Flagstaff Metropolitan Planning Organization

Regional Strategic Transportation Safety Plan

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STRATEGIC TRANSPORTATION SAFETY PLAN
NACOG | CYMPO | FMPO

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Executive Summary

This Regional Strategic Transportation Safety Plan (RSTSP) establishes a framework for reducing fatal and serious injury crashes on public roads in the FMPO region by identifying crash trends, emphasis areas, performance measures, high-risk crash locations, funding resources, and potential projects. The Northern Arizona Council of Governments (NACOG) led the development of this RSTSP in partnership with the Central Yavapai Metropolitan Planning Organization (CYMPO) and Flagstaff Metropolitan Planning Organization (FMPO). The purpose of the RSTSP is to address safety from a holistic, regional perspective to reduce the risk of death and serious injury to all transportation users. These plans are prepared in support of the 2014 Arizona State Highway Safety Plan (SHSP). In order to qualify for Highway Safety Improvement Program (HSIP) Funding, Councils of Governments (COG)s and Metropolitan Planning Agencies (MPO)s must have a STSP and update it, at a minimum, every five years. Projects must use approved safety countermeasures, have a benefit-to-cost (B/C) ratio over 1.5, and have a project cost between $250,000 and $5,000,000, among other requirements.

The RSTSP utilized a data-driven approach to assess crash trends in each region. Area-specific analysis and implementation plans were developed for each agency. Safety priorities, funding strategies, and future safety analysis tools were reviewed and developed for the three regions. Safety analysis tools were developed in tandem with the RSTSP to facilitate future safety-related project identification and development. These tools include an ArcGIS Online Mapping tool for viewing and exporting data, the Crash Analysis Tool (CAT), the Predictive Analysis Tool – Existing (PATe) for performing predictive analyses, and the Economic Analysis and Project Justification Tool (eJUST) for assisting the Highway Safety Improvement Program (HSIP) application process.

To identify crash trends and emphasis areas, a crash analysis was performed for the FMPO region based on the most recent five years of available crash data: January 1, 2012 to December 31, 2016. Over this period, 11,042 total and 57 fatal crashes were reported in the FMPO region. Key crash trends for the region include:

- 59.6% of fatal crashes were lane or roadway departure crashes.
- 35.1% of fatal crashes involved a pedestrian.
    - Of those, 70% involved impaired pedestrians.
- 45.6% of fatal crashes occurred on I-17 or I-40.
- The most common driver violations cited in fatal crashes were impairment and lack of restraint use.
- The most common driver violations cited in crashes of all severity was failing to yield right-of-way and speeding.
- The most common manner of collision was rear end (42.5%), followed by angle (19.8%) and same direction sideswipe (13.9%).
- The most common first harmful event in serious crashes was a car striking another car (43.4%), followed by pedestrian collisions (16.8%), fixed object collisions (15.0%), and overturning crashes (12.0%).
- The most prevalent first harmful event for crashes of all severities was a car striking another car (67.1%), followed by fixed object collisions (11.0%), and non-fixed object collisions (6.9%).

The FMPO RSTSP Vision is "Towards zero deaths." Goals and strategies were developed in support of this Vision; champions were identified for individual strategies. RSTSP goals are:

- Reduce fatalities and the occurrence and severity of serious injuries on all public roadways in FMPO.
- Reduce crashes in the next five years.
- Reduce the severity and number of pedestrian and bicycle crashes.
- Enhance community awareness of transportation safety issues.

Emphasis areas were identified for the FMPO region in support of the SHSP. Of these 12 areas, FMPO experienced a higher rate than the statewide rate for fatal crashes in the following areas:

- Speeding and Aggressive Driving;
- Impaired Driving;
- Roadway Infrastructure and Operations: Lane/Roadway Departure;
- Non-motorized Users: Pedestrians;
- Heavy Vehicles/Buses/Transit;
- Natural Risks: Weather; and
- Traffic Incident Management.

Performance measures were addressed in accordance with the National Performance Management Measures Final Rule (23 CFR Part 490), which established five metrics used to guide HSIP implementation for state and local agencies. Performance targets based on five-year rolling averages must be established and reported annually for these five metrics:

1. Number of fatalities.
2. Rate of fatalities per 100 million Vehicle Miles Traveled (VMT).
3. Number of serious injuries.
4. Rate of serious injuries per 100 million VMT.
5. Number of combined non-motorized fatalities and serious injuries.

A predictive analysis was performed for select intersections and segments in FMPO. Predictive analysis is a state-of-the-practice safety analysis method introduced by the Highway Safety Manual (HSM). Predictive analysis generates a metric called the Potential for Safety Improvement (PSI). PSI is the difference between the predicted and expected number of crashes per year. When the predicted number of crashes is lower than the expected number of crashes, the site is performing worse than similar sites and the location has a high PSI: a greater potential for improvement. A summary of predictive analysis results for these select locations is provided in ***Table E-1*** and ***Table E-2***.

Table E-1 – Predictive Analysis Summary: Intersections

	Predicted Crashes/Year			Expected Crashes/Year			PSI**		
	Total	Fatal & Injury	PDO*	Total	Fatal & Injury	PDO	Total	Fatal & Injury	PDO
Route 66/Milton Road & Humphreys Street	7.9	3.3	4.6	12.0	3.3	8.7	***4.1***	***0.0***	***4.1***
US 89 & Marketplace Drive	6.3	2.2	4.1	9.7	2.9	6.8	***3.4***	***0.7***	***2.7***
US 89 & Cummings Street	4.7	1.8	2.9	8.9	2.5	6.4	***4.2***	***0.8***	***3.4***
E Route 66 & Ponderosa Parkway	4.3	1.5	2.7	10.7	2.3	8.4	***6.4***	***0.7***	***5.6***
Woodlands Village Boulevard & University Avenue	2.6	0.9	1.7	4.1	1.0	3.1	***1.5***	***0.1***	***1.5***
Lockett Road & Fourth Street	1.8	0.7	1.1	2.6	0.7	1.9	***0.9***	***0.1***	***0.8***

Note: Bold, red, italicized text under "PSI" denotes that the location has a positive PSI.
*Property Damage Only
**Potential for Safety Improvement

Table E-2 – Predictive Analysis Summary: Segments									
	Predicted Crashes/Year			Expected Crashes/Year			PSI		
	Total	Fatal & Injury	PDO	Total	Fatal & Injury	PDO	Total	Fatal & Injury	PDO
E Route 66/Milton Road: McConnell Drive to Elden Street	50.4	16.1	34.2	87.3	20.3	67.0	***37.0***	***4.2***	***32.8***
E Route 66: Switzer Canyon Drive to Fourth Street	23.5	6.7	16.7	28.9	7.3	21.6	***5.4***	***0.6***	***4.9***
US 89: Country Club Drive to Townsend-Winona Road	19.9	5.6	14.3	34.5	7.9	26.7	***14.7***	***2.3***	***12.4***
Fourth Street: Andes Drive to I-40	14.0	4.2	9.8	16.9	4.5	12.4	***2.9***	***0.3***	***2.6***
Butler Avenue: Sawmill Road to Ponderosa Parkway	13.2	3.8	9.4	11.9	3.5	8.4	-1.3	-0.3	-1.0
San Francisco Street: Pine Knoll Drive to E Route 66	3.2	1.1	2.2	4.3	1.2	3.2	***1.1***	***0.1***	***1.0***
B-40: Woody Mountain Road to Woodlands Village Boulevard	3.2	0.9	2.3	3.5	1.0	2.5	***0.3***	***0.1***	***0.2***
Note: Bold, red, italicized text under "PSI" denotes that the location has a positive PSI.									

The FMPO region has been proactive in addressing safety and congestion needs. FMPO has partnered with ADOT, Northern Arizona Intergovernmental Public Transportation Authority (NAIPTA), the City of Flagstaff, Coconino County, US Forest Service, Federal Highway Administration (FHWA), and Northern Arizona University (NAU) to prepare the Milton Road and US 180 Corridor Master Plans. The Study includes Milton Road from Forest Meadows Street to Beaver Street, and US 180 from Milton Road to the Crowley Pit turn-out (milepost 232.25). This planning effort will shape the long-term vision for these routes, including the role of transit. Due to this ongoing effort, plan recommendations were not included for these routes.

Highway Safety Improvement Program (HSIP) applications were not recommended to mitigate impaired pedestrian crashes where no other pedestrian crashes were present due to the overall randomness of the crashes. Stakeholders are pursuing societal measures through the strategies developed in support of this plan in lieu of engineering solutions.

A limited number of HSIP applications including street lighting were recommended. Stakeholders are pursuing alternative approaches to lighting that are consistent with dark sky ordinances.

The RSTSP identified potential HSIP projects for the FMPO region and the benefit to cost ratios (B/C). Spot improvement projects are listed in ***Table E-3*** and ***Table E-4***.

Table E-3 – Potential HSIP Intersection Spot Improvements		
Intersection	**Project**	**Preliminary B/C Ratio**
Lockett Road and Fourth Street	Roundabout	4.5

Table E-4 – Potential HSIP Segment Spot Improvements		
Segment	**Project**	**Preliminary B/C Ratio**
Townsend-Winona Road: US 89 to Koch Field Road	Rumble strips	21.2
Milton Road/E Route 66: McConnell Drive to Elden Street	Median	10.4
Milton Road: McConnell Drive to Ponderosa Parkway*	Variable Speed Limit Signs	2.5
I-40: I-17 to Country Club Drive	Lighting	3.9
Pedestrian Refuge Locations – Combined Application**		
*Crash data includes segment collisions of all types and rear-end collisions at intersections. **Installation of a single pedestrian refuge median does not meet the minimum HSIP project cost. Potential locations should be evaluated with an engineering study consistent with the MUTCD. Consider combining projects to meet the minimum cost or implementing a systemic pedestrian refuge improvement program.		

A systemic project to install flashing yellow arrows (FYA) may be merited in the future. Presently, the City is converting Beulah / Forest Meadows, SR 89 / Marketplace and potentially the University / Woodlands Village intersections to FYA. Other signals have recently been converted to protected-only phasing.

The crash history at some locations was not conducive to HSIP project funding, either due to the benefits associated with very low-cost countermeasures (project costs under $250,000) or the approved Crash Modification Factors (CMF)s may not best address the safety issue. Safety improvements were identified at many of these locations and are included in ***Appendix B***.

Project recommendations should be considered as part of Flagstaff, ADOT, and Coconino County capital improvement and maintenance programs. Additionally, they should be incorporated into future plans and studies in the region. In accordance with ADOT requirements, this plan should be updated at least every five years.

Crash history should be monitored on an ongoing basis; in particular, segments and intersections identified through network screening should be reviewed annually. These locations should be considered for inclusion in future HSIP applications if the crash history worsens, an appropriate CMF is identified, or other circumstances are present. These locations represent most probable candidates for future HSIP applications if current crash patterns persist.

1.0 Introduction

The Northern Arizona Council of Governments (NACOG) led the development of three Regional Strategic Transportation Safety Plans (RSTSP) in partnership with the Central Yavapai Metropolitan Planning Organization (CYMPO) and Flagstaff Metropolitan Planning Organization (FMPO). The purpose of the RSTSPs is to address safety from a holistic, regional perspective to reduce the risk of death and serious injury to all transportation users. The RSTSP establishes a framework identifying objectives, strategies, and performance measures for transportation safety that are consistent with the Arizona Strategic Highway Safety Plan (SHSP). The RSTSP included crash data analysis, safety emphasis area identification, and implementation plan development. The plan was developed with coordination and input from NACOG, CYMPO, FMPO, stakeholders, and the general public.

Collaborative meetings were held with NACOG, CYMPO, and FMPO during RSTSP development. Individual plans were developed for each agency. A shared set of safety analysis tools was developed incorporating input from each agency. This plan addresses the FMPO region, shown in ***Figure 1.1***. A map of the central Flagstaff area is shown as ***Figure 1.2***; this larger-scale map was developed to illustrate crash trends throughout this report in this dense portion of the city.

The RSTSP is a data driven plan with clear goals for overall crash reduction. These goals focus on reducing fatality and serious injury crashes. In addition, excel based tools which complement the RSTSP were developed to mine insights buried in large crash data sets and automatically calculate data required for Highway Safety Improvement Program (HSIP) funding applications. After RSTSP development, NACOG, CYMPO, and FMPO will be able to use the tools for future safety analysis and HSIP funding applications.

The data presented in this report analyzes crashes which occurred in the FMPO region from January 1, 2012 through December 31, 2016, the five-year analysis period for this study. A study process flow chart is shown in ***Figure 1.3***.

Figure 1.1 – Study Area

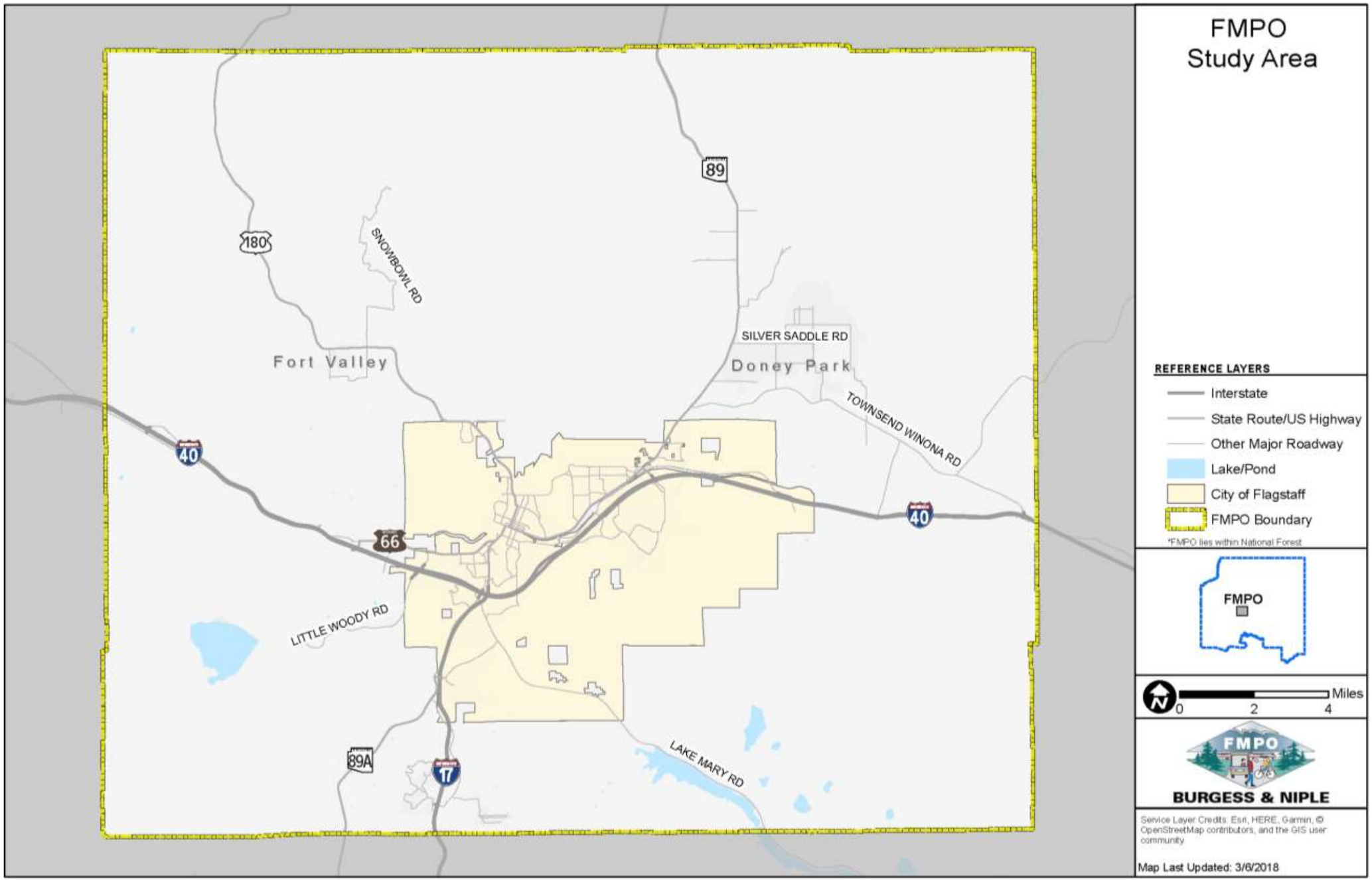
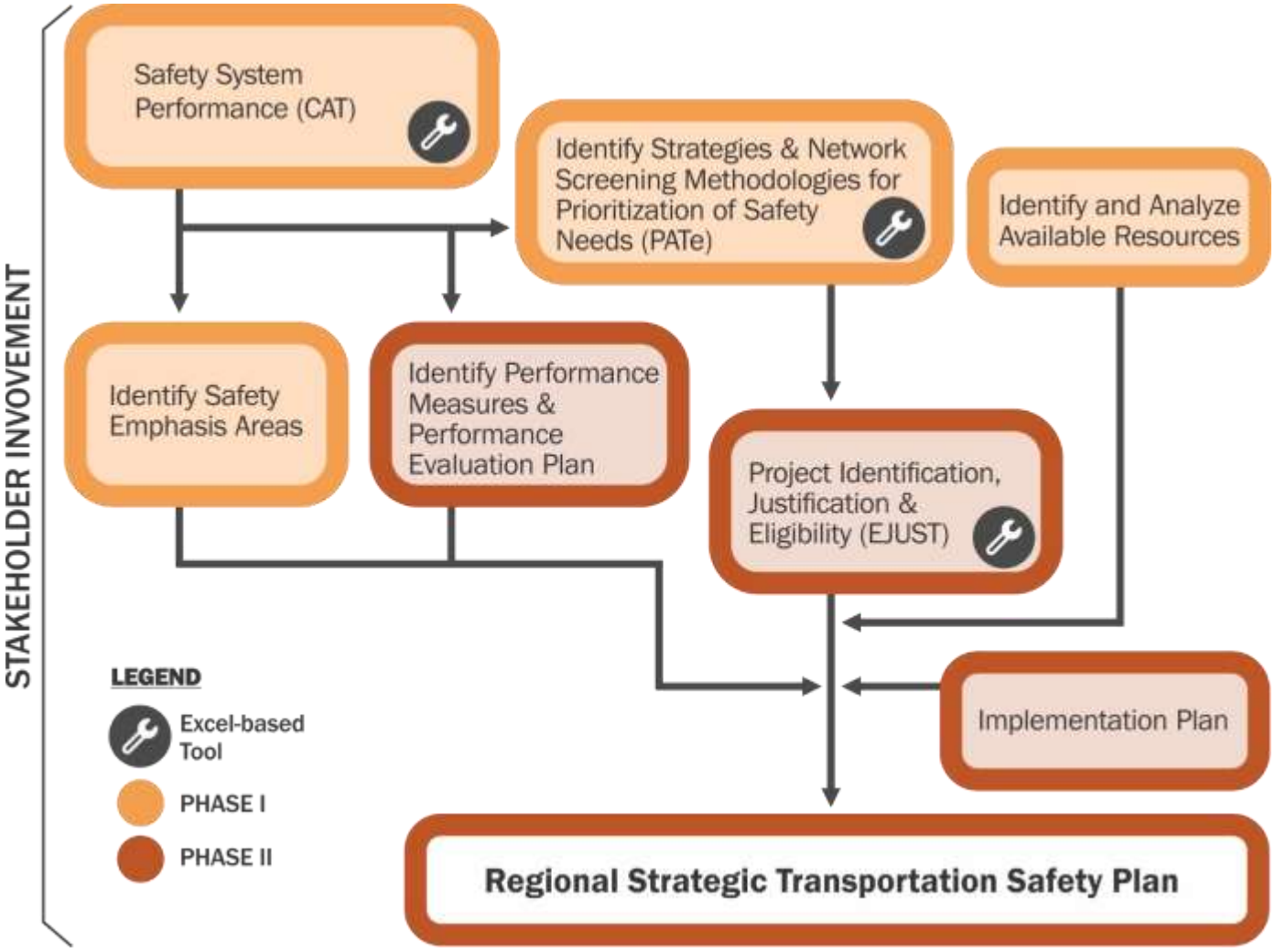


Figure 1.2 – Central Flagstaff Area

Figure 1.3 – RSTSP Process Flow Chart



2.0 Stakeholder Engagement

Community outreach and stakeholder engagement are an important part of understanding and addressing local safety concerns, as well as opportunities for safety improvement. Multiple meetings, workshops, and community surveys were conducted throughout the development of the RSTSP to ensure the RSTSP best meets community needs. A facilitated workshop was conducted August 3, 2017, to discuss crash trends and Vision and Goals, included in Section 3.0 . Online public and stakeholder engagement opportunities were available August 3, 2017, through November 17, 2017. A summary of the Stakeholder Engagement Workshop and the online engagement is provided in ***Appendix A***. 183 responses were received from stakeholder engagement efforts and recorded in the GIS Online Tool for future consideration during capital improvement project and maintenance program development.

Themes from public and stakeholder engagement include:

- Concerns about bicyclist and pedestrian safety;
- Concerns regarding traffic signal timing;
- Concern regarding congestion along Milton Road and US 180;
- Comments that some intersections feel unsafe or confusing; and
- Public comments generally reflect an interest in more traffic control.

Workshop participants noted the need for increased education and enforcement to reduce the severity of crashes.

3.0 Vision, Goals, and Strategies

This RSTSP supports the FHWA Vision, "Towards zero deaths and serious injuries on the Nation's roadways", and the 2014 Arizona SHSP Vision, "Toward Zero Deaths by Reducing Crashes for a Safer Arizona." The RSTSP established a framework identifying objectives, strategies, and performance measures for transportation safety that are consistent with the SHSP. A facilitated workshop was held to seek stakeholder input for regional Vision, Goals, and Strategies. Strategies were developed to help realize Goals. The Vision, Goals, and Strategies were refined during the April 5, 2018 FMPO Technical Advisory Committee (TAC) meeting. At this time, volunteers were identified to champion the Goals. The FMPO Vision is:

Vision: Towards zero deaths.

Goal: Reduce fatalities and the occurrence and severity of serious injuries on all public roadways in FMPO.

Strategy: Reduce the total number of fatalities and serious injuries in FMPO by three to seven percent during the next five years.
Champion(s): FMPO, City of Flagstaff (Flagstaff), and Coconino County.

Strategy: Identify innovative solutions to safety issues, such as variable speed limits and dark sky compliant lighting, to reduce crashes.
Champion(s): FMPO and Flagstaff. Initial leads: Dave Wessel, Martin Ince, and Jeff Bauman.

Goal: Reduce crashes in the next five years.

Strategy: Provide information regarding crash "hot spots" to law enforcement to encourage targeted enforcement.
Champion(s): Flagstaff.

Strategy: Lead an effort to expand public education related to dangers of intoxication while using streets in FMPO region.
Champion(s): Flagstaff Public Involvement Officer, Sheriff's office.

Strategy: Identify partners in health and human services (e.g., behavioral health and addiction) and collaborate to promote sobriety while using streets in FMPO region.
Champion(s): Northern Arizona Intergovernmental Public Transportation Authority (NAIPTA) and City Housing Authority. Initial lead: Kate Morley.

Strategy: Use predictive analysis to identify potential for safety improvement to inform project investment decisions.
Champion(s): Flagstaff and Coconino County. Initial leads: Rick Barrett and Christopher Tressler.

Strategy: Include safety elements in project development cost estimation.
Champion(s): FMPO, ADOT, and Flagstaff. Initial leads: Dave Wessel, Dan Gabiou, and Bret Peterson.

Strategy: Identify and utilize existing channels to communicate safety messages, such as Dynamic Message Signs (DMS), Northern Arizona University alerts, and others.
Champion(s): ADOT and NAIPTA. Initial leads: Dan Gabiou and Kate Morley.

Goal: Reduce the severity and number of pedestrian and bicycle crashes.

Strategy: Assess pedestrian safety as part of project development.
Champion(s): FMPO. Initial lead: Martin Ince.

Strategy: Evaluate Public Rights-of-Way Accessibility Guidelines (PROWAG) on projects.
Champion(s): FMPO. Initial lead: Martin Ince.

Strategy: Incorporate multimodal accommodations in project development.
Champion(s): FMPO and Coconino County. Initial lead: Martin Ince and Christopher Tressler.

Goal: Enhance community awareness of transportation safety issues.

Strategy: Conduct public education targeting driver behaviors.
Champion(s): FMPO. Initial lead: Dave Wessel and Martin Ince.

Goal: Assess safety performance and current practices on an ongoing basis.

Strategy: Conduct semiannual meetings to review crash trends, discuss progress on RSTSP strategies, and determine action items.
Champion(s): FMPO. Initial lead: Dave Wessel.

4.0 Safety Tools

A suite of online and Excel-based tools was developed to facilitate the safety analysis process. The tools, as well as a Safety System Analysis Tools User Guide, are available to NACOG, CYMPO, and FMPO for future use. They include:

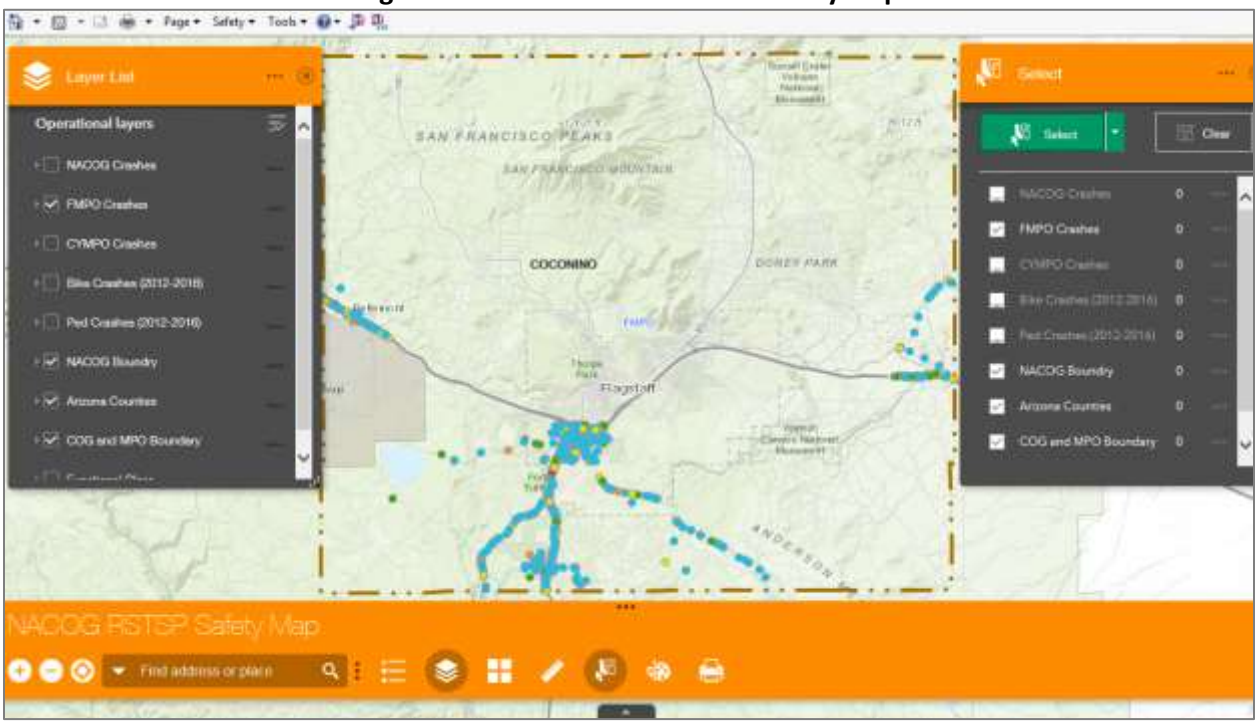
- ArcGIS Online Mapping Tool;
- Crash Analysis Tool (CAT);
- Predictive Analysis Tool – Existing (PATe); and
- Economic Analysis and Project Justification Tool (eJUST).

These tools support typical safety analysis tasks, including viewing and exporting site-specific data, analysis of system and site-specific crash data for crash trends, network screening, countermeasure selection, alternatives analysis, and HSIP application preparation. Brief descriptions of each tool are contained in the following sections. More detailed information regarding tool use is available in the associated Safety System Analysis Tools User Guide.

4.1 ArcGIS Online Mapping Tool

An ArcGIS Online Mapping tool was created to facilitate review of crash data, as shown in ***Figure 4.1***. The tool includes crash data for NACOG, CYMPO, and FMPO, which allows review of crash trends within and across these agencies. Users can select site-specific data, review information related to specific incidents, filter for specific crash characteristics, and export data for further analysis to Excel.

Figure 4.1 – ArcGIS Online RSTSP Safety Map

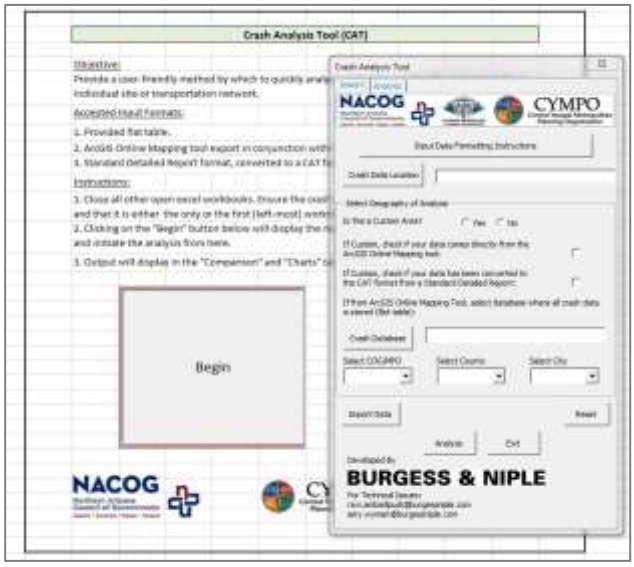


4.2 Crash Analysis Tool (CAT)

The CAT is a macro-enabled Excel tool developed to perform crash analyses. The crash analysis performed for this RSTSP was completed using the CAT, which has the capacity to analyze data for a variety of crash trends or combination thereof, including:

- Year;
- Month;
- Day of Week;
- Alcohol Involvement;
- Drug Involvement;
- Hour of Day;
- Weather;
- Light Conditions;
- Person Age;
- Fatal/Injury Crash Frequency;
- Pedestrian Crash Frequency;
- Bicyclist Crash Frequency;
- Intersection Relation;
- Crash Type;
- First Harmful Event;
- Motorcyclist Involvement; and
- Restraint Use.

Figure 4.2 – CAT Data Import Interface



The CAT generates emphasis area statistics for provided data, highlighting areas that are above the state average to aid HSIP funding applications and reporting. It supplies a series of automatically-generated tables and summary charts, which visualize a variety of crash trends. The CAT tool can be used in conjunction with the ArcGIS Online Mapping tool or Safety Data Mart Standard Detailed Reports. It is able to analyze both custom areas and larger regions.

4.3 Predictive Analysis Tool – Existing (PATe)

The PATe is an Excel-based tool developed to perform HSM predictive analysis. Predictive analysis is a state-of-the-practice safety analysis method introduced by the Highway Safety Manual (HSM) in 2010. It is currently being adopted in states nationwide and ADOT has indicated it plans to adopt predictive analysis for HSIP applications by 2021. More information on predictive analysis is available in the Safety System Analysis Tools User Guide.

4.4 Economic Analysis and Project Justification Tool (eJUST)

The eJUST is an Excel-based tool which facilitates HSIP application development. It includes the following features:

- Facilitates selection of appropriate countermeasure(s) for mitigating fatal and incapacitating crashes at chosen locations;
- Automatic calculation of annual benefit due to countermeasure implementation;
- Automatic calculation of B/C ratio and auto-population of "B/C Tabulation" sheet in the HSIP application; and
- Selection of the appropriate cost estimate sheet to accompany the HSIP application.

More information about the eJUST is available in the Safety System Analysis Tools User Guide.

5.0 Emphasis Areas

The SHSP identifies 12 emphasis areas, including five top focus emphasis areas, for analyzing crash trends throughout the state. The top five focus areas are:

- Speeding and Aggressive Driving;
- Impaired Driving;
- Occupant Protection;
- Motorcycles; and
- Distracted Driving.

The remaining emphasis areas are:

- Roadway Infrastructure and Operations;
- Age Related;
- Heavy Vehicles/ Buses/ Transit;
- Non-Motorized Users;
- Natural Risks;
- Traffic Incident Management; and
- Interjurisdictional.

Emphasis areas were developed based on fatal crashes experienced during the 2012 to 2016 analysis period. Crash rates are compared to data in both the SHSP (2014) and 2012 to 2016 statewide incident reports. ***Table 1*** summarizes these emphasis areas. Red, bold, italicized text indicates the crash rate in the FMPO region for this emphasis area was higher than 2012 to 2016 statewide incident reports.

Table 1 – Emphasis Area Evaluation

	FMPO Fatal	State Fatal	SHSP Fatal
Speeding and Aggressive Driving	***35.1%***	32.0%	36.7%
Impaired Driving	***40.4%***	35.4%	34.1%
Occupant Protection	33.3%	40.9%	46.8%
Motorcycles	3.5%	17.5%	16.1%
Distracted Driving	31.6%	39.0%	14.3%
Roadway Infrastructure and Operations: Lane/Roadway Departure	***59.6%***	47.4%	51.1%
Roadway Infrastructure and Operations: Intersections/Railroad Crossings	12.3%	27.2%	23.8%
Age Related: Young Drivers	22.8%	26.0%	29.7%
Age Related: Older Drivers	12.3%	22.0%	18.2%
Non-motorized Users: Pedestrians	***35.1%***	20.4%	17.1%
Non-motorized Users: Bicyclists	1.8%	3.4%	2.8%
Heavy Vehicles/Buses/Transit*	***21.1%***	12.9%	12.4%
Natural Risks: Weather	***5.3%***	2.9%	3.7%
Natural Risks: Animal	0.0%	0.2%	0.3%
Traffic Incident Management (Work Zones)	***3.5%***	1.3%	1.4%
Interjurisdictional	Does not represent a particular crash type		

*All crashes applicable to this emphasis area included heavy vehicles; no fatal bus or transit crashes occurred.

FMPO supports all emphasis areas identified by the SHSP. However, the following emphasis area categories for FMPO exceed statewide numbers and should be given special consideration:

- Speeding and Aggressive Driving;
- Impaired Driving;
- Roadway Infrastructure and Operations: Lane/Roadway Departure;
- Non-motorized Users: Pedestrians;
- Heavy Vehicles/Buses/Transit;
- Natural Risks: Weather; and
- Traffic Incident Management.

Detailed crash analysis, including sub analysis of these emphasis areas is presented in the following section.

6.0 Crash Analysis

The most recent five years of crash data, January 1, 2012, to December 31, 2016, for the FMPO region was obtained from state crash records in the Safety Data Mart (SDM) database and processed to improve data quality. Crash data was extracted on June 29, 2017, to include the most comprehensive account of incidents possible and filtered to include only those crashes which occurred in the FMPO region on non-tribal lands. This data was analyzed with the CAT, discussed in Section 4.2. Crash mapping is included for emphasis areas that exceeded statewide averages in subsequent sections. Detailed, site-specific crash information is included in ***Appendix B*** for many locations that included fatal crashes.

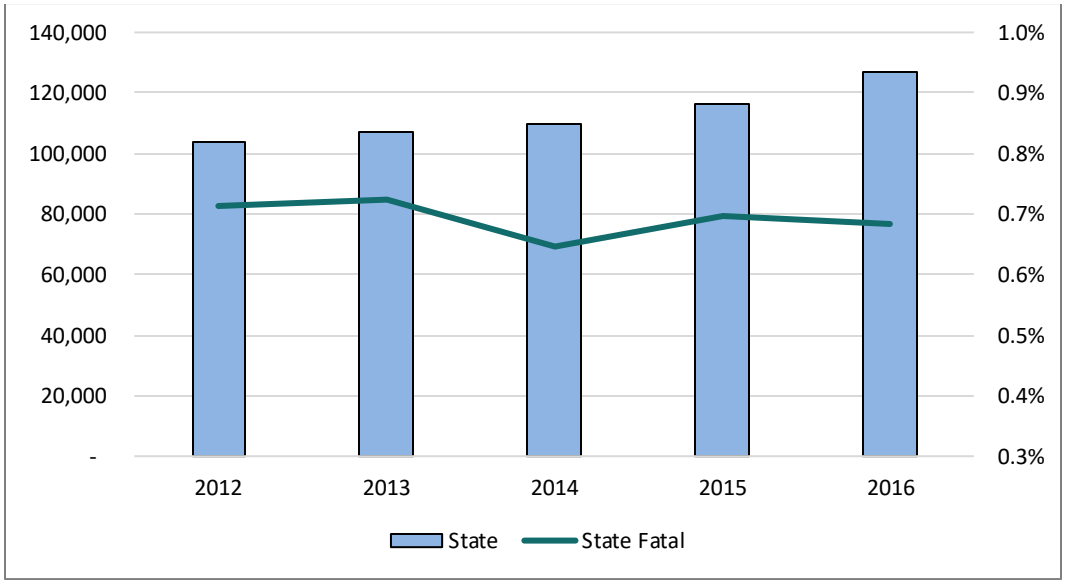
6.1 Data Processing

Crash data was processed for use as part of this RSTSP to consolidate data by crash, combine data from multiple queries in SDM, calculating values for fields that are missing or unavailable in SDM, and removing extraneous data not pertinent to crash analysis. Raw data downloaded from the SDM was "flattened" in a table so that there is one row per crash. Data was simplified by deleting non-critical fields (i.e., photographer) and was augmented by adding and/or calculating values from separate tables. A detailed description of data processing for existing, dropped, added, and calculated fields is available for review in the Safety System Analysis Tools User Guide.

6.2 Statewide and Local Crash Analysis

During the five-year analysis period, there were 563,993 crashes statewide with 3,899 fatal crashes. As shown in ***Figure 6.1,*** the number of crashes statewide steadily rose from 2012 (103,637 crashes) to 2016 (126,845 crashes) while the percentage of fatal crashes remained fairly constant (~0.7%).

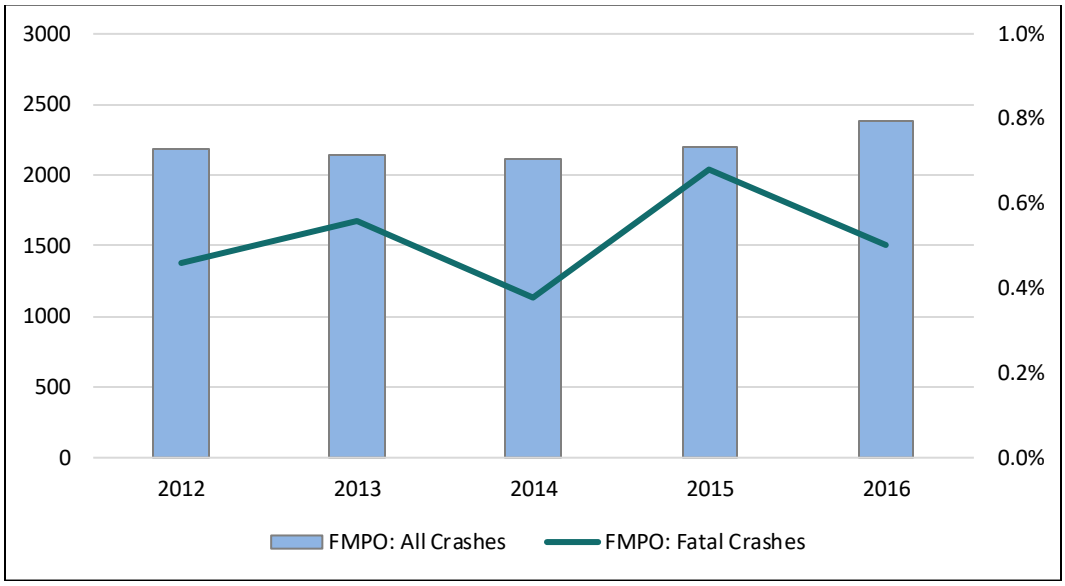
Figure 6.1 – Statewide Crash Trends



From 2012 to 2016, there were 11,042 crashes reported in the FMPO region. There were 57 (0.5%) fatal crashes which resulted in 59 fatalities, 217 (2.0%) incapacitating crashes, 956 (8.7%) injury crashes, 1,237 (11.2%) possible injury crashes, and 8,575 (77.7%) property damage only (PDO) crashes. ***Table 2*** and ***Figure 6.2*** summarize yearly crash trends in the region for all crashes and by crash severity. ***Figure 6.3*** and ***Figure 6.4*** illustrate crash locations for the region and central Flagstaff.

Table 2 – Crash Summary by Year and Severity							
Year	Crashes	Fatal	% Fatal	Incapacitating	Injury	Possible Injury	PDO
2012	2,185	10	0.5%	46	177	251	1,701
2013	2,147	12	0.6%	44	184	238	1,669
2014	2,118	8	0.4%	36	209	245	1,620
2015	2,206	15	0.7%	50	192	252	1,697
2016	2,386	12	0.5%	41	194	251	1,888
Total	**11,042**	**57**	**0.5%**	**217**	**956**	**1,237**	**8,575**

Figure 6.2 – FMPO Crash Summary by Year



As shown, crash frequency in FMPO was fairly consistent during the 5-year analysis period; the annual number of fatal crashes varied between 10 and 15 crashes. ***Figure 6.5*** through ***Figure 6.8*** show where fatal and incapacitating crashes occurred. Nearly half of the fatal crashes occurred on I-40 or I-17. The majority of fatal crashes in the central Flagstaff area were pedestrian crashes.

Figure 6.3 – Crash Map

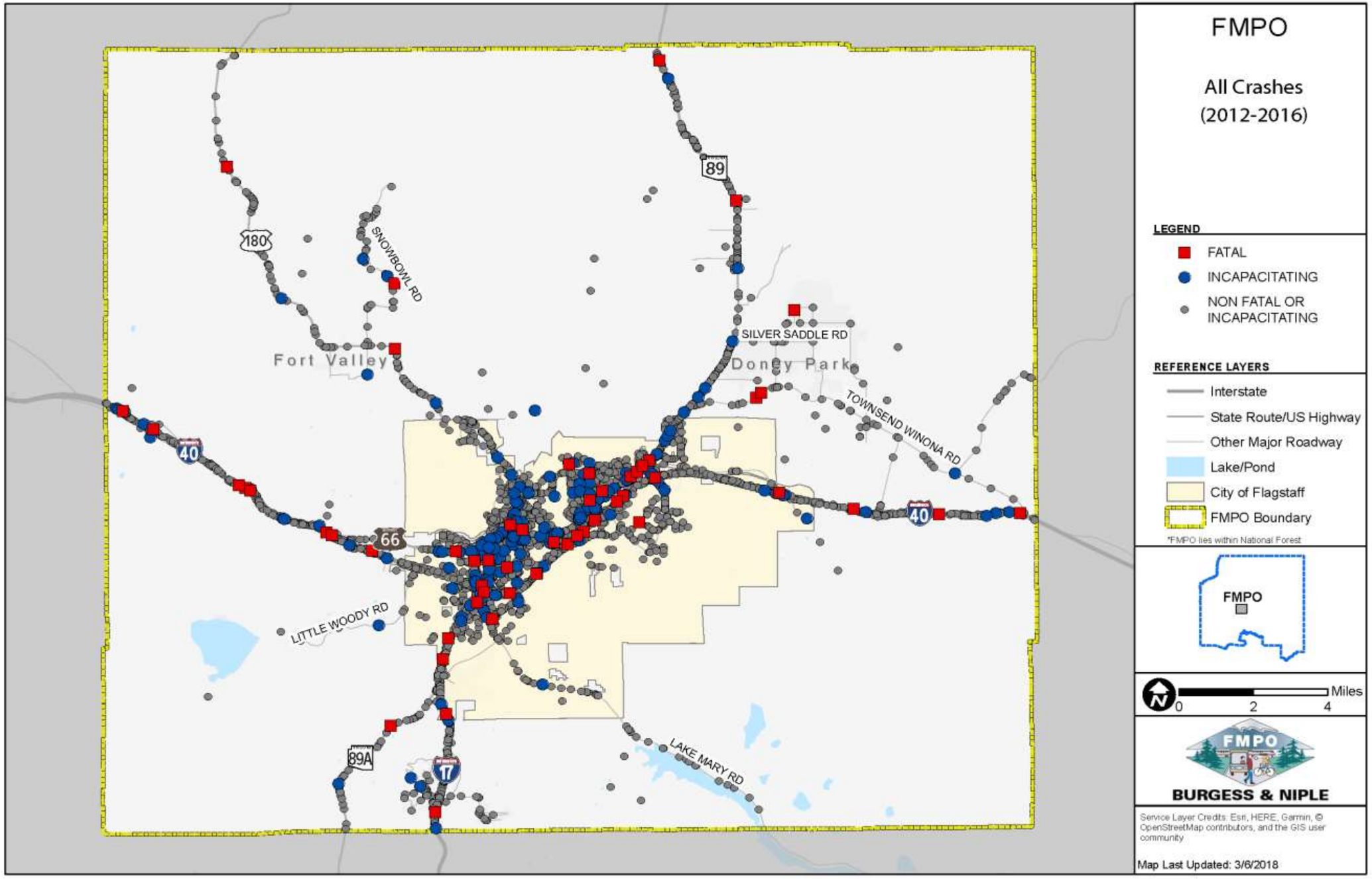


Figure 6.4 – Central Flagstaff Crash Map

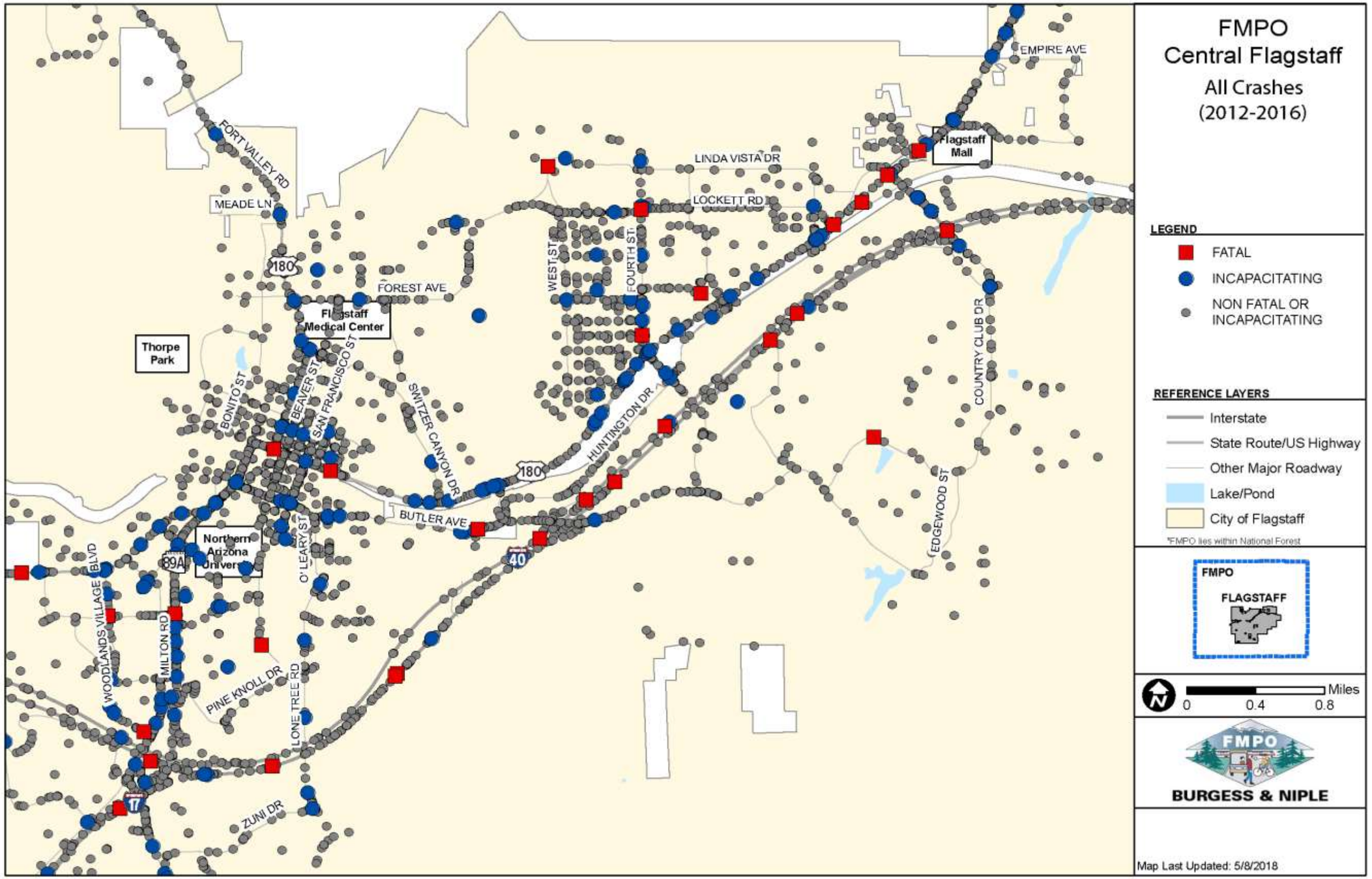


Figure 6.5 – Fatal Crash Locations

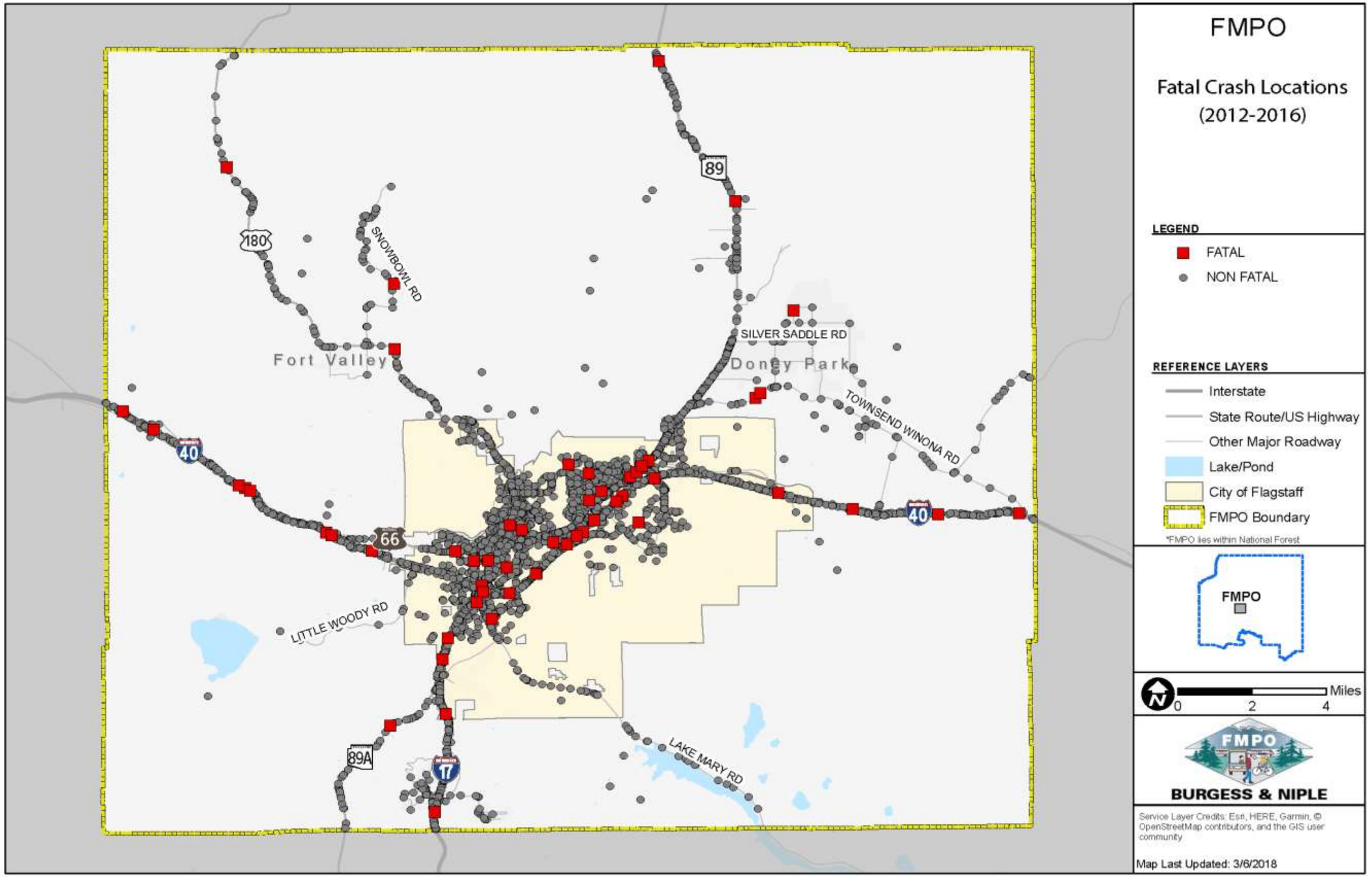


Figure 6.6 – Central Flagstaff Fatal Crash Locations

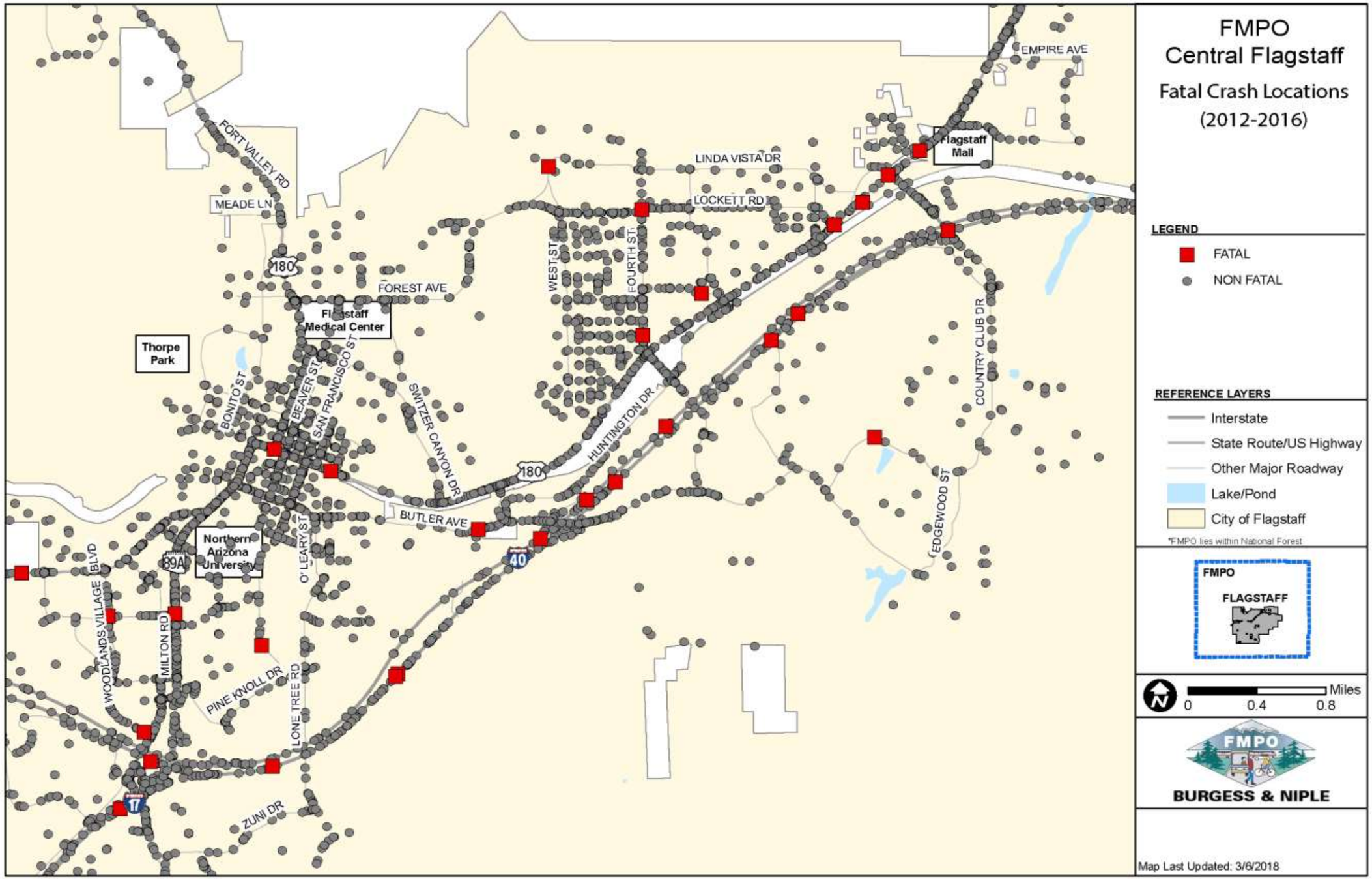


Figure 6.7 – Incapacitating Crash Locations

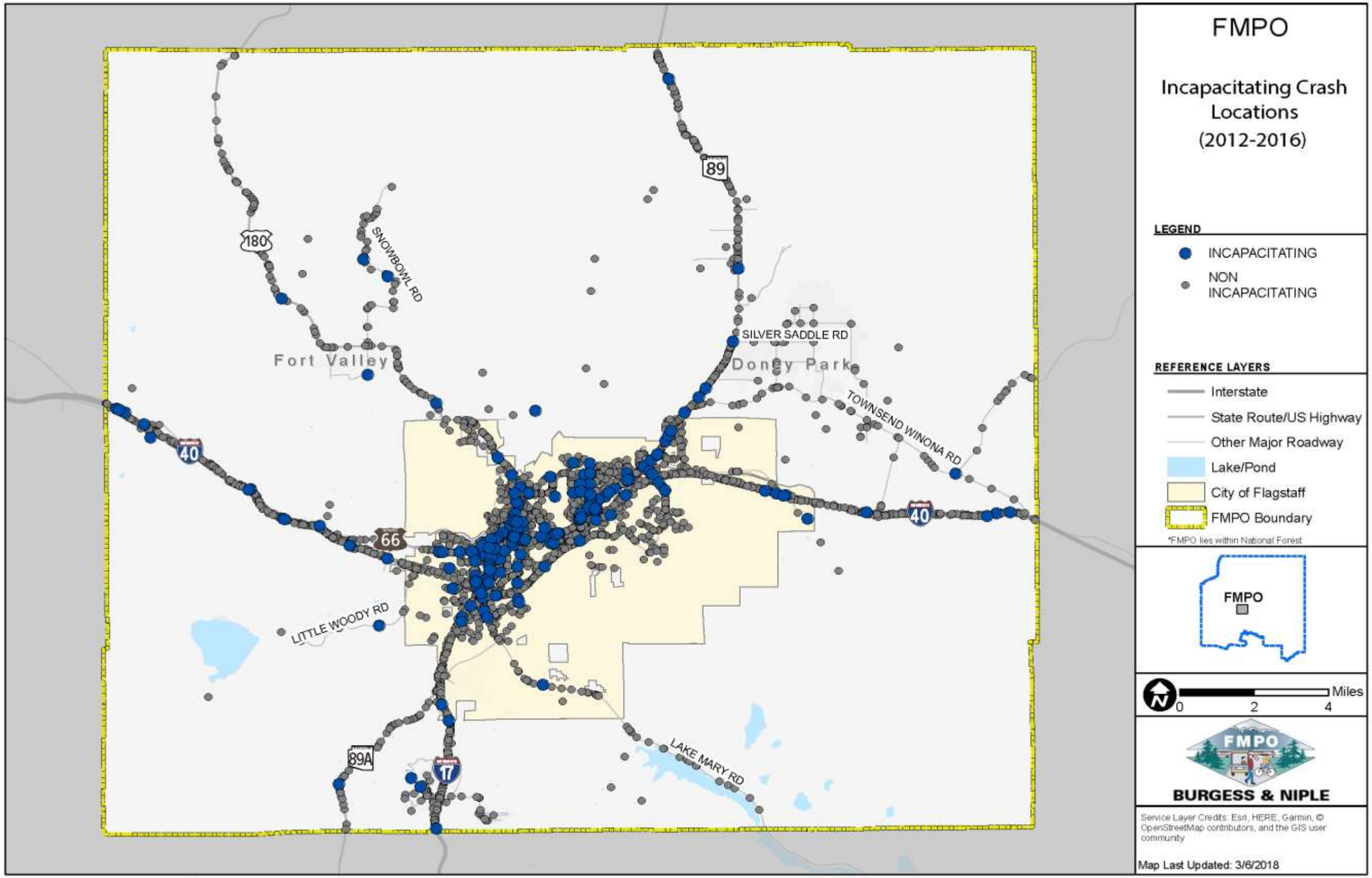
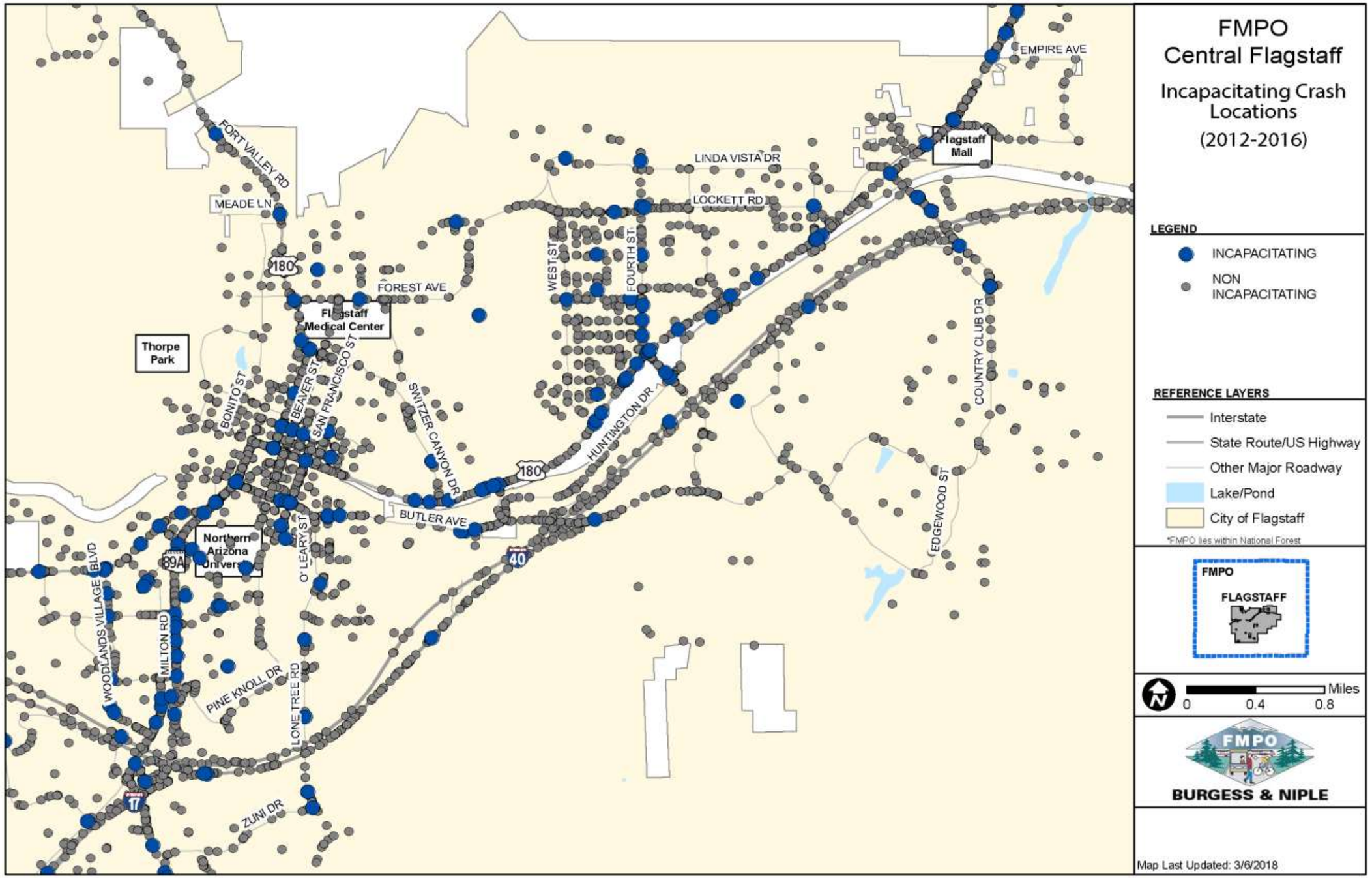


Figure 6.8 – Central Flagstaff Incapacitating Crash Locations



A summary of crashes by the first causal factor (first harmful event) for the region is provided in ***Table 3***, as well as a comparison to statewide statistics. The comparison numbers are based on the five-year averages published by ADOT in the Arizona Motor Vehicle Crash Facts for the same time period. Bold, red, italicized text denotes values above the statewide percentage. Almost every category exceeds the statewide rate except for unknown and vehicle fire or explosion categories. Unknown is 0.3% in FMPO and 14.6% statewide; the proportionate redistribution of unknown crashes across other categories would generally have them align with statewide rates. Based on the idea of crash redistribution, collisions with animals, pedalcyclists (bicyclists), and non-fixed objects are elevated compared to statewide rates.

FMPO includes both urban (e.g., central Flagstaff and Northern Arizona University campus) and rural areas (e.g., mountainous areas and the area near Snowbowl). Crash patterns reflect both urban and rural characteristics; as such, comparisons to rural and urban areas are provided.

Table 3 – Crash Distribution by First Harmful Event (All Severities)

First Harmful Event	FMPO		% Statewide	% Rural Areas	% Urban Areas
	Total	%			
Collision with Motor Vehicle in Transport	7,404	***67.1%***	64.3%	51.4%	67.3%
Overturning	325	***2.9%***	2.2%	8.2%	0.8%
Collision with Pedestrian	160	***1.4%***	1.0%	0.7%	1.1%
Collision with Pedalcyclist	285	***2.6%***	1.2%	0.6%	1.4%
Collision with Animal	743	***6.7%***	1.6%	7.2%	0.3%
Collision with Fixed Object	1,215	***11.0%***	10.0%	19%	8.0%
Collision with Non-fixed Object*	766	***6.9%***	4.0%	5.0%	3.7%
Vehicle Fire or Explosion	13	0.1%	0.3%	1.0%	0.1%
Other Non-collision**	102	***0.9%***	0.8%	2.0%	0.5%
Unknown	29	0.3%	14.6%	5.0%	16.8%
*Includes Collision with Parked Vehicles, Trains, Railway Vehicles, and Work Zone Equipment					
**Includes Vehicle Immersion, Jackknife, and Cargo Loss or Shift					

If these crashes were proportionately redistributed across other categories, FMPO crash trends would closely align with statewide averages. It is important to note that the first harmful event may differ from the most harmful event and/or may be incomplete without examining secondary events. For example, ***Table 3*** indicates that 67.1% of crashes originate with one vehicle striking another; however, 8,563 (77.5%) of crashes involved more than one vehicle. This indicates a second event after the first harmful event that contributed to the crash. A summary of first harmful event for fatal and incapacitating crashes is provided in ***Table 4***.

Table 4 – Crash Distribution by First Harmful Event of Fatal and Incapacitating Crashes		
First Harmful Event	FMPO	
	Fatal and Incapacitating	% of Fatal and Incapacitating
Collision with Motor Vehicle in Transport	119	43.4%
Overturning	33	12.0%
Collision with Pedestrian	46	16.8%
Collision with Pedalcyclist	25	9.1%
Collision with Animal	1	0.4%
Collision with Fixed Object	41	15.0%
Collision with Non-fixed Object*	4	1.5%
Vehicle Fire or Explosion	0	0.0%
Other Non-collision**	5	1.8%
Unknown	0	0.0%
Total	**274**	**100%**
*Includes Collision with Parked Vehicles, Trains, Railway Vehicles, and Work Zone Equipment		
**Includes Vehicle Immersion, Jackknife, and Cargo Loss or Shift		

Overturning, pedestrian and bicyclist crashes, and fixed object crashes, and non-collision crashes comprise a higher percentage of serious crashes than crashes of all severities. A summary by manner of collision for multi-vehicle crashes is provided in ***Table 5***.

Table 5 – Manner of Collision in Multi-Vehicle Crashes (All Severities)			
Crash Type	Total	%	Statewide %
Rear End	3,638	42.5%	45.8%
Angle	1,694	***19.8%***	16.0%
Sideswipe (same)	1,190	***13.9%***	13.4%
Left Turn	900	10.5%	15.0%
Other	456	***5.3%***	4.5%
Rear to Side	208	***2.4%***	0.8%
Head on	201	***2.3%***	1.8%
Sideswipe (opposite)	157	***1.8%***	1.4%
Rear to Rear	49	***0.6%***	0.5%
Unknown	70	0.8%	0.8%
Total	**8,563**	**100.0%**	**100%**

FMPO experienced higher percentages than the statewide rate for angle, sideswipe (same and opposite direction), other, rear to side, head on, and rear to rear, although all are within 4% of the statewide rate. Angle crashes are 125% the statewide rate; rear to side crashes occurred at triple the statewide rate. A summary of collision manner for fatal and incapacitating crashes is shown in ***Table 6***.

Table 6 – Manner of Collision in Fatal and Incapacitating Multi-Vehicle Crashes		
Crash Type	**Fatal and Incapacitating**	**% of Fatal and Incapacitating**
Rear End	95	41.1%
Angle	49	21.2%
Sideswipe (same)	30	13.0%
Left Turn	23	10.0%
Other	12	5.2%
Rear to Side	6	2.6%
Head on	4	1.7%
Sideswipe (opposite)	6	2.6%
Rear to Rear	1	0.4%
Unknown	5	2.2%
Total	**231**	100.0%

The most prevalent fatal and serious injury crash types for multi-vehicle crashes were rear-end (41.1%), angle (21.2%), and same direction sideswipe (13.0%). There were 43 fatal and incapacitating single vehicle crashes in FMPO, representing 15.7% of all fatal and incapacitating crashes.

6.3 Emphasis Area Crash Analysis

Emphasis area crash trends were reviewed in detail in support of HSIP project development and FHWA, Arizona SHSP, and FMPO Visions towards zero deaths. The following emphasis areas are identified in the Arizona SHSP for which FMPO exceeded the statewide percentage. Other crash trends are reviewed in subsequent sections.

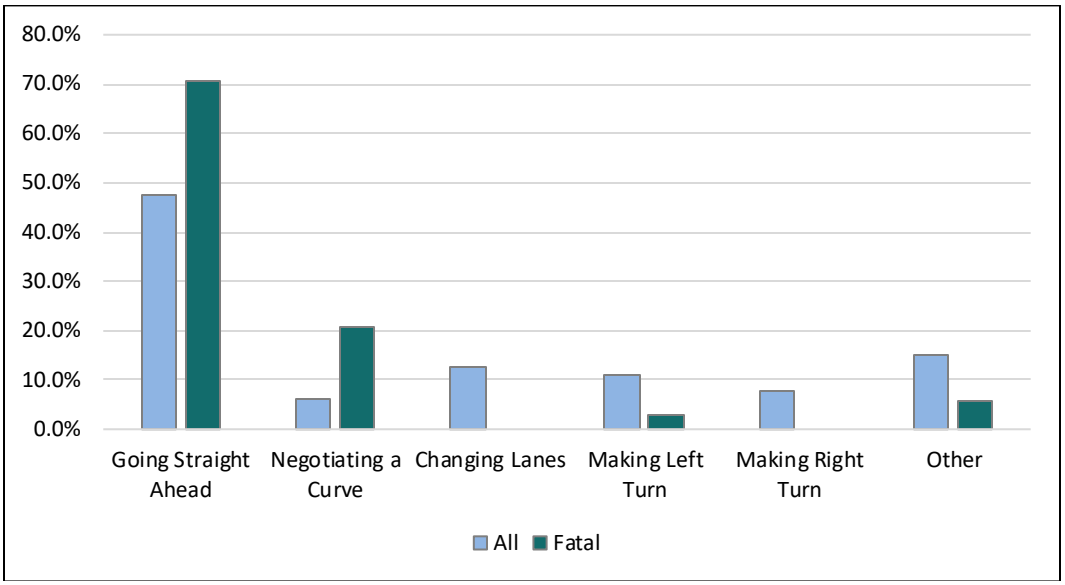
6.3.1 Roadway Infrastructure and Operations: Lane/Roadway Departure

59.6% of all fatal crashes in FMPO were lane/roadway departure crashes, 12.2% higher than the statewide average. ***Table 7*** summarizes select person-related factors for fatal and all lane departure crashes during the five-year analysis period.

Table 7 – Lane/Roadway Departure Crash Characteristics				
Behavior	**All Crashes**	**%**	**Fatal**	**%**
Speeding	956	31.0%	18	52.9%
Impaired	387	12.5%	22	64.7%
Distracted	919	29.8%	14	41.2%
Unrestrained	169	5.5%	19	55.9%
Older	373	12.1%	3	8.8%
Younger	1,139	36.9%	7	20.6%
Weather	628	19.9%	3	8.8%
Note: Crashes may include more than one factor; percentages do not sum to 100%.				

As shown in ***Table 7***, speeding and lack of restraint use were factors in over half of all fatal lane departure crashes. Impairment was a factor in 64.7% of fatal and 12.5% of all lane departure crashes. ***Figure 6.9*** summarizes lane departure crashes based on at-fault unit action and crash severity. Note the majority of high severity lane departure crashes were along I-40 and I-17 and that very few were within central Flagstaff. There was alcohol or drug involvement in all but one lane departure crash in central Flagstaff. In addition, restraints were not used.

Figure 6.9 – At-Fault Unit Action: Lane/Roadway Departure Crashes



Going straight ahead was the most common unit action in lane departure crashes (47.5%, 1,467 crashes), followed by changing lanes (12.5%, 387). Going straight ahead was the most common unit action in fatal lane departure crashes (70.6%, 24), followed by negotiating a curve (20.6%, 7).

Figure 6.10 – Lane/Roadway Departure Crash Locations

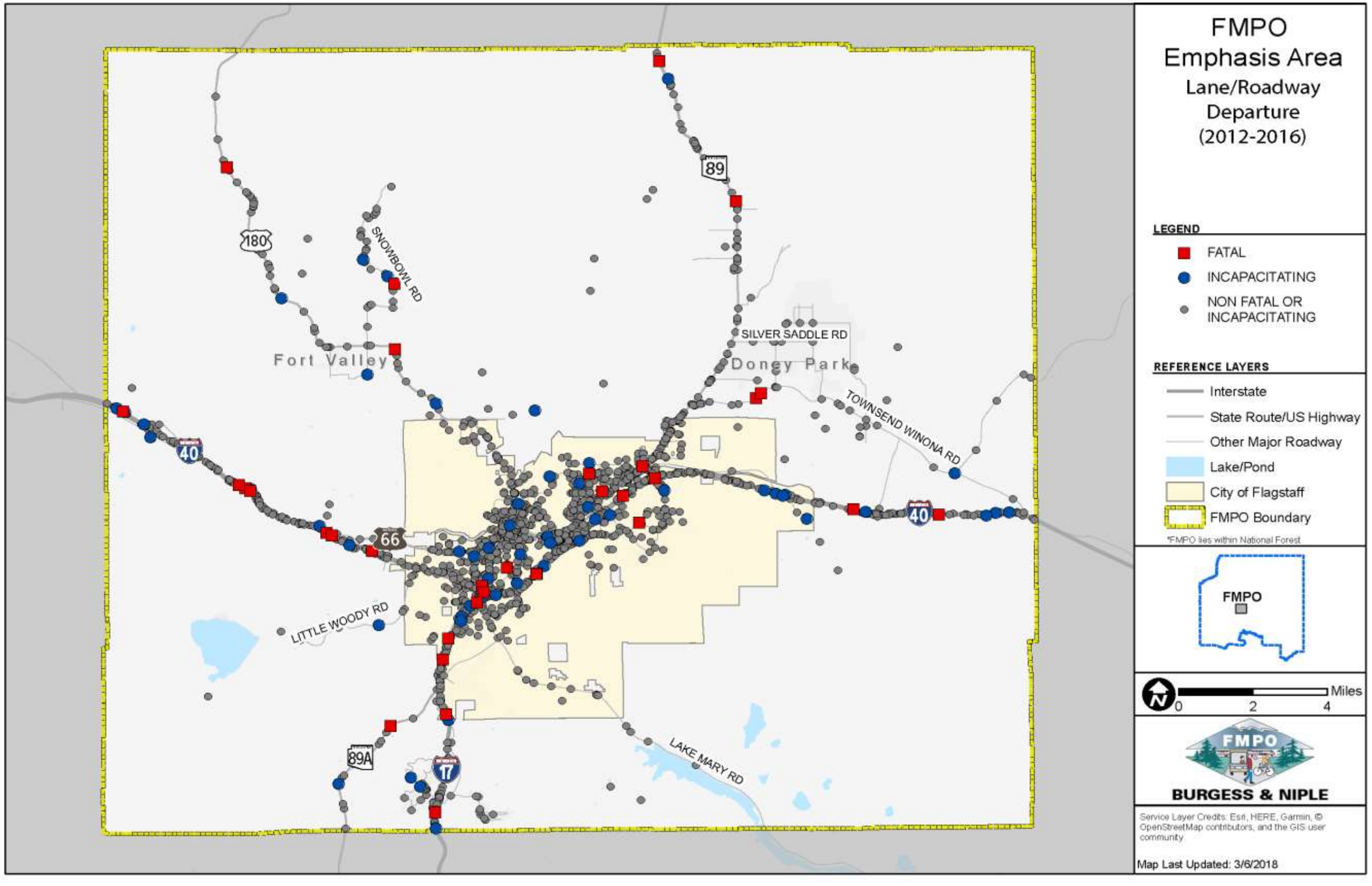
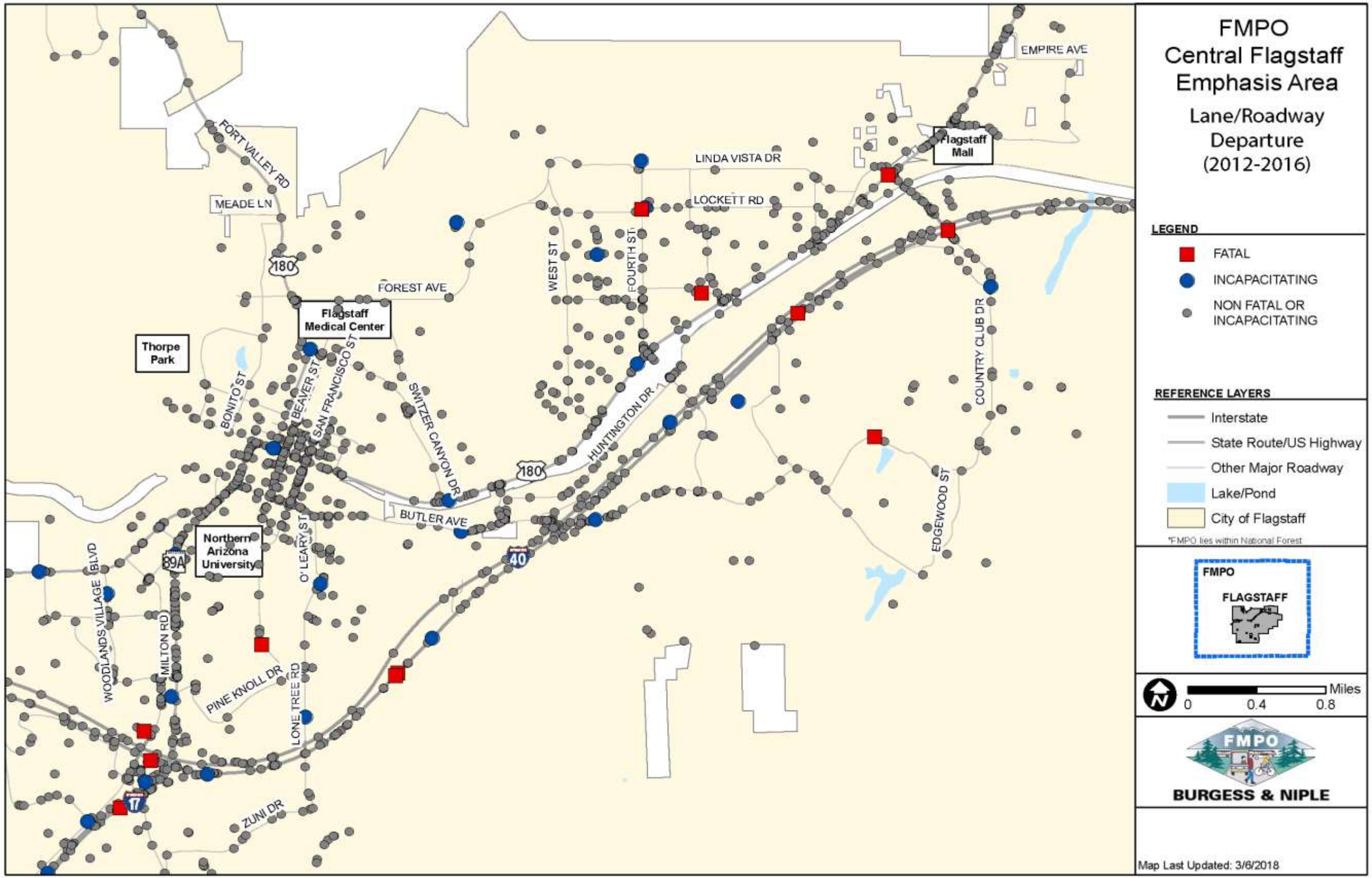


Figure 6.11 – Central Flagstaff Lane/Roadway Departure Crash Locations



6.3.2 Non-motorized Users: Pedestrians

Fatal pedestrian crashes accounted for 35% of all fatal crashes in the 5-year analysis period, double the statewide rate. ***Table 8*** summarizes pedestrian crashes over the 10-year period and indicated pedestrians were involved in 33.5% of fatal crashes in the ten year period. This indicates an increase in the number of fatal crashes involving pedestrians. After initial data review, pedestrian crashes were analyzed by alcohol involvement and lighting condition. ***Table 9*** and ***Table 10*** use the 10-year period to evaluate lighting and alcohol involvement for pedestrian crashes. The 10-year period was used to consider more data points to better evaluate the trend.

Table 8 – Pedestrian Crash Summary (2007-2016)

Year	Crashes	Fatal Crashes	Pedestrian Crashes	Fatal Ped Crashes	% of Fatal Crashes Involving Peds	% of Fatal Ped Crashes
2007	2,720	7	52	1	14.3%	1.9%
2008	2,586	10	36	2	20.0%	5.6%
2009	2,234	6	36	4	66.7%	11.1%
2010	2,230	11	40	3	27.3%	7.5%
2011	2,068	11	34	3	27.3%	8.8%
2012	2,185	10	32	4	40.0%	12.5%
2013	2,147	12	30	5	41.7%	16.7%
2014	2,118	8	45	3	37.5%	6.7%
2015	2,206	15	29	4	26.7%	13.8%
2016	2,386	12	27	4	33.3%	14.8%
Total	22,880	102	361	33	33.5% average	9.9% average

Table 9 – Lighting Condition Associated with Pedestrian Crashes

Year	Pedestrian Crashes	Dark - Lighted	Dark - Lighted (% Total)	Dark - Not Lighted	Dark - Not Lighted (% Total)
2007	52	0	0.0%	0	0.0%
2008	36	0	0.0%	0	0.0%
2009	36	9	25.0%	8	22.2%
2010	40	8	20.0%	6	15.0%
2011	34	8	23.5%	2	5.9%
2012	32	4	12.5%	7	21.9%
2013	30	7	23.3%	3	10.0%
2014	45	15	33.3%	3	6.7%
2015	29	10	34.5%	1	3.4%
2016	27	7	25.9%	2	7.4%
Average	36.1	6.8	19.8%	3.2	9.3%

Table 10 – Summary of Alcohol and Lighting in Pedestrian Crashes										
Year	Pedestrian Crashes			Alcohol Related Pedestrian Crashes			Alcohol & Dark – Not Lighted Ped Crashes			% Alcohol & Dark – Not Lighted Ped Crashes
	Total	Fatal	% Fatal	Total	Fatal	% Fatal	Total	Fatal	% Fatal	
2007	52	1	1.9%	14	0	0.0%	0	0	0%	0.0%
2008	36	2	5.6%	8	1	12.5%	0	0	0%	0.0%
2009	36	4	11.1%	10	2	20.0%	1	1	100%	2.8%
2010	40	3	7.5%	8	3	37.5%	3	2	67%	7.5%
2011	34	3	8.8%	6	1	16.7%	1	0	0%	2.9%
2012	32	4	12.5%	13	4	30.8%	5	3	60%	15.6%
2013	30	5	16.7%	7	2	28.6%	3	2	67%	10.0%
2014	45	3	6.7%	7	2	28.6%	2	1	50%	4.4%
2015	29	4	13.8%	6	3	50.0%	0	0	0%	0.0%
2016	27	4	14.8%	12	3	25.0%	1	1	100%	3.7%

Table 11 analyzes alcohol involvement in the typical 5-year analysis period.

Table 11 – Alcohol Involvement in Pedestrian Crashes (2012-2016)				
	Number of Crashes	Alcohol Involved	Impaired Driver	% Pedestrian Alcohol Involvement
Pedestrian Crashes	163	45	7	23.3%
Fatal Pedestrian Crashes	20	14	0	70.0%

As noted in ***Table 1,*** 35.1% of all fatal crashes involve pedestrians and 40.3% involve impaired drivers. ***Table 11*** illustrates there is a high correlation, 70%, between pedestrian alcohol use and fatal pedestrian crashes. Pedestrian crashes with an impaired pedestrian account for 24.6% of all fatal crashes during the 5-year analysis period. Drug use was reviewed, but found to be a subset of alcohol involvement for the 5-year period (e.g., no drug use without alcohol use). There is a lesser incidence of driver impairment in pedestrian crashes compared to all fatal crashes.

The analysis indicates a stronger correlation in fatal pedestrian crashes between pedestrian alcohol use than to lighting condition. ***Figure 6.12*** and ***Figure 6.13*** provide a graphical representation of where fatal and other severity pedestrian crashes occurred and the role of alcohol in those crashes. Most pedestrian crashes occurred in central Flagstaff. It is important to note pedestrian crashes include motorists that left their vehicles for various reasons, such as retrieving a lost item, addressing a vehicle malfunction, or other cause***. Figure 6.14*** and ***Figure 6.15*** provide a graphical representation of where fatal and other severity pedestrian crashes occurred and the lighting condition in those crashes.

Figure 6.12 – Pedestrian Crash Locations and Alcohol Involvement

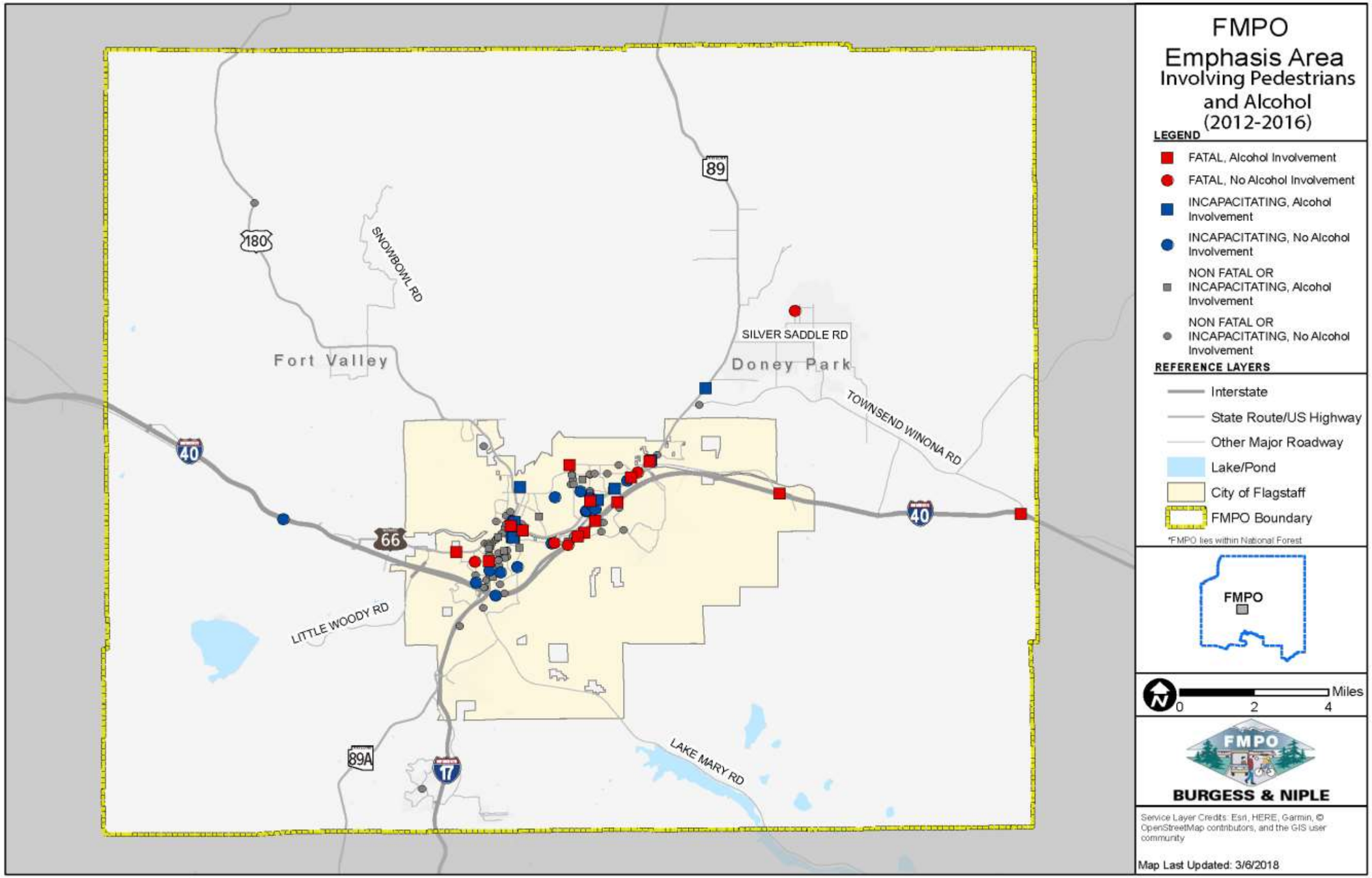


Figure 6.13 – Central Flagstaff Pedestrian Crash Locations and Alcohol Involvement

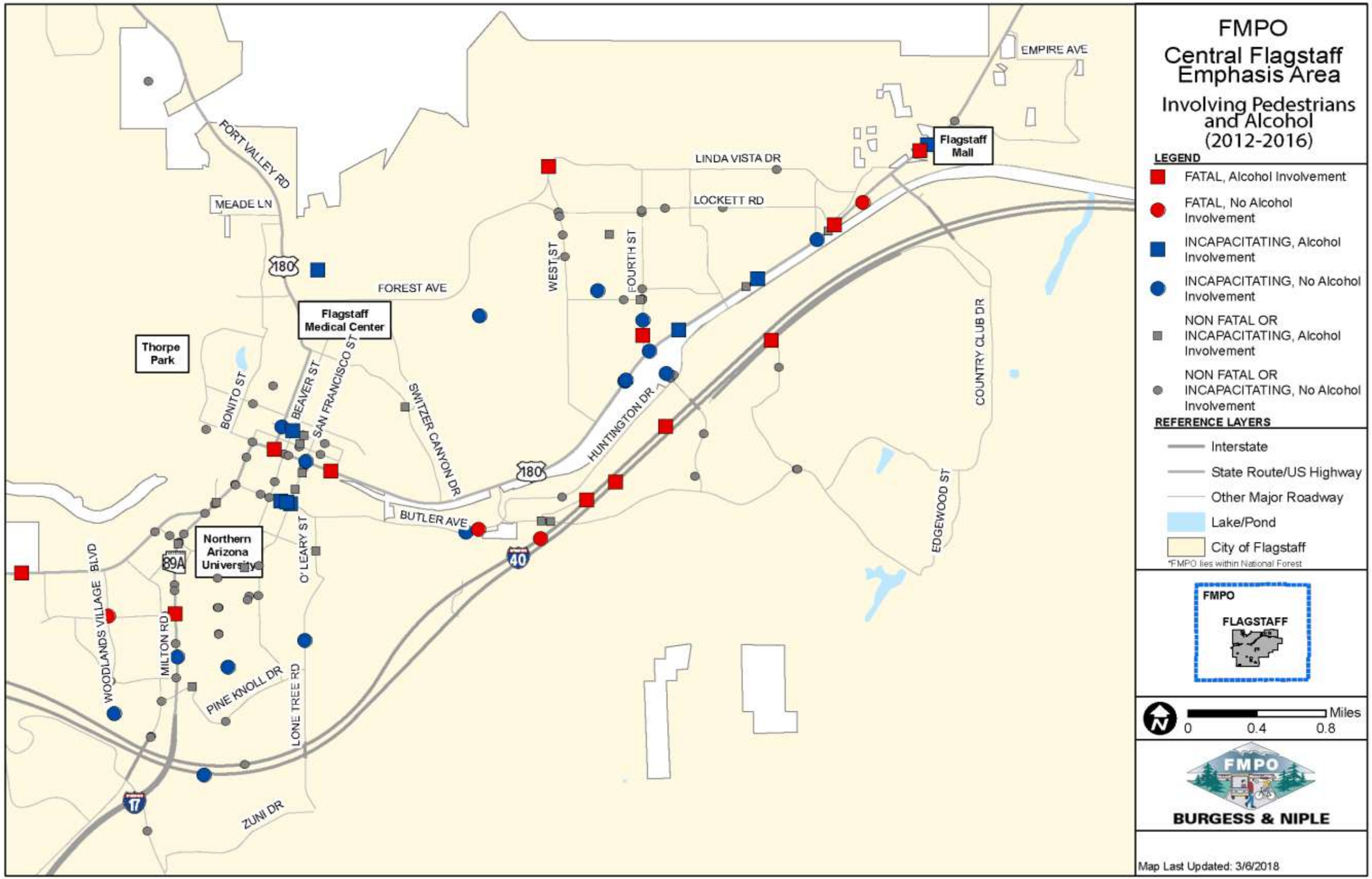


Figure 6.14 – Pedestrian Crash Locations and Lighting

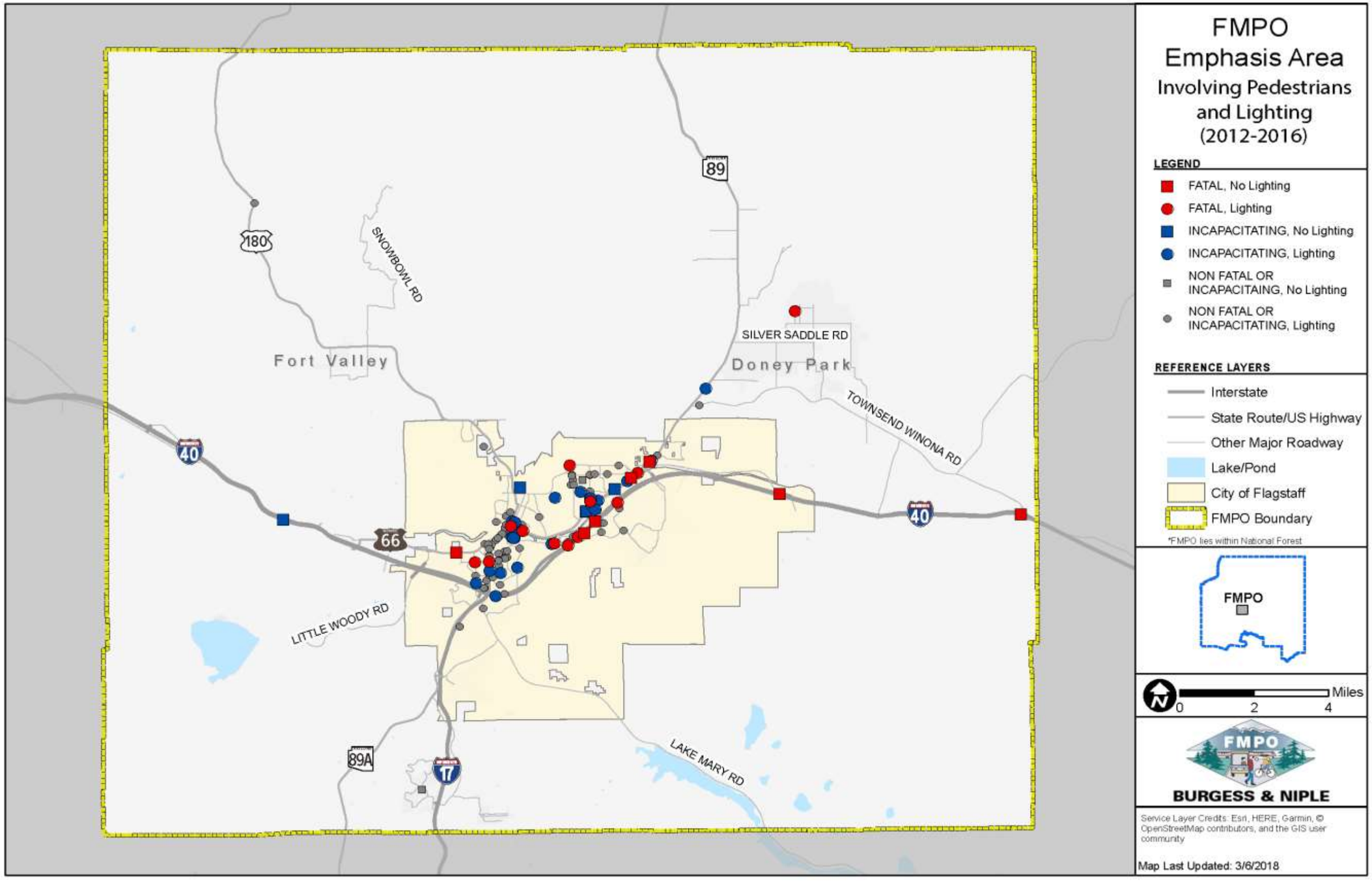
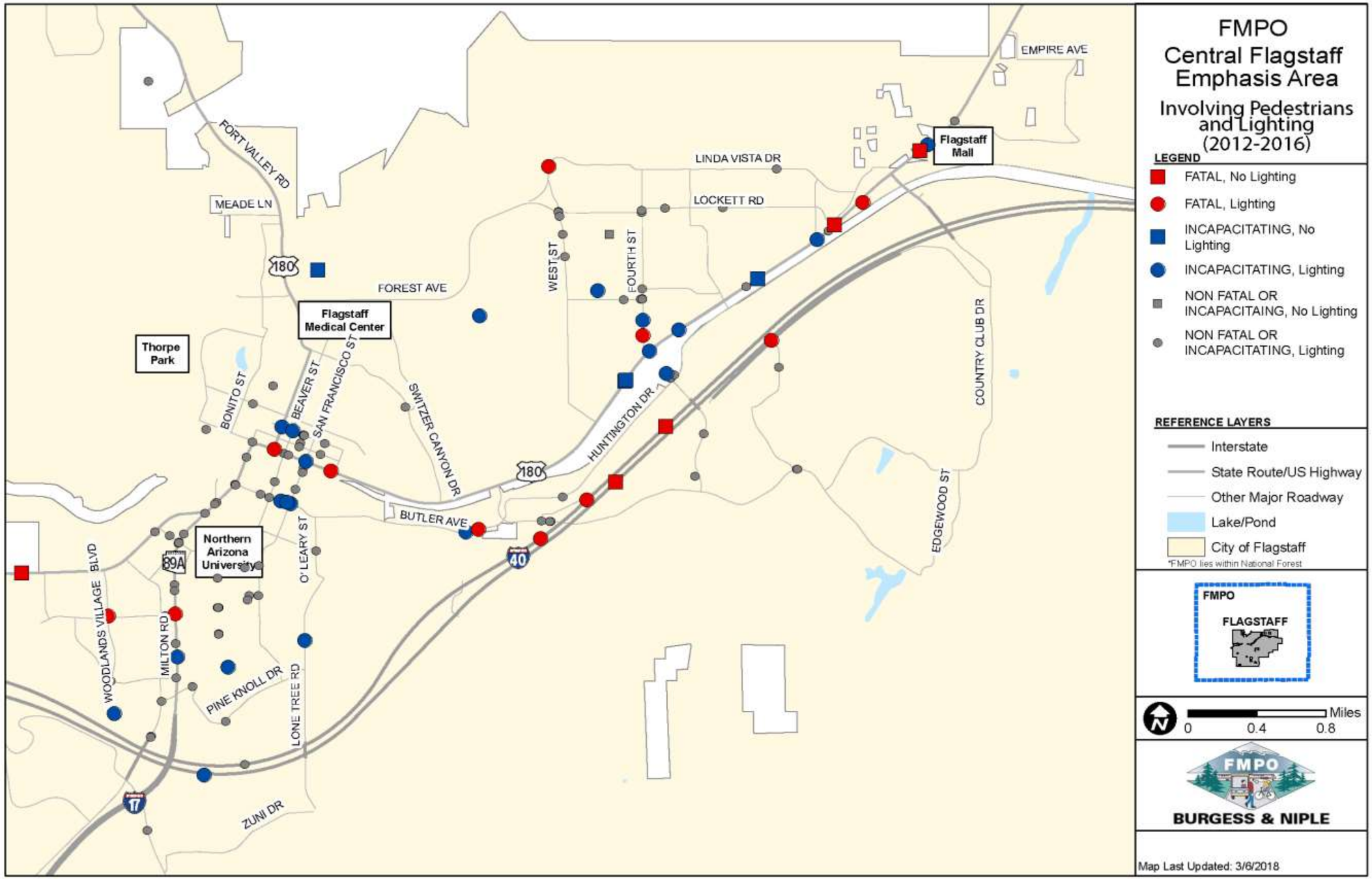


Figure 6.15 – Central Flagstaff Pedestrian Crash Locations and Lighting



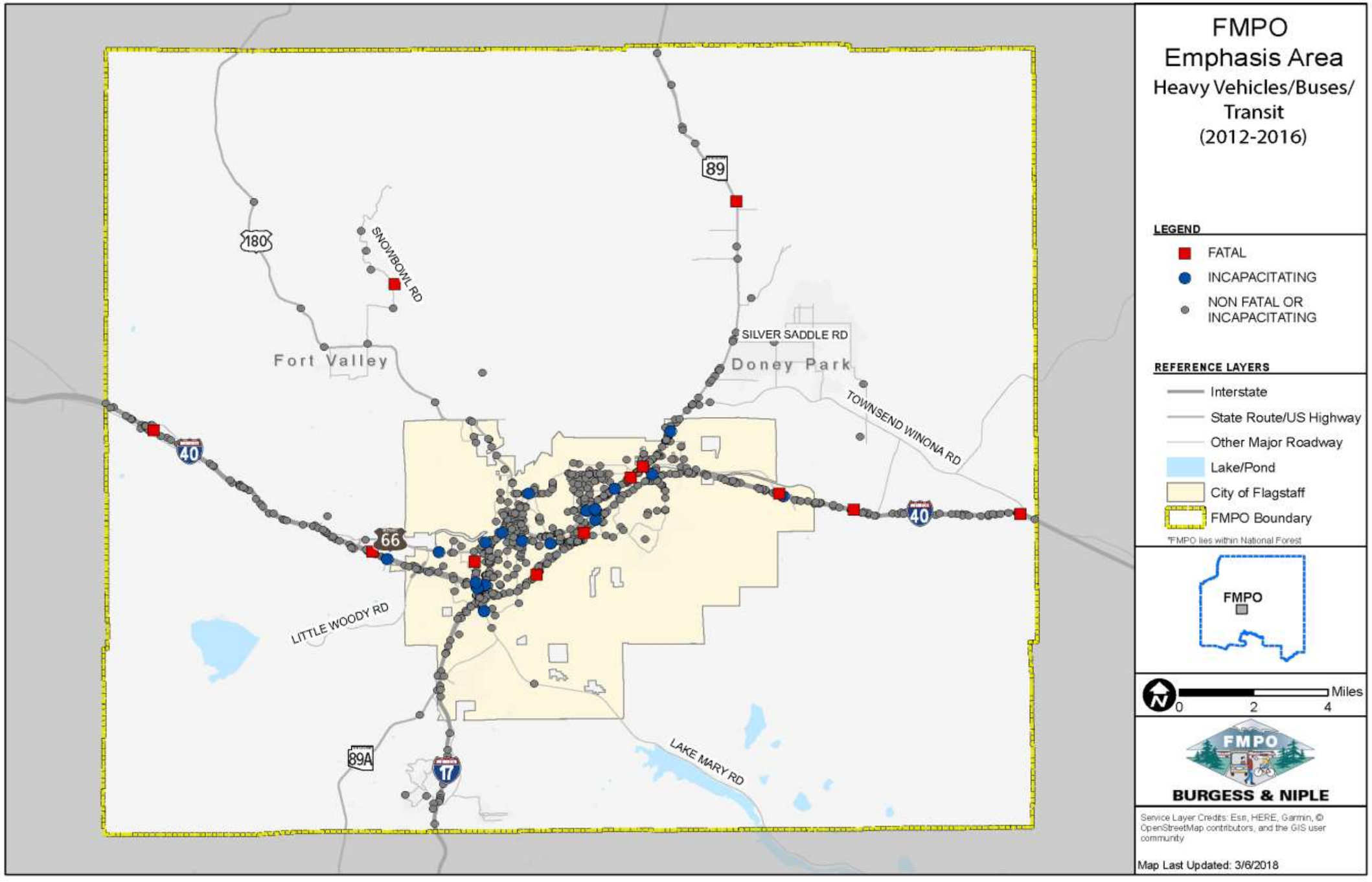
6.3.3 Heavy Vehicles/Buses/Transit

There were 12 fatal heavy vehicle crashes during the analysis period, which were distributed as follows:

- 7 on I-40 (3 pedestrian);
- 7 dark, not lighted;
- 6 lane departure;
- 6 speeding involved;
- 5 pedestrian crashes; and
- 4 single vehicle.

Figure 6.16 provides a graphical representation of where fatal and other severity heavy vehicle/bus/transit crashes occurred. Though the emphasis area includes consideration of bus and transit related crashes, no fatal bus or transit crashes occurred during the analysis period. Over half of heavy vehicle crashes occurred on I-40.

Figure 6.16 – Heavy Vehicles/Buses/Transit Crash Locations



6.3.4 Speeding and Aggressive Driving

There were 3,112 total crashes during the analysis period which involved speeding. Of these, 20 were fatal. Of the fatal crashes:

- 18 were lane departure crashes;
- 15 were single vehicle crashes;
- 10 involved alcohol or drugs;
- 3 occurred under dark-not lighted conditions; and
- 3 occurred under dark lighted conditions.

Figure 6.17 and ***Figure 6.18*** provide a graphical representation of where fatal and other severity crashes involving speeding and aggressive driving occurred. The majority of the high severity crashes occur outside of central Flagstaff. This is fitting based on congestion often experienced in central Flagstaff.

Figure 6.17 – Speeding and Aggressive Driving Crash Locations

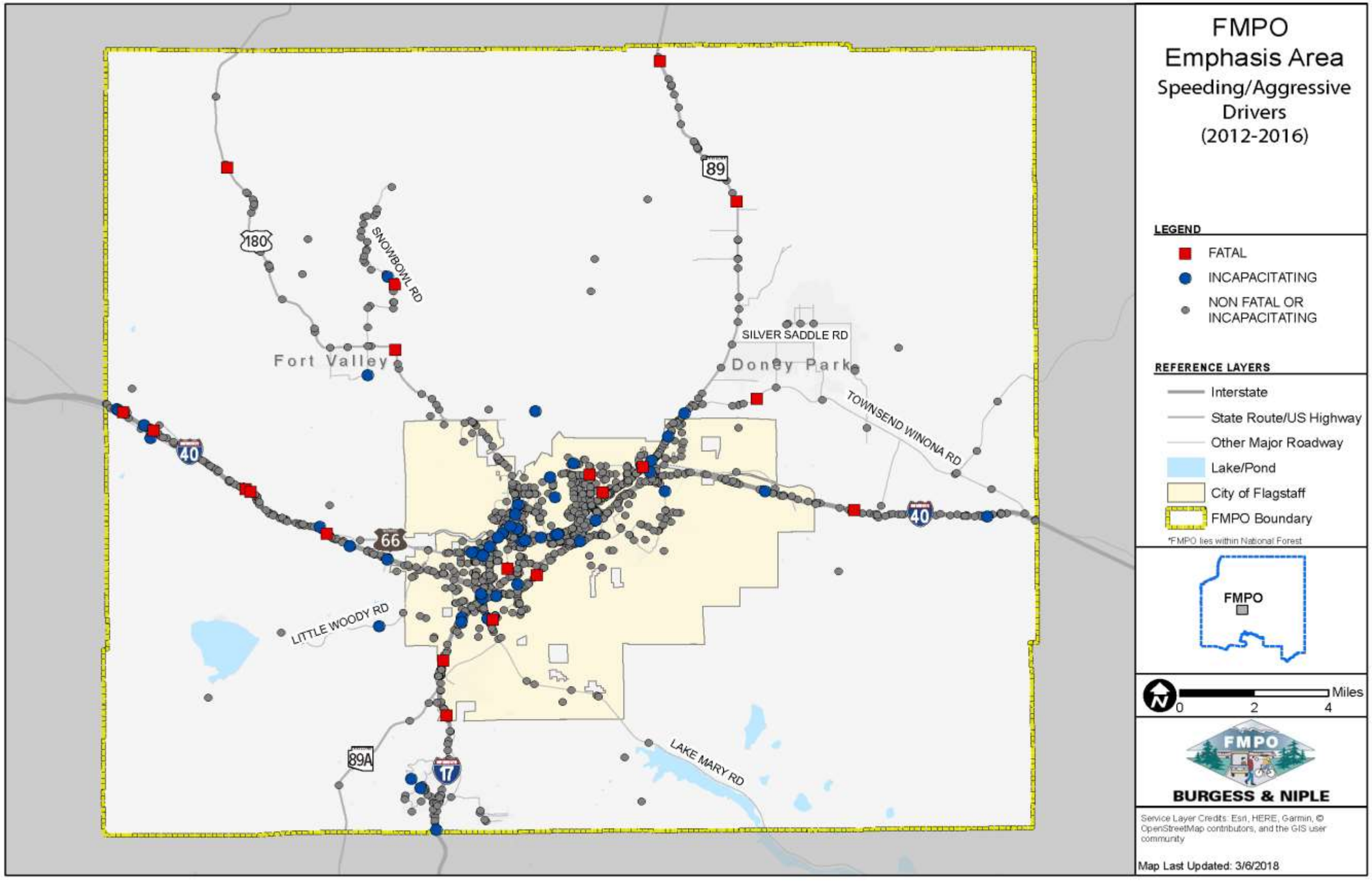
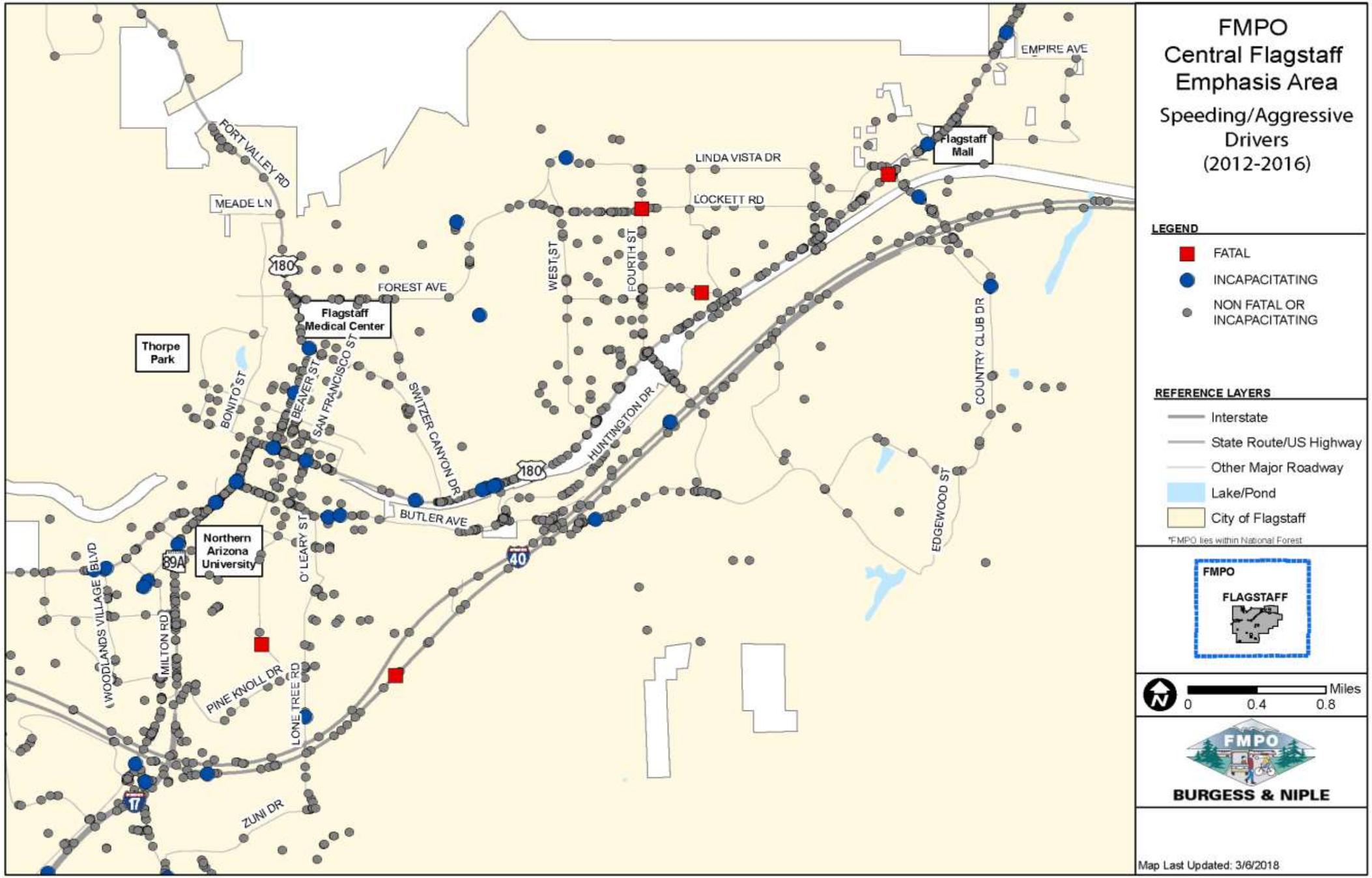


Figure 6.18 – Central Flagstaff Speeding and Aggressive Driving Crash Locations



6.3.5 Impaired driving

Impaired driving was a factor in 40.4% of fatal crashes, with alcohol and drugs as the most common types of impairment. ***Table 12*** shows drug and alcohol involvement for all crash severities and fatal crashes only.

Table 12 – Crashes by Drug and Alcohol Involvement				
	Total	%	Fatal	%
Alcohol	460	4.2%	26	45.6%
Drugs	100	0.9%	15	6.9%

Alcohol was a factor in nearly half of all fatal crashes and 4.2% of all crashes. Fewer crashes involved drugs: drug use was a factor in 0.9% of all crashes and 6.9% of fatal crashes in FMPO. ***Figure 6.19*** and ***Figure 6.20*** provide a graphical representation of where fatal and other severity crashes involving impaired drivers occurred. The majority of the severe drug and alcohol crashes occurred outside of central Flagstaff, as did most fatal crashes excluding pedestrians.

Figure 6.19 – Impaired Driver Crash Locations

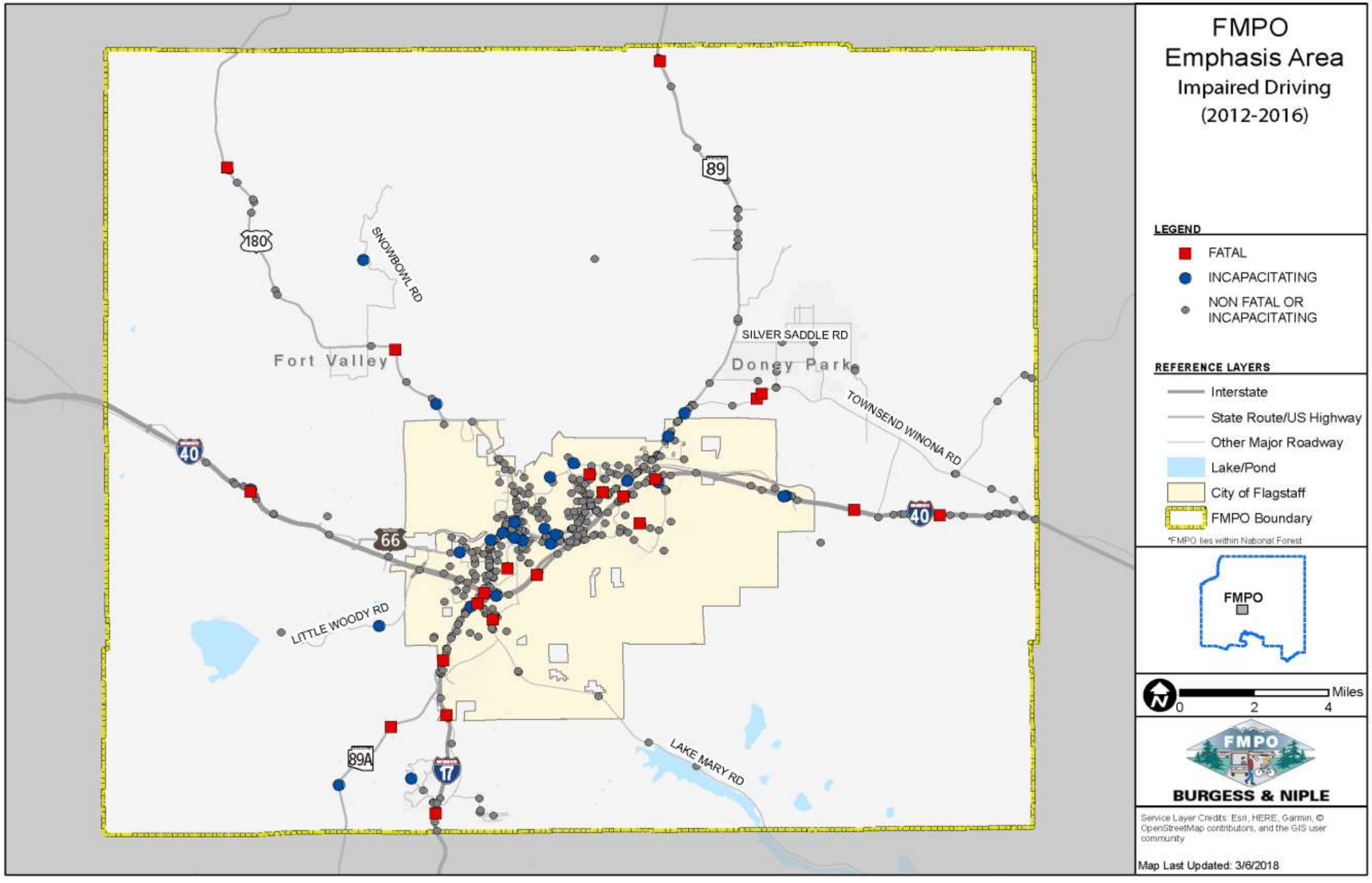
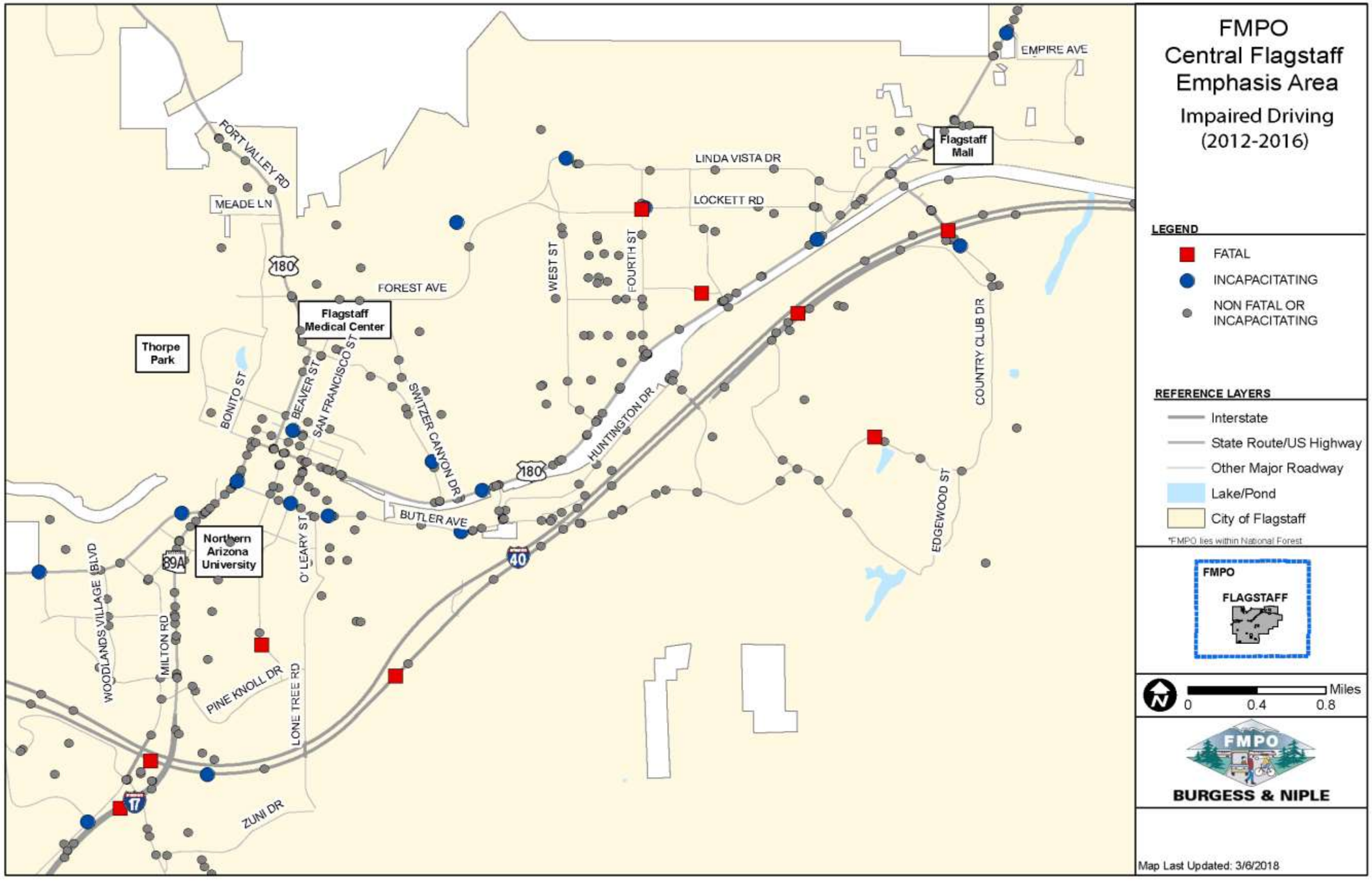


Figure 6.20 – Central Flagstaff Impaired Driver Crash Locations



6.3.6 Natural Risks: Weather

FMPO is at a higher elevation than much of the state and experiences cooler, more seasonal weather. ***Table 13*** summarizes crashes by weather condition compared to the statewide average.

Table 13 – Weather Conditions

Weather Conditions	FMPO		% Statewide
	Count	%	
Clear	7,634	69.1%	86.5%
Cloudy	1,730	***15.7%***	8.7%
Rain	436	***3.9%***	3.3%
Snow	950	***8.6%***	0.5%
Sleet, Hail, Freezing Rain, or Drizzle	73	***0.7%***	0.1%
Unknown	123	***1.1%***	0.6%
Severe Crosswinds	16	0.1%	0.1%
Fog Smog Smoke	21	***0.2%***	<0.1%
Blowing Snow	42	***0.4%***	<0.1%
Other	17	***0.2%***	0.1%
Blowing Sand, Soil, or Dirt	0	0.0%	0.1%
Total	**11,042**	**100.0%**	100%

FMPO experienced higher rates of crashes associated with precipitation, snow, and cooler weather. This higher percentage of weather-related crashes is reasonable considering FMPO experiences more inclement weather than the majority of Arizona. Flagstaff also experiences more days that are overcast than most places in Arizona. This leads to a higher percentage of crashes that occur during cloudy conditions. ***Figure 6.21*** and ***Figure 6.22*** provide a graphical representation of where fatal and other severity crashes involving inclement weather occurred. While FMPO experiences a higher percentage of weather-related crashes, the majority are low severity. Two crashes involving inclement weather were fatal in the five-year analysis period.

Figure 6.21 – Weather-Related Crash Locations

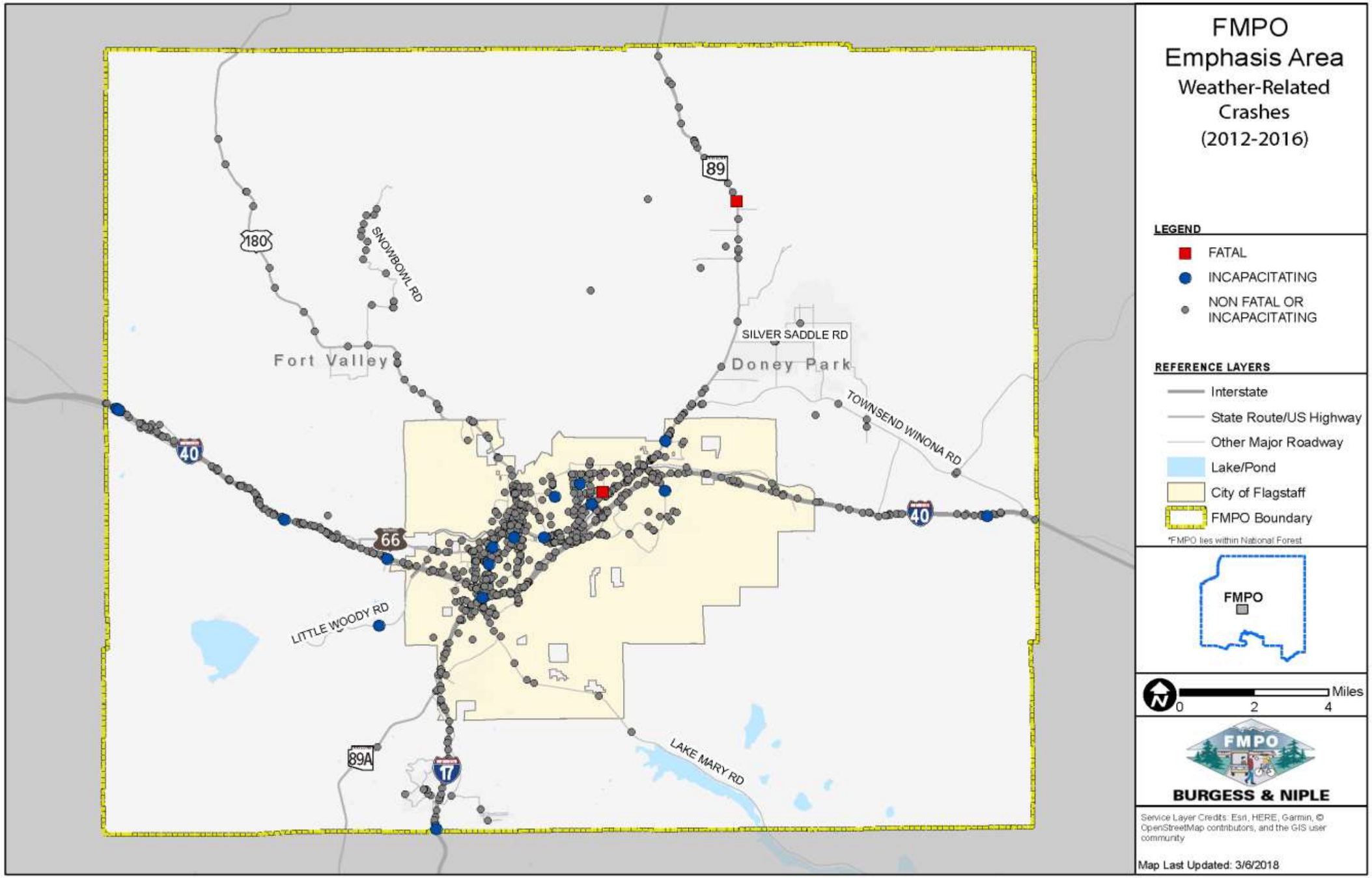
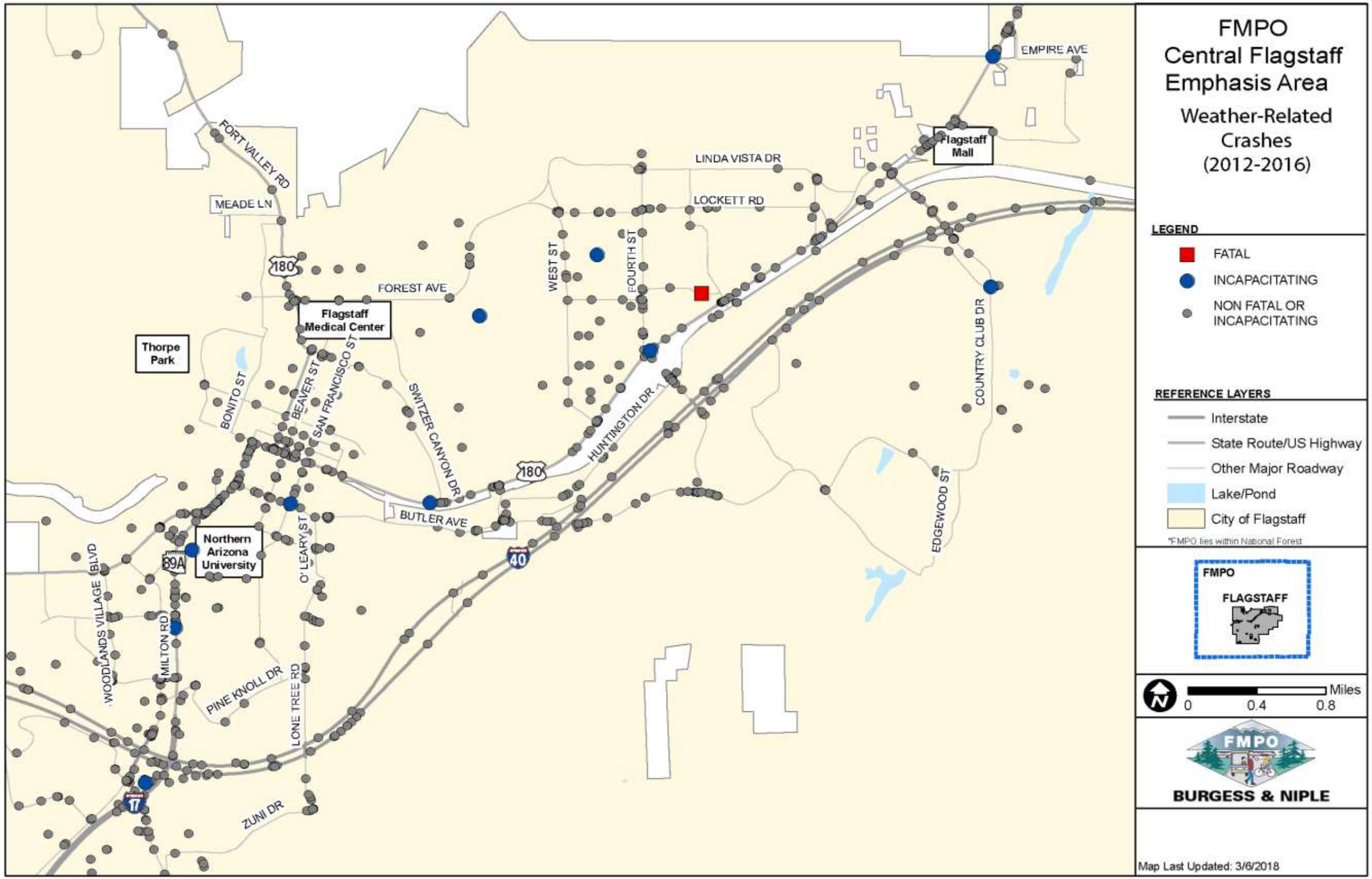


Figure 6.22 – Central Flagstaff Weather-Related Crash Locations



6.3.7 Traffic Incident Management (Work Zone)

There were 2 fatal work zone-related crashes in FMPO during the analysis period. One crash was a daytime rear end involving a young driver, speeding, and a heavy truck. The second crash was a dark-lighted pedestrian collision and involved lane departure, distraction, alcohol and drugs. ***Figure 6.23*** and ***Figure 6.24*** provide a graphical representation of where fatal and other severity crashes involving work zones occurred.

Figure 6.23 – Traffic Incident Management (Work Zone) Crash Locations

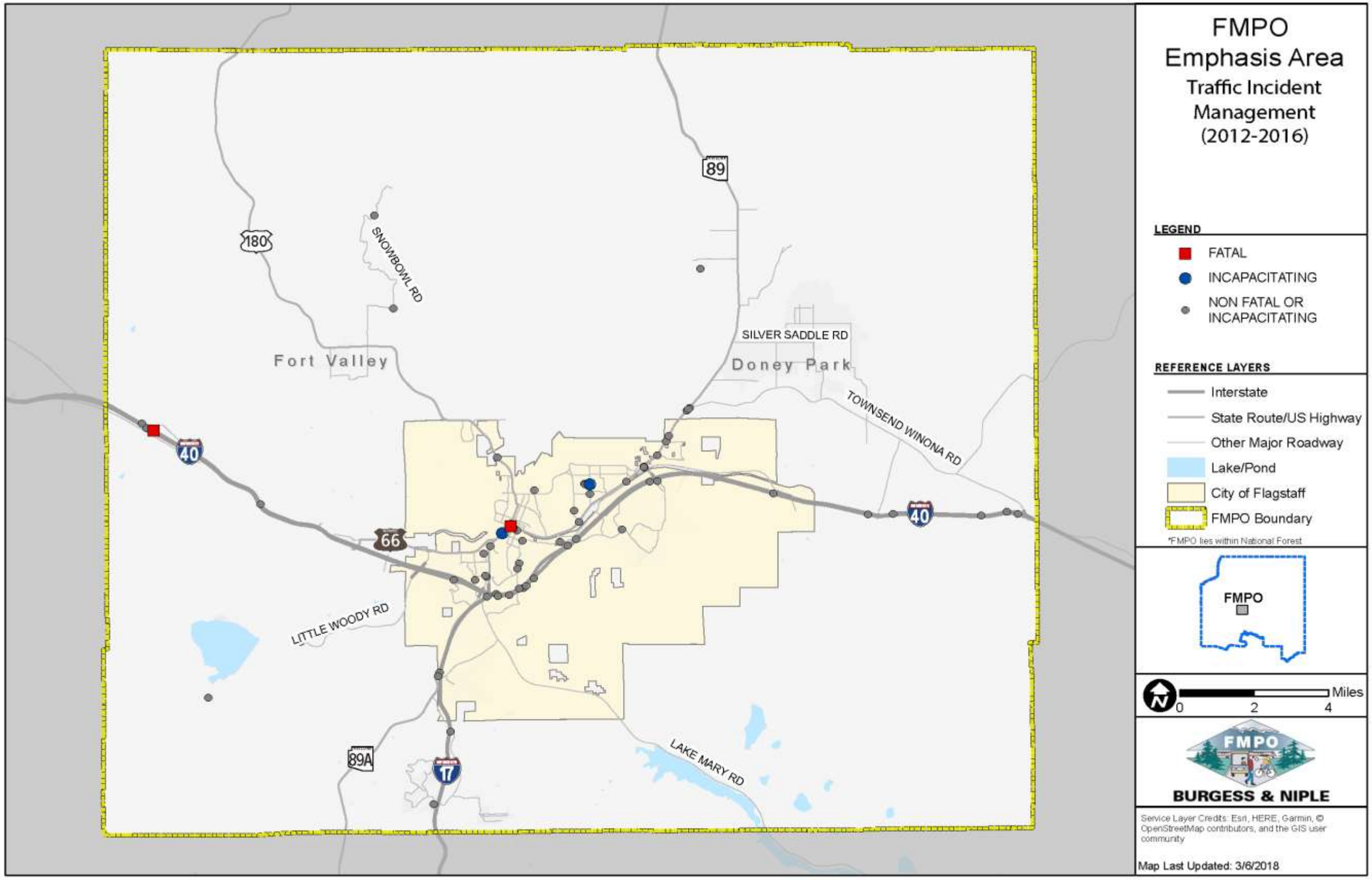
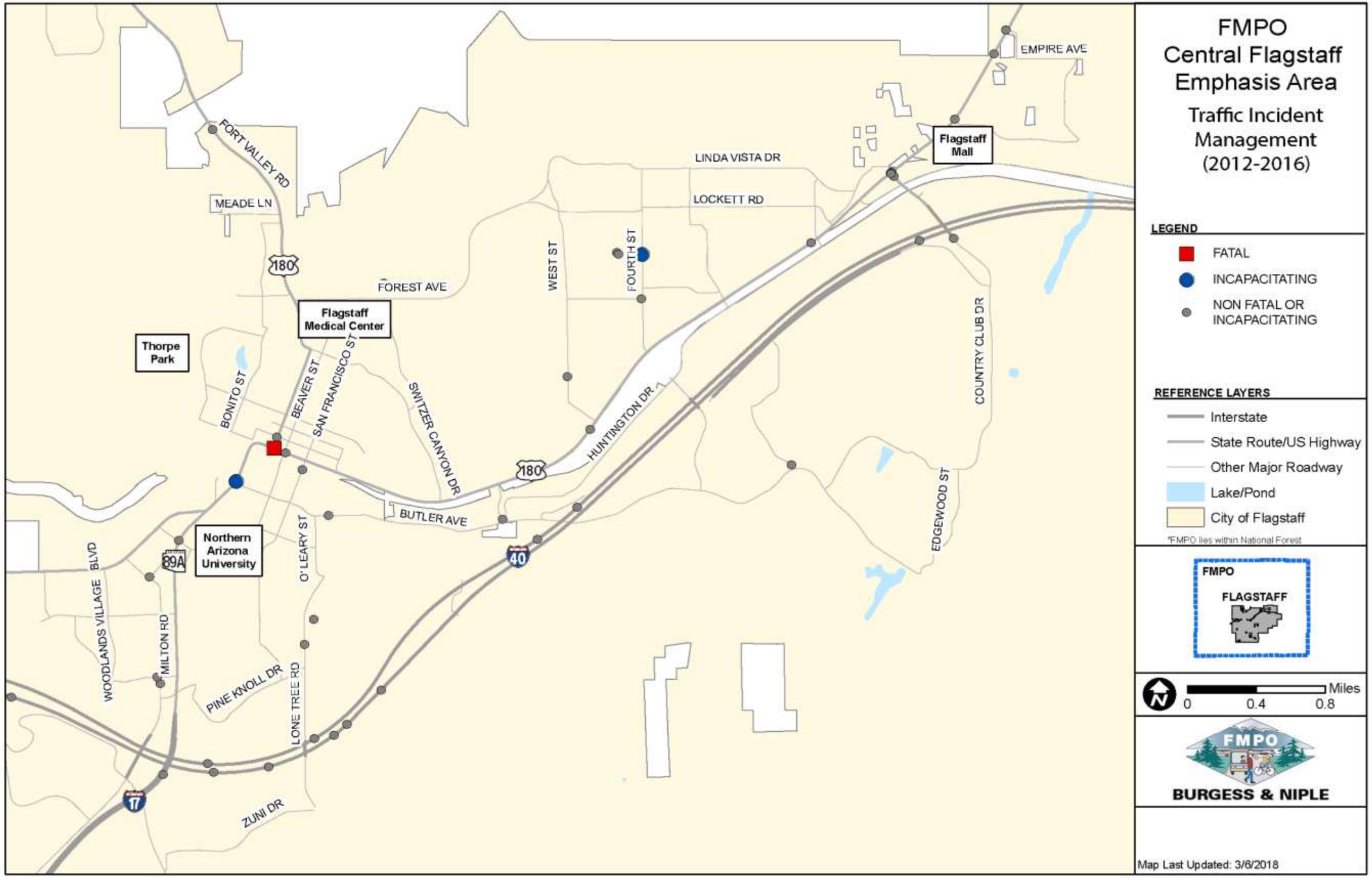


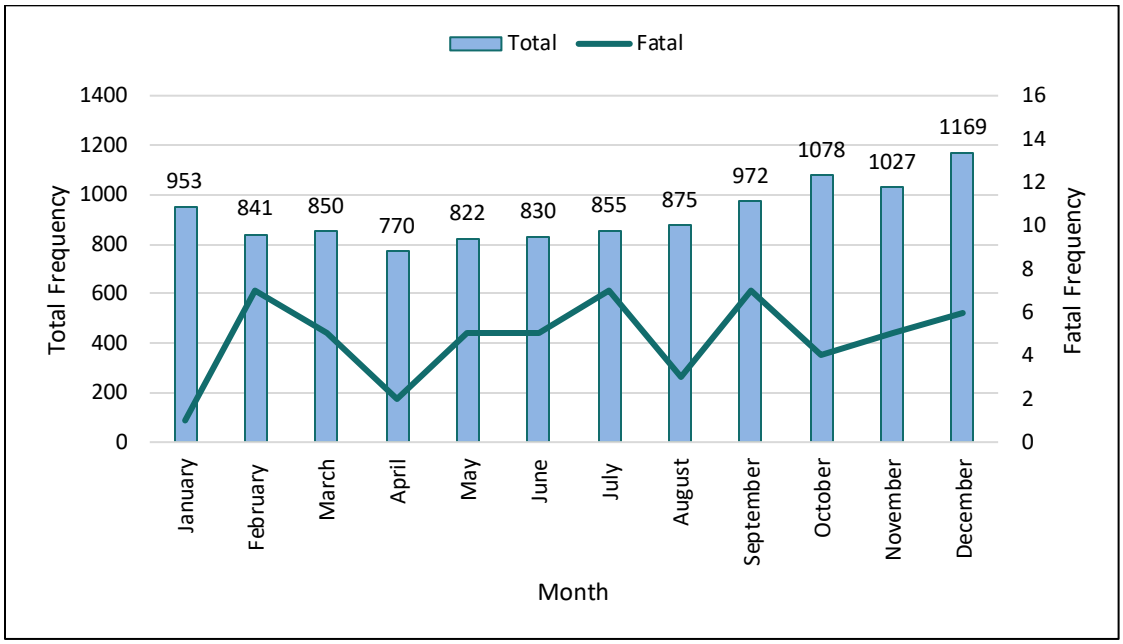
Figure 6.24 – Central Flagstaff Traffic Incident Management (Work Zone) Crash Locations



6.4 Temporal Trends

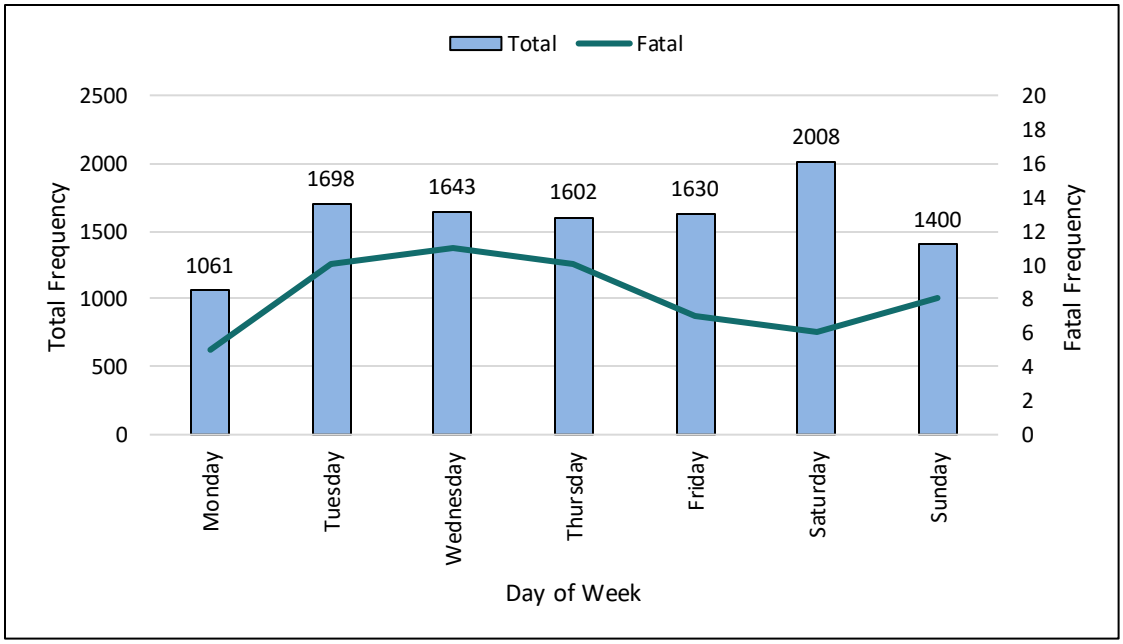
This section summarizes temporal trends for the analysis period. ***Figure 6.25*** summarizes crash frequency by month.

Figure 6.25 – Crash Distribution by Month



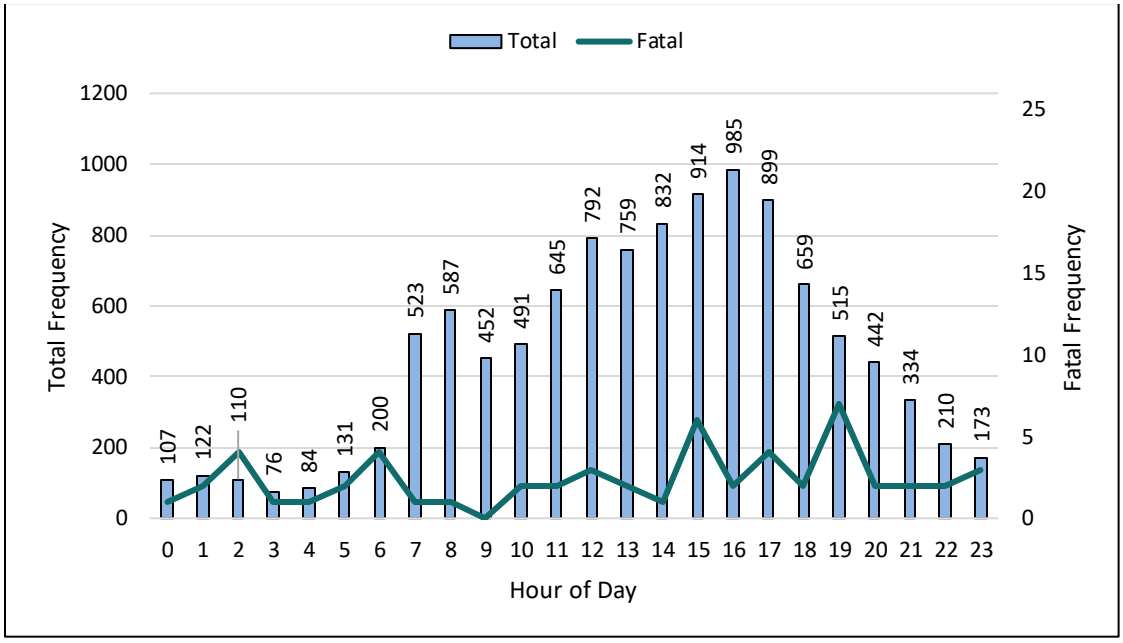
Each month accounts for between approximately 7% and 10% of total crashes. There is no strong correlation between month and crash occurrence; however, a slightly higher percentage of crashes occurred from October through January. ***Figure 6.26*** summarizes crashes by day of week.

Figure 6.26 – Crash Summary by Day of Week



The most crashes occurred on Saturday (18.2%), while the least occurred on Monday (9.6%). Statewide, there are typically more crashes during the week, with the fewest crashes on Sunday. This trend may be attributable to a lower percentage of commuters using vehicles when compared to the state and a higher number of tourists driving in Flagstaff on the weekends. The most fatal crashes in FMPO occurred on Tuesday, Wednesday, and Thursday. Statewide, there is a higher occurrence of fatal crashes during the weekend. ***Figure 6.27*** summarizes crashes by hour of day.

Figure 6.27 – Crash Summary by Hour of Day



Crash frequency began rising at 7 am, with a slight peak from 3 pm to 5 pm. The morning peak is less pronounced than the pm peak. Statewide, the peak hour for all crashes was 5 pm to 6 pm for 2012 to 2014 and 4 pm to 5 pm in 2015 and 2016. The most fatal crashes occurred at 7 pm (7 crashes).

6.5 Environmental Trends

Table 14 compares crash data by lighting condition to statewide percentages.

Table 14 – Lighting Condition

Type of Lighting Conditions	Count	%	% Statewide
Daylight	7,821	70.8%	71.4%
Dawn	203	***1.8%***	1.7%
Dusk	397	***3.6%***	3.0%
Dark - Lighted	1,371	12.4%	17.7%
Dark - Not Lighted	1,130	***10.2%***	5.7%
Dark - Unknown Lighting	120	***1.1%***	0.6%
Total	**11,042**	**100.0%**	100.0%

FMPO experienced nearly double the statewide rate of dark – not lighted crashes, but fewer dark – lighted crashes.

This pattern may be attributed to large unlit areas in rural areas surrounding Flagstaff rather than a concentration of crashes attributed to dark conditions.

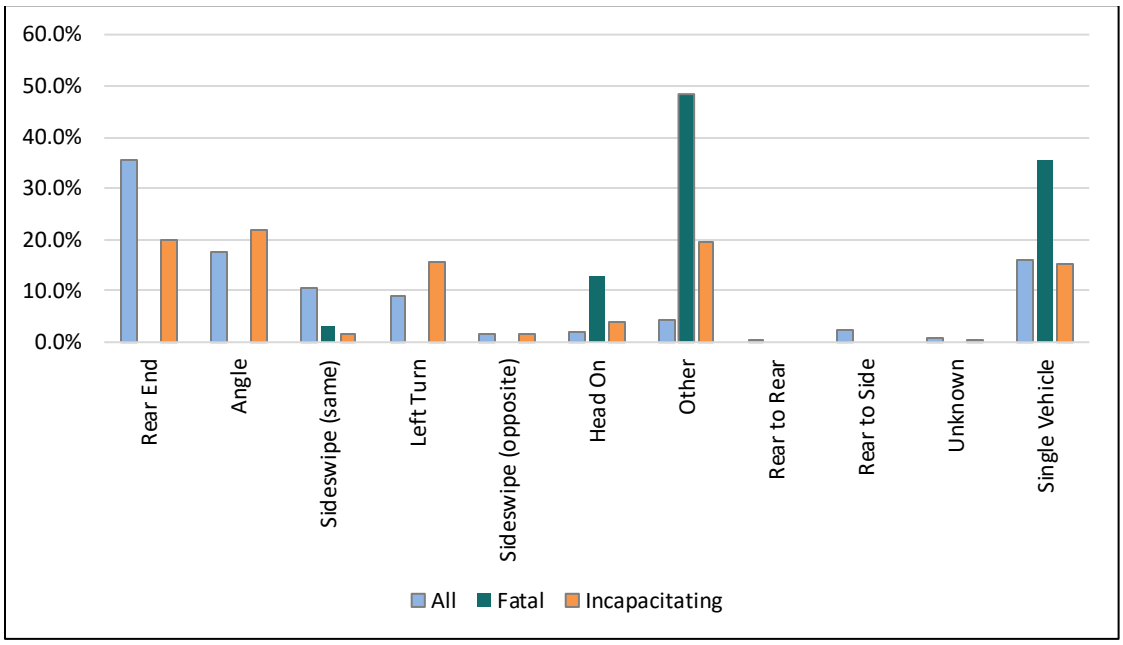
6.6 Functional Classification Trends

The following section identifies trends for severity and collision manner based on functional classification as 1) Arterial or collector; or 2) Freeway. Within FMPO, there were 9,363 crashes and 31 fatal crashes on roadways functionally classified as arterial or below; 1,679 crashes and 26 fatal crashes occurred on freeways.

6.6.1 Functional Classification: Arterial and Collector

Figure 6.28 summarizes crash frequency based on collision manner and severity for crashes occurring on arterial and collector roads.

Figure 6.28 – Arterial and Collector Road Crashes by Collision Manner

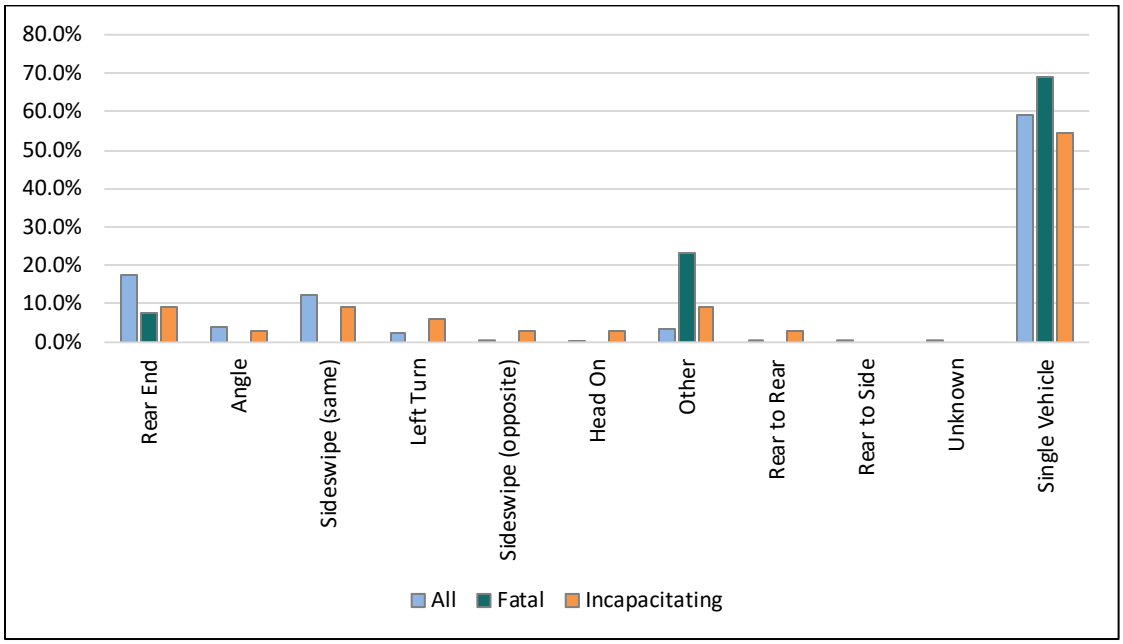


Rear end crashes account for the largest number of crashes on arterial and collector roads (35.7%), followed by angle (17.4%) and single vehicle crashes (15.9%). Despite the high occurrence of rear end, angle, and left turn crashes overall, there were no fatal crashes of these types. The majority of fatal crashes were other (48.4%), single vehicle (35.5%), and head on (12.9%) crashes. The majority of incapacitating crashes were rear end (20.1%), angle (21.7%), left turn (15.8%), other (19.6%), and single vehicle (15.2%). The other category for both fatal and incapacitating crashes was predominately pedestrian crashes (70.6%). Most single vehicle crashes were lane departure crashes (89.7%).

6.6.2 Functional Classification: Interstate and Freeway

Figure 6.29 summarizes crash frequency based on collision manner and severity for crashes occurring on freeways.

Figure 6.29 – Freeway Crashes by Collision Manner



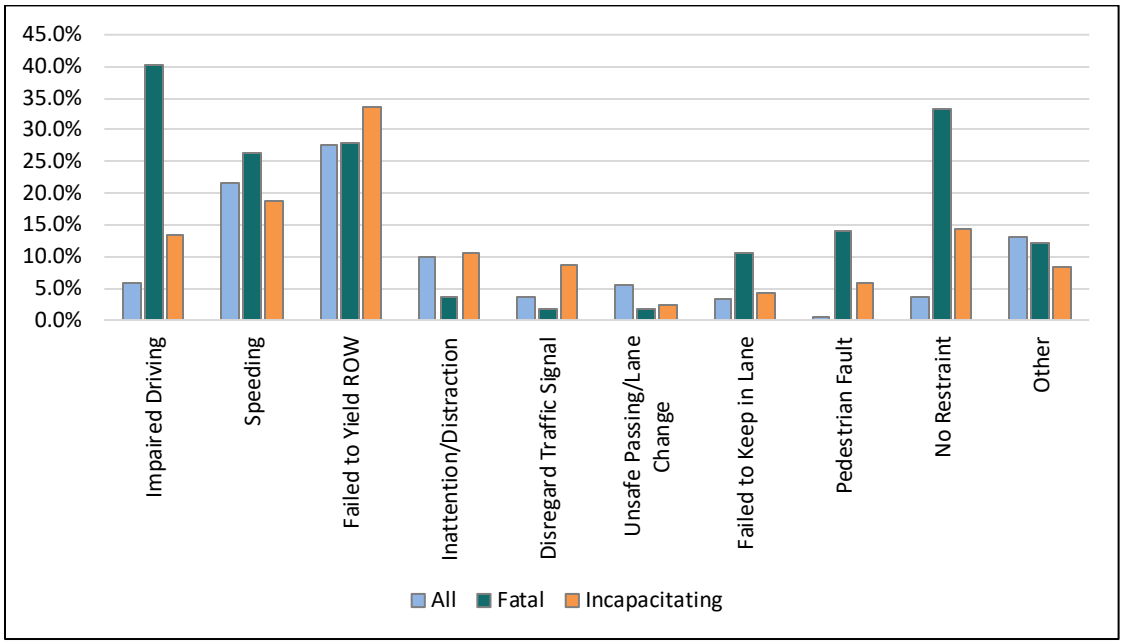
Single vehicle crashes accounted for the most total crashes (59.0%), fatal crashes (69.2%), and incapacitating crashes (54.5%) out of any other crash type by at least 40%. Lane departure and animal crashes accounted for the most single vehicle crashes: 550 (55.5%) and 305 (30.8%) crashes, respectively. Rear end crashes were the second-most represented crash type (17.6%), followed by same direction sideswipe (12.2%) crashes.

Note that arterial and local roads have higher percentages of head on, angle, left turn, and rear end collisions than freeway crashes for both all crashes and incapacitating crashes. This is likely access and/or congestion related.

6.7 Person-Related Trends

Person-related trends review characteristics associated with the at-fault unit (driver, pedestrian, or bicyclist). These attributes include the person's behavior, unit type, (driver, pedestrian, or bicyclist), age, and any cited violations. Potential violations include drug and alcohol use, distraction, speeding, failure to yield, and others. ***Figure 6.30*** summarizes at-fault driver violations for all crashes.

Figure 6.30 – At-Fault Violation in All Crashes



Failing to yield right-of-way was the most-represented violation for FMPO (27.7%), followed by speeding (21.8%), other (13.0%), and inattention/distraction (9.9%). Other includes violations such as following too closely, making an improper turn, driving or riding in the opposite traffic lane, operating with faulty or missing equipment, not using motorcycle safety equipment, and disregarding pavement markings. Impaired driving (40.4%), lack of restraint (33.3%), failing to yield right of way (28.1%), and speeding (26.3%) were cited in the most fatal crashes. Pedestrian fault was cited in 14% of all fatal crashes.

6.7.1 Person-Level Analysis

The SHSP identifies older drivers as those over 65 years old and younger drivers as those under 25 years old. Younger drivers are often at a higher risk for crashes due to inexperience and are over-represented in driver-behavior related crashes. Older drivers may be experiencing changes in vision, reaction time, and other characteristics that increase their likelihood of being in a crash.

The occurrence of fatal crashes in the region is lower for these two groups when compared to statewide trends. Of the 57 fatal crashes, 7 (12.3%) involved an older driver, pedestrian, or bicyclist and 13 (22.8%) involved a younger driver. ***Table 15*** summarizes the total number and the number of impaired, speeding, distracted, and unrestrained crashes in FMPO that occurred in each of these age groups. Note that the totals for each age group do not add up to the total number of crashes in FMPO since a younger and older driver, for example, could have been involved in the same crash. Distraction was a factor in approximately one third of all crashes for each age group.

Table 15 – Fatal Crashes by Age and Contributing Factor						
Citation	Age 65+		Younger Driver (<25)		Drivers 25 - 64	
	Total	Fatal	Total	Fatal	Total	Fatal
Speeding	347	0	1,473	7	1,391	13
Impaired	54	2	236	5	369	16
Distracted	533	3	1,686	3	1,691	12
Unrestrained	52	1	164	6	194	12
All age group crashes	1,520	7	4,654	13	5,226	38

Per the 2010 Census, 6.4% of Flagstaff's population was 65 years old or older, and 29.6% was between 15 and 24 (data was not readily available for persons 16-24 years old). For comparison, statewide, 13.8% of the population was 65 years old or older, and 14.1% was between 15 and 24 (data was not readily available for persons 16-24 years old). Neither of these age groups were involved in more fatal crashes than the statewide average. Notably, there are roughly half as many older drivers in FMPO and they were involved in roughly half as many fatal crashes in FMPO as they were statewide. The younger driver population in FMPO is roughly double the statewide percentage, yet younger drivers in FMPO are involved in a lower percentage of fatal crashes than they are statewide.

6.8 Crash Summary

Key crash trends for the region are as follows:

- Emphasis areas for FMPO which exceed the state average for that emphasis area include speeding and aggressive driving, impaired driving, lane/roadway departure, pedestrian crashes, heavy vehicles/buses/transit, weather-related crashes, and work zone crashes.
- 59.6% of fatal crashes were lane or roadway departure crashes.
- 35.1% of fatal crashes involved a pedestrian.
    - Of those, 70% involved impaired pedestrians.
- 45.6% of fatal crashes occurred on I-17 or I-40.
- The most common driver violations cited in fatal crashes were impairment and lack of restraint use.
- The most common driver violations cited in crashes of all severity was failing to yield right-of-way and speeding.
- The most common manner of collision was rear end (42.5%), followed by angle (19.8%) and same direction sideswipe (13.9%).
- The most common first harmful event in serious crashes was a car striking another car (43.4%), followed by pedestrian collisions (16.8%), fixed object collisions (15.0%), and overturning crashes (12.0%).
- The most prevalent first harmful event for crashes of all severities was a car striking another car (67.1%), followed by fixed object collisions (11.0%), and non-fixed object collisions (6.9%).

7.0 National Performance Management Measures

This plan evaluates crash data in accordance with the National Performance Management Measures Final Rule (23 CFR Part 490), effective April 14, 2016. The Rule establishes procedures, performance measures, data, reporting requirements, and potential consequences for safety performance at the State Department of Transportation (DOT) and Municipal Planning Organization (MPO) level. Its goal is to reduce fatalities and serious injuries by promoting the use of data to inform transportation planning and programming.

The Final Rule establishes five important performance measures to guide HSIP implementation for State DOTs. These performance measures are based on five-year rolling averages and must assess the following:

1. Number of fatalities.
2. Rate of fatalities per 100 million VMT.
3. Number of serious Injuries.
4. Rate of serious injuries per 100 million VMT.
5. Number of combined non-motorized fatalities and serious injuries.

The performance measures apply to all public roads and must be updated annually. State DOTs must report on performance measure targets beginning with the first HSIP annual report, due one year from the effective date of the Final Rule and in each subsequent HSIP annual report. Targets are assessed and progress noted as satisfactory if four of the five performance measures either meet targets or exceed baseline averages. Baseline averages are taken from the most recent five years of crash data, ending prior to the year in which targets were established; e.g., if the targets are established in 2017, the five-year analysis period must analyze years 2012 to 2016.

All MPOs must establish performance targets for each performance measure within 180 days of when the state DOT establishes and reports its targets in its HSIP annual report. MPOs can establish either targets specific to their MPO, or targets which encourage project planning and programming towards achieving a statewide target. If the MPO establishes quantifiable targets specific to the MPO, it must report the VMT estimate and methodology used to estimate the target. This methodology must be consistent with other federal reporting systems.

7.1 State Performance Measures

On August 31, 2017, ADOT established safety targets, or projections, for Arizona for 2018. The state targets for 2018 were adopted by FMPO and are as follows:

- State fatality projection/target is a 4% increase (2018 target 1,040 fatalities, 5-year rolling average 934.6 fatalities).
- State fatality rate projection/target is a 2% increase (2018 target fatality rate 1.53 fatalities/100 mil VMT, 5 year rolling average 1.41 fatalities/100 mil VMT).
- State serious injuries projection/target is neutral (2018 target 4,515 serious injuries, 5-year rolling average 4,330 serious injuries).
- State serious injury rate projection/target is a 1% decrease (2018 target 6.62 serious injuries/100 million VMT, 5-year rolling average 6.55 serious injuries/100 million VMT).
- State non-motorized fatal and serious injuries projection/target is a 2% increase (2018 target 889 non-motorized fatalities and serious injuries, 5-year rolling average 790 fatalities and serious injuries).

7.2 FMPO Performance Measures

Figure 7.1 through ***Figure 7.5*** display performance data for FMPO for each of the required measurements of the projected performance under each adopted goal. VMT was assumed to increase 1% per year to align with ADOT assumptions.

Figure 7.1 – Rolling Average for Number of Fatalities

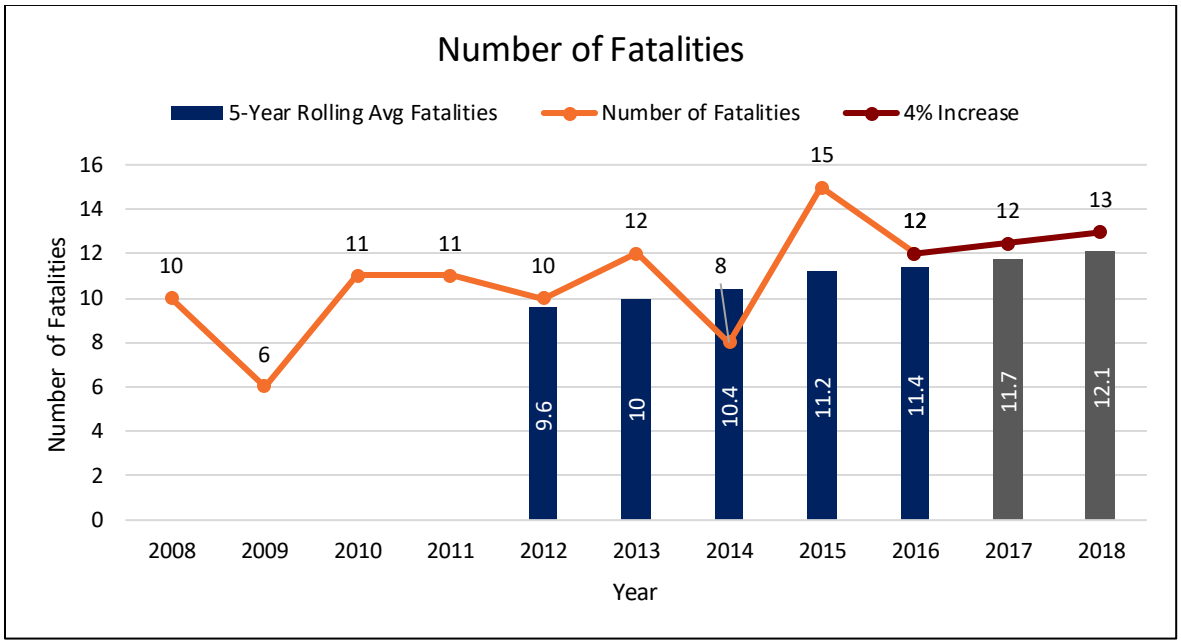


Figure 7.2 – Rolling Average for Fatality Rate

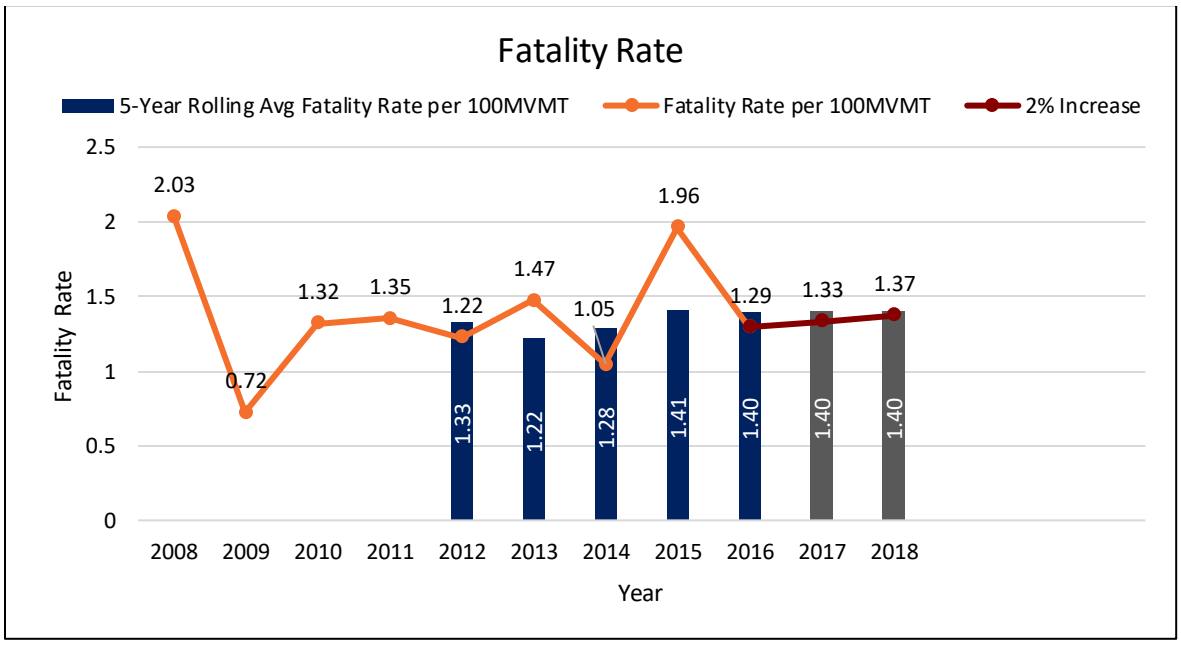


Figure 7.3 – Rolling Average for Number of Serious Injuries

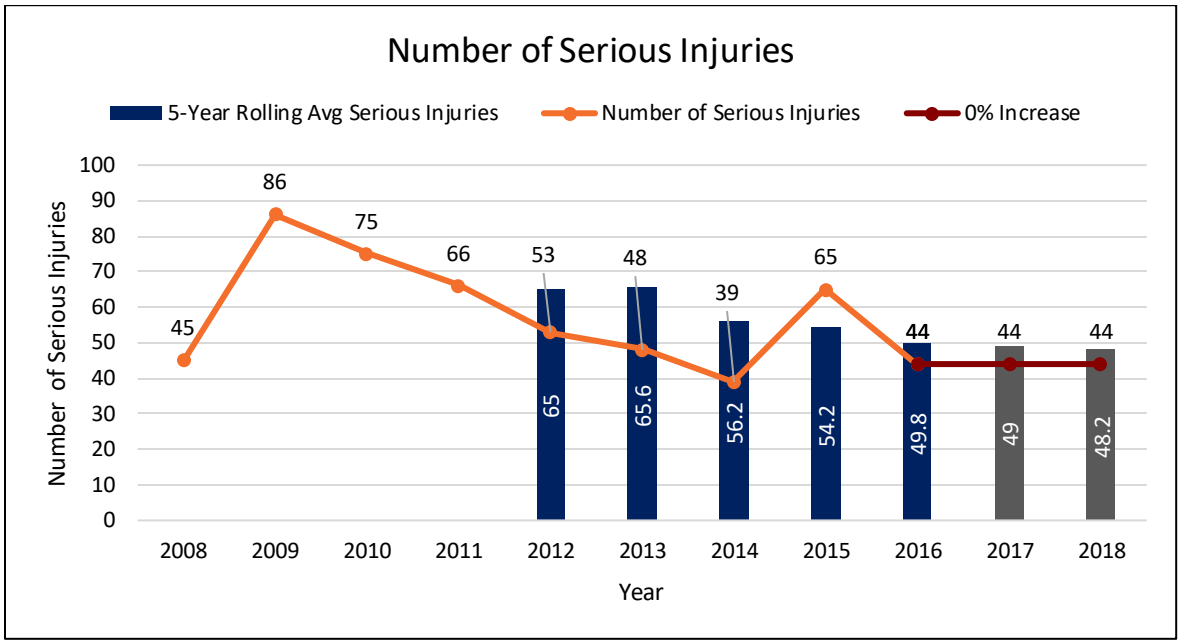


Figure 7.4 – Rolling Average for Serious Injury Rate

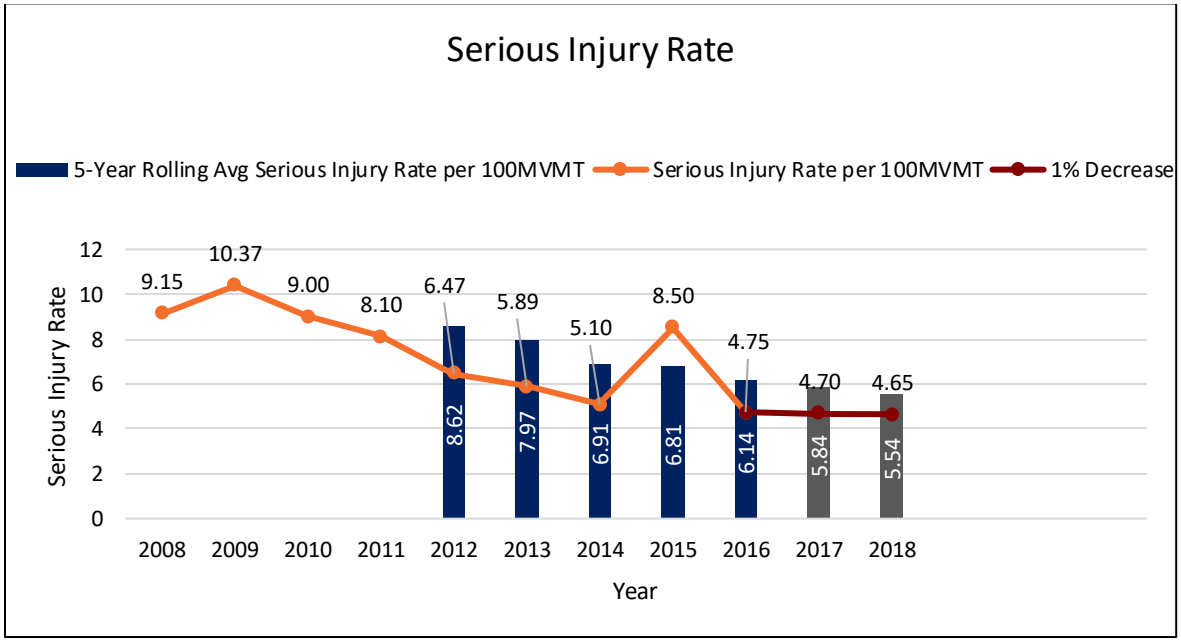
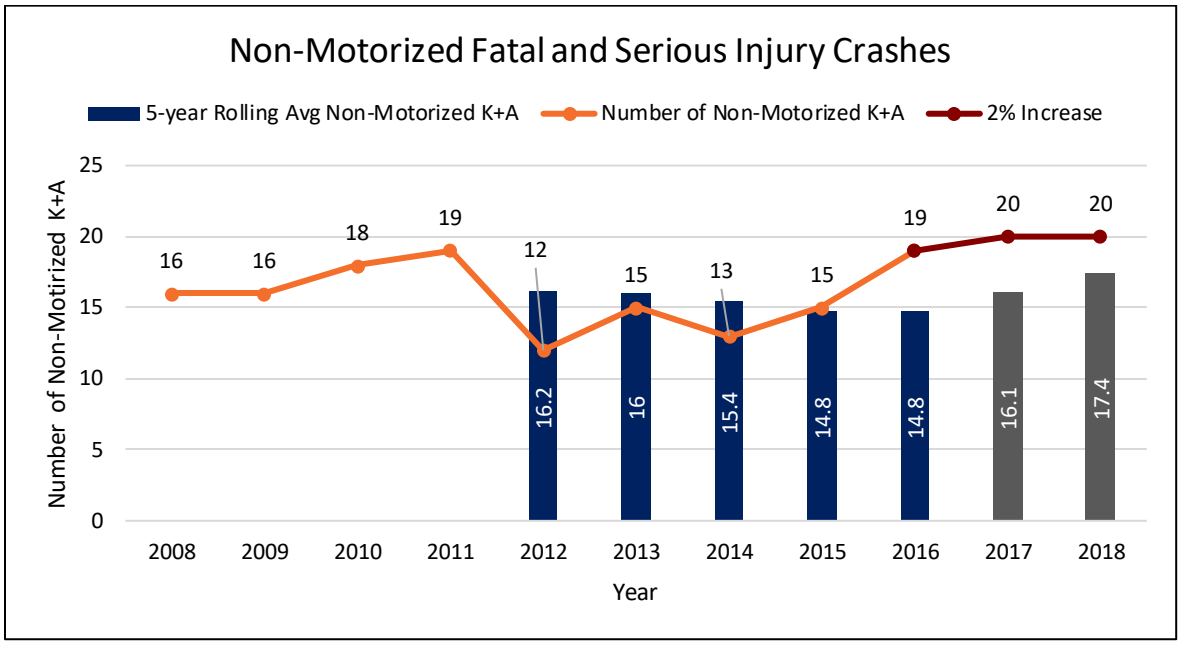


Figure 7.5 – Rolling Average for Non-Motorized Fatal and Serious Injury Crashes



7.3 FMPO Performance Measure Goals

FMPO elected to mirror the SHSP Goals for crash reduction in all performance measure categories. That decision was reached after reviewing the trends and range of projections shown in ***Figure 7.6*** through ***Figure 7.10***.

Figure 7.6 – FMPO Goal for Number of Fatalities Rolling Average

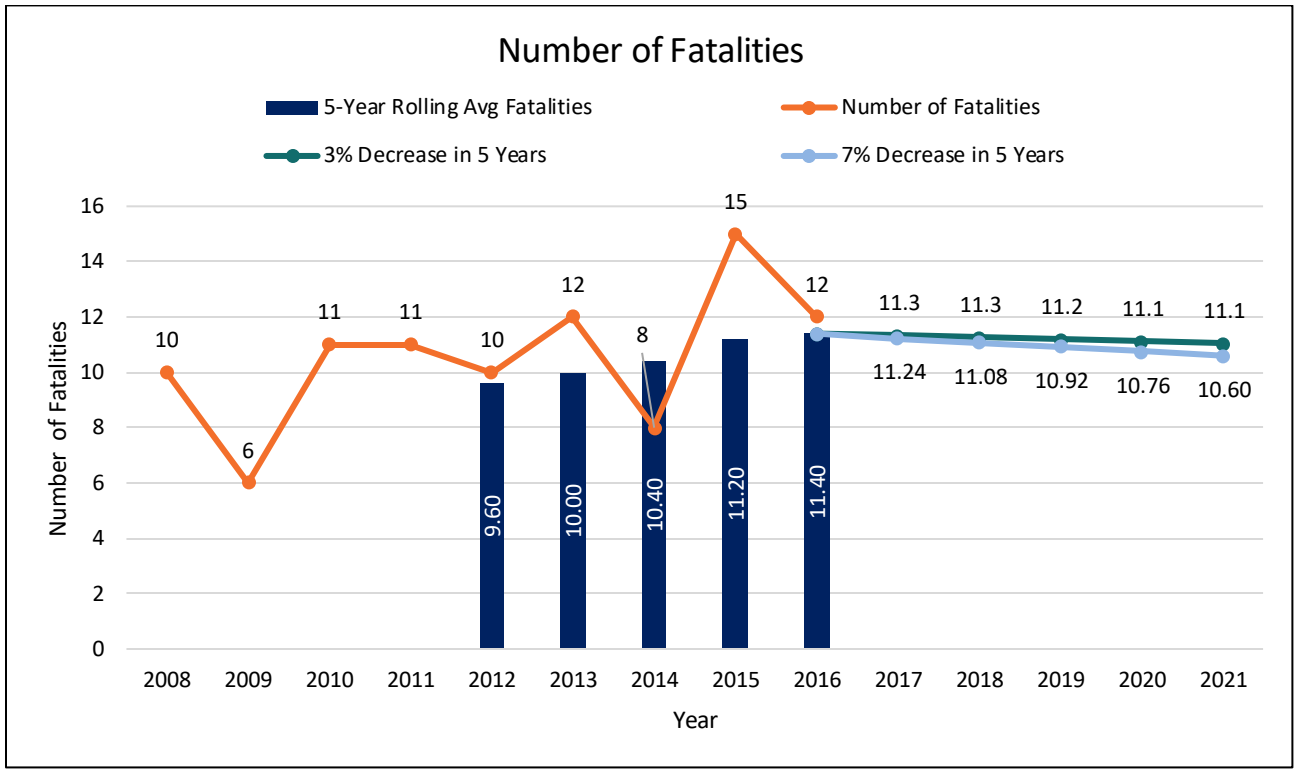


Figure 7.7 – FMPO Goal for Fatality Rate Rolling Average

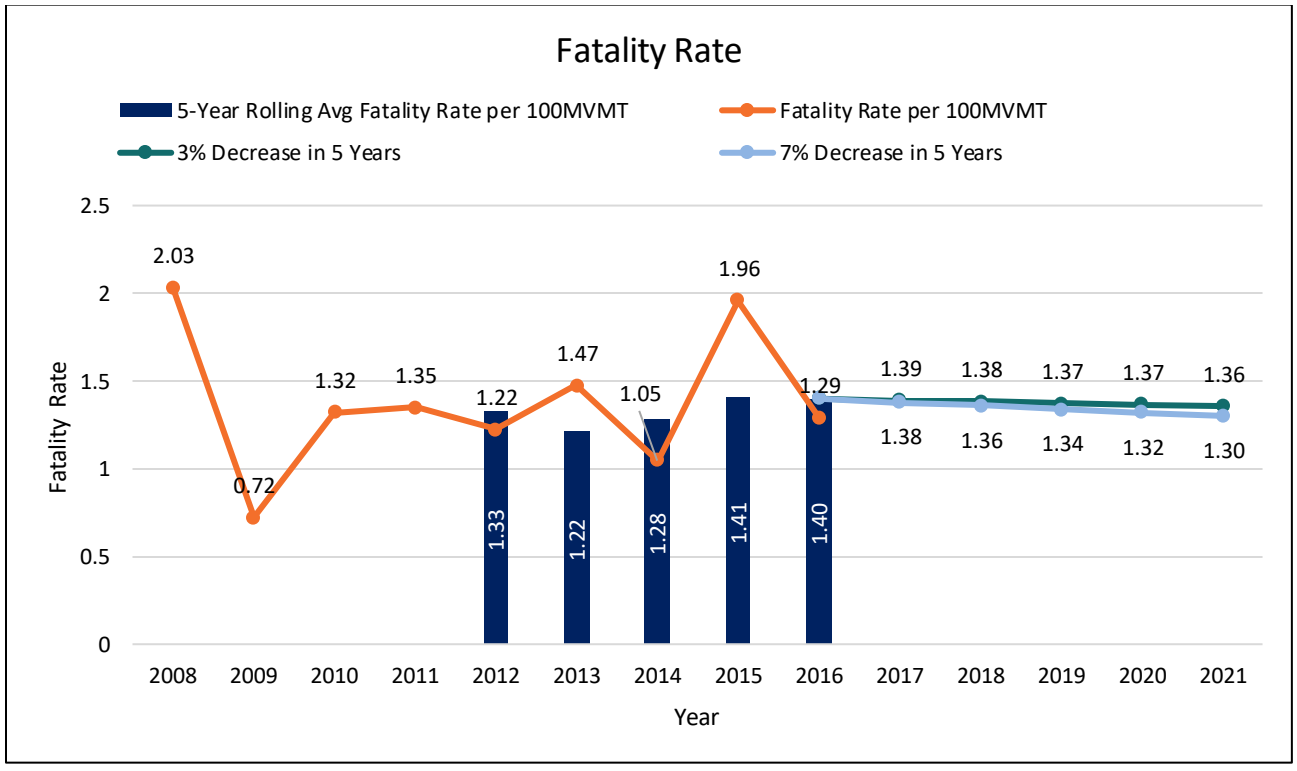


Figure 7.8 – FMPO Goal for Number of Serious Injuries Rolling Average

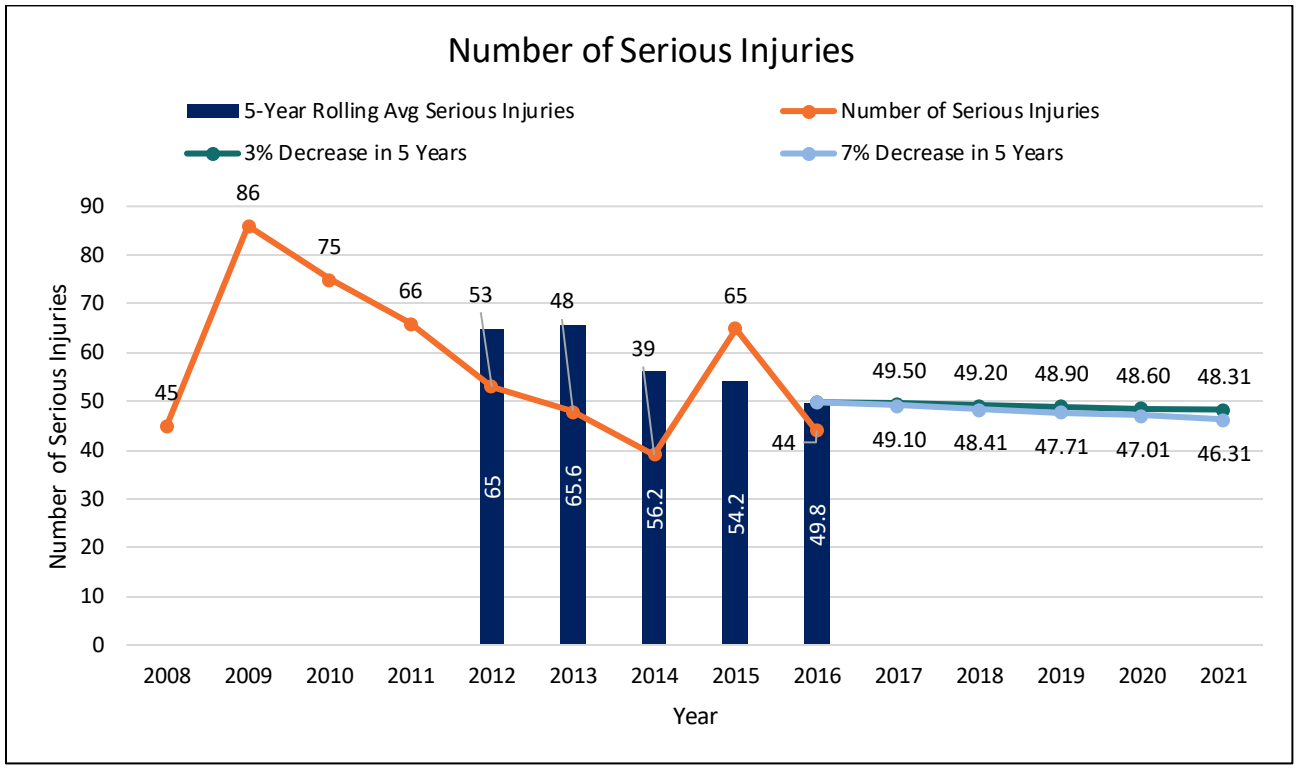


Figure 7.9 – FMPO Goal for Serious Injury Rate Rolling Average

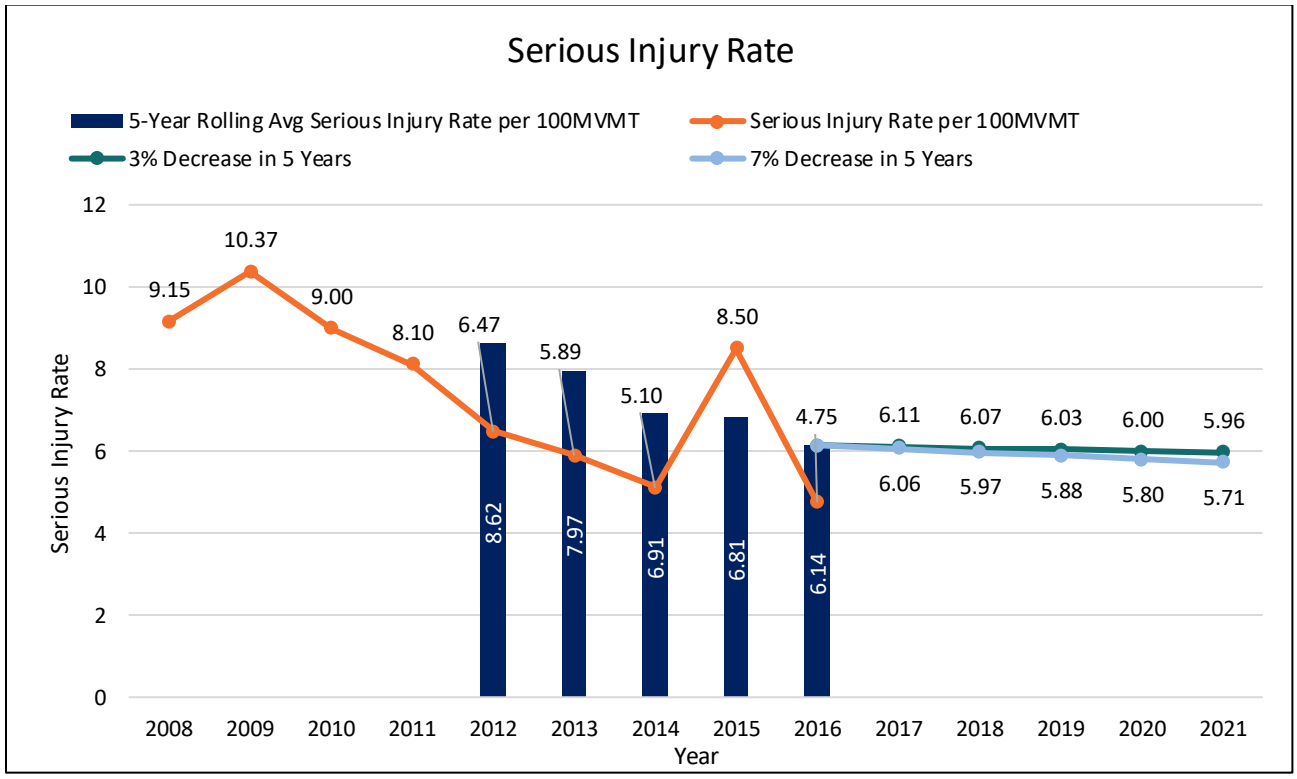
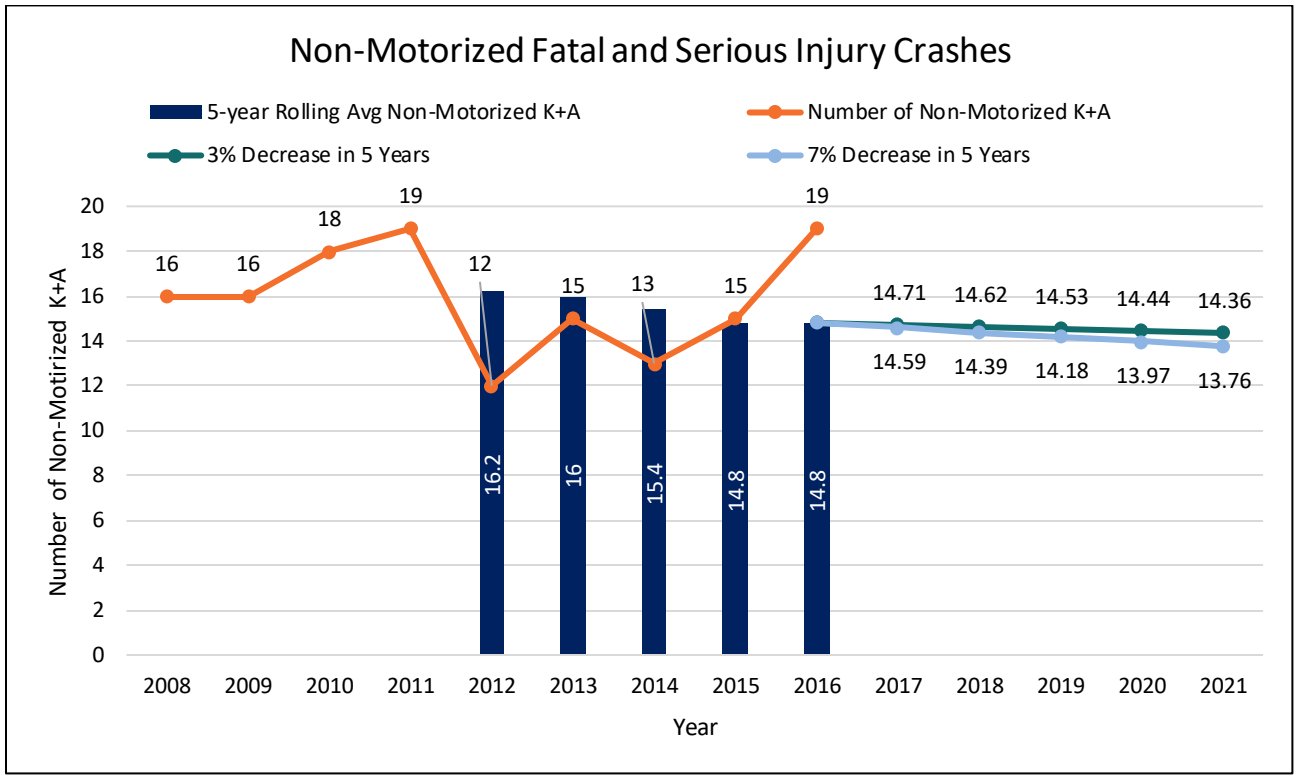


Figure 7.10 – FMPO Goal for Non-Motorized Fatal and Serious Injury Rolling Average



8.0 Network Screening

Network screening was conducted to determine intersections and segments with the highest occurrence of fatal and incapacitating crashes. The following sections describe the analysis process and results for intersection and segment screening.

8.1 Intersection Screening Process

Intersections were identified and ranked by an index developed to weight incapacitating and fatal crashes based on the cost assigned to fatal and incapacitating crashes per the HSIP application. Fatal crashes were assigned a value of 14.5; incapacitating crashes were assigned a value of 1. The ranking index is a combination of the fatal and incapacitating crashes at that intersection. An Excel-based tool was used to aggregate crashes that occurred within one-tenth of a mile of an intersection, calculate the intersection index, and develop preliminary intersection rankings. Top-ranked intersections were back-checked and updated through a manual review of the intersections in the ArcGIS Online tool. Only fatal and incapacitating crashes within 500 feet of the intersection in the ArcGIS Online tool were considered in the final rankings.

8.2 Intersection Screening Results

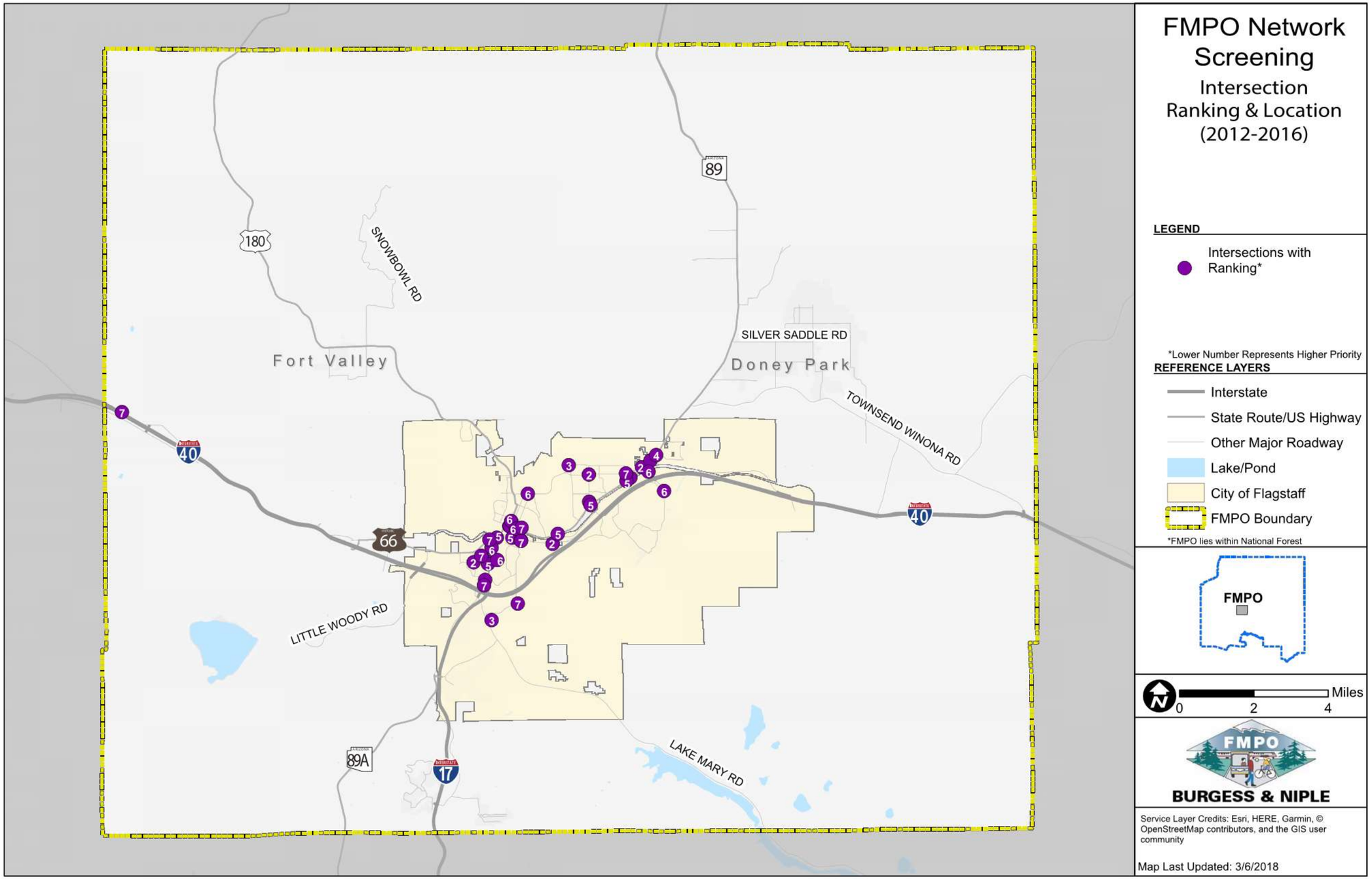
The top 25 ranked intersections for the FMPO region are presented in ***Table 16***. Alternate names for cross streets are provided in parentheses underneath the road name given in the crash record. Intersection screening identified crash hot spots for further analysis; in some instances, locations may not be ideal HSIP candidates due to project feasibility, cost, stakeholder input, or other factors. Intersection locations and rankings are shown in ***Figure 8.1*** and ***Figure 8.2***.

Table 16 – Intersection Screening Summary

Rank	On Road	Intersection	Fatal Crashes	Incapacitating Crashes	Index
1	East Route 66 (I 40 BUS) (US 180)	Humphreys Street	1	3	17.5
2	Lockett Road (Cedar Avenue)	Fourth Street	1	1	15.5
2	Butler Avenue	Babbitt Drive	1	1	15.5
2	University Avenue	Milton Road (AZ 89A)	1	1	15.5
2	Fourth Street	Third Avenue	1	1	15.5
2	U.S. Highway 89	Country Club Drive	1	1	15.5
2	U.S. Highway 89	Cummings Street	1	1	15.5
2	Woodlands Village Boulevard	University Avenue	1	1	15.5
3	Paradise Road	Linda Vista Drive	1	0	14.5
3	East Route 66 (US 180) (I 40 BUS)	Lockett Road	1	0	14.5
3	Walapai Drive	Mohawk Drive	1	0	14.5
4	U.S. Highway 89	East Marketplace Drive	0	5	5
5	Route 66 (I 40 BUS) (US 180)	Enterprise Road (Ponderosa Parkway)	0	3	3

Table 16 – Intersection Screening Summary					
Rank	On Road	Intersection	Fatal Crashes	Incapacitating Crashes	Index
5	University Drive	Milton Road (AZ 89A)	0	3	3
5	East Route 66 (I 40 BUS) (US 180)	Fourth Street	0	3	3
5	East Route 66 (I 40 BUS) (US 180)	Fanning Drive	0	3	3
5	Milton Road (Route 66) (I 40 BUS)	Malpais Lane	0	3	3
5	San Francisco Street	Butler Avenue	0	3	3
6	Humphreys Street	Birch Avenue	0	2	2
6	University Drive	Knoles Drive	0	2	2
6	South Elden Street	Butler Avenue	0	2	2
6	McConnell Drive	Beulah Boulevard	0	2	2
6	San Francisco Street	Forest Avenue	0	2	2
6	San Francisco Street	East Route 66 (US 180) (I 40 BUS)	0	2	2
6	Nestle Purina Avenue (Motel Drive)	Country Club Drive (I 40 BUS) (US 180)	0	2	2
6	Riordan Road	Riordan Ranch Street	0	2	2
6	East Soliere Avenue	Country Club Drive	0	2	2
7	NF-171	Brannigan Park Road	0	1	1
7	Woodlands Village Boulevard	Beulah Boulevard	0	1	1
7	South Lone Tree Road	East Butler Avenue	0	1	1
7	Yale Street	Plaza Way	0	1	1
7	Zuni Drive	Lone Tree Road	0	1	1
7	Verde Street	Aspen Avenue	0	1	1
7	Lockett Road	Fanning Drive	0	1	1
7	Route 66 (I 40 BUS)	South Blackbird Roost Street	0	1	1

Figure 8.1 – Intersection Ranking and Locations



FMPO Network Screening

Intersection Ranking & Location (2012-2016)

LEGEND

Intersections with Ranking*

*Lower Number Represents Higher Priority

REFERENCE LAYERS

- Interstate
- State Route/US Highway
- Other Major Roadway
- Lake/Pond
- City of Flagstaff
- FMPO Boundary

*FMPO lies within National Forest

FMPO

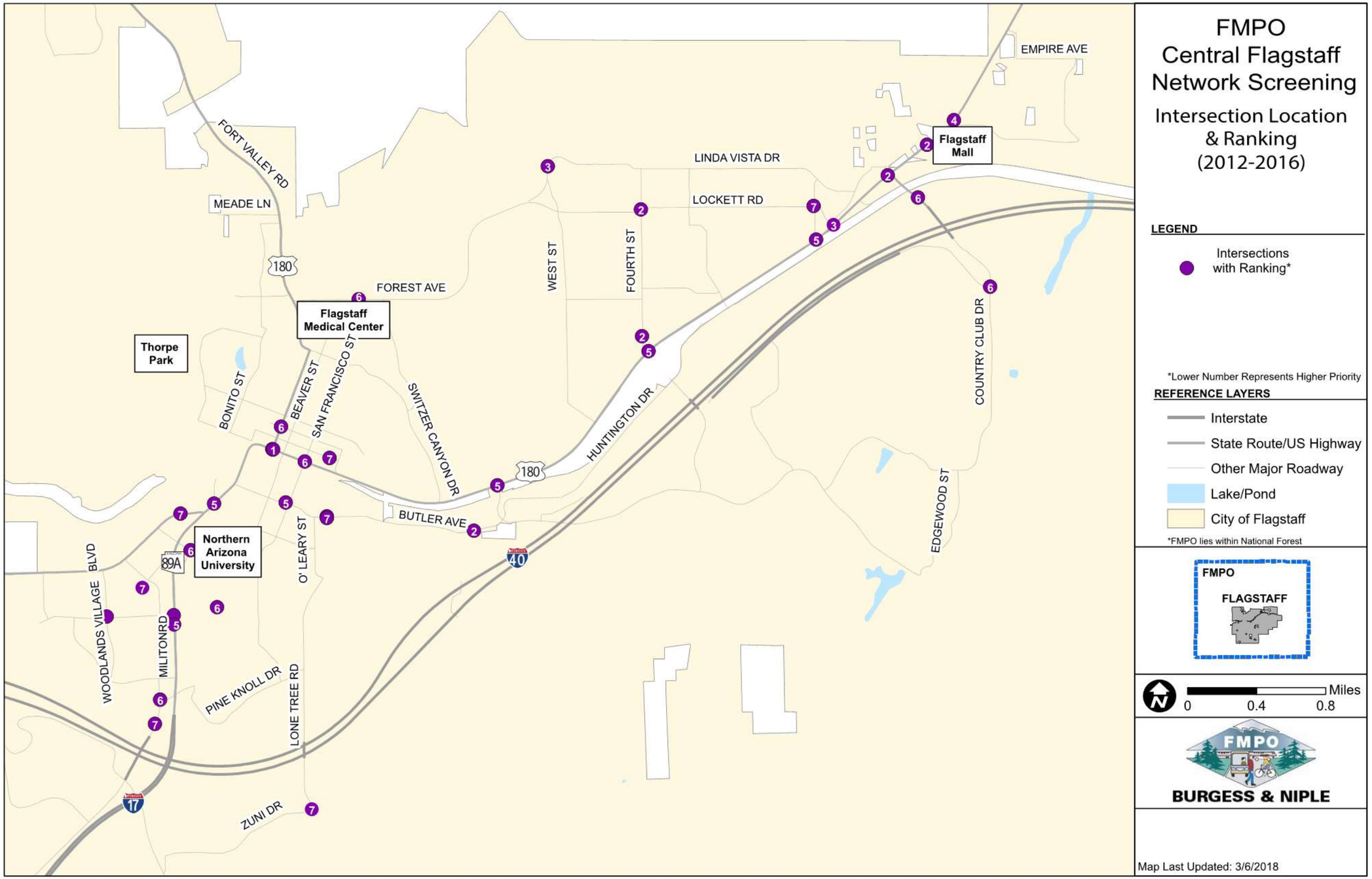
0 2 4 Miles

BURGESS & NIPLE

Service Layer Credits: Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community

Map Last Updated: 3/6/2018

Figure 8.2 – Central Flagstaff Intersection Ranking and Locations



8.3 Segment Screening Process

Segments with higher incidence of fatal and incapacitating crashes were identified via a segment-specific network screening. Segments classified as collector and above were considered. The Environmental Systems Research Institute (ESRI) ArcGIS for Local Government tool was used to help automate the process of network screening. Model Inventory of Roadway Elements (MIRE) data was provided by ADOT and was supplemented by data from FMPO, including intersection traffic control, medians and lane counts, and functional classification. Where data was not readily available, assumptions were made based upon the best available information. GIS-based screening was achieved in three steps: first the existing road network was segmented; then five years of severe (fatal and incapacitating) crash data was assigned to the segments; and third, risk maps were created.

Roadway segmentation was based upon the United States Road Assessment Program (usRAP) Protocol, which segments the network when the following changes in a roadway occur:

- A route begins or ends.
- A county name changes.
- There is a discontinuity in the route.
- The roadway type changes (including functional classification, division type, area type).
- The annual average daily traffic (AADT) changes by 20% or more.
- The speed limit category changes.

Based on segmentation and crash assignation, segments were identified as highest risk, medium-high risk, medium risk, medium-low risk, and lowest risk. Only fatal and incapacitating crashes were considered for screening to help identify HSIP-eligible sites. Roadway characteristics that influence risk assignment include:

- Speed;
- Number of lanes;
- Annual Average Daily Traffic (AADT);
- Roadway division type (undivided/divided);
- Area type (rural/urban); and
- Access control.

Network screening was completed by assessing crash risk, crash frequency, crash trends, and characteristics of the existing roadway. Segments identified as medium-low risk or above were manually examined in conjunction with fatal and incapacitating crash history to determine whether the segment should be targeted. Note that not all segments within these risk categories were identified for improvement. For example, a segment might be identified as a highest risk segment because of roadway characteristics, but may not have experienced any severe crashes during the analysis period. Likewise, a medium risk segment might have several severe crashes attributed to it, but its roadway characteristics identify the segment as lower risk. A manual review adjusted for these phenomena and included segments that might benefit from systemic improvements. Additionally, locations known to have received safety improvements within the past five years that may have addressed crash risk were removed.

8.4 Segment Screening Results

Network screening and stakeholder engagement revealed a list of segments in FMPO for further review, shown in ***Table 17***. Note that this list **does not** represent segment rankings.

Table 17 – Segment Screening Summary			
On Road	**Start**	**End**	**Crash Risk**
I-17	MP 333 (NACOG border)	Pine Knoll Drive	Highest
Woodlands Village Boulevard	B-40	Beulah Boulevard	Highest
B-40	Woody Mountain Road	Woodlands Village Boulevard	Medium-High to Highest
Milton Road/East Route 66/Santa Fe Avenue	Pine Knoll Drive	Fourth Street	Medium-High to Highest
San Francisco Street	Pine Knoll Drive	East Route 66/Santa Fe Avenue	Medium to Highest
Birch Avenue	Humphreys Street	Leroux Street	Highest
I-40	I-17	Townsend-Winona Road	Highest
Butler Avenue	Sawmill Road	Ponderosa Parkway	Highest
Fourth Street	Andes Drive	I-40	Highest
Seventh Avenue/Lakin Drive	Fourth Street	Steves Boulevard	Highest
I-40	NF-171	Flagstaff Ranch Road	Highest
US 89	Fanning Drive	NF-552	Medium to Highest
Townsend-Winona Road	US 89	Koch Field Road	Medium

These locations are mapped in ***Figure 8.3*** and ***Figure 8.4***.

Figure 8.3 – Potential HSIP-Eligible Segments

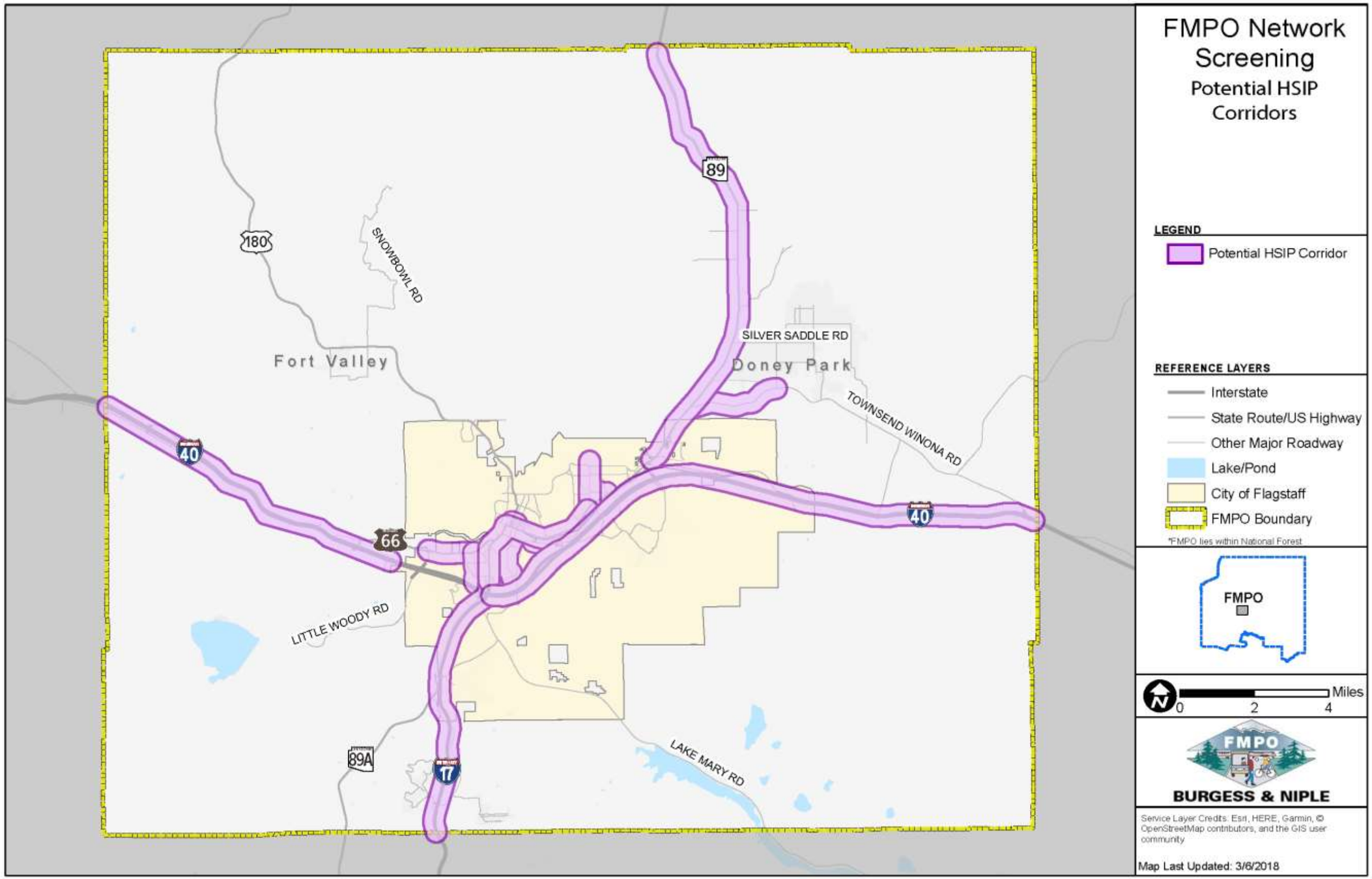


Figure 8.4 – Central Flagstaff Potential HSIP-Eligible Segments

9.0 Predictive Analysis

Predictive analysis was performed in accordance with the HSM for select intersections identified by project stakeholders. Predictive analysis is a process rooted in extensive research that was introduced with the HSM. Knowing the characteristics of a segment or intersection, predictive analysis can forecast the number of crashes per year that will occur at a similar segment or intersection. Given crash data for a segment or intersection, it can also provide a look at how a site is *expected* to perform in a "typical" year by accounting for regression to the mean. The difference between the *expected* number of crashes per year and the *predicted* number of crashes per year is the Potential for Safety Improvement (PSI). When the expected number is greater than the predicted number, the site is performing worse than similar sites. Note that a site with a negative PSI may still justify improvement if it experiences a high number of crashes. In this case, a change to the base conditions of the site could be considered. See the accompanying Safety System Analysis Tools User Guide for these base characteristics. For the purposes of this report, all segments and intersections were modeled as urban/suburban arterial intersections and segments. A summary of predictive analysis results for these select locations is provided in ***Table 18*** and ***Table 19***.

Table 18 – Predictive Analysis Summary: Intersections

	Predicted Crashes/Year			Expected Crashes/Year			PSI		
	Total	Fatal & Injury	PDO	Total	Fatal & Injury	PDO	Total	Fatal & Injury	PDO
Route 66/Milton Road & Humphreys Street	7.9	3.3	4.6	12.0	3.3	8.7	***4.1***	***0.0***	***4.1***
US 89 & Marketplace Drive	6.3	2.2	4.1	9.7	2.9	6.8	***3.4***	***0.7***	***2.7***
US 89 & Cummings Street	4.7	1.8	2.9	8.9	2.5	6.4	***4.2***	***0.8***	***3.4***
E Route 66 & Ponderosa Parkway	4.3	1.5	2.7	10.7	2.3	8.4	***6.4***	***0.7***	***5.6***
Woodlands Village Boulevard & University Avenue	2.6	0.9	1.7	4.1	1.0	3.1	***1.5***	***0.1***	***1.5***
Lockett Road & Fourth Street	1.8	0.7	1.1	2.6	0.7	1.9	***0.9***	***0.1***	***0.8***

Note: Red text under "PSI" indicates a positive potential for safety improvement.

Table 19 – Predictive Analysis Summary: Segments									
	Predicted Crashes/Year			Expected Crashes/Year			PSI		
	Total	Fatal & Injury	PDO	Total	Fatal & Injury	PDO	Total	Fatal & Injury	PDO
E Route 66/Milton Road: McConnell Drive to Elden Street	50.4	16.1	34.2	87.3	20.3	67.0	***37.0***	***4.2***	***32.8***
E Route 66: Switzer Canyon Drive to Fourth Street	23.5	6.7	16.7	28.9	7.3	21.6	***5.4***	***0.6***	***4.9***
US 89: Country Club Drive to Townsend-Winona Road	19.9	5.6	14.3	34.5	7.9	26.7	***14.7***	***2.3***	***12.4***
Fourth Street: Andes Drive to I-40	14.0	4.2	9.8	16.9	4.5	12.4	***2.9***	***0.3***	***2.6***
Butler Avenue: Sawmill Road to Ponderosa Parkway	13.2	3.8	9.4	11.9	3.5	8.4	-1.3	-0.3	-1.0
San Francisco Street: Pine Knoll Drive to E Route 66	3.2	1.1	2.2	4.3	1.2	3.2	***1.1***	***0.1***	***1.0***
B-40: Woody Mountain Road to Woodlands Village Boulevard	3.2	0.9	2.3	3.5	1.0	2.5	***0.3***	***0.1***	***0.2***
Note: Red text under "PSI" indicates a positive potential for safety improvement.									

Predictive analysis results in ***Table 18***, along with the intersection screening results of ***Table 16***, effectively identify intersections in need of improvement when used together. ***Table 20*** compares the intersection ranking based on the five-year crash history identified in ***Table 16*** to the PSI provided in ***Table 18***.

Table 20 – Comparison of PSI and Crash History Rank				
	PSI			Rank Based on Crash History
	Total	Fatal & Injury	PDO	
Route 66/Milton Road & Humphreys Street	4.1	0.0	4.1	1
US 89 & Cummings Street	4.2	0.8	3.4	2
Woodlands Village Boulevard & University Avenue	1.5	0.1	1.5	2
Lockett Road & Fourth Street	0.9	0.1	0.8	2
US 89 & Marketplace Drive	3.4	0.7	2.7	4
E Route 66 & Ponderosa Parkway	6.4	0.7	5.6	5

Note that, in general, the sites with higher PSIs correspond to sites with a higher ranking based on crash history. The exception is Route 66 and Ponderosa Parkway; however, this is likely attributed to the weighting given to fatal and incapacitating crashes in the ranking system. The crash severities were weighted based on HSIP funding criteria, while the HSM does not apply the same weighting to these crash severities. Based on the combined evaluation, Route 66 and Ponderosa Parkway and US 89 and Cummings Street appear to be the highest priority locations.

10.0 Funding Resources

State and local transportation systems are primarily funded by two programs: the Federal Aid Highway Program and the Arizona Highway User Revenue Fund (HURF). Both programs generate revenue from system users, who pay a variety of transportation-related taxes. These taxes include a gas tax, vehicle license fees, and auto registration fees. However, a variety of programs at the federal level also provide funds for state and local transportation projects. The largest of these is the HSIP, which incorporates programs such as the Railway-Highway Crossings and High Risk Rural Roads programs. The following sections discuss these funding opportunities in more detail and presents further funding opportunities.

10.1 Higher Potential Funding Sources

10.1.1 Highway Safety Improvement Program (HSIP)

The HSIP provides federal funds for projects which aim to reduce traffic fatalities and serious injuries on public roads, including tribal lands and roads owned by non-state entities. Projects considered must be consistent with United States Code Section 148 of Title 23 (23 U.S.C. 148) and must support a "data-driven, strategic approach to improving safety." To be eligible for funding, ADOT requires applications for potential HSIP projects to demonstrate a benefit-to-cost ratio of at least 1.5, a minimum project cost of $250,000, and a maximum project cost of $5,000,000. Each project must address five performance measures, established by the Safety Performance Management Final Rule to guide the implementation, assessment, and safety target reporting for HSIP projects. Performance measures are discussed in Section 7.0 Note that following the establishment of the FAST Act in 2015, HSIP no longer supports non-infrastructure projects, such as education and law enforcement. More information is available at **https://safety.fhwa.dot.gov/hsip/**

10.1.2 Arizona Highway User Revenue Fund (HURF)

HURF provides funding to cities, towns, counties, and to the State Highway Fund for highway construction, improvements, and other related expenses.

10.1.3 Railway-Highway Crossings (Section 130) Program

The Railway-Highway Crossings (Section 130) program provides federal funds for safety improvement projects at public railway crossings. Projects are funded at a 90% federal share, allocated through the HSIP and set aside annually, through fiscal year 2020. Half of these funds must go towards the installation of safety devices at crossings, while the remainder may be designated toward any safety improvement project. States may use a maximum of 2 percent of these federal funds for data compilation and analysis in support of program reporting requirements. States are required to conduct and maintain a survey of all highways to identify railroad crossings in need of safety improvements. Note that this study did not find a correlation between railway crossings and fatal vehicular crashes and did not investigate bicycle/pedestrian crashes involving railway crossings. More information is available at **https://safety.fhwa.dot.gov/hsip/xings/**

10.1.4 High Risk Rural Roads (HRRR)

Local rural roads and rural major or minor collector roads with "significant safety risks", identified as such in an updated state SHSP, may receive funding through the High Risk Rural Roads (HRRR) program. The program is supported by a Special Rule in 23 USC 148, which maintains that the state must designate funds to the HRRR in an amount equal to 200% its Fiscal Year (FY) 2009 HRRR set-aside if fatalities increase on high risk rural roads. The increase must be observed "over the most recent 2-year period for which data are available," which the FHWA calculates using data from the Highway Performance Monitoring System (HPMS) and the National Highway Traffic Safety Administration (NHTSA) Fatality Analysis Reporting System (FARS). The $90 million set-aside which previously supported the HRRR program was simultaneously eliminated by the Moving Ahead for Progress in the 21st Century

Act (MAP-21) and replaced by the current Special Rule, continued in the Fixing America's Surface Transportation (FAST) Act. More information is available at **https://safety.fhwa.dot.gov/hsip/hrrr/**

10.1.5 Governor's Office of Highway Safety

The Governor's Office of Highway Safety allocated funding through the NHTSA for grant projects under the Highway Safety Act. These federal funds are meant to supplement ongoing state or local expenditures and can be used for programs including law enforcement, education, and crash data collection. Funded programs include Accident Investigation and the Impaired Driving program. More information is available at **https://www.azgohs.gov/grant-opportunities/FFY%202018%20GOHS%20Proposal%20Guide_final1.pdf**

10.2 Lower Potential Funding Sources

10.2.1 Infrastructure for Rebuilding America (INFRA) Grant Program

The US Department of Transportation recently launched the Infrastructure for Rebuilding America (INFRA) Grant Program, which will allocate $1.5 billion in federal funds towards transportation infrastructure. The program builds from an existing program under the FAST Act using new evaluation criteria. Among other projects, the program will support safety projects which employ innovative design solutions or technologies "to improve the detection, mitigation, and documentation of safety risks." Safety projects are competitive under the "Economic Vitality" and "Innovation" evaluation criteria. Of note, at least 25% of funds will be designated towards rural areas. All project applications must include a benefit-cost analysis. Funds awarded to a project must be designated within three years of the fiscal year for which they were authorized. More information is available at **https://www.transportation.gov/sites/dot.gov/files/docs/policy-initiatives/buildamerica/283311/fy17-18-infra-grant-program-faqs.pdf**

10.2.2 Surface Transportation System Funding Alternatives (STSFA) Program

The Surface Transportation System Funding Alternatives (STSFA) program provides federal funds to states for projects which support "user-based alternative revenue mechanisms" which generate income for the Federal Highway Trust Fund from infrastructure users. The program will provide $20 million each year, starting with fiscal year 2017 and ending with fiscal year 2020, for demonstration projects through the Highway Research and Development Program. Currently, no routes are good candidates for revenue sources. More information is available at **https://www.grants.gov/custom/viewOppDetails.jsp?oppId=293213**

10.2.3 Surface Transportation Block Grant (STBG) Program

Previously known as the Surface Transportation Program (STP), the Surface Transportation Block Grant (STBG) Program is the most flexible of all federal transportation funding programs. Funds are designated to each state as a lump sum calculated using a legal percentage, then subdivided among the state's programs. A set-aside amount of 2% of provided funds is reserved for planning and research and Transportation Alternatives. Of the remaining funds, a percent of funds established by the FAST Act must be sub-allocated between the following in an amount corresponding to their proportion of the state population: urban areas of population greater than 200,000; areas with populations between 5,000 and 200,000; and, areas with less than 5,000 people. The balance may be divided among the state freely. FMPO receives a sub-allocation through the STBG program and programmed those funds for General Administration and Planning. More information is available at **https://www.fhwa.dot.gov/fastact/factsheets/transportationalternativesfs.cfm**

10.2.4 STBG Transportation Alternatives

STBG Transportation Alternatives (TA) funding replaces the MAP-21 Transportation Alternatives Program (TAP). The MAP-21 TAP replaced the Transportation Enhancement (TE) Activities Program. The STBG program continues to support all programs and projects supported by the TAP, including smaller-scale transportation projects like safe

routes to school projects and pedestrian and bicycle facilities. Funds are awarded on a competitive basis and awarded projects and project applications must report annually to the Department of Transportation. Currently, ADOT has flexed these funds to other programs. More information is available at **https://www.fhwa.dot.gov/fastact/factsheets/transportationalternativesfs.cfm**

10.2.5 NHTSA Assessment Program

The National Highway Traffic Safety Administration (NHTSA) offers technical support to state agencies that request an assessment of the state highway safety program. The assessment can identify program strengths and weaknesses and recommend improvements to assist in long-range planning and resource allocation. The assessment is not punitive; it is meant to be constructive and encourage open dialogue. Assessments can be conducted for pedestrian safety, motorcycle safety, traffic records, occupant protection, impaired driving, and emergency medical services. More information is available at **https://www.nhtsa.gov/pedestrian-safety/pedestrian-program-assessment**

10.2.6 Congestion Mitigation and Air Quality Improvement (CMAQ) Program

CMAQ, funded through MAP-21, provides a flexible funding source to state and local governments for transportation projects and programs to help reduce congestion and improve air quality for nonattainment and maintenance areas. Eligible activities include, but are not limited to: projects that improve traffic flow, such as improving signalization, constructing high-occupancy vehicle (HOV) lanes, improving intersections, and adding turning lanes. Other approved activities include projects to improve incident and emergency response or improve mobility. Funds may be used for projects that shift traffic demand to nonpeak hours or other transportation modes, increase vehicle occupancy rates, or otherwise reduce demand. There is some expanded authority to use funds for transit operations. Funds may not be used for projects that increase the number of single occupant vehicles in the network. FMPO is currently in attainment and thus ineligible for funding through CMAQ.

10.2.7 Intelligent Transportation Systems (ITS) Program

FHWA's Intelligent Transportation Systems (ITS) Program provides federal funds for up to 80% of a project to support the research and development of ITS for a variety of purposes, including road safety improvement. The Program requires a five-year ITS Strategic Plan and is currently focused on improving road safety through safety systems which support wireless communications between surface transportation modes and transportation infrastructure. More information is available at **https://www.fhwa.dot.gov/fastact/factsheets/itsprogramfs.cfm**

10.3 Other Funding Sources

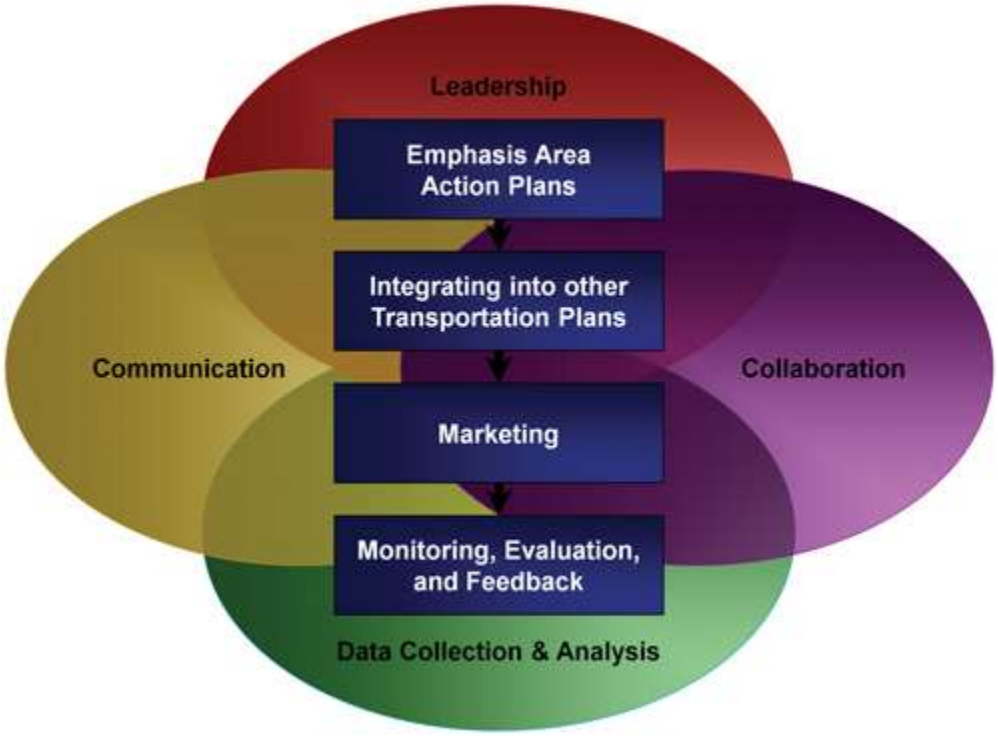
Numerous funding sources are used for transportation projects and could be utilized for safety projects. These include development impact fees, revenue bonds, and public-private partnerships. In addition, ADOT's Road Safety Assessment (RSA) program is a valuable project development resource.

11.0 Implementation Plan

This implementation plan will guide successful application of this RSTSP. Per FHWA guidance, at least four fundamental elements support all SHSP/STSP implementation practices: leadership, collaboration, communication, and data collection and analysis. Effective use of these elements is essential for moving forward on the following steps:

1. Developing emphasis area action plans;
2. Integrating the SHSP into other transportation and safety plans;
3. Developing a marketing strategy; and
4. Monitoring progress, evaluating results, and establishing a feedback loop to ensure SHSP adjustments and updates are continually incorporating experiences and lessons learned.

Figure 11.1 – FHWA Implementation Process Model Elements



The RSTSP is one step toward enhancing safety in the FMPO region. The "Four E's" of safety: engineering, education, enforcement, and emergency medical services (EMS) are all necessary elements for the success of this plan. FMPO will coordinate with stakeholders on an ongoing basis, at least semiannually, to review progress on strategies and crash trends. In addition to RSTSP specific strategies, the SHSP provides specific strategies in support of each emphasis area.

The RSTSP is made livable by the set of RSTSP Safety Tools, discussed in Section 4.0 which will assist in future assessment of crash data and identifying safety projects. NACOG, CYMPO, and FMPO should collaboratively approach updates to the crash data stored in the GIS Online Tool and the crash data used in analysis. The GIS based network screening can be updated by each agency by importing new crash data annually.

11.1 Leadership

The FMPO Manager is the leader and main point of contact for this STSP. Based upon strategies in the SHSP and in this Plan, members of the Flagstaff Engineering Department, Public Involvement Office, and Capital Improvements Engineer; Coconino County Public Works Director and Engineering Department; ADOT Multimodal Planning Division and District Engineering staff; NAIPTA staff; and law enforcement will be involved in strategy implementation. Based on the strategies developed with this plan, the group could easily expand to include human services and other groups.

11.2 The HSIP Process

Every year, the federal government apportions a set amount of funds to each state for its HSIP. ADOT oversees the HSIP process in Arizona and accepts and reviews applications. State and local agencies must compete for project funding based on the B/C ratios of their proposed projects. The HSIP funds up to 100% of the costs associated with safety improvement projects at sites with a demonstrated high number of fatal and incapacitating crashes. Projects must meet the basic requirements outlined below:

- Minimum B/C ratio of 1.5.
- Benefit calculated using only most recent 5 years of fatal and incapacitating crashes.
- Minimum project cost $250,000.
- Maximum project cost $5 million, although exceptions may be made through coordination with ADOT.
- Use of 4 and 5 star countermeasures from the online CMF Clearinghouse, although lower star countermeasures have been accepted through coordination with ADOT.

11.3 Potential HSIP Projects

The HSIP application process is data driven. The approach incorporated network screening, crash analysis, predictive analysis, and local stakeholder coordination. As part of project development, the review of crash reports and coordination with local law enforcement is encouraged to provide a broader understanding of crash causal factors to ensure the effectiveness of a proposed project.

The FMPO region has been proactive in addressing safety and congestion needs. FMPO has partnered with ADOT, NAIPTA, the City of Flagstaff, Coconino County, US Forest Service, FHWA, and NAU to prepare the Milton Road and US 180 Corridor Master Plans. The Study includes Milton Road from Forest Meadows Street to Beaver Street, and US 180 from Milton Road to the Crowley Pit turn-out (milepost 232.25). This planning effort will shape the long-term vision for these routes, including the role of transit. Due to this ongoing effort, projects that may be inconsistent with plan recommendations were not included as part of this Plan.

HSIP applications were not recommended to mitigate impaired pedestrian crashes where no other pedestrian crashes were present due to the overall randomness of the crashes. Stakeholders are pursuing societal measures through the Strategies developed in support of this RSTSP in lieu of engineering solutions.

A limited number of HSIP applications including street lighting were recommended. Stakeholders are pursuing alternative approaches to lighting through the strategies developed in support of this RSTSP that are consistent with dark sky ordinances.

Potential projects are identified and included in ***Appendix B*** with the results of HSM predictive analysis, which was conducted at select sites. Countermeasures from both the ADOT HSIP application and the Crash Modification Clearinghouse were utilized. Planning-level costs were used to determine preliminary B/C ratios for potential HSIP projects. A summary list of potential intersection and segment spot improvement projects is provided in ***Table 21*** and ***Table 22***, respectively.

Table 21 – Potential HSIP Intersection Spot Improvements		
Intersection	**Project**	**Preliminary B/C Ratio**
Lockett Road and Fourth Street	Roundabout	4.5

Table 22 – Potential HSIP Segment Spot Improvements		
Segment	**Project**	**Preliminary B/C Ratio**
Townsend-Winona Road: US 89 to Koch Field Road	Rumble strips	21.2
Milton Road/E Route 66: McConnell Drive to Elden Street	Median	10.4
Milton Road: McConnell Drive to Ponderosa Parkway*	Variable Speed Limit Signs	2.5
I-40: I-17 to Country Club Drive	Lighting	3.9
Pedestrian Refuge Locations – Combined Application**		
*Crash data includes segment collisions of all types and rear-end collisions at intersections. **Installation of a single pedestrian refuge median does not meet the minimum HSIP project cost. Potential locations should be evaluated with an engineering study consistent with the MUTCD. Consider combining projects to meet the minimum cost or implementing a systemic pedestrian refuge improvement program.		

Crash history should be monitored on an ongoing basis; in particular, segments and intersections identified through network screening in should be reviewed annually. These locations should be considered for inclusion in future HSIP applications if the crash history worsens, an appropriate CMF is identified, or other circumstances are present. These locations represent most probable candidates for future HSIP applications if current crash patterns persist.

A systemic project to install flashing yellow arrows (FYA) may be merited in the future. Presently, the City is converting Beulah / Forest Meadows, SR 89 / Marketplace and potentially the University / Woodlands Village intersections to FYA. Other signals have recently been converted to protected-only phasing.

The crash history at some locations was not conducive to HSIP project funding, either due to the benefits associated with very low-cost countermeasures (project costs under $250,000) or approved CMFs may not best address the safety issue. Safety improvements were identified at many of these locations and are included in ***Appendix B***.

Project recommendations should be considered as part of Flagstaff, ADOT, and Coconino County capital improvement and maintenance programs. Additionally, they should be incorporated into future plans and studies in the region. In accordance with ADOT requirements, this plan should be updated at least every five years.

11.4 Performance Evaluation Plan

A benefit of the tools developed through this process is that performance metrics are easier to measure. ADOT Traffic Safety Section (TSS) requires crash data be provided on a yearly basis and a written before-and-after study utilizing the same crash data included in the countermeasure influence area in order to determine the effectiveness of the countermeasure on fatal and serious injury crashes after project implementation. The CAT tool facilitates subsequent crash trend analysis. Regional analysis can easily be completed annually using the CAT to assess overall safety performance and trends.