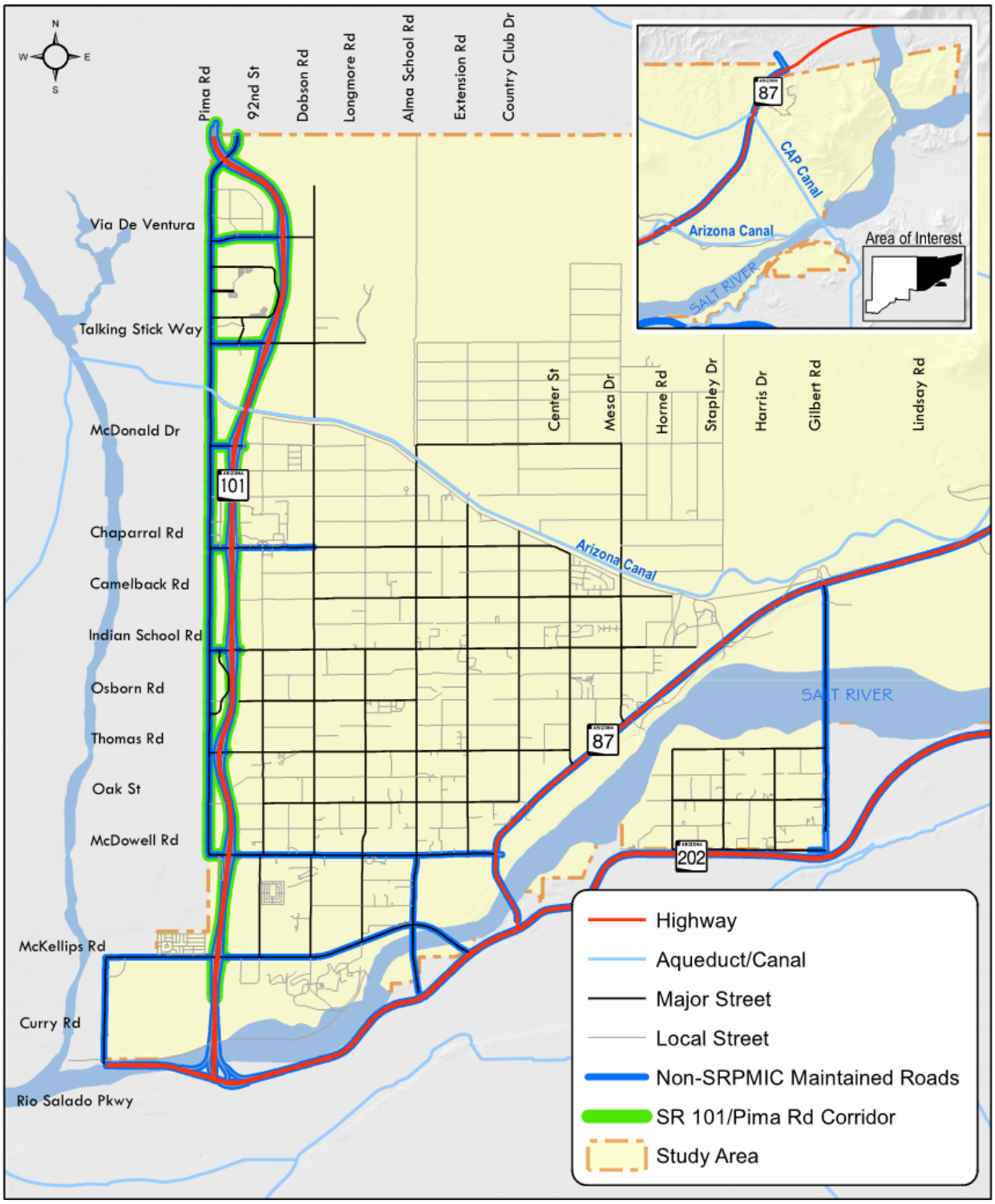


Figure 2. Study Area



Crash Database

The TTSP is based on an analysis of crashes that occurred from January 1, 2012 to December 31, 2016, representing five years of data. Crash data was received and compiled from two sources:

1. Salt River Police Department, entered into an excel crash database prepared for this project.
2. Arizona Department of Transportation (ADOT), through the ACIS (Arizona Crash Information System).

The ADOT crash data included crashes reported by Arizona Department of Public Safety (DPS), Maricopa County Sheriff's Office (MCSO), Scottsdale Police Department, and Mesa Police Department. The two crash datasets were merged and the duplicates removed to provide a comprehensive overview of safety on the SRPMIC.

2. Crash Summary

This section provides a summary of crash statistics for the five-year analysis period. Three analyses scenarios were completed to provide insight into crash trends and inform emphasis area identification and strategy development.

Scenario 1: *All crashes on all roadways on SRPMIC*. Scenario 1 includes 1,968 crashes that occurred during the five-year analysis period (2012-2016) on all roadways on SRPMIC, including those maintained by other jurisdictions (ADOT, MCDOT) with exception to SR 101 mainline (for which crashes are excluded). This scenario includes crashes that occurred on Pima Road at SR 101 on-ramp and off-ramp intersections with arterial streets, SR 87, McDowell Road, and McKellips, Road.

Scenario 2: Crashes that occurred only on roadways maintained/owned by SRPMIC and Bureau of Indian Affairs (BIA). In this scenario, crashes on roadways maintained by ADOT, MCDOT, and City of Scottsdale are excluded. This analysis excludes Pima Road, McDowell Road, McKellips Road, SR 87, and arterials connecting to the SR 101 as shown in **Figure 2.** 164 of the 1,968 crashes occurred on roadways maintained by SRPMIC or BIA. These 'interior' roads are most commonly utilized by community members and provide the most opportunity for intervention by SRPMIC to address safety issues.

Scenario 3: Crashes that occurred on the SR 101/Pima Road corridor. Pima Road ownership and maintenance responsibilities are shared by ADOT and the City of Scottsdale. Strategies and countermeasures implemented on these roadways will require additional coordination to incorporate safety improvements. This analysis shows 1,280 crashes within the urban SR 101/Pima Road corridor. Total crashes by scenario is summarized in **Table 1** below.

Table 1: Total Crashes by Scenario

	Scenario 1 - All	Scenario 2 - Interior	Scenario 3 – SR 101/ Pima Rd
Total Crashes	1,968	164	1,280

Detailed crash statistics for each scenario are presented in the following sections.

Crashes by Year

The number of crashes per year increased during the analysis period, in both *Scenario 1* (all roads) and *Scenario 2* (SRPMIC/BIA-maintained roadways). *Scenario 1* crashes grew from 343 in 2012 to 491 in 2016. *Scenario 2* crashes increased from 24 to 44 crashes during the same period.

Figure 3 shows crashes by year for *Scenario 1* (all crashes); **Figure 4** shows crashes for *Scenario 2* (interior crashes); **Figure 5** shows crashes for *Scenario 3* (SR 101/Pima Road corridor crashes).

COMPARISON TO STATEWIDE AVERAGE

A review of statewide data (2012-2016) shows that crashes on SRPMIC increased more than crashes increased statewide. The statewide increase in crashes is approximately 22%, while SRPMIC experienced a 43% increase over the same period.

Figure 3: Crashes by Year (All Crashes)

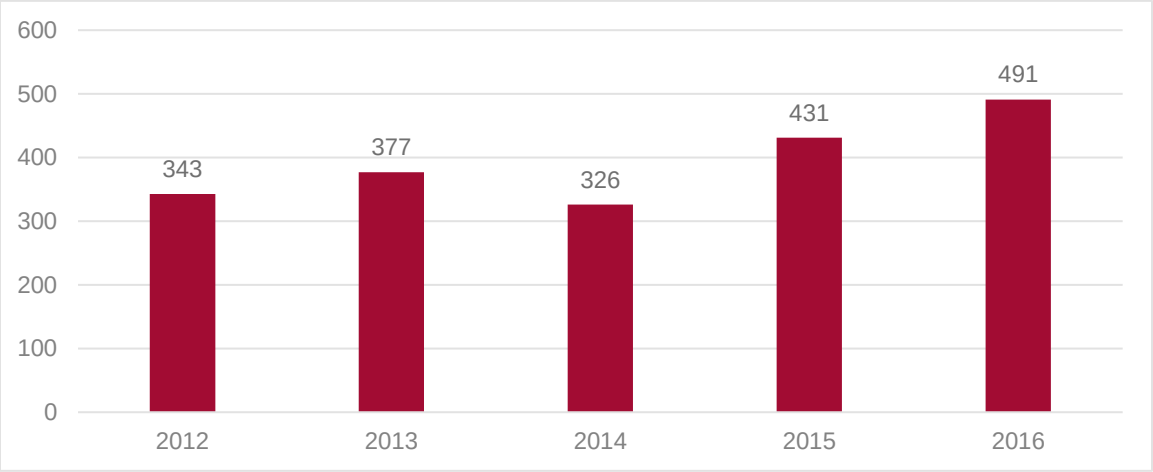


Figure 4: Crashes by Year (SRPMIC/BIA-maintained Roadways)

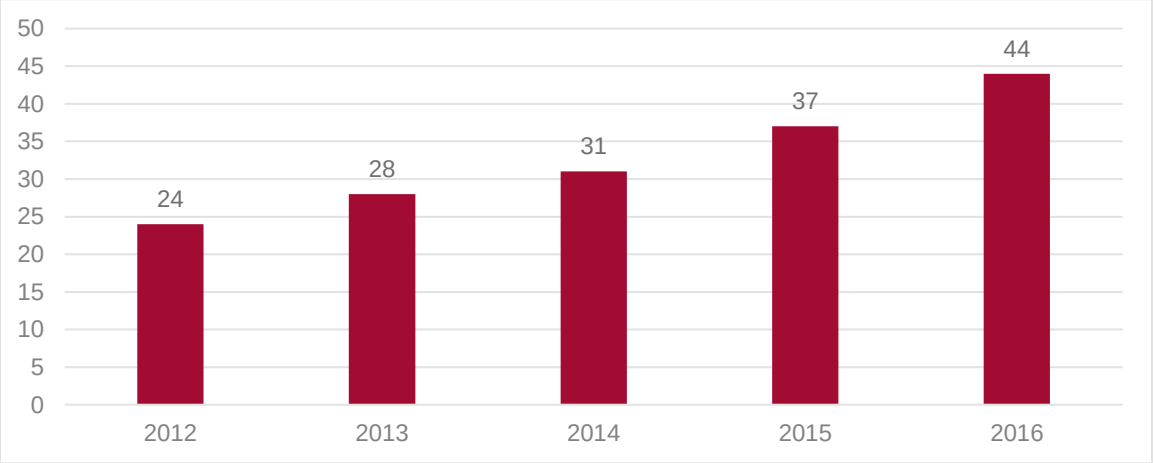
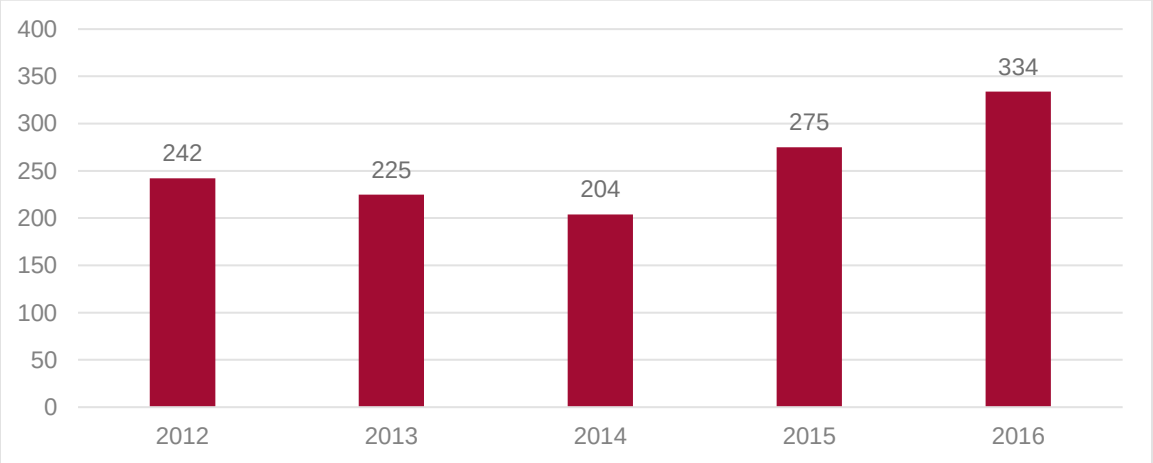


Figure 5: Crashes by Year (SR 101/Pima Road)



Crashes by Severity

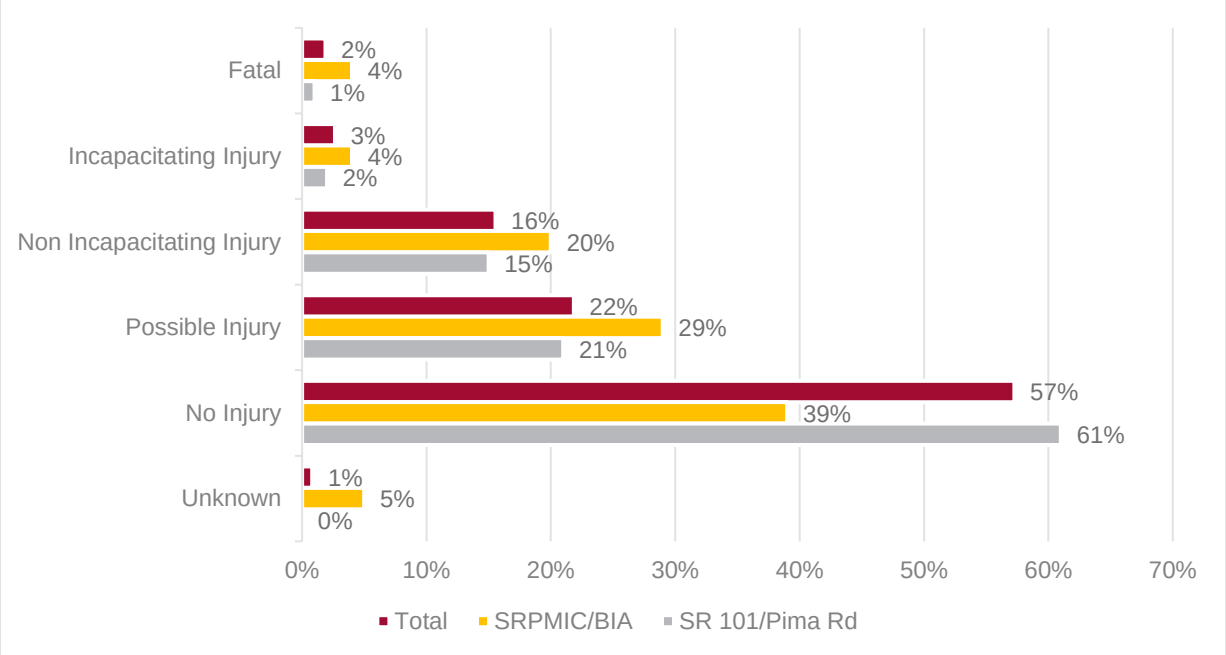
Table 2 shows crashes by injury severity for each scenario.

Over half of the total crashes (57%) resulted in no injury; however, only 39% of crashes on SRPMIC/BIA-maintained roads resulted in no injury. There was a total of 37 fatal and 52 incapacitating injury crashes over the analysis period representing approximately 1.9% and 2.7% of total crashes, respectively. Both fatal and incapacitating injuries represent slightly larger proportions of crashes on SRPMIC/BIA-maintained roadways, and smaller proportions on the SR 101/Pima Road corridor, than the entire roadway system on the SRPMIC. **Table 2** and **Figure 6** shows a breakdown of all crashes by severity.

Table 2: Crashes by Severity

	Scenario 1 - All		Scenario 2 - Interior		Scenario 3 – SR 101/ Pima Rd	
	Total	*%*	*Total*	*%*	*Total*	*%*
Fatal	37	2%	6	4%	10	1%
Incapacitating Injury	52	3%	6	4%	22	2%
Non-Incapacitating Injury	306	16%	33	20%	188	15%
Possible Injury	430	22%	47	29%	273	21%
No Injury	1127	57%	64	39%	781	61%
Unknown	16	1%	8	5%	6	0%

Figure 6: Crashes by Severity



COMPARISON TO STATEWIDE AVERAGE

The percentage of fatal crashes for *Scenario 1* (1.9%) is double the statewide average (0.7%), and the fatality crash rate in *Scenario 2* is five times the statewide average. The injury percentage for *Scenario 1* (40.1%) and *Scenario 2* (52.4%) are also higher than the statewide average of 31.3%.

Driver Condition/Influence

Alcohol was the most common influence observed in crashes, with 65 alcohol-related crashes during the analysis period (*Scenario 1*), representing over 3% of all crashes, and an additional six crashes that involved alcohol and another influence. There were also 15 drug-related crashes observed, representing approximately 0.9% of total crashes (*Scenario 1*).

In *Scenario 2* (SRPMIC/BIA-maintained roadways), nearly 21% of crashes involved alcohol. There were also three drug-related crashes, and an additional seven crashes that involved multiple influences.

A breakdown of crashes is provided in **Table 3**.

COMPARISON TO STATEWIDE AVERAGE

Alcohol-related crashes, at 3.3% of total crashes in *Scenario 1*, are slightly lower than the statewide average of 4.5%. However, alcohol-related crashes in *Scenario 2* (20.7%) are substantially higher than the statewide average. *Scenario 1* crashes involving illegal drugs or narcotics, at 0.6% of total crashes, are slightly lower than the statewide average of 0.7%. *Scenario 2* drug-related crashes (1.8%) are more than twice the statewide average.

Table 3: Crashes by Driver Condition/Influence

	Scenario 1 - All		Scenario 2 - Interior		Scenario 3 – SR 101/ Pima Rd	
	Total	*%*	*Total*	*%*	*Total*	*%*
No Apparent Influence	1,569	79.7%	93	56.7%	1,073	83.8%
Alcohol	65	3.3%	34	20.7%	19	1.5%
Drugs	11	0.6%	3	1.8%	6	0.5%
Fell Asleep/Fatigued	9	0.5%	5	3.0%	2	0.2%
Illness	4	0.2%	0	0.0%	2	0.2%
Physical Impairment	4	0.2%	2	1.2%	1	0.1%
*Other/Multiple Influences**	20	1.0%	7	4.3%	2	0.2%
Unknown	295	18.8%	20	12.2%	175	13.7%

*Includes additional alcohol- and drug-related crashes

Crashes by Day of Week

Scenario 1 crashes peak on Fridays, with 333 crashes observed. Sunday was the lowest day of the week observed with 194 crashes. *Scenario 2* crashes peaked on Saturdays, with weekdays representing lower proportions. *Scenario 3* crashes peaked on Wednesday, with all weekdays representing higher proportions than weekends. The crashes by day of the week are shown graphically in **Figure 7**, **Figure 8**, and **Figure 9**.

COMPARISON TO STATEWIDE AVERAGE

Overall, the state experiences a similar distribution of crashes over the days of the week to *Scenario 1* crashes, with crashes peaking on Fridays. Crashes on Fridays represent approximately 9.2% of crashes for the state and 13.3% for SRPMIC. However, the distribution of crashes in *Scenario 2* peaks on Saturday.

Figure 7: Crashes by Day of Week (Scenario 1 - All Crashes)

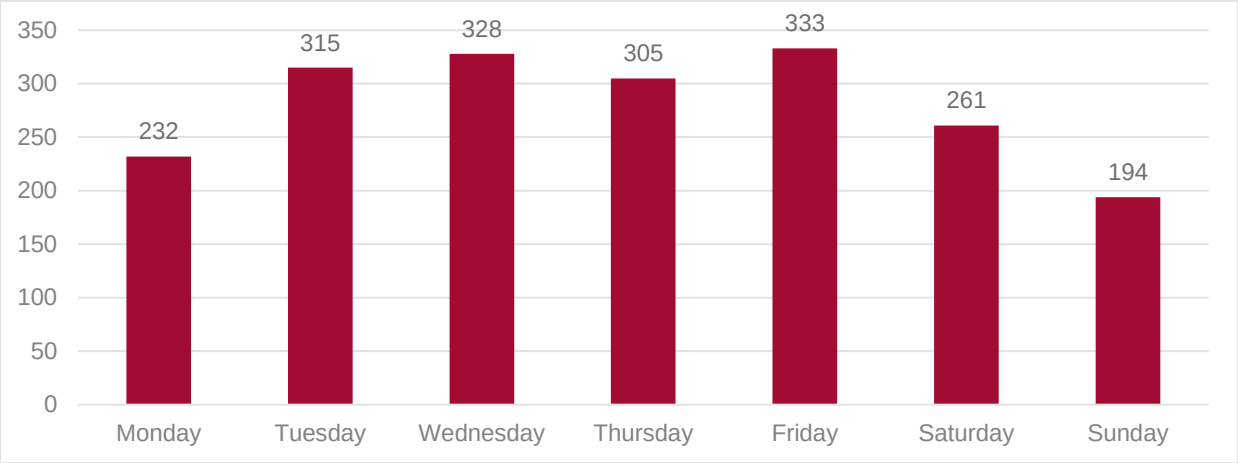


Figure 8: Crashes by Day of Week (Scenario 2 – Interior Crashes)

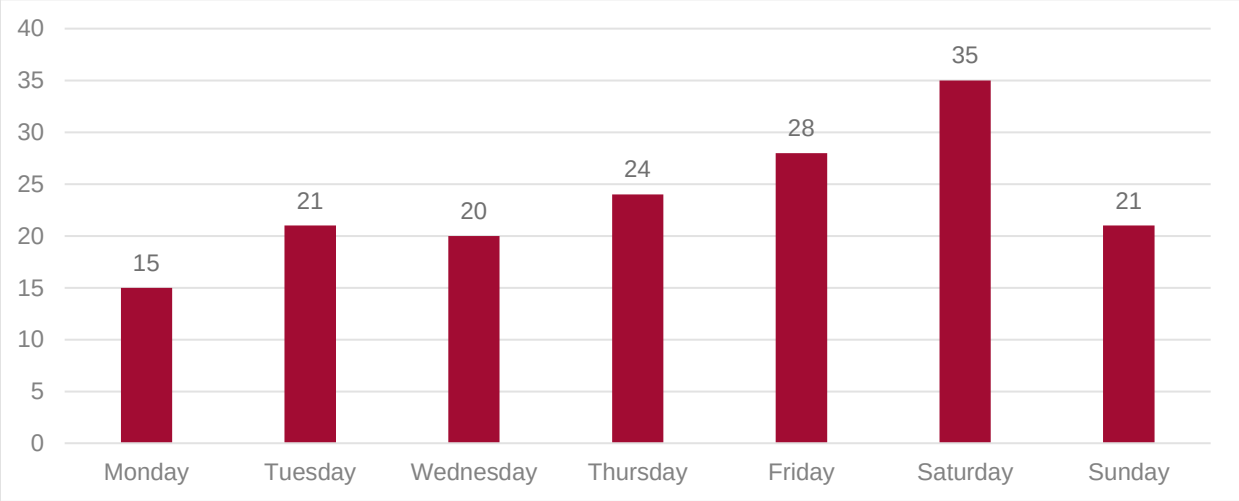
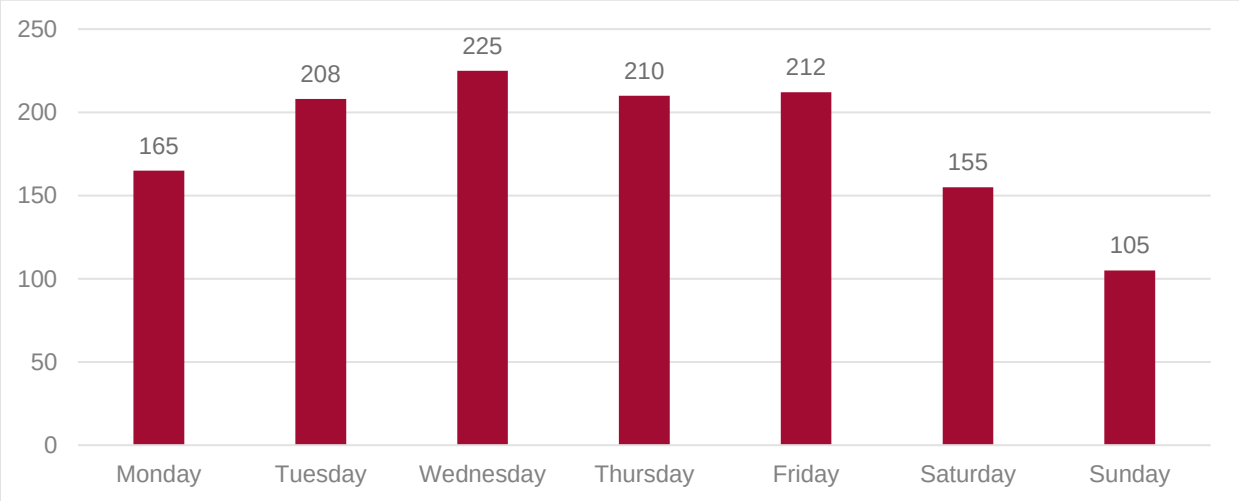


Figure 9: Crashes by Day of Week (Scenario 3 – SR 101/Pima Road Corridor)



Crashes by Time of Day

Total crashes (*Scenario 1*) peak in tandem with typical commuter peaks in the morning (around 8:00 am) and in the afternoon (around 5:00 pm). There is also a minor peak around mid-day, between 12:00 pm and 1:00 pm. Crashes by time of day are shown graphically in **Figure 10**. Crashes on SRPMIC/BIA-maintained roadways are more distributed throughout the day, with crashes in late evening and early morning hours occurring as frequently as crashes in the middle of the day, as shown in **Figure 11**. Crashes along the SR 101/Pima Road Corridor more closely follow the trend of crashes overall, as shown in **Figure 12**.

Figure 10: Crashes by Time of Day (Scenario 1 - All Crashes)

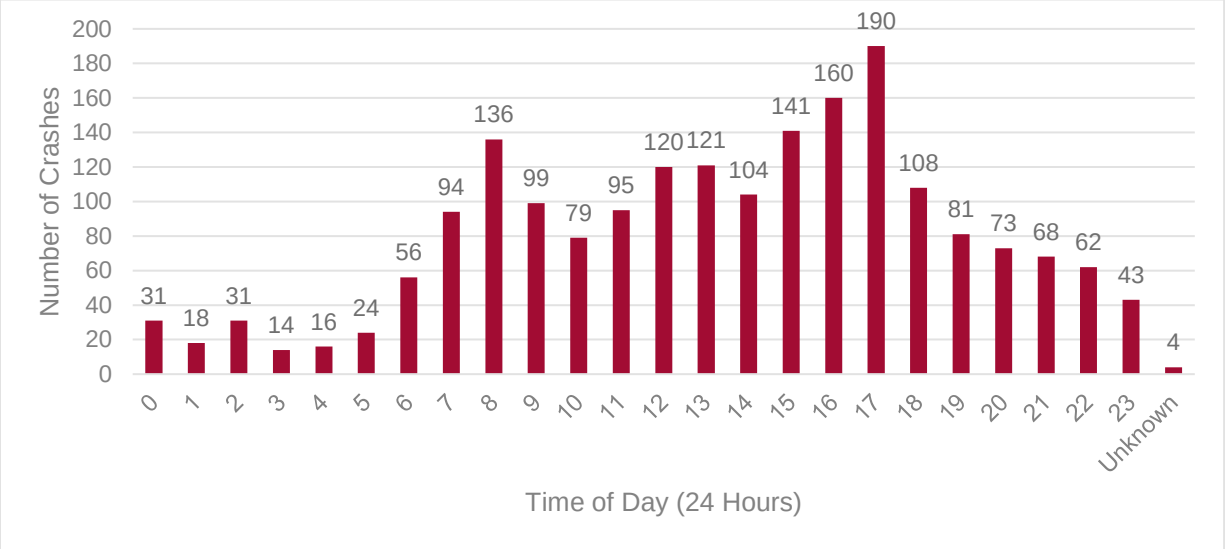


Figure 11: Crashes by Time of Day (Scenario 2 – Interior Roadways)

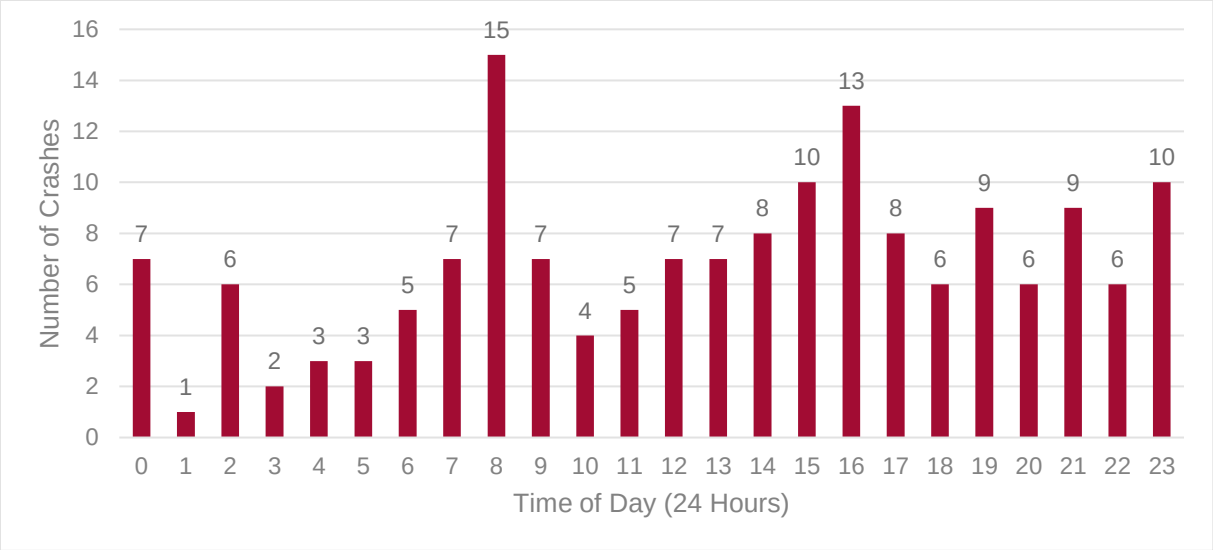
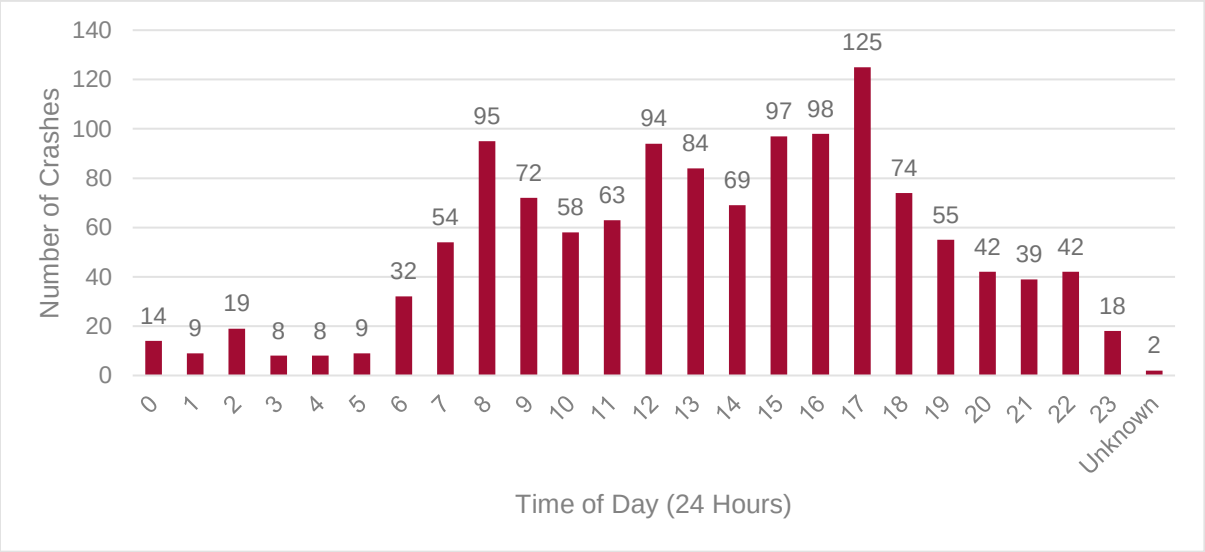


Figure 12: Crashes by Time of Day (Scenario 3 – SR 101/Pima Road)



COMPARISON TO STATEWIDE AVERAGE

The state experiences a similar distribution of crashes over the course of the day compared to total crashes on SRPMIC, with peaks during the morning and afternoon commute times.

Crashes by Type

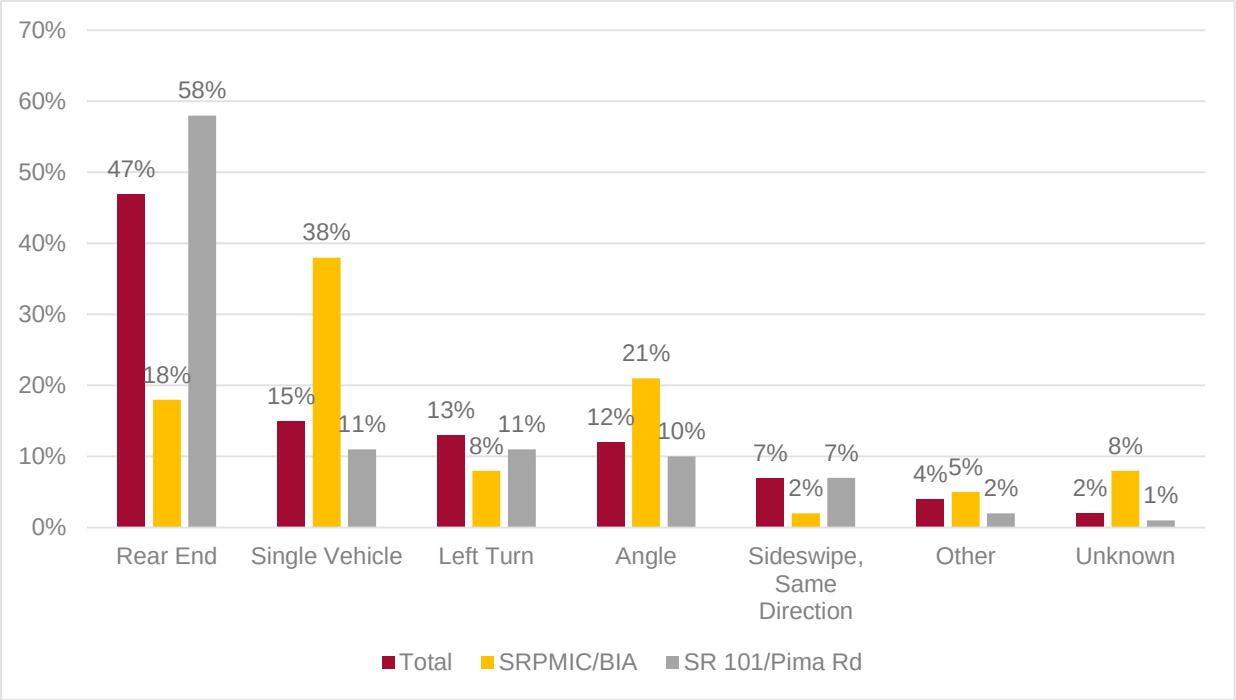
Scenario 1 Rear End crashes are the most common crash type at 47% of all crashes. The next most common types of crashes are Single Vehicle crashes at 15%, Left Turn crashes at 13%, and Angle crashes at 12%.

Scenario 2 crash types follow a different pattern, with Single Vehicle crashes representing 38%, Angle crashes representing 21% and Rear End crashes representing only 18% of all crashes. **Figure 13** shows a summary of crash types.

COMPARISON TO STATEWIDE AVERAGE

The most common types of crashes experienced in SRPMIC are the same as the most common for the state of Arizona. The distribution is also relatively similar between the most common types of crashes, with Rear End crashes being the most common by far, followed by Left Turn, Angle, Sideswipe, and Same Direction crashes. However, crashes on SRPMIC/BIA-maintained roadways follow a different pattern with Single Vehicle and Angle crashes representing larger proportions than the statewide average.

Figure 13: Crashes by Type



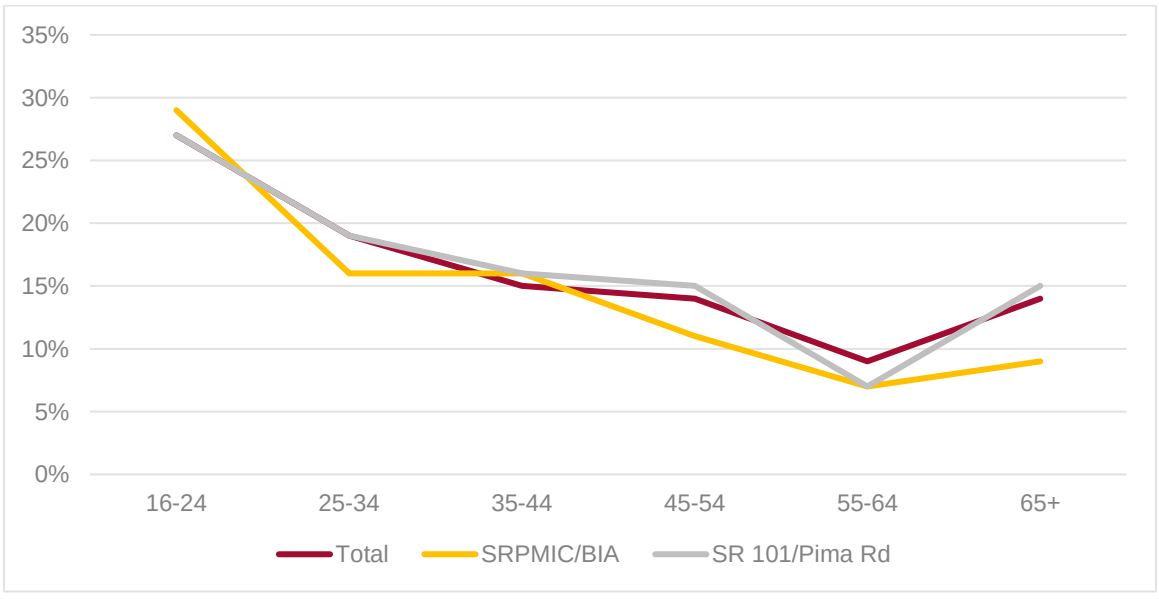
Crashes by Age of Driver

In general, as the age of the driver increases, the frequency of crashes decreases. However, there is a slight increase in crash frequencies for drivers aged 65 and older. Total crashes and crashes on SRPMIC/BIA-maintained roadways follow similar distributions. A graph of crash frequencies by age group is provided in **Figure 14**.

COMPARISON TO STATEWIDE AVERAGE

The distribution of age groups for the state is largely the same as SRPMIC; however, the percentage of crashes with young drivers (16-24) is higher in SRPMIC (27.4%) than the statewide average (22.4%).

Figure 14: Crashes by Age Group of Driver



Violation Behavior

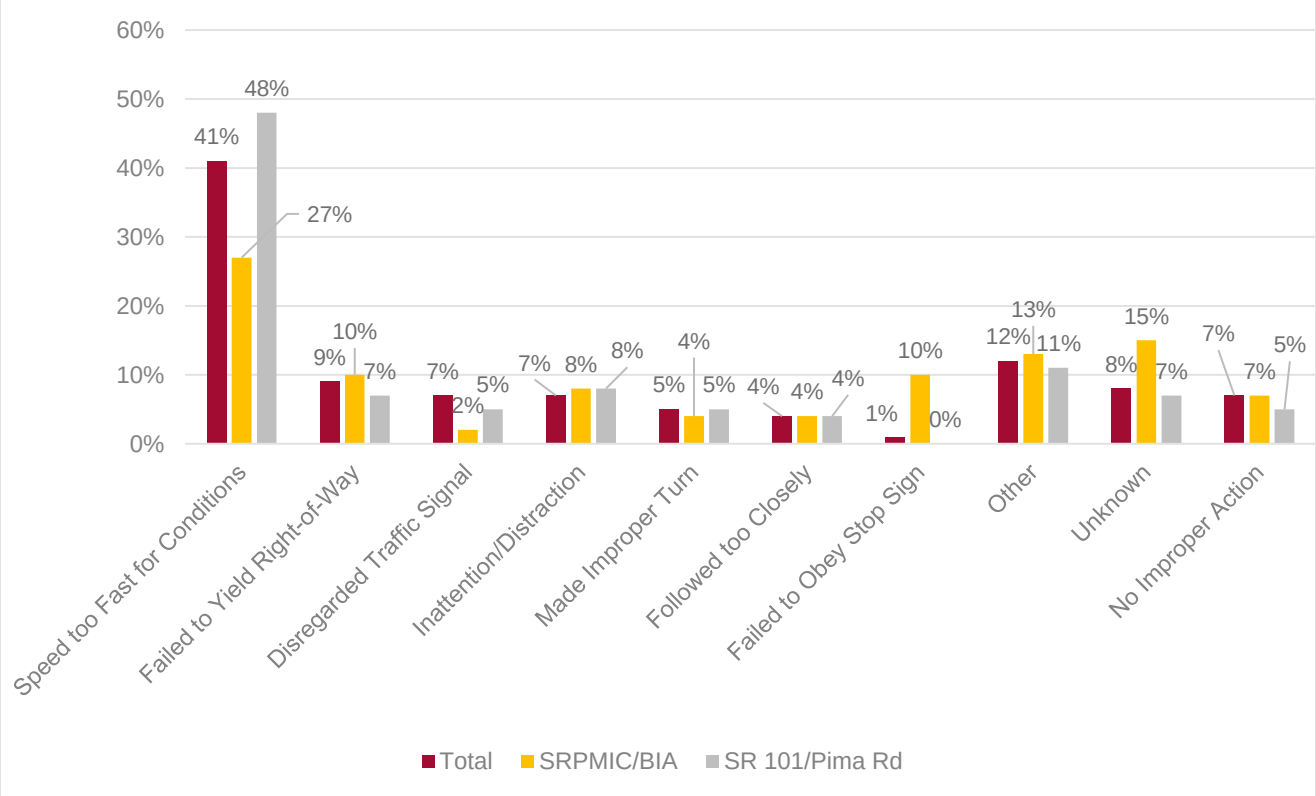
In *Scenario 1*, the most prevalent violation cited in total crashes was 'Speed too Fast for Conditions' with 41% of crashes, and the next most common violations much less prevalent with 'Failed to Yield Right-of-Way' at 9%, and 'Disregarded Traffic Signal' and 'Inattention/Distraction' both at 7%.

In *Scenario 2*, violations are more distributed, and 'Failed to Obey Stop Sign' is more prevalent. A full breakout of violations cited is provided graphically in **Figure 15**.

COMPARISON TO STATEWIDE AVERAGE

The distribution of crashes is much the same between the statewide averages and SRPMIC. 'Speed too Fast for Conditions' is the most prevalent violation by a large margin and 'Failed to Yield Right-of-Way' is the next most prevalent.

Figure 15: Violation Behavior



Other Crash Statistics

Other crash statistics that were selected in addition to the ones previously mentioned are listed below in **Table 4**.

Table 4: Other Selected Crash Statistics

		Scenario 1 - All Crashes	Scenario 2 – Interior Roads	Scenario 3 – SR 101/Pima Road
Speeding	Speeding Involved	14%	26%	8%
Lighting Conditions	Daylight	69%	53%	73%
	Dark – Lighted	18%	13%	20%
	Dark – Not Lighted	7%	22%	3%
	Dawn/Dusk	4%	5%	3%
Weather Conditions	Clear	89%	82%	89%
	Cloudy	7%	5%	8%
	Rain	2%	2%	2%
Surface Conditions	Dry	93%	79%	95%
	Wet	3%	2%	3%
	Mud, dirt, gravel	1%	8%	0%
Safety Device	Seatbelt/Helmet	84%	68%	86%
	No Safety Device Used	4%	12%	3%

3. Geographic Distribution of Crashes

This section displays the geographic distribution of crashes throughout SRPMIC. These maps inform identification of emphasis areas where additional crash investigation is needed, and where recommendations for safety enhancements are necessary.

Crash Severity

Figure 16 shows the distribution of crashes by severity. Crashes are densely clustered along the western side of the community, at SR 101 ramps and on Pima Road, McKellips Road, and SR 87.

Fatal Crashes

There were 37 total fatal crashes during the five-year analysis period. A substantial proportion of fatal crashes occurred along the McKellips Road corridor (16 fatalities), significantly higher than any other corridor. The McDowell Road corridor experienced six fatalities, and the SR 87 corridor experienced five fatalities. The distribution of fatal crashes is provided in **Figure 17**.

Incapacitating Injury Crashes

There were 52 total incapacitating injury crashes during the five-year analysis period. Similar to overall crashes, incapacitating injury crashes are concentrated on the western edge of SRPMIC. **Figure 18** provides the distribution of incapacitating injury crashes.

Crash Frequencies

Figure 19 shows the distribution of crash frequencies in SRPMIC. Segment crashes are shown as the number of crashes per mile to account for the varying lengths of the segments. Intersection crash frequencies are highest along SR 101 and Pima Road. The intersections of McKellips Road/McClintock Drive and the SR 202 Ramps/McClintock Drive are also notable high-crash locations. Segment crashes are relatively high on McClintock Drive and portions of Pima Road, Talking Stick Way, and McKellips Road.

Overall Crash Rates

Intersection crash rates are calculated as the number of crashes per million vehicles entering the intersection. Segment crash rates are calculated as the number of crashes per million Vehicles Miles Traveled (VMT), which normalizes the varying lengths and volume of traffic on the segments. Crash rates can only be determined on roadways and at intersections where the Average Daily Traffic (ADT) is known. The resulting intersection and segment crash rates are shown in **Figure 20**.

The highest intersection crash rate is the SR 101 and Pima Road/90th Street intersection. Segments with the highest crash rates include:

- Pima Road (Indian School Road to Chaparral Road)
- Extension Road (Thomas Road to Indian School Road)
- Osborn Road (Center Street to Mesa Drive)
- Dobson Road (McDowell Road to Oak Street)
- McClintock Drive (SR 202 to Curry Road)
- Several on- and off-ramps along SR 101

Figure 16: Crashes by Severity

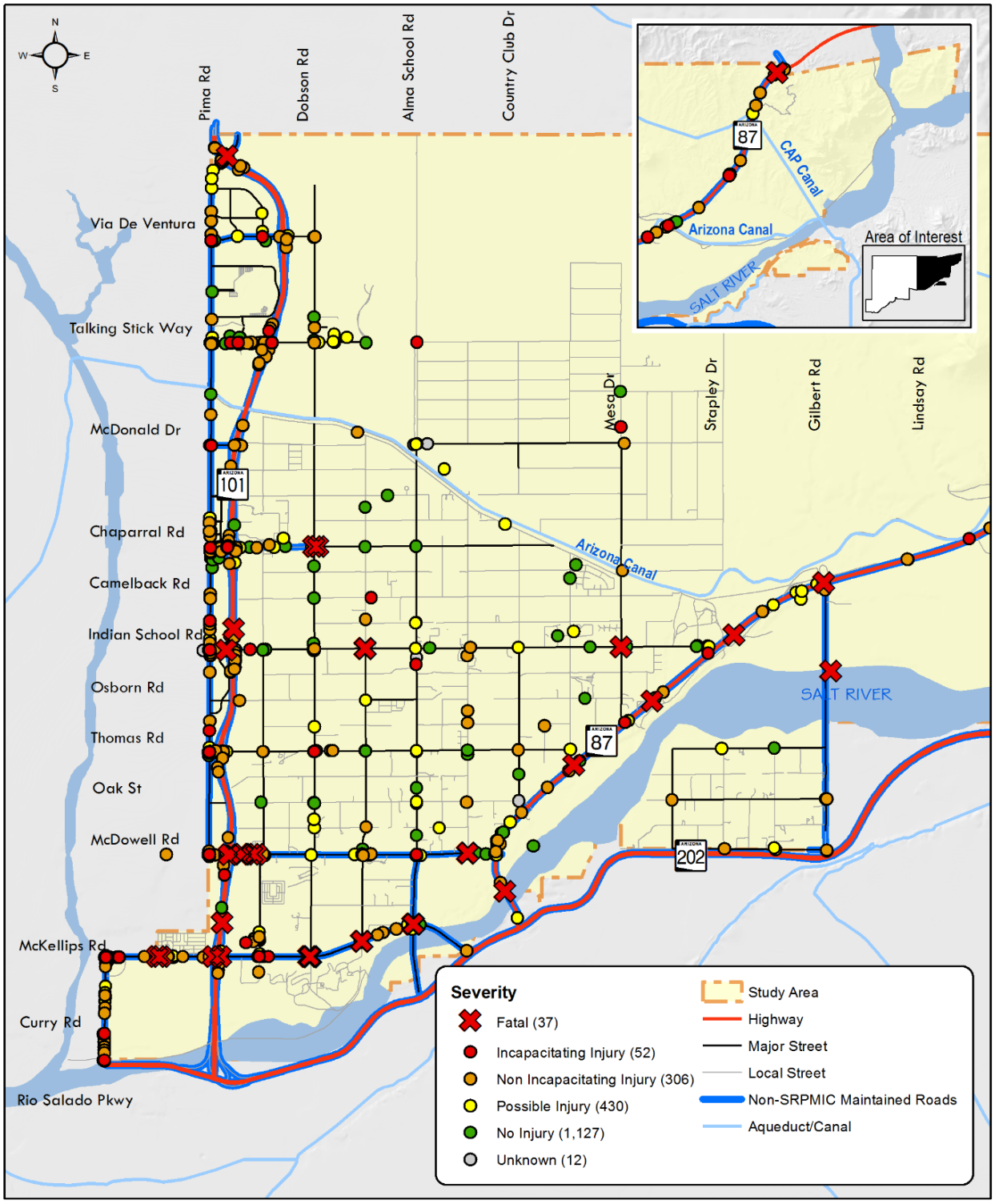


Figure 17: Fatal Crashes

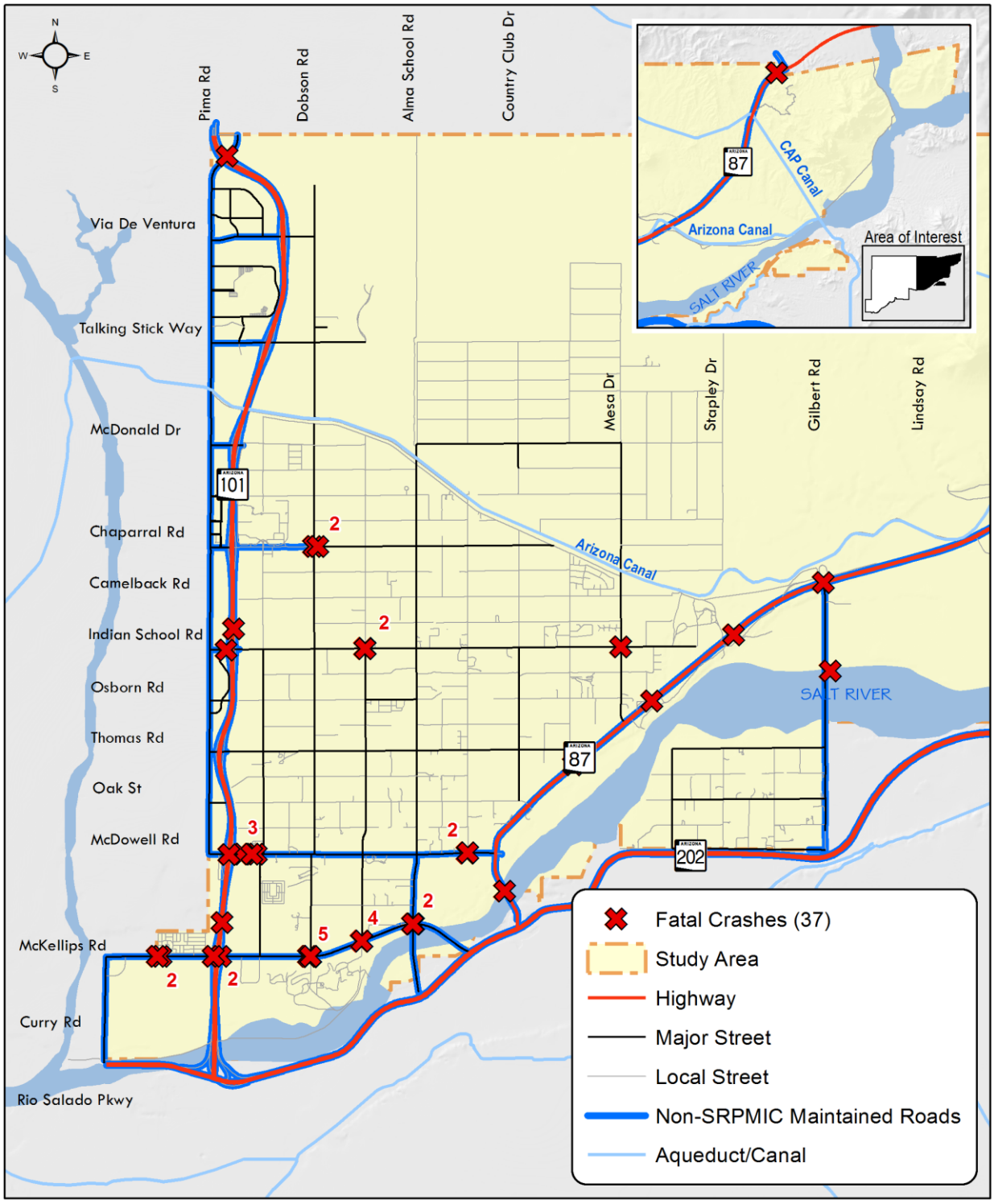


Figure 18: Incapacitating Injury Crashes

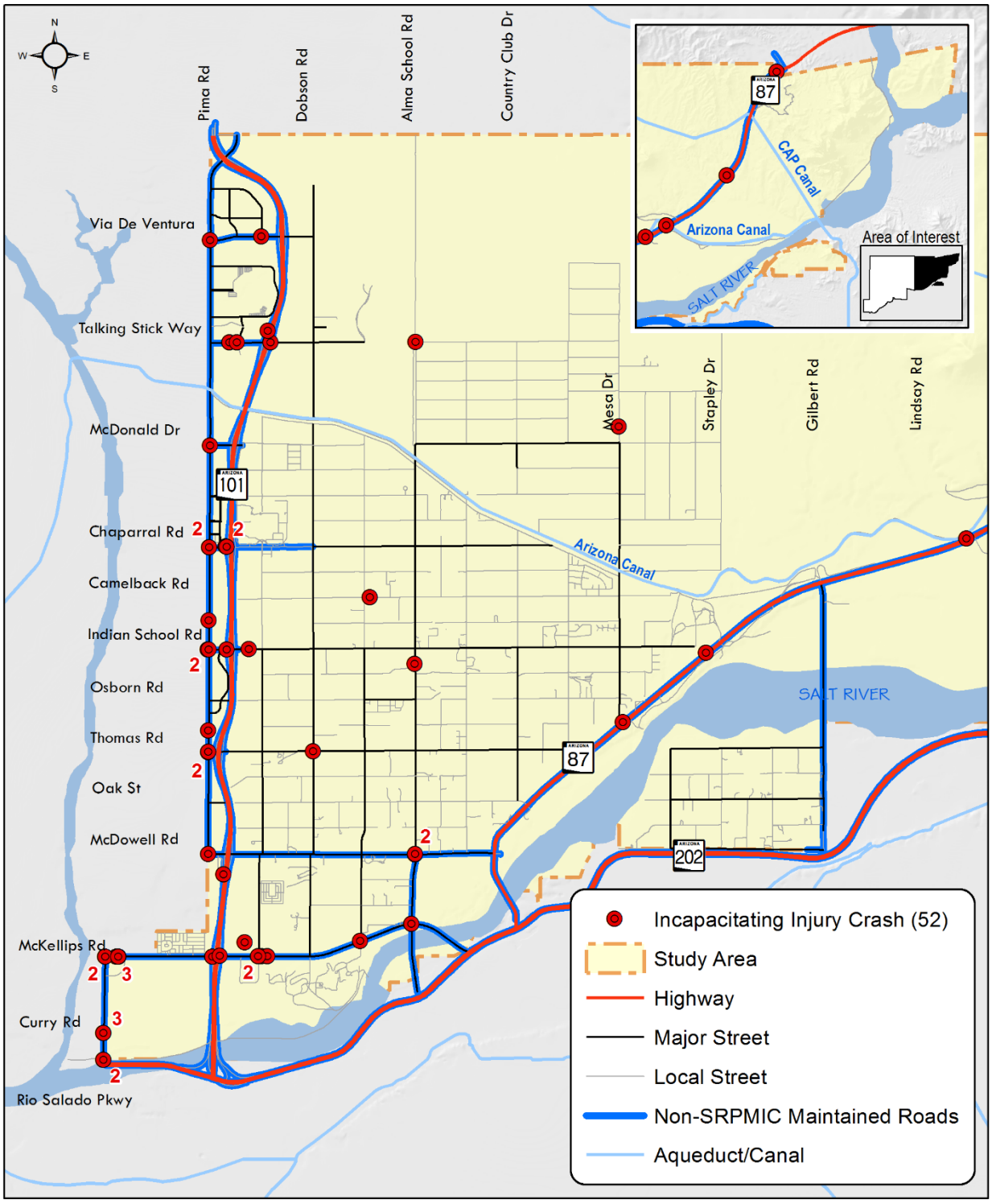


Figure 19: Intersection and Segment Crash Frequencies

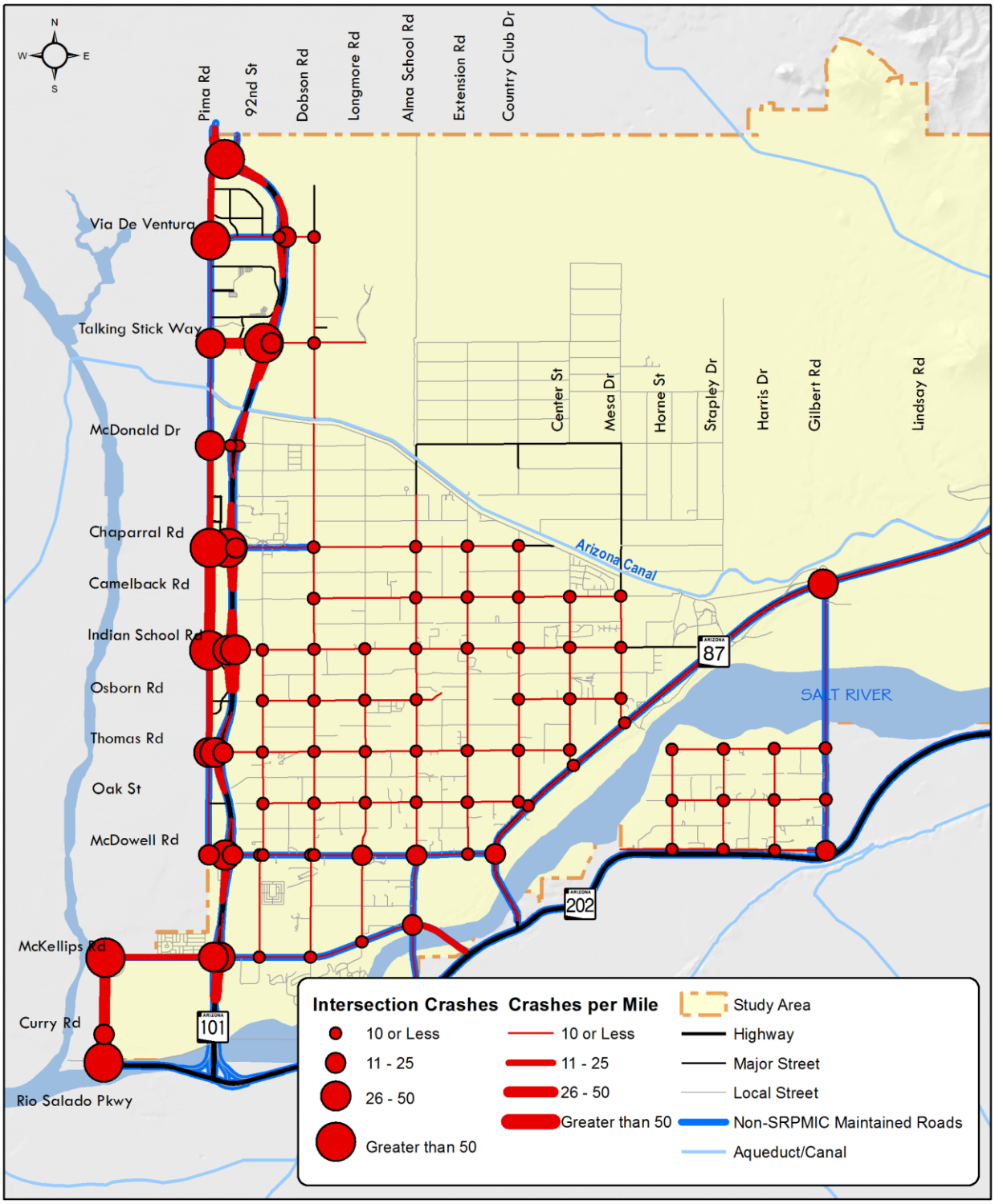
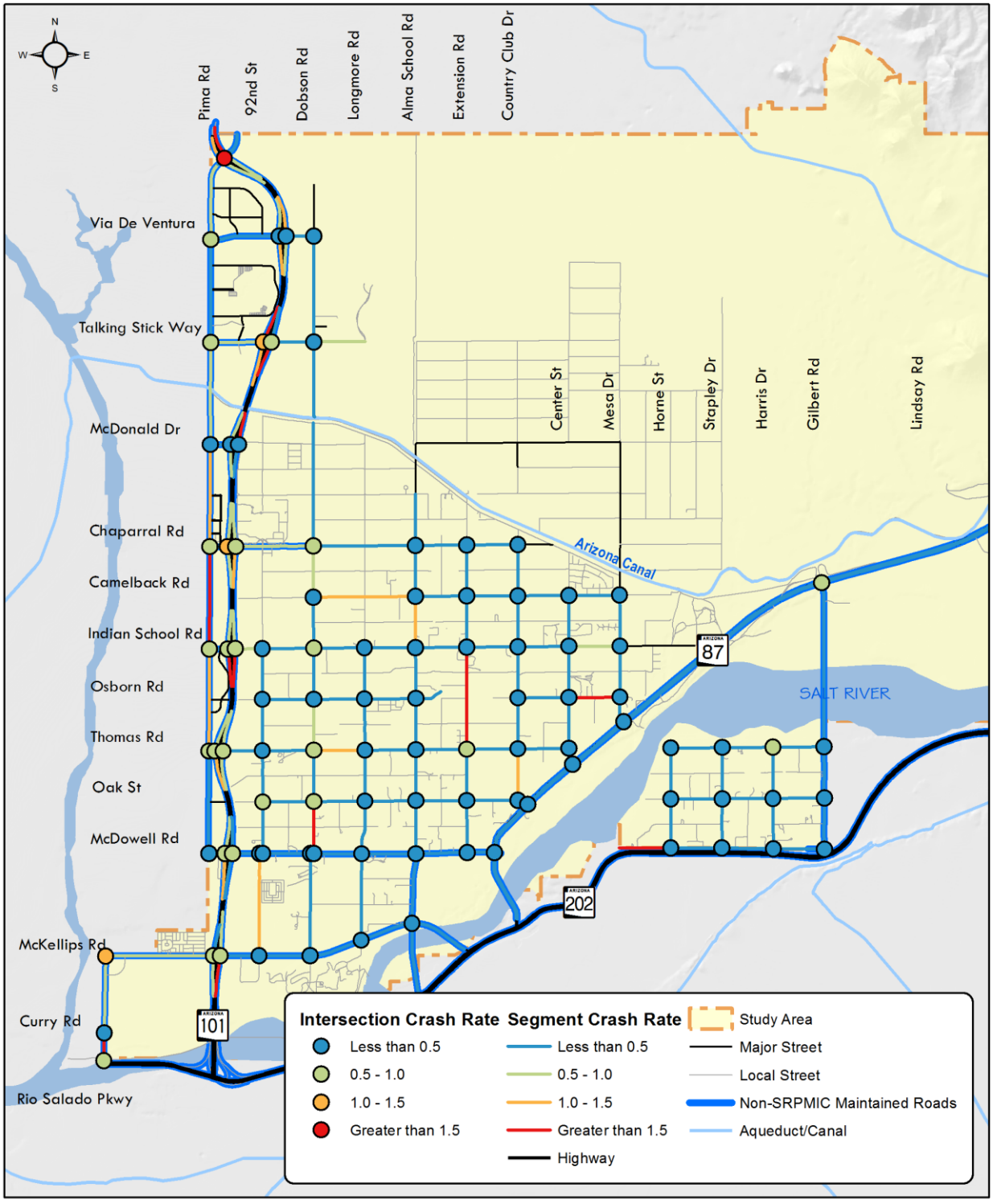


Figure 20: Intersection and Segment Crash Rates



Severe Crash Rates

Severe crash rates were calculated for severe (fatal and incapacitating) crashes. **Figure 21** shows severe crash rates for intersections and roadway segments where traffic volumes are available.

The intersections with the highest rates of severe crashes are:

- Chaparral Road/Dobson Road
- Indian School Road/Longmore Road

Segments with the highest severe crash rates include:

- Camelback Road (Dobson Road to Alma School Road)
- Alma School Road (Osborn Road to Indian School Road)
- SR 101 southbound off-ramp at Talking Stick Way
- SR 101 northbound on-ramps at Indian School Road and McKellips Road

Comparison to Statewide Average Severe Crash Rates

The latest statewide average crash rates available (2010-2014) were used as a comparison tool to determine if crash rates within SRPMIC are generally higher or lower than the rest of Arizona. While the analysis period does not exactly match up with this document's, it is not anticipated that aggregate statewide data would change significantly in the two subsequent years after the statewide data is available. The statewide average crash rates by roadway types present in SRPMIC are provided in **Table 5** along with the nearest standard deviations away from the average crash rates. Segments with crash rates more than 1 standard deviation above average are considered relatively unsafe when compared to the statewide average.

Table 5: Statewide Average Crash Rates by Roadway Type (2010-2014)

Roadway Type	Avg. Crash Rate*	-1 Standard Deviation	+1 Standard Deviation
2/3 Lane Roadway	0.0737	0.0669	0.0805
2/4 Lane Divided Roadway	0.0492	0.037	0.0615
4/5 Lane Roadway	0.0723	0.0577	0.087
6-Lane Roadway	0.0354	0.0214	0.0495

***Crash rates are calculated as severe crashes per 1,000,000 VMT.*

Table 6 lists roadway segments that are more than one standard deviation above the statewide average crash rate. For this analysis, the segment and intersection crashes were consolidated onto the segments as there are no separate statewide averages for intersections. **Figure 22** shows each roadway segment's relation to the statewide averages graphically.

Pedestrian and Bicycle Crashes

Figure 23 shows the location of pedestrian and bicycle-related crashes on SRPMIC. There were eight fatalities and six incapacitating injury crashes that involved pedestrians and bicycles. Pedestrian and bicycle crashes are also concentrated along the western side of SRPMIC. McKellips Road between McClintock Drive and 92nd Street had several bicycle and pedestrian crashes.

Alcohol-Related Crashes

Figure 24 shows the locations of alcohol-related crashes by severity. There are no identifiable concentrations of alcohol-related crashes around the major entertainment areas on SRPMIC. Alcohol-

related crashes are distributed geographically across the Community.

Table 6: Roadway Segments Over One Standard Deviation Above the Statewide Average

Roadway	From	To	Severe Crash Rate
Alma School Road	SR 202	McKellips Road	0.1047
Alma School Road	McDowell Road	Oak Street	0.2911
Alma School Road	Osborn Road	Indian School Road	0.2951
Camelback Road	Dobson Road	Alma School Road	1.0381
Chaparral Road	Pima Road	SR 101 SB Ramps	0.1433
Chaparral Road	Dobson Road	Alma School Road	0.1635
Dobson Road	Oak Street	Thomas Road	1.0074
Dobson Road	Chaparral Road	Arizona Canal	1.2109
Extension Road	McDowell Road	Oak Street	0.844
Indian Bend Road	SR 101 NB Ramps	Dobson Road	0.289
Indian School Road	Pima Road	92nd Street	0.1771 – 0.5372
Indian School Road	Dobson Road	Longmore Road	0.3333
Longmore Road	Osborn Road	Indian School Road	0.3831
McClintock Drive	SR 202	McKellips Road	0.1953 – 0.1962
McDonald Drive	Pima Road	SR 101 SB Ramps	0.1207
McDowell Road	Pima Road	92nd Street	0.1811 – 0.4466
McKellips Road	McClintock Drive	SR 101 NB Ramps	0.1695 – 0.4178
McKellips Road	92nd Street	Longmore Road	0.1537 – 0.4366
Mesa Drive	SR 87	Indian School Road	0.4577 – 0.8733
Pima Road	McDowell Road	McDonald Drive	0.1255 – 0.2918
SR 101 SB On-Ramp	McKellips Road	SR 101	0.1868
SR 101 NB On-Ramp	McKellips Road	SR 101	0.4566
SR 101 SB On-Ramp	McDowell Road	SR 101	0.1976
SR 101 NB On-Ramp	Indian School Road	SR 101	0.2272
SR 101 SB Off-Ramp	SR 101	Chaparral Road	0.1665
SR 101 SB Off-Ramp	SR 101	Indian Bend Road	0.2709

Figure 21: Severe Intersection and Segment Crash Rates

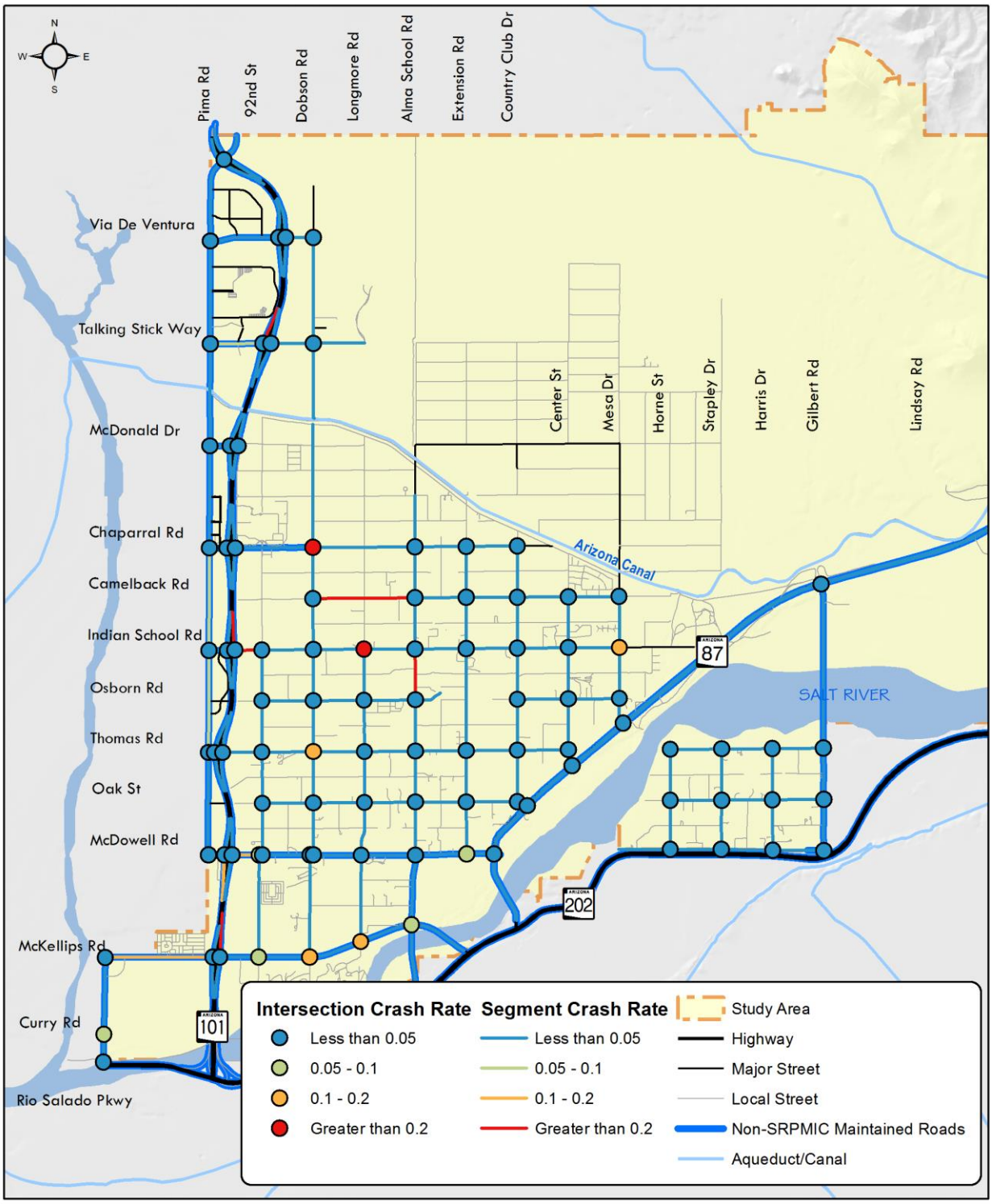


Figure 22: Statewide Average Severe Crash Rate Comparison

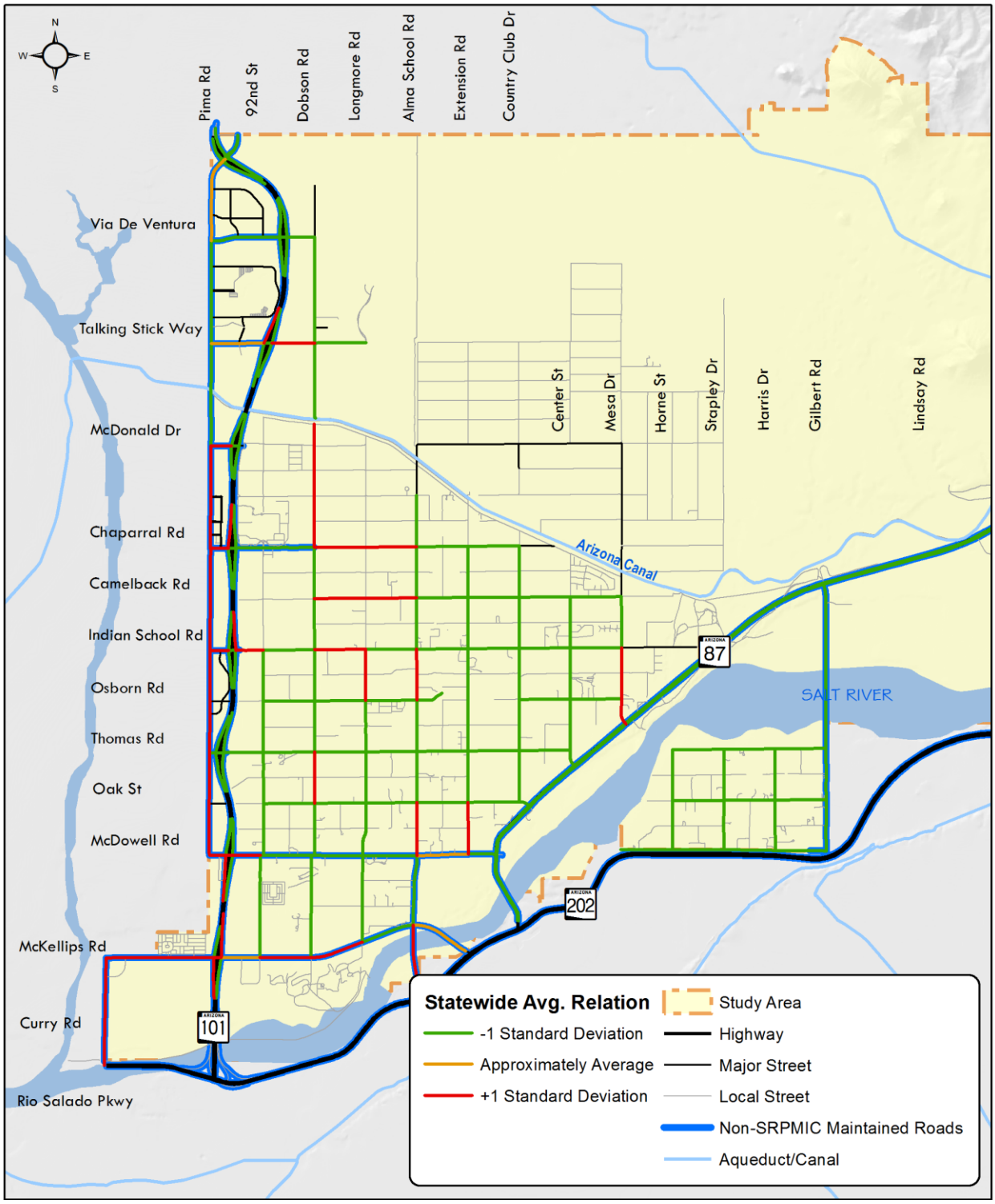


Figure 23: Pedestrian and Bicycle-Related Crashes

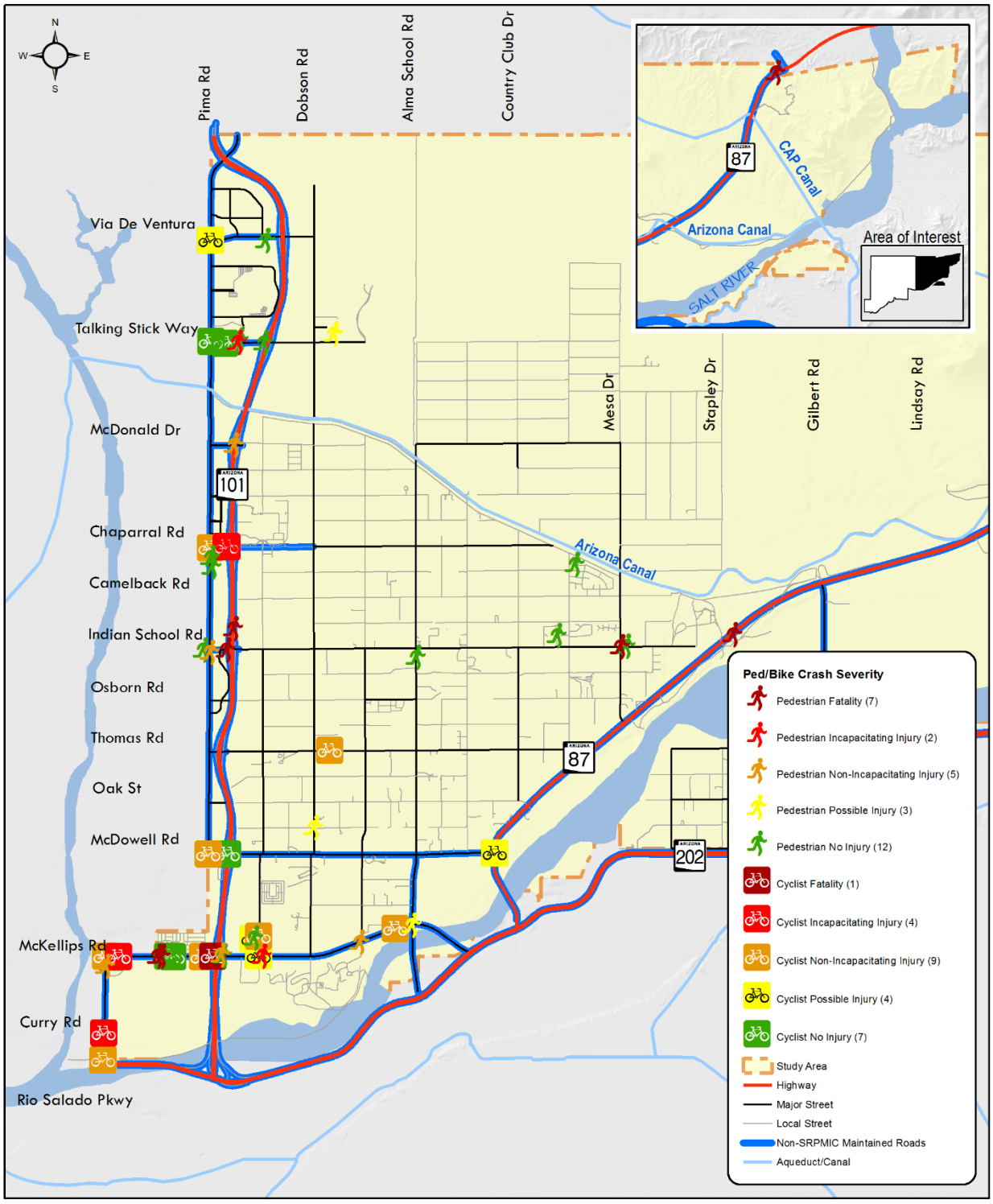
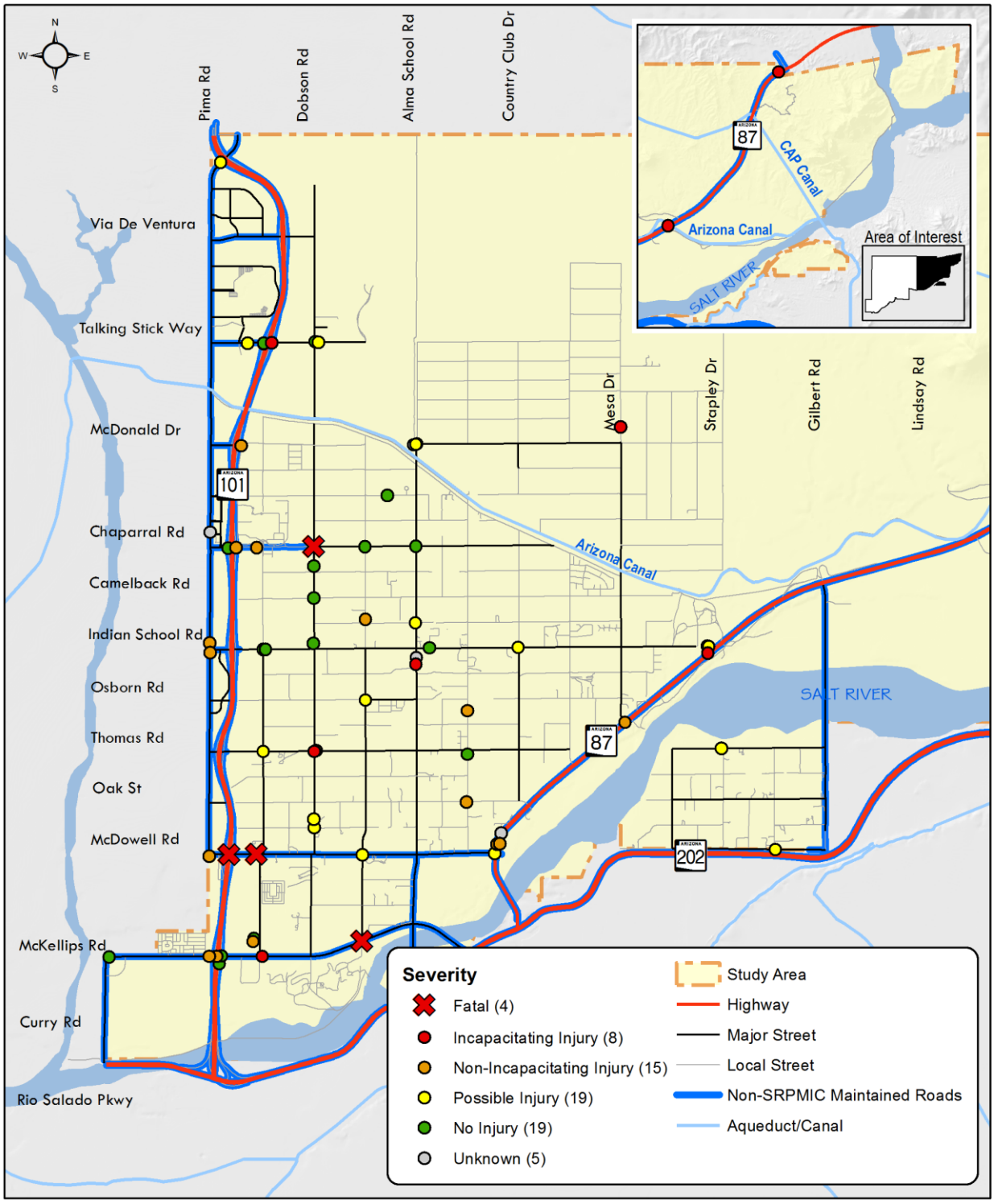


Figure 24: Alcohol-Related Crashes



4. Severe Crash Analysis

Table 7 shows the total number of crashes by severity. Fatal and incapacitating injury crashes are considered 'severe'.

Table 7: Severe Crashes

Severity	Crashes	Percent
Fatal	37	2%
Incapacitating Injury	52	3%
Non-Incapacitating Injury	306	15%
Possible Injury	430	22%
No Injury	1,127	57%
Unknown	16	1%
Total	1,968	

Table 8 shows data stratifications for severe crashes to help identify factors that have the highest impact on crash severity.

Table 8: Severe Crash Data Stratifications

Category	Crash Statistic	Severe Crashes	All Crashes
Alcohol	Alcohol-Related Crashes	14%	4%
Collision Manner	Rear-End Crashes	10%	47%
	Single Vehicle Crashes	18%	15%
	Left Turn Crashes	18%	13%
	Angle Crashes	19%	12%
Lighting	Daylight Crashes	42%	69%
	Dawn/Dusk	7%	4%
	Dark-Lighted	24%	18%
	Dark-Not Lighted	11%	7%
Violation Behaviors	Speed too Fast for Conditions	15%	41%
	Failed to Yield Right-of-Way	15%	9%
	Disregarded Traffic Signal	6%	7%
	Inattention/Distraction	1%	7%
	Ran Stop Sign	9%	1%
	Made Improper Turn	6%	5%
	Failed to Keep in Proper Lane	6%	3%
Roadway Type	No Median in Place	58%	47%
	Divided or One-Way	22%	51%
Safety Device	No Safety Device Used	28%	4%
Age of Driver	Young (16-24)	9%	8%
	Older (65+)	10%	4%

Alcohol-related crashes accounted for nearly 14% of severe crashes, whereas they account for 4% of all crashes, indicating that alcohol-related crashes lead to more severe crashes than non-alcohol related crashes.

Rear-end crashes are less prevalent when only looking at severe crashes, accounting for only 10% compared to 47% overall. Left turn and angle crashes accounted for somewhat higher proportions of severe crashes than crashes overall.

Severe crashes occurred at a higher rate at night than during the day, accounting for 35% of crashes compared to 25% of all crashes, respectively. Severe crashes occurred more frequently for both lighted and not-lighted crashes at night.

Violation behaviors occurred in a different pattern with severe crashes. 'Failed to Yield Right-of-Way', 'Ran Stop Sign', and 'Failed to Keep in Proper Lane' proportionately occurred more frequently in severe crashes than in all crashes. 'Speed too Fast for Conditions' and 'Inattention/Distraction' accounted for a smaller proportion of severe crashes than all crashes.

Roadways with a median, or one-way roadways, accounted for a smaller percentage of severe crashes (22%) compared to all crashes (51%); inclusion of physical medians or barriers could have a noticeable impact on crash severity.

28% of severe crashes occurred when the driver was not wearing a safety device, such as a seatbelt or motorcycle helmet. This percentage is substantially higher than all crashes where the driver was not wearing a safety device (4%).

26% of pedestrian and bicycle-related crashes resulted in an incapacitating injury or fatality, higher than the percentage for all crashes (4.6%). Bicyclists and pedestrians are more vulnerable, increasing the need for protective design in the multi-modal network.

Analysis of Severe Crash Narratives

Crash narratives were available for 39 of the fatal and incapacitating injury crashes. Several trends were identified from the narratives:

- Eight of the crashes involved impairment, either alcohol or drugs;
- Seven of the crashes were caused by a driver failing to stop, or fully stop, at stop signs;
- Seven of the crashes involved motorcycles;
- Six of the crashes involved vehicles failing to yield right-of-way to oncoming traffic while making left turns at signals;
- Four of the crashes involved pedestrians. In two of the crashes the pedestrian was not in a marked crosswalk or on a sidewalk. In two of the crashes the pedestrian was in a marked crosswalk; and
- Two of the crashes involved vehicles making illegal U-turns.

5. Emphasis Areas

Arizona Strategic Highway Safety Plan

The Arizona Department of Transportation completed a statewide Strategic Highway Safety Plan (SHSP) in 2014. An overarching goal and objective were developed as guiding principles for what is intended to be achieved through the SHSP. The goal and objective are:

GOAL: "*Reduce fatalities and the occurrence and severity of serious injuries on all public roadways in Arizona."*

OBJECTIVE: "Reduce the total number of fatalities and serious injuries in Arizona by three to seven percent during the next five years from the 2013 base year."

This document lays a blueprint for how ADOT and DPS planned on addressing specific emphasis areas that were developed after a similar analysis of crash statistics to what is in this document. These statewide emphasis areas are the focus of design and enforcement mitigation measures due to their heavy impact on fatal and incapacitating injury crashes. These emphasis areas are:

- **Speeding and aggressive driving**
- **Impaired driving**
- **Occupant protection (seatbelts/helmets)**
- **Motorcycles**
- **Distracted driving**
- Roadway infrastructure and operations
- Age related
- Heavy vehicles/buses/transit
- Nonmotorized users
- Natural risks
- Traffic incident management
- Interjurisdictional

The top five emphasis areas (**in bold type**) are the main focus of mitigation strategies because they account for the greatest number of fatalities and serious injuries and appear to be trending upwards.

Maintaining consistency with the SHSP will not only help SRPMIC most effectively combat severe injury crashes on the Community because all jurisdictions are focused on the same goals, it will aid SRPMIC when applying for state funding for safety projects. Projects that address the specific emphasis areas in the SHSP may receive higher scores in evaluations for competitive grants and other funding sources.

SRPMIC Emphasis Areas

A goal and objective for the SRPMIC TTSP are proposed:

GOAL: "Make the Salt River Pima-Maricopa Indian Community a safer place to live and work by reducing fatalities and serious injuries in the transportation system."

OBJECTIVE: "Reduce the total number of fatalities and serious injuries by ten percent during the next five years from the 2017 base year through a comprehensive combination of methodologies including engineering, enforcement, education, and emergency services."

Seven emphasis areas are proposed to guide transportation safety investments for SRPMIC. Emphasis areas **in bold** are consistent with the Arizona SHSP emphasis areas.

- **Roadway Infrastructure and Operations** at High Severe-Crash Locations*;*
- **Nonmotorized Users**;
- **Impaired Driving**;
- **Occupant Protection**;
- **Speeding and Aggressive Driving;**
- Incident Response;
- Crash Data Reporting.

The following pages describes these emphasis areas in more detail, including a description of the emphasis area, and objectives and success indicators. Strategies to address these emphasis areas include the following information:

- Strategy type – types include either engineering, enforcement, education, or emergency services strategies
- Goal – what will the strategy accomplish
- Strategies – this is the specific strategy
- Target Output – what will be accomplished as a result of the strategy
- Organizations and Persons Responsible – who would take the lead in implementing the strategy
- Date of Completion – either a general timeframe, or whether the strategy would be done continuously or annually
- Performance Measures – how will the strategy be evaluated
- Monitoring and Evaluation – how would evaluation be done

EMPHASIS AREA 1: ROADWAY INFRASTRUCTURE AND OPERATIONS

Emphasis Area: Roadway Infrastructure and Operations at High Severe-Injury Crash Locations				**Description:** Severe crashes are concentrated at high severe-crash locations on SRPMIC.			
Objectives: Reduce fatalities and severe injury crashes at identified intersections and corridors. See **Chapter 6** for list of high severe-crash locations.				**Success Indicators:** Reduction in fatalities and severe injury crashes at identified intersections and corridors over a five-year period.			
Strategy Type	**Goals**	**Strategies**	**Target Output**	**Organizations and Persons Responsible**	**Date of Completion**	**Performance Measures**	**Monitoring and Evaluation**
Engineering	Improve high severe crash locations	Countermeasures as identified in **Chapter 6**.	Improve two locations per year.	Public Works	Annually	Reduction in annual number of severe crashes at these locations	Annual summary of fatal and severe crashes at high-crash locations.
Enforcement	Reduce aggressive driving behavior at high severe crash locations	Targeted enforcement at high severe crash locations	Increased public awareness	Police Department	Annually		
Education		Post signage indicating areas as "safety corridors"		Public Works	Mid-2019		
Emergency Services	N/A	N/A	N/A	N/A	N/A		

EMPHASIS AREA 2: NON-MOTORIZED USERS

Emphasis Area: Nonmotorized Users				**Description:** There were 54 total crashes involving pedestrians and cyclists between 2012 and 2016, 26% of which resulted in fatalities or incapacitating injuries.			
Objectives: Reduce the frequency and severity of crashes involving pedestrians and cyclists.				**Success Indicators**: Reduction in the frequency and severity of crashes involving pedestrians and cyclists over a five-year period.			
Strategy Type	**Goals**	**Strategies**	**Target Output**	**Organizations and Persons Responsible**	**Date of Completion**	**Performance Measures**	**Monitoring and Evaluation**
Engineering	Increased safety for pedestrians and bicyclists.	Additional bicycle and pedestrian facilities; see **Figure 23** for locations.	Implement one pedestrian or bicycle infrastructure enhancement project each year.	Public Works	Annually	Reduction in annual number of crashes involving a pedestrian or bicyclist.	Annual summary of crashes involving a pedestrian or bicyclist.
Enforcement	Improve driver compliance at pedestrian crossings, enforce bicyclist safe passing distances.	Targeted enforcement at areas with high number of pedestrians /bicyclists	Increased public awareness of pedestrians and bicyclists.	Police Department	Annually		
Education	Educate drivers about rules when interacting with pedestrians and bicyclists	Safety fair; classes for new drivers and children about the rules of the road for pedestrians, bicyclists and drivers	Increased public awareness of pedestrians and bicyclists.	SRPMIC Injury Prevention Program (under SRPMIC Health and Human Services)	Annually		
Emergency Services	N/A	N/A	N/A	N/A	N/A		

EMPHASIS AREA 3: IMPAIRED DRIVING

Emphasis Area: Impaired Driving	**Description:** Approximately 5% of all crashes involved alcohol or drugs as a contributing circumstance, while 15% of severe crashes involved these impairments.
Objectives: Reduce the frequency of crashes involving impaired drivers.	**Success Indicators:** Reduction in the frequency of crashes involving impaired drivers over a five-year period

Strategy Type	Goals	Strategies	Target Output	Organizations and Persons Responsible	Date of Completion	Performance Measures	Monitoring and Evaluation
Engineering	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Enforcement	Decrease in number of crashes involving impaired driving.	Provide targeted enforcement during early-morning hours at locations with a history of alcohol-related crashes, enforcement checkpoints on holidays, pursue additional grant funding for increased enforcement	Increased public awareness of police enforcement for impaired driving	Police Department	Annually	Reduction in annual number of crashes involving an impaired motorist.	Annual crash summary to determine number of crashes involving an impaired motorist.
Education	Educate road users about dangers and consequences of impaired driving	Post signs with the legal blood-alcohol limit; implement an injury prevention program for young drivers in high schools that includes impaired driving, occupant protections, and speeding/aggressive driving; implement a "Know Your Limit" campaign in casinos; utilize a DUI van with a sign during the holiday season	Increased public awareness that reduction in impaired driving is a Community priority	SRPMIC Injury Prevention Program (under SRPMIC Health and Human Services)	Annually		
Emergency Services	N/A	N/A	N/A	N/A	N/A		

EMPHASIS AREA 4: OCCUPANT PROTECTION

Emphasis Area: Occupant Protection				**Description:** Almost 30% of fatalities and severe injuries did not involve a safety device			
Objectives: Increase utilization of seatbelt and motorcycle helmets				**Success Indicators:** Reduction in the frequency of crashes where safety devices are not used over a five-year period.			
Strategy Type	**Goals**	**Strategies**	**Target Output**	**Organizations and Persons Responsible**	**Date of Completion**	**Performance Measures**	**Monitoring and Evaluation**
Engineering	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Enforcement	Improve seat belt and helmet law compliance	Increased enforcement of seatbelt law violations and reinstate the motorcycle helmet; perform visual seatbelt counts.	Increased public awareness that seatbelt and helmet law compliance is a community priority.	Police Department	Annually	Annual number of crashes where the driver is not wearing a seatbelt or helmet.	Annual crash summary to determine number of crashes involving a motorist without occupant protection.
Education	Educate road users about dangers and consequences of not complying with seatbelt and helmet laws	Add signage with seatbelt law; implement an injury prevention program for young drivers in high schools that includes impaired driving, occupant protections, and speeding/aggressive driving.	Increased public awareness of consequences of failure to wear a seatbelt or helmet.	Injury Prevention Program (under SRPMIC Health and Human Services)	Annually		
Emergency Services	N/A	N/A	N/A	N/A	N/A		

EMPHASIS AREA 5: SPEEDING AND AGGRESSIVE DRIVING

Emphasis Area: Speeding and Aggressive Driving				**Description:** Eight of 89 severe crashes involved speeding, which accounts for approximately 9%.			
Objectives: Reduce speeding on SRPMIC-maintained roadways				**Success Indicators:** Reduction in speeding-involved crashes on SRPMIC-maintained roadways over a five-year period.			
Strategy Type	**Goals**	**Strategies**	**Target Output**	**Organizations and Persons Responsible**	**Date of Completion**	**Performance Measures**	**Monitoring and Evaluation**
Engineering	Align design speeds with speed limits of roadways.	Utilize USLimits2 when establishing speed limits.[1] Where appropriate, implement traffic calming; additional speed limit signage, speed feedback signs.	Reduce compliance with speed limit.	Public Works	Annually	Reduction in annual number of crashes that involved speeding or aggressive driving.	Annual crash summary to determine number of crashes involving a speeding and aggressive driving.
Enforcement	Reduce speeding through increased police enforcement.	Increase police enforcement of speeding on roadways with a history of speed-involved crashes.	Increased public awareness that reducing speeding is a community priority	Police Department	Annually		
Education	Educate road users about dangers and consequences of speeding.	Implement an injury prevention program for young drivers in high schools that includes impaired driving, occupant protections, and speeding/aggressive driving.	Increased public awareness of consequences of speeding	Police Department	Annually		
Emergency Services	N/A	N/A	N/A	N/A	N/A		

[1] https://safety.fhwa.dot.gov/uslimits/

EMPHASIS AREA 6: INCIDENT RESPONSE

Emphasis Area: Incident Response				**Description:** Improve incident response through improved street name signing			
Objectives: Improve incident response time on SRPMIC-maintained roadways through improved street name signage				**Success Indicators:** Completion of street name signage project; Improved average incident response times			
Strategy Type	**Goals**	**Strategies**	**Target Output**	**Organizations and Persons Responsible**	**Date of Completion**	**Performance Measures**	**Monitoring and Evaluation**
Engineering	Improve incident response time to crashes and Improved wayfinding	Add and/or replace street name signage to all streets in the Community	Replacement of 1,835 street name signs and 1,685 stop signs by June 2019 (dependent on funding)	Public Works	Mid-2019	Number of signs upgraded / replaced	Status of sign replacement project
Enforcement	Improve incident response time to crashes	Coordination regarding timeframe / locations for signage improvements	Improved incident response time	Public Works/ Police	Continuously	Average incident response times	Report to Tribal Council.
Education	Educate road users on how to act around emergency vehicles	Educational programs or messaging that reinforces to drivers that they must pull over for emergency vehicles	Increased public awareness of proper procedures around emergency vehicles	Injury Prevention Program (under SRPMIC Health and Human Services)	Annually	-	
Emergency Services	Improve incident response time to crashes	Hold regular meetings between police and emergency responders to share information on best routes to respond to incidents; implement Mesa 911 system	Improved emergency response routing to incidents	Police Department, Emergency Responders	Annually	Average incident response times	

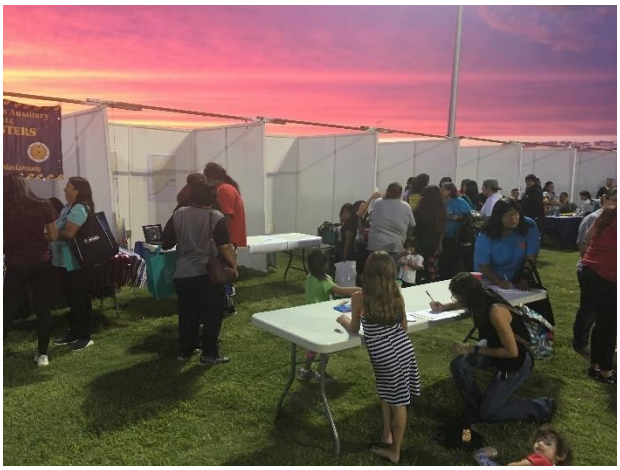
EMPHASIS AREA 7: CRASH DATA REPORTING

Emphasis Area: Improve Crash Data Reporting				**Description:** Improved crash data reporting will assist in identifying safety issues and provide justification for funding safety improvements			
Objectives: Provide improved crash data reporting system				**Success Indicators:** Improved crash data reporting system			
Strategy Type	**Goals**	**Strategies**	**Target Output**	**Organizations and Persons Responsible**	**Date of Completion**	**Performance Measures**	**Monitoring and Evaluation**
Engineering	Improved usability of crash data	Coordination with Police Department on use of crash data for identifying safety needs	Automated query data system	Public Works and Police Department	Late 2019	-	Report to Tribal Council
Enforcement	Updated crash data reporting system	Computerized crash data reporting system; automated query data system Investigate use of Arizona TraCS (Traffic and Criminal Software)	All crashes are entered into the automated query data system	Public Works and Police Department	Late 2019	100% of crashes are entered into the database	
Education	N/A	N/A	N/A	N/A	N/A	N/A	
Emergency Services	N/A	N/A	N/A	N/A	N/A	N/A	

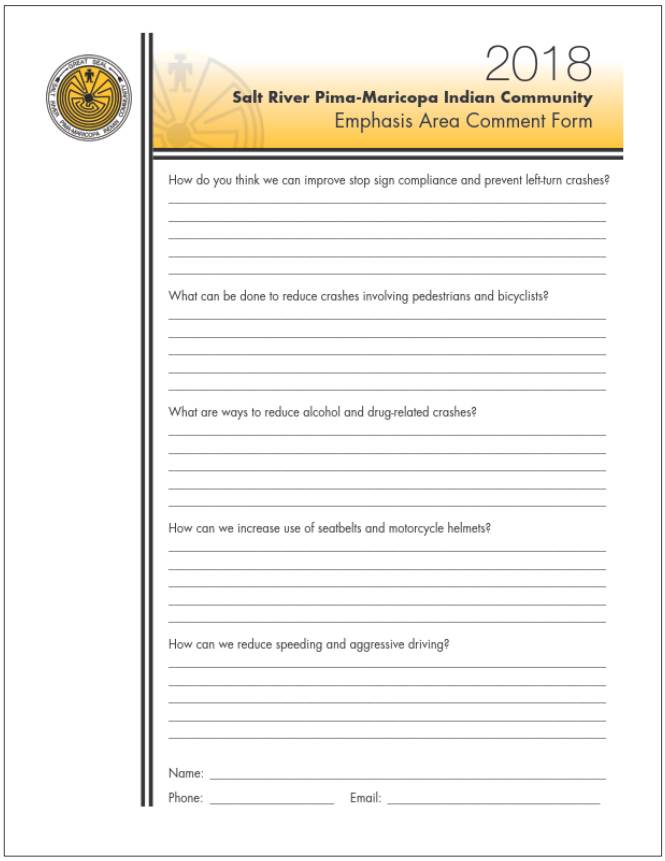
Public Outreach

A safety fair was held by the SRPMIC on October 11th, 2018. At the fair, information was provided about the Tribal Transportation Safety Plan and Long-Range Transportation Plan. A survey was distributed asking respondents about ways to improve safety for emphasis areas identified in this study. This survey form is shown at right.

Suggestions were incorporated into the emphasis area strategies where feasible. A complete list of survey responses is shown in **Appendix A**.



Safety Day 2018



2018

Salt River Pima-Maricopa Indian Community

Emphasis Area Comment Form

How do you think we can improve stop sign compliance and prevent left-turn crashes?

What can be done to reduce crashes involving pedestrians and bicyclists?

What are ways to reduce alcohol and drug-related crashes?

How can we increase use of seatbelts and motorcycle helmets?

How can we reduce speeding and aggressive driving?

Name: _____

Phone: _____ Email: _____

6. Potential Countermeasures at High Crash Locations

High Crash Location Identification

The initial step to develop a list of potential countermeasures was to calculate severe and total crash rates for all roadway segments and intersections for which traffic volume data was available.

- Roadway segments crash rates were calculated as severe crashes per million VMT.
- Intersections crash rates were calculated as severe crashes per million vehicles entering the intersection.

With the high number of low-volume roads on SRPMIC, it was observed that segments and intersections with a single severe crash significantly influenced the crash rate results. Segments with one crash and a traffic volume resulted in a high crash rate. As such, roadway segments and intersections with a single severe crash were evaluated for any identifiable crash patterns, considering all crashes. If none were observed, the location was removed from further consideration of countermeasures.

Several locations with high crash rates are on SR 101 on and off-ramps. While crash rates were high at these locations, these are responsibility of ADOT. These locations were reviewed, and if no mitigatable crash pattern was identified that could be addressed by SRPMIC, they were removed from further consideration of countermeasures.

Locations with high frequencies of non-severe crashes (greater than 25 total crashes in the five-year analysis period) were also reviewed and included for further consideration of countermeasures.

Roadway segments and intersections that met these criteria resulted in an initial list of 25 locations (segments and intersections) where potential countermeasures were identified.

Countermeasure Identification

Potential countermeasures were identified at the 25 locations, based upon a review of crash types, crash conditions such as lighting, violations, and movements that led to the crash.

The Federal Highway Administration publishes *Proven Safety Countermeasures* to promote certain infrastructure-oriented safety treatments and strategies based on effectiveness and benefits. It also is meant to encourage widespread implementation by State, tribal, and local transportation agencies to reduce serious injuries and fatalities on American highways.

The Proven Safety Countermeasures list includes 20 treatments and strategies to address various types of crashes along with guidance on implementation and design. Additional information about the countermeasures is available at: https://safety.fhwa.dot.gov/provencountermeasures/. Many of the recommended countermeasures at SRPMIC locations are based on those promoted by FHWA. Others were identified based on experience of the study team.

A Crash Modification Factor (CMF) was identified for each potential countermeasure, as available. A CMF is a multiplicative factor used to compute the expected number of crashes after implementing a countermeasure. CMFs were identified from the FHWA CMF Clearinghouse and are referenced in this report for information only to illustrate the potential benefit of the countermeasures. As listed in **Table 9**, CMFs often include a range of values dependent upon existing conditions and characteristic of the roadway or location.

Table 9: Countermeasures and Associated CMFs

Countermeasure	Description	CMF
Install intersection lighting	New/additional lighting at an intersection to provide illumination of waiting vehicles and pedestrians	0.62
Install corridor lighting	Consistent, regular intervals of streetlights to illuminate the length of a corridor	0.72-0.83
*Provide intersection conflict warning system***	Vehicle detection system placed on stop-controlled side streets that provide real-time alerts to vehicles on the main roadway of the presence of stopped vehicles	0.68
Install edge line rumble strips	Milled or raised patterns installed in the longitudinal direction near the edge line of the roadway to provide audible alert to motorists who are drifting from their travel lane	0.61-0.67
Install retroreflective edge line striping (both sides)	Striping along the edge of travel lanes that reflect light back to drivers to improve visibility at night	0.64-0.83
Pave shoulder with safety edge	The pavement edge is at a 30-degree angle instead of vertical to allow drivers to safely re-enter the roadway if they drift off the pavement	0.85-0.92
Implement protected left-turn signal phasing	Only allow left-turning vehicles to make turns on a green arrow and not while the opposing direction traffic has a green light	0.94
Implement protected/permitted left-turn signal phasing	Provide a left-turn arrow on a traffic signal to provide protected left-turn movements, while also allowing left-turn movements while the opposing direction of travel has a green light	0.84
Add signal backplates with high-visibility border	Add backplates to signals with retroreflective borders to improve the visibility of the signal heads, particularly at night	0.85
Install dynamic speed feedback sign	Digital signs that are programmed to provide a message to drivers exceeding a certain speed threshold	0.95
Install chevrons on curve	A series of warning signs placed on the outside of a roadway curve, black chevron shapes on a yellow background perpendicular to the roadway, to increase the visibility of the roadway path	0.75-0.96
Install curve warning signs	A sign placed in advance of a roadway curve that indicates the direction of the curve and an advisory speed if necessary	0.92
Multiple Low-Cost Countermeasures at Stop-Controlled Intersections	A combination of low-cost treatments to provide advanced warning and improved visibility at stop-controlled intersections. Treatments on the stop approach(es) include left and right oversized advanced "Stop Ahead" intersection warning signs, left and right oversized stop signs, retroreflective sheeting on sign posts, properly placed stop bar, removal of line-of-sight obstructions, double arrow warning at "T" intersections, transverse rumble strips, beacons/LED flashers on stop signs. Treatments on through approach(es), if present, include left and right oversized advance intersection warning signs with street name sign plaques, enhanced pavement markings that delineate through lane edge lines.	0.92

**CMF not available*
***More information on intersection conflict warning systems are provided in Appendix B*

Non-infrastructure-based improvements may also be considered to improve traffic safety on SRPMIC. These include:

- Increase patrol and enforcement of speeding laws
- Develop and implement an aggressive driving, impaired driving, distracted driving, or seat belt/helmet use education campaign

Proposed project locations are illustrated in **Figure 25.** The location, number, and severity of crashes in five-year analysis period, and potential countermeasures for each location is summarized in **Table 10**.

Figure 25: Recommended Safety Project Locations

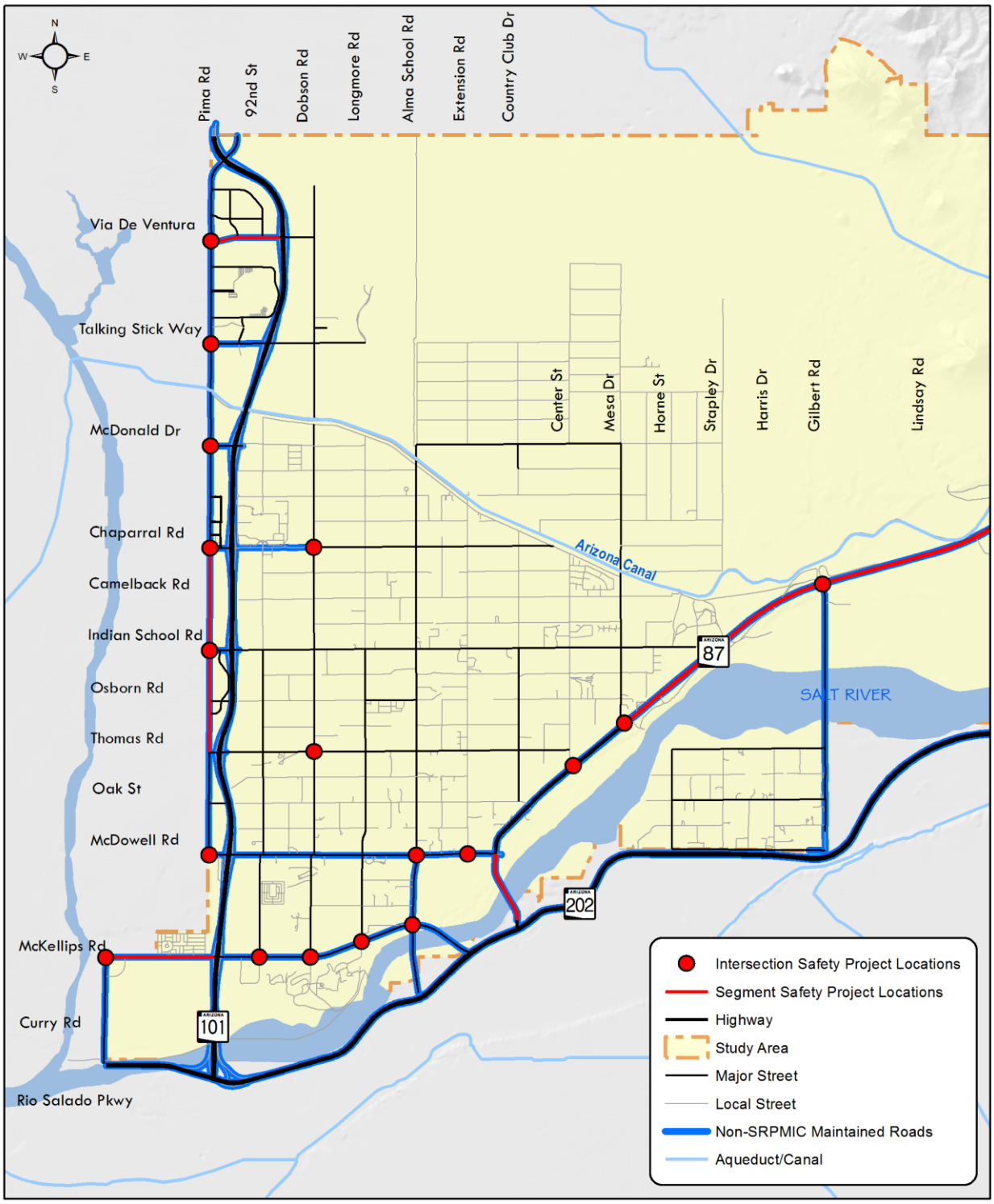


Table 10: Project Locations and Recommended Countermeasures

	Intersection or Segment	Roadway	Intersection Street	From	To	Crash Severity	Quantity	Potential Countermeasures
1	Segment	McKellips Road	-	McClintock Drive	SR 101 SB Ramps	**Fatal**	2	Install intersection lighting at three side street intersections
						Incapacitating Injury	3	
						Non-Incapacitating Injury	5	
						Possible Injury	3	
						No Injury	12	
						Total	**25**	
2	Intersection	McKellips Road	Longmore Road	-	-	**Fatal**	4	Install intersection lighting Multiple low-cost countermeasures for stop-controlled intersections
						Incapacitating Injury	1	
						Non-Incapacitating Injury	1	
						Possible Injury	2	
						No Injury	0	
						Total	**8**	
3	Intersection	McKellips Road	Dobson Road	-	-	**Fatal**	5	Multiple low-cost countermeasures for stop-controlled intersections Provide intersection conflict warning system
						Incapacitating Injury	0	
						Non-Incapacitating Injury	1	
						Possible Injury	0	
						No Injury	1	
						Total	**7**	
4	Intersection	McKellips Road	92nd Street	-	-	**Fatal**	0	Implement protected left-turn phasing Add signal backplates with high-visibility border
						Incapacitating Injury	2	
						Non-Incapacitating Injury	2	
						Possible Injury	4	
						No Injury	0	
						Total	**8**	
5	Intersection	McKellips Road	Alma School Road	-	-	**Fatal**	2	Implement protected left-turn phasing Add signal backplates with high-visibility border
						Incapacitating Injury	1	
						Non-Incapacitating Injury	1	
						Possible Injury	4	
						No Injury	9	
						Total	**17**	

	Intersection or Segment	Roadway	Intersection Street	From	To	Crash Severity	Quantity	Potential Countermeasures
6	Segment	SR 87	-	Mesa Drive	Gilbert Road	**Fatal**	2	Install edgeline rumble strips Pave shoulder with safety edge Install retroreflective edgeline striping (both sides) Install corridor lighting
						Incapacitating Injury	1	
						Non-Incapacitating Injury	2	
						Possible Injury	5	
						No Injury	17	
						Total	**27**	
7	Intersection	Chaparral Road	Dobson Road	-	-	**Fatal**	2	Multiple low-cost countermeasures for stop-controlled intersections
						Incapacitating Injury	0	
						Non-Incapacitating Injury	2	
						Possible Injury	3	
						No Injury	1	
						Total	**8**	
8	Intersection	McDowell Road	Extension Road	-	-	**Fatal**	2	Multiple low-cost countermeasures for stop-controlled intersections
						Incapacitating Injury	0	
						Non-Incapacitating Injury	0	
						Possible Injury	1	
						No Injury	0	
						Total	**3**	
9	Intersection	McDowell Road	Alma School Road	-	-	**Fatal**	0	Add signal backplates with high-visibility border
						Incapacitating Injury	2	
						Non-Incapacitating Injury	1	
						Possible Injury	5	
						No Injury	4	
						Total	**12**	
10	Intersection	Chaparral Road	Pima Road	-	-	**Fatal**	0	Implement protected left-turn phasing Add signal backplates with high-visibility border
						Incapacitating Injury	2	
						Non-Incapacitating Injury	12	
						Possible Injury	8	
						No Injury	30	
						Total	**52**	

	Intersection or Segment	Roadway	Intersection Street	From	To	Crash Severity	Quantity	Potential Countermeasures
11	Intersection	McKellips Road	McClintock Road	-	-	**Fatal**	0	Add signal backplates with high-visibility border
						Incapacitating Injury	2	
						Non-Incapacitating Injury	12	
						Possible Injury	13	
						No Injury	45	
						Total	**72**	
12	Intersection	Indian School Road	Pima Road	-	-	**Fatal**	0	Add signal backplates with high-visibility border
						Incapacitating Injury	2	
						Non-Incapacitating Injury	11	
						Possible Injury	14	
						No Injury	35	
						Unknown	1	
						Total	**63**	
13	Segment	SR 87	-	Gilbert Road	Arizona Canal	**Fatal**	0	Pave shoulder with safety edge Install retroreflective edgeline striping (both sides) Install corridor lighting
						Incapacitating Injury	2	
						Non-Incapacitating Injury	3	
						Possible Injury	2	
						No Injury	12	
						Unknown	1	
						Total	**20**	
14	Intersection	Thomas Road	Dobson Road	-	-	**Fatal**	0	Multiple low-cost countermeasures for stop-controlled intersections
						Incapacitating Injury	1	
						Non-Incapacitating Injury	1	
						Possible Injury	1	
						No Injury	1	
						Total	**4**	
15	Segment	Pima Road	-	Thomas Road	Indian School Road	**Fatal**	0	Install speed feedback sign mid-segment Increase patrols for speeding
						Incapacitating Injury	1	
						Non-Incapacitating Injury	2	
						Possible Injury	4	
						No Injury	6	
						Total	**13**	

	Intersection or Segment	Roadway	Intersection Street	From	To	Crash Severity	Quantity	Potential Countermeasures
16	Segment	Pima Road	-	Indian School Road	Chaparral Road	**Fatal**	0	Install speed feedback sign mid-segment Increase patrols for speeding
						Incapacitating Injury	1	
						Non-Incapacitating Injury	4	
						Possible Injury	7	
						No Injury	15	
						Total	**27**	
17	Segment	Via De Ventura	-	Pima Road	SR 101 SB Ramps	**Fatal**	0	Signal warrant study for Via de Ventura/Pima Center Parkway intersection
						Incapacitating Injury	1	
						Non-Incapacitating Injury	0	
						Possible Injury	1	
						No Injury	1	
						Total	**3**	
18	Intersection	SR 87	Mesa Drive	-	-	**Fatal**	0	Multiple low-cost countermeasures for stop-controlled intersections Signal warrant study for SR 87/Mesa Drive intersection Install intersection lighting
						Incapacitating Injury	1	
						Non-Incapacitating Injury	1	
						Possible Injury	1	
						No Injury	1	
						Total	**4**	
19	Intersection	SR 87	Center Street	-	-	**Fatal**	1	Install intersection lighting Multiple low-cost countermeasures for stop-controlled intersections
						Incapacitating Injury	0	
						Non-Incapacitating Injury	1	
						Possible Injury	1	
						No Injury	1	
						Total	**4**	
20	Intersection	SR 87	Gilbert Road	-	-	**Fatal**	1	Implement protected/permitted left-turn phasing on NB/SB approaches Add signal backplates with high-visibility border Install intersection lighting
						Incapacitating Injury	0	
						Non-Incapacitating Injury	4	
						Possible Injury	6	
						No Injury	22	
						Total	**33**	

	Intersection or Segment	Roadway	Intersection Street	From	To	Crash Severity	Quantity	Potential Countermeasures
21	Intersection	McDowell Road	Pima Road	-	-	**Fatal**	0	Increased enforcement/patrol for speeding Add signal backplates with high-visibility border
						Incapacitating Injury	1	
						Non-Incapacitating Injury	5	
						Possible Injury	6	
						No Injury	9	
						Total	**21**	
22	Intersection	McDonald Drive	Pima Road	-	-	**Fatal**	0	Implement protected only left-turn phasing Improve signal visibility
						Incapacitating Injury	1	
						Non-Incapacitating Injury	6	
						Possible Injury	4	
						No Injury	16	
						Total	**27**	
23	Segment	Country Club Drive	-	SR 202 Ramps	McDowell Road	**Fatal**	1	Install chevrons on curves each side of the bridge Install curve warning signs each side of the bridge
						Incapacitating Injury	0	
						Non-Incapacitating Injury	1	
						Possible Injury	2	
						No Injury	1	
						Total	**5**	
24	Intersection	Via De Ventura	Pima Road	-	-	**Fatal**	0	Implement protected/permitted left-turn phasing on NB/SB approaches
						Incapacitating Injury	0	
						Non-Incapacitating Injury	0	
						Possible Injury	3	
						No Injury	11	
						Total	**14**	
25	Intersection	Talking Stick Way	Pima Road	-	-	**Fatal**	0	Implement protected/permitted left-turn phasing on NB/SB approaches Increase enforcement/patrol for speeding
						Incapacitating Injury	0	
						Non-Incapacitating Injury	10	
						Possible Injury	8	
						No Injury	26	
						Total	**44**	

Pedestrian/Bicycle Safety Projects

There are several locations around the SRPMIC that were identified in the crash analysis as having concentrations of pedestrian and bicycle crashes. These sites were evaluated for potential safety improvements that could be made to improve the safety and comfort of pedestrians and bicyclists. Potential countermeasures are provided in Error! Not a valid bookmark self-reference..

Table 11: Pedestrian and Bicycle Project Locations and Recommended Countermeasures

	Intersection or Segment	Roadway	Intersection Street	From	To	Crash Severity	Quantity	Potential Countermeasures
1	Segment	McKellips Road	-	McClintock Drive	SR 101 SB Ramps	**Fatal**	2	Install a continuous sidewalk along the length of the segment Install high visibility crosswalks across side streets Install bicycle lanes along the length of the segment
						Incapacitating Injury	1	
						Non-Incapacitating Injury	1	
						Possible Injury	0	
						No Injury	2	
						Total	**6**	
2	Intersection	McKellips Road	SR 202 Ramps	-	-	**Fatal**	0	Install high visibility bicycle lane transitions to the sidewalks on both sides of the roadway through the intersection
						Incapacitating Injury	0	
						Non-Incapacitating Injury	2	
						Possible Injury	0	
						No Injury	1	
						Total	**3**	
3	Segment	Talking Stick Way	-	Pima Road	SR 101 SB Ramps	**Fatal**	0	Install a continuous sidewalk on the north side of the road Install bicycle lanes between Pima Road and Pavilions Blvd.
						Incapacitating Injury	1	
						Non-Incapacitating Injury	0	
						Possible Injury	0	
						No Injury	2	
						Total	**3**	
4	Intersection	McKellips Road	McClintock Drive	-	-	**Fatal**	0	Install high visibility crosswalks across all four legs Install pedestrian-scale lighting
						Incapacitating Injury	0	
						Non-Incapacitating Injury	2	
						Possible Injury	0	
						No Injury	1	
						Total	**3**	
5	Intersection	Indian School Road	Mesa Drive	-	-	**Fatal**	1	Install a high visibility crosswalk across the south leg Install pedestrian-scale lighting
						Incapacitating Injury	0	
						Non-Incapacitating Injury	0	
						Possible Injury	0	
						No Injury	1	
						Total	**2**	

	Intersection or Segment	Roadway	Intersection Street	From	To	Crash Severity	Quantity	Potential Countermeasures
6	Intersection	McKellips Road	92nd Street	-	-	**Fatal**	0	Install high visibility crosswalks across all four legs Install pedestrian-scale lighting
						Incapacitating Injury	1	
						Non-Incapacitating Injury	0	
						Possible Injury	1	
						No Injury	0	
						Total	**2**	
7	Intersection	Pima Road	Indian School Road	-	-	**Fatal**	0	Install high visibility crosswalks across all four legs Install pedestrian-scale lighting
						Incapacitating Injury	0	
						Non-Incapacitating Injury	1	
						Possible Injury	0	
						No Injury	1	
						Total	**2**	

7. Project Prioritization

This chapter documents how projects were prioritized based on a benefit-cost evaluation. For evaluation purposes, logical locations were grouped together to form larger, more continuous or systemic projects that address corridors or groups of locations that have similar or interdependent crash statistics. The projects that were advanced through the benefit-cost evaluation are shown in **Table 12**.

Table 12: Safety Project Locations

Project Name	Location	Proposed Countermeasures
McKellips Rd East	92nd St Intersection	Implement protected left-turn phasing
		Add signal backplates with high-visibility border
		Install high-visibility crosswalks across all four legs
		Install pedestrian-scale lighting
	Dobson Rd Intersection	Install multiple low-cost countermeasures for stop-controlled intersections
		Provide intersection conflict warning system
	Longmore Rd Intersection	Install intersection lighting
		Install multiple low-cost countermeasures for stop-controlled intersections
	Alma School Rd Intersection	Implement protected left-turn phasing
		Add signal backplates with high-visibility border
McKellips Rd West	McClintock Dr-SR 101 SB Ramps Segment	Install intersection lighting (3)
		Install a continuous sidewalk
		Install high visibility crosswalks across side streets
		Install bicycle lanes
	McClintock Dr Intersection	Add signal backplates with high-visibility border
Pima Rd	Thomas Rd-Indian School Rd Segment	Install speed feedback sign mid-segment
		Increase patrols for speeding
	Indian School Rd-Chaparral Rd Segment	Install speed feedback sign mid-segment
		Increase patrols for speeding
	Indian School Rd Intersection	Add signal backplates with high-visibility border
		Install high-visibility crosswalks across all four legs
		Install pedestrian-scale lighting
	Chaparral Rd Intersection	Implement protected left-turn phasing
		Add signal backplates with high-visibility border
SR 87	Mesa Dr Intersection	Install multiple low-cost countermeasures for stop-controlled intersections
		Install intersection lighting
	Mesa Dr-Gilbert Rd Segment	Install rumble strips on inside shoulders
		Pave shoulder with safety edge
		Install retroreflective edgeline striping (both sides)
		Install corridor lighting
	Gilbert Rd Intersection	Implement protected/permitted left-turn phasing NB/SB
		Add signal backplates with high-visibility border
		Install intersection lighting
	Gilbert Rd-Arizona Canal Segment	Pave shoulder with safety edge
		Install retroreflective edgeline striping (both sides)
		Install corridor lighting

Project Name	Location	Proposed Countermeasures
4-Way Stop Intersections	Chaparral Rd & Dobson Rd Intersection	Multiple low-cost countermeasures for stop-controlled intersections
	McDowell Rd & Extension Rd Intersection	Multiple low-cost countermeasures for stop-controlled intersections
	Thomas Rd & Dobson Rd Intersection	Multiple low-cost countermeasures for stop-controlled intersections
	Indian School Rd & Longmore Rd	Multiple low-cost countermeasures for stop-controlled intersections
	Indian School Rd & Mesa Dr	Multiple low-cost countermeasures for stop-controlled intersections
		Install high-visibility crosswalk across south leg
		Install pedestrian-scale lighting

Benefit-Cost Evaluation

The Benefit-Cost Ratio (BCR) analysis compares benefits of potential countermeasures to the project costs. The BCR enables potential countermeasures and locations to be prioritized in order of their:

- Project costs
- Monetary value of benefits
- Number of total crashes reduced
- Number of fatal and incapacitating injury crashes reduced
- BCR

Ranking sites and countermeasures can assist ADOT to select sites that will provide the most impact and benefit to reducing total and pedestrian crashes statewide.

PROJECT BENEFIT

Countermeasure benefits are expressed in terms of projected future change (decrease in pedestrian crashes) in average crash frequency as a result of implementing the countermeasure. This is done by applying CMFs to estimate the expected change in crash frequency after countermeasure implementation. If there are multiple CMFs at a location that apply to the same crash types, the CMF values are multiplied together.

Conversion of the estimated change in crash frequency to a monetary value is accomplished using societal crash costs by injury severity. The societal cost per crash in Arizona is based on the average economic cost per incident as published in the Arizona Highway Safety Improvement Manual (HSIP) Revised December 2018, and carried forward into the 2019 Application for HSIP Projects spreadsheet tool:

- Fatality: $9,515,371
- Incapacitating Injury: $550,499
- Non-Incapacitating Injury: $149,132
- Possible Injury: $103,145
- No Injury: $10,680

PROJECT COST

The conceptual costs for each countermeasure and location were used as an input to calculate the BCR. The assumed costs for countermeasures are provided in **Table 13**.

Table 13: Assumed Countermeasure Costs

Countermeasure	Assumed Cost
Protected or protected/permissive left-turn phasing	$6,000/intersection
Signal backplates with high-visibility border	$1,500/intersection
High-visibility crosswalks	$300/intersection leg
Pedestrian-scale lighting	$22,000/intersection
Multiple low-cost countermeasures for stop-controlled intersections	$6,000/intersection
Intersection conflict warning system	$25,000/intersection
Intersection lighting	$22,000/intersection
New sidewalk	$500,000/mile
Widen road and install bike lanes	$850,000/mile
Speed feedback sign	$3,500/sign
Pave shoulder with safety edge	$65,000/mile
Retroreflective edgeline striping	$1,800/mile
Corridor lighting	$140,000/mile
Rumble strip	$6,000/mile

To estimate the annual cost of each project/location, a service life was assigned to each countermeasure using guidance from the Arizona HSIP Manual, Revised December 2018. As stated in the HSIP Manual the following procedures were used to determine the annual cost:

1. Determine the total construction cost
2. Determine the service life of the countermeasure
3. Obtain or assume an interest rate, which is appropriate for current economic conditions, in percent (8% was assumed)
4. Compute the annual construction cost by multiplying the total construction cost by the appropriate capital recover factor, based on the interest rate and service life of the countermeasure
5. Determine the annual estimated operating and maintenance cost for the countermeasure
6. Compute the total annual cost of the project

BENEFIT-COST RATIOS

After calculating the capital costs and safety benefits, the cost benefit ratios were derived. Two sets of BCRs were calculated, one set which includes all crash severities and one set that includes only fatal and incapacitating injury crashes. ADOT's HSIP application process only calculates BCRs based on fatal and incapacitating injury crashes. **Table 14** shows the calculated BCR values for each project. The calculations for both BCR values for each project are provided in **Appendix C**.

Table 14: Benefit-Cost Ratios

Project	Location	All Crashes			Fatal/Incap. Injury Crashes		
		Annual Benefit	Annual Cost	BCR	Annual Benefit	Annual Cost	BCR
McKellips East	Intersections at 92nd St, Dobson Rd, Longmore Rd, Alma School Rd	$7,891,146	$14,234	554.4	$7,780,655	$14,234	546.6
McKellips West	McClintock Dr – SR 101 SB Ramps and McClintock Dr Intersection	$5,186,611	$121,147	42.8	$4,959,147	$121,147	40.9
Pima Road	Thomas Rd – Chaparral Dr and Intersections at Indian School Rd and Chaparral Dr	$357,605	$8,731	41.0	$88,300	$8,731	10.1
SR 87	Mesa Dr – Arizona Canal, Mesa Drive and Gilbert Rd intersections	$4,094,778	$131,144	31.2	$3,727,448	$131,144	28.4
Four-Way Stop Intersections	Chaparral Rd & Dobson Rd, McDowell Rd & Extension Rd, Thomas Rd & Dobson Rd	$2,582,232	$7,209	358.2	$2,564,637	$7,209	355.7

The projects at intersections on McKellips Road east of SR 101 and the Four-Way Stop Intersections have the highest BCR values. Several fatal crashes have occurred on McKellips Road on SRPMIC.

The remaining three projects have a lower BCR but are still well above a BCR of 1.0.

ADOT's 2019 HSIP application states that any projects with a BCR of 2.5 or greater may be eligible for HSIP funding; therefore, all the projects evaluated could pursue HSIP funding.

8. Evaluation and Implementation

This chapter describes the process that will be used to evaluate the success of the plan, ensure implementation, and determine when an update is needed.

The SRPMIC Tribal Transportation Safety Plan is a living document. Periodic reviews by the Technical Advisory Committee (TAC) established for this plan can identify what is working well, whether there are new priorities and / or changed conditions.

Four areas are discussed:

1. How often will the goals be evaluated to measure success?
2. When should revisions of the plan be considered? (TTP Safety Fund considers a plan to be outdated after five years)
3. Will a committee be formed to oversee implementation?
4. Will the Tribal Council hold any departments accountable for progress on the plan goals? Is further involvement needed from safety partners from entities outside the Tribal Government?

Timeframe for Goal Evaluation

It is recommended that the TAC meet annually to monitor progress towards meeting goals, discuss what has been implemented, and generally check in with the departments responsible for the strategies.

When Should A Revision of the Plan be Considered?

The Tribal Transportation Safety Fund considers a plan to be outdated after five years. Therefore, work on an update of the plan should begin in year four of the plan, or 2022, to provide time to obtain and analyze crash data.

Will a Committee be Formed to Oversee Implementation?

If it is agreeable to the TAC, it is advisable for the group to continue to monitor the plan, since the members represent departments and agencies involved with transportation safety.

Will the Tribal Council hold any Departments Accountable for Progress on the Plan Goals?

This will be determined.

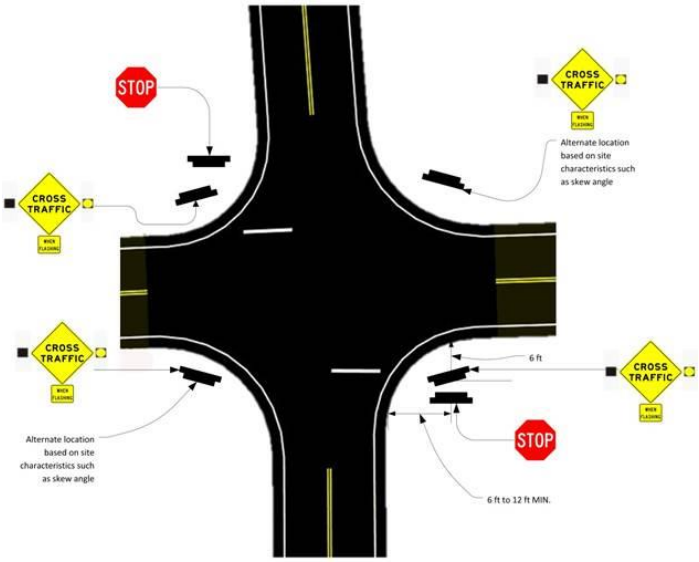
Appendix A – Safety Fair Responses

1. How do you think we can improve stop sign compliance and prevent left-turn crashes?
    a. You need tall signs like in the city. Need street lights. Need police
    b. We can prevent by making the signs huge.
    c. Photo Radar
    d. Photo radar
    e. Light for right intersect & one way stops
    f. Flashing Red lights
    g. Lights that flash
    h. Flashing red lights
    i. Street light
    j. Over lights @ 4 way stops
    k. Yield signs
    l. Bigger signs
    m. Have a light with left turn arrow
    n. Flashing stop signs
    o. More police at major crossings.
    p. Street lights
    q. Offer defensive driving seminars/online
    r. Warning signs/yield
    s. Stop sign warnings, maybe 20-50 ft before
2. What can be done to reduce crashes involving pedestrians and bicyclists?
    a. More vigilance, cameras
    b. Install a pedestrian walkway that stops traffic. There is one in front of PHX med center
    c. Make Bicycle lanes
    d. Install sidewalk, street light @ high traffic 4 way stop areas
    e. Tell them to stay on the sidewalk
    f. Put concrete poles up
    g. Better lanes
    h. Street lights
    i. You include bike lanes and brighter paint
    j. More area for bikes to cruise around.
    k. More sidewalks
    l. Have awareness walk day. Have community come out and walk for a day to help awareness.
    m. Photo cameras
    n. More community meetings regarding this matter
    o. More sidewalks
    p. Create an AVP to update individuals – Something like amber alerts – Cross Walks
    q. Make a bigger lane
    r. Promote reflection wear for pedestrians & bicyclists. More caution signs around the reservation.
3. What are ways to reduce alcohol and drug-related crashes?
    a. Education, testing of drugs, a program to steer them from drugs. Clinics for drug related crimes.
    b. Have [an] alcohol breather thing in every car system
    c. Cut % per cap if they are proven guilty, it they get caught.
    d. Education
    e. Have police more visible. We have a large police force, but they are not out in the community.

   f. Don't do them
   g. Help out family go to AA meets
   h. Inter community statistics
   i. Penalty fee signs
   j. I just can't say, people do what they want, more jailtime I guess.
   k. Have available rides for people who need a ride home.
   l. Just don't drive
   m. Treatment and awareness
   n. Checkpoints on holidays
   o. Warning sign – no drugs or alcohol
   p. Health education & prevention for teens.
4. How can we increase use of seatbelts and motorcycle helmets?
   a. Education, signs in community & cameras
   b. Random road block checks
   c. Education
   d. Promote education
   e. Make people use them
   f. Tickets
   g. Ticket no seat belts
   h. More information classes. Flyers. Social Media Advertisement
   i. Continue stopping them and give them fines.
   j. Start early with kids make sure they are always wearing seatbelt & helmet contest for kids. They can decorate helmets and win a small gift.
   k. Implement into tribal policy
   l. Community Meetings
   m. More information
   n. Street signs/reminders
   o. Warning signs prosecuted for not. You will be wearing seatbelts.
   p. Promotion on billboards & local paper to remind folks.
5. How can we reduce speeding and aggressive driving?
   a. Speed traps
   b. Speed bumps in streets. Most common for speeding.
   c. Educate
   d. More police presence
   e. Don't drive mad
   f. More cops on the road
   g. Street Cams
   h. Have police patrol more
   i. A bit more patrol
   j. Speed bump
   k. Higher fines.
   l. Reduce speed limits
   m. Put up false police cars
   n. Police at major crossings
   o. More surveillance
   p. Street signs/reminders
   q. More speed limit signs and warnings. Speed bumps. Cameras
   r. Continue to make frequent police traffic stops (pullovers) More speed limit signs.

Appendix B: Intersection Conflict Warning System

Intersection conflict warning systems utilize vehicle detection technology to illuminate beacons that indicate when cross traffic or entering traffic is present. The intent is to provide additional warning to vehicles on both the through street and the stop-controlled side street to proceed with caution, particularly at locations where sight distance is an issue.

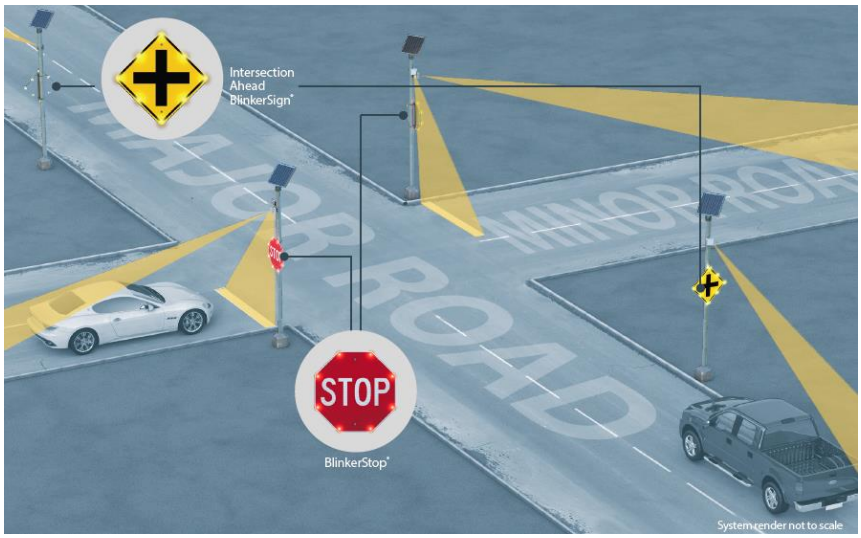


Sensors within the roadway pavement or ones that are pole-mounted feed information to signs to indicate when approaching vehicles to the intersection are present.

There are several ways in which enhanced signage can be implemented:

- Major approaches (not stop-controlled):
  - Signs with beacons or embedded LED flashers that say “CROSS TRAFFIC” or “EXPECT CROSS TRAFFIC” if the “WHEN FLASHING” placard is not present.
  - In addition, standard Intersection Ahead signage with beacons or LED flashers can be placed further in advance of the intersection.
- Minor approaches (stop-controlled):
  - Sensors on the mainline roadway and the minor approach activate a stop sign with a beacon or embedded LED flashers to attract the attention of the driver approaching the stop sign.
  - Sensors on the mainline roadway activate a “CROSS TRAFFIC” sign on the opposite side of the mainline roadway from the stop sign to indicate to a stopped vehicle whether or not approaching traffic is present.

A diagram, produced by FHWA, is shown at the top right of the page to indicate the relative placement of signs at a standard, four-legged intersection. The illustration at right shows potential sign and sensor placement.



Appendix C – Benefit-Cost Ratio Calculations

Benefit Cost Ratios based on All Crash Severities

Project	Segment/Intersection	Countermeasures	Crashes					Treatment CMF	Total CMF	Annual Crash Reduction					Annual Benefit	Total Annual Benefit	Cost	Service Life	Annual Cost	Total Annual Cost	BCR
			K	A	B	C	O			K	A	B	C	O							
McKellips East	92nd St Intersection	Implement protected left-turn phasing	0	2	2	4	0	0.94	0.80	0.00	0.08	0.08	0.16	0.00	$72,836	$7,891,146	$6,000	10	$894	$14,234	554.4
		Add signal backplates with high-visibility border						0.85									$1,500	10	$224		
		Install high visibility crosswalks across all four legs	*0*	*1*	*0*	*1*	*0*	*0.6*	*0.37*	*0.00*	*0.13*	*0.00*	*0.13*	*0.00*	*$82,098*		*$1,200*	*2*	*$673*		
		Install pedestrian-scale lighting						*0.62*									*$22,000*	*15*	*$2,570*		
	Dobson Rd Intersection	Multiple low-cost countermeasures for stop-controlled intersections	5	0	1	0	1	0.92	*0.63*	0.37	0.00	0.07	0.00	0.07	$3,574,522		$6,000	10	$894		
		Provide intersection conflict warning system						0.68									$25,000	10	$3,726		
	Longmore Rd Intersection	Install intersection lighting	4	1	1	2	0	0.62	*0.57*	0.34	0.09	0.09	0.17	0.00	$3,348,079		$22,000	15	$2,570		
		Multiple low-cost countermeasures for stop-controlled intersections						0.92									$6,000	10	$894		
	Alma School Rd Intersection	Implement protected left-turn phasing	2	1	1	4	9	0.94	*0.80*	0.08	0.04	0.04	0.16	0.36	$813,611		$6,000	10	$894		
		Add signal backplates with high-visibility border						0.85									$6,000	10	$894		
McKellips West	McClintock Dr - SR 101 SB Ramps	Install intersection lighting (3)	2	3	5	3	12	0.62	0.62	0.15	0.23	0.38	0.23	0.91	$1,661,778	$5,186,611	$66,000	15	$7,711	$121,147	42.8
		Install a continuous sidewalk	*2*	*1*	*1*	*0*	*2*	*N/A*	*0.144*	0.34	0.17	0.17	0.00	0.34	$3,383,472		*$250,000*	*20*	*$25,463*		
		Install high visibility crosswalks across side streets						*0.35*									*$900*	*2*	*$505*		
		Install bicycle lanes						*0.41*									*$850,000*	*20*	*$86,574*		
	McClintock Dr Intersection	Add signal backplates with high-visibility border	0	2	12	13	45	0.85	0.85	0.00	0.06	0.36	0.39	1.35	$141,362		$6,000	10	$894		
Pima Rd	Thomas Rd - Indian School Rd	Install speed feedback sign mid-segment (2)	0	1	2	4	6	0.95	*0.95*	0.00	0.01	0.02	0.04	0.06	$13,254	$357,605	$7,000	6	$1,514	$8,731	41.0
		Increase patrols for speeding						N/A									-	-	-		
	Indian School Rd - Chaparral Rd	Install speed feedback sign mid-segment (2)	0	1	4	7	15	0.95	*0.95*	0.00	0.01	0.04	0.07	0.15	$20,292		$7,000	6	$1,514		
		Increase patrols for speeding						N/A									-	-	-		
	Indian School Rd Intersection	Add signal backplates with high-visibility border	0	2	11	14	35	0.85	0.85	0	0.1	0.3	0.4	1.1	$136,778		$1,500	10	$224		
		Install high visibility crosswalks across all four legs	*0*	*0*	*1*	*0*	*1*	*0.35*	*0.22*	*0.00*	*0.00*	*0.16*	*0.00*	*0.16*	*$25,027*		$1,200	2	$673		
		Install pedestrian-scale lighting						*0.62*									$22,000	15	$2,570		
	Chaparral Rd Intersection	Implement protected left-turn phasing	0	2	12	8	30	0.94	0.80	0.00	0.08	0.48	0.32	1.21	$162,253		$9,000	10	$1,341		
		Add signal backplates with high-visibility border						0.85									$6,000	10	$894		
SR 87	Mesa Dr Intersection	Multiple low-cost countermeasures for stop-controlled intersections	0	1	1	1	1	0.92	*0.57*	0.00	0.09	0.09	0.09	0.09	$69,892	$4,094,788	$5,000	10	$745	$131,144	31.2
		Install intersection lighting						0.62									$22,000	15	$2,570		
	Mesa Dr - Gilbert Rd	Install rumble strips on inside shoulders	2	1	2	5	17	0.64	0.33	0.27	0.13	0.27	0.67	2.28	$2,762,339		$6,000	10	$894		
		Pave shoulder with safety edge						0.89									$156,000	20	$15,889		
		Install retroreflective edgeline striping (both sides)						0.74									$4,500	2	$2,523		
		Install corridor lighting						0.78									$338,000	15	$39,488		
	Gilbert Rd Intersection	Implement protected/permissive left-turn phasing NB/SB	*1*	*0*	*4*	*6*	*22*	0.94	0.50	0.10	0.00	0.40	0.61	2.22	$1,106,705		$6,000	10	$894		
		Add signal backplates with high-visibility border						0.85									$100,000	10	$14,903		
		Install intersection lighting						0.62									$22,000	15	$2,570		
	Gilbert Rd - Arizona Canal	Pave shoulder with safety edge	*0*	*2*	*3*	*2*	*12*	0.89	0.59	0.00	0.17	0.25	0.17	0.99	$155,841		$137,000	20	$13,954		
		Install retroreflective edgeline striping (both sides)						0.74									$3,800	2	$2,131		
		Install corridor lighting						0.89									$296,000	15	$34,582		
4-Way Stops	Chaparral Rd & Dobson Rd	Multiple low-cost countermeasures for stop-controlled intersections	2	0	2	3	1	0.92	0.92	0.03	0.00	0.03	0.05	0.02	$314,386	$2,582,232	$6,000	10	$894	$7,209	358.2

Project	Segment/Intersection	Countermeasures	Crashes					Treatment CMF	Total CMF	Annual Crash Reduction					Annual Benefit	Total Annual Benefit	Cost	Service Life	Annual Cost	Total Annual Cost	BCR
			K	A	B	C	O			K	A	B	C	O							
	McDowell Rd & Extension Rd	Multiple low-cost countermeasures for stop-controlled intersections	2	0	0	1	0	0.92	0.92	0.03	0.00	0.00	0.02	0.00	$306,142		$6,000	10	$894		
	Thomas Rd & Dobson Rd	Multiple low-cost countermeasures for stop-controlled intersections	0	1	1	1	1	0.92	0.92	0.00	0.02	0.02	0.02	0.02	$13,015		$6,000	10	$894		
	Indian School Rd & Longmore Rd	Multiple low-cost countermeasures for stop-controlled intersections	2	0	0	0	0	0.92	0.92	0.03	0.00	0.00	0.00	0.00	$304,492		$6,000	10	$894		
	Indian School Rd & Mesa Dr	Multiple low-cost countermeasures for stop-controlled intersections	1	0	0	0	1	0.92	0.92	0.02	0.00	0.00	0.00	0.02	$152,417		$6,000	10	$894		
		Install high visibility crosswalk across south leg	1	0	0	0	1	*0.35*	*0.22*	*0.16*	*0.00*	*0.00*	*0.00*	*0.16*	*$1,491,780*		*$300*	*2*	*$168*		
		Install pedestrian-scale lighting						*0.62*									*$22,000*	*15*	*$2,570*		

NOTE: Calculations in *italics* are pedestrian-oriented countermeasures and the benefit calculations only consider pedestrian-related crashes.

Benefit-Cost Ratios based on Fatal and Incapacitating Injury Crashes Only

Project	Segment/Intersection	Countermeasures	Crashes		Treatment CMF	Total CMF	Ann. Crash Reduction		Annual Benefit	Total Annual Benefit	Cost	Service Life	Annual Cost	Total Annual Cost	BCR
			K	A			K	A							
McKellips East	92nd St Intersection	Implement protected left-turn phasing	0	2	0.94	0.80	0.00	0.08	$44,260	$7,780,665	$6,000	10	$894	$14,234	546.6
		Add signal backplates with high-visibility border			0.85						$1,500	10	$224		
		Install high visibility crosswalks across all four legs	*0*	*1*	*0.6*	*0.37*	*0.00*	*0.13*	*$69,143*		*$1,200*	*2*	*$673*		
		Install pedestrian-scale lighting			*0.62*						*$22,000*	*15*	*$2,570*		
	Dobson Rd Intersection	Multiple low-cost countermeasures for stop-controlled intersections	5	0	0.92	*0.63*	0.37	0.00	$3,562,555		$6,000	10	$894		
		Provide intersection conflict warning system			0.68						$25,000	10	$3,726		
	Longmore Rd Intersection	Install intersection lighting	4	1	0.62	*0.57*	0.34	0.09	$3,317,542		$22,000	15	$2,570		
		Multiple low-cost countermeasures for stop-controlled intersections			0.92						$6,000	10	$894		
	Alma School Rd Intersection	Implement protected left-turn phasing	2	1	0.94	*0.80*	0.08	0.04	$787,166		$6,000	10	$894		
		Add signal backplates with high-visibility border			0.85						$6,000	10	$894		
McKellips West	McClintock Dr - SR 101 SB Ramps	Install intersection lighting (3)	2	3	0.62	0.62	0.15	0.23	$1,571,850	$4,959,147	$66,000	15	$7,711	$121,147	40.9
		Install a continuous sidewalk	*2*	*1*	*N/A*	*0.144*	0.34	0.17	$3,354,267		*$250,000*	*20*	*$25,463*		
		Install high visibility crosswalks across side streets			*0.35*						*$900*	*2*	*$505*		
		Install bicycle lanes			*0.41*						*$850,000*	*20*	*$86,574*		
	McClintock Dr Intersection	Add signal backplates with high-visibility border	0	2	0.85	0.85	0.00	0.06	$33,030		$6,000	10	$894		
Pima Rd	Thomas Rd - Indian School Rd	Install speed feedback sign mid-segment (2)	0	1	0.95	*0.95*	0.00	0.01	$5,505	$88,300	$7,000	6	$1,514	$8,731	10.1
		Increase patrols for speeding			N/A						-	-	-		
	Indian School Rd - Chaparral Rd	Install speed feedback sign mid-segment (2)	0	1	0.95	*0.95*	0.00	0.01	$5,505		$7,000	6	$1,514		
		Increase patrols for speeding			N/A						-	-	-		
	Indian School Rd Intersection	Add signal backplates with high-visibility border	0	2	0.85	0.85	0	0.06	$33,030		$1,500	10	$224		
		Install high visibility crosswalks across all four legs	*0*	*0*	*0.35*	*0.22*	*0.00*	*0.00*	*$0*		$1,200	2	$673		
		Install pedestrian-scale lighting			*0.62*						$22,000	15	$2,570		
	Chaparral Rd Intersection	Implement protected left-turn phasing	0	2	0.94	0.80	0.00	0.08	$44,260		$9,000	10	$1,341		
		Add signal backplates with high-visibility border			0.85						$6,000	10	$894		
SR 87	Mesa Dr Intersection	Multiple low-cost countermeasures for stop-controlled intersections	0	1	0.92	*0.57*	0.00	0.09	$47,299	$3,727,448	$5,000	10	$745	$131,144	28.4
		Install intersection lighting			0.62						$22,000	15	$2,570		
	Mesa Dr - Gilbert Rd	Install rumble strips on inside shoulders	2	1	0.64	0.33	0.27	0.13	$2,628,691		$6,000	10	$894		
		Pave shoulder with safety edge			0.89						$156,000	20	$15,889		
		Install retroreflective edgeline striping (both sides)			0.74						$4,500	2	$2,523		
		Install corridor lighting			0.78						$338,000	15	$39,488		
	Gilbert Rd Intersection	Implement protected/permissive left-turn phasing NB/SB	*1*	*0*	0.94	0.50	0.10	0.00	$960,329		$6,000	10	$894		
		Add signal backplates with high-visibility border			0.85						$100,000	10	$14,903		
		Install intersection lighting			0.62						$22,000	15	$2,570		
	Gilbert Rd - Arizona Canal	Pave shoulder with safety edge	*0*	*2*	0.89	0.59	0.00	0.17	$91,129		$137,000	20	$13,954		
		Install retroreflective edgeline striping (both sides)			0.74						$3,800	2	$2,131		
		Install corridor lighting			0.89						$296,000	15	$34,582		

Project	Segment/Intersection	Countermeasures	Crashes		Treatment CMF	Total CMF	Ann. Crash Reduction		Annual Benefit	Total Annual Benefit	Cost	Service Life	Annual Cost	Total Annual Cost	BCR
			K	A			K	A							
4-Way Stops	Chaparral Rd & Dobson Rd	Multiple low-cost countermeasures for stop-controlled intersections	2	0	0.92	0.92	0.03	0.00	$304,492	$2,564,637	$6,000	10	$894	$7,209	355.7
	McDowell Rd & Extension Rd	Multiple low-cost countermeasures for stop-controlled intersections	2	0	0.92	0.92	0.03	0.00	$304,492		$6,000	10	$894		
	Thomas Rd & Dobson Rd	Multiple low-cost countermeasures for stop-controlled intersections	0	1	0.92	0.92	0.00	0.02	$8,808		$6,000	10	$894		
	Indian School Rd & Longmore Rd	Multiple low-cost countermeasures for stop-controlled intersections	2	0	0.92	0.92	0.03	0.00	$304,492		$6,000	10	$894		
	Indian School Rd & Mesa Dr	Multiple low-cost countermeasures for stop-controlled intersections	1	0	0.92	0.92	0.02	0.00	$152,246		$6,000	10	$894		
		Install high visibility crosswalk across south leg	1	0	*0.35*	*0.22*	*0.16*	*0.00*	*$1,490,107*		*$300*	*2*	*$168*		
		Install pedestrian-scale lighting			*0.62*						*$22,000*	*15*	*$2,570*		

NOTE: Calculations *in italics* are pedestrian-oriented countermeasures and the benefit calculations only consider pedestrian-related crashes.