

GVMC
Safety
Planning

March 1

2018

Safety
Planning

Table of Contents

<u>Section</u>	<u>Page</u>
Chapter 1. Introduction1
1.1 Purpose	3
1.2 Background	3
1.3 Vision and Targets	6
Chapter 2. Analyze Traffic Safety Data	10
2.1 Crash Frequency	10
2.2 Crash Rate	13
Chapter 3. Emphasis Areas	15
3.1 Intersection Safety	16
3.2 Lane Departure	22
3.3 Young Drivers Safety	25
3.4 Pedestrian and Bicycle Safety	30
3.5 Distracted Driving	37
3.6 Impaired Driving	39
Chapter 4. Additional Emphasis Area	45
4.1 Senior Mobility and Safety	45
4.2 Traffic Incident Management.....	50
4.3 Traffic Records and Information Systems.....	52
Chapter 5. Implementation and Evaluation of the Plan.....	54
Appendix A: GVMC Traffic Crash Data.....	55
Appendix B: Top Crash Location Lists	58
Appendix C: Top Crash Location Maps.....	68

List of Figures

<u>Figure</u>	<u>Page</u>
Figure 1: GVMC Study Area Map	5
Figure 2: GVMC Total Crashes 2007-2016.....	11
Figure 3: GVMC Traffic Crash Fatalities 2007-2016.....	11
Figure 4: GVMC Traffic Crash Serious Injuries 2007-2016.....	11
Figure 5: GVMC 5-Year Moving Average Traffic Fatalities	12
Figure 6: GVMC 5-Year Moving Average Traffic Serious Injuries	13
Figure 7: GVMC 5-Year Moving Average Traffic Fatality Rate	14
Figure 8: GVMC 5-Year Moving Average Traffic Serious Injury Rate.....	14
Figure 9: GVMC Intersection Crashes	17
Figure 10: Intersection Crashes Percentage	17
Figure 11: Young Driver Crashes	26
Figure 12: Young Driver Fatal and Serious Injury Crash Percentage	26
Figure 13: GVMC Bicycle/Pedestrian Crashes	31
Figure 14: GVMC Bicycle/Pedestrian Fatalities and Serious Injuries	31
Figure 15: Fatal and Serious Injury Pedestrian Crash Percentage	33
Figure 16: GVMC Alcohol-Related Crash Percentages.....	41
Figure 17: GVMC Drug-Related Crash Percentages.....	41
Figure 18: Senior Driver Fatal Crash Percentage	46
Figure A-1 Fatalities and Serious Injuries Percent Crashes by Type, 2012-2016.....	55
Figure A-2 Fatalities and Serious Injuries by Month, 2012-2016.....	55
Figure A-3 Fatalities and Serious Injuries by Week, 2012-2016.....	56
Figure A-4 Fatalities and Serious Injuries by Time, 2012-2016.....	56
Figure A-5 Fatalities and Serious Injuries by Age Group, 2012-2016.....	57

List of Tables

<u>Table</u>	<u>Page</u>
Table 1: Michigan State Traffic Safety Target.....	8
Table 2 GVMC Traffic Safety Performance Data.....	9
Table 3: Percentage Distribution of Crashes in GVMC, 2012-2016.....	13
Table 4: Emphasis Areas Crash Percent, 2012-2016.....	15
Table 5: Percentage Distribution of Lane Departure Crashes	22
Table 6: Percentage Distribution of Young Driver Crashes in GVMC area.....	25
Table 7: Percentage Distribution of Pedestrian and Bicycle Crashes	30
Table 8: Percentage Distribution of Alcohol-Related Crashes	40
Table 9: Percentage Distribution of Drug-Related Crashes	40
Table 10: Percentage Distribution of Senior Driver Crashes in GVMC area	45
Table B-1: Intersections Ranking by Expected Excess Fatal and Injury Crash.....	58
Table B-2: Intersections Ranking by Total Crash (2012-2016)	59
Table B-3: Intersections Ranking by Fatal and Serious Injury Crash (2012-2016).....	60
Table B-4: Freeway Segments Ranking by Expected Excess Crash	61
Table B-5: Non-Freeway Segments Ranking by Expected Excess Crash.....	62
Table B-6: Segments Ranking by Total Crash (2012-2016).....	63
Table B-7: Segments Ranking by Fatal and Serious Injury Crash.....	64
Table B-8: Pedestrian Ranking by Expected Excess Crash.....	65
Table B-9: Intersection Pedestrian Crash Ranking (2012-2016).....	66
Table B-10: Bicycle Ranking by Expected Excess Crash.....	67

PROTECTION FROM DISCOVERY AND ADMISSION INTO EVIDENCE

Under 23 U.S.C. 148(g)(4) information collected or compiled for any purpose directly relating to this report shall not be subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location identified or addressed in this report.

Chapter 1. INTRODUCTION – Causes of Traffic Crashes

Traffic crashes are the leading cause of death for Michiganders under the age of 45. Traffic crashes produce not only personal tragedy, but increased burdens on the region due to medical and insurance costs, lost production potential, and delay of passengers and freight. Although traffic crashes are rare in terms of the number of vehicles on the road and the distances traveled, addressing the contributing factors can reduce their likelihood. Studies suggest that there are 4 basic causes for traffic crashes: Equipment failure, roadway design, poor roadway maintenance, and driver behavior. Over 95% of crashes can be attributed to some degree of driver behavior combined with one of the other three factors.

Equipment Failure - Manufacturers are required by law to design and engineer cars that meet a minimum safety standard. Computers, combined with companies' extensive research and development, have produced safe vehicles that are easy and safe to drive. The most cited types of equipment failure are loss of brakes, tire blowouts or tread separation, and steering/suspension failure. Combined totals for all reported equipment failure accounts for less than 5% of all motor vehicle accidents.

Roadway Design - Civil engineers, local governments, and law enforcement agencies all contribute to the design of safe road designs and traffic management systems. In Michigan, MDOT and the FHWA provide guidelines to their construction. Roadways are designed by engineers with special consideration to hazard visibility, roadway surfaces, traffic control devices, behavioral control devices, traffic flow, street signs, and weather.

Poor Roadway Maintenance - Roadway maintenance can often contribute to some motor vehicle accidents. Debris, faded road signs, potholes and road construction can lead to traffic crashes but these factors are not leading causes of traffic crashes.

Driver Behavior – Driver distraction has been a major problem in traffic safety and is believed to increase traffic crash risk. Some mistakes occur when a driver becomes distracted, perhaps by a cell phone call, texting or tweeting on a smartphone, or a spilled cup of coffee. In 2015 alone, there were 3,477 people killed and 391,000 injured in motor vehicle crashes due to distract driving.

Without question, the faster vehicle is traveling, the greater the risk of an accident. Exceeding the speed limit by only 5 mph in the wrong place can be dangerous. Traffic engineers and local governments have determined the maximum speeds allowable for safe travel on the nation's roadways. Speeding is a deliberate and calculated behavior where the driver knows the risk but ignores the danger. Fully 90% of all licensed drivers speed at some point; 75% admit to committing this offense regularly.

Example: A pedestrian walks out in front of a car. If the car is traveling at just 30 mph, and the driver brakes when the pedestrian is 45 feet away, there will be enough space in which to stop without hitting the pedestrian. Increase the vehicle speed by just 5 mph and the situation changes dramatically. At 35 mph, with the pedestrian 45 feet away and the driver braking at the same point, the car will be traveling at 18 mph when it hits the pedestrian. An impact at 18 mph can seriously injure or even kill the pedestrian.

Nearly 1/3 of all fatal crashes in the United States involved impaired drivers. Of the 37,461 traffic deaths in 2016, 10,497 people lost their lives as the result of a vehicle being operated by a drunk driver.

GVMC fully supports efforts of state and local law enforcement agencies in their efforts to combat those who put others in peril through negligent use of the transportation system by operating a vehicle in an impaired state, speeding, fleeing, or driving while distracted. Through coordinated efforts on various GVMC committees, GVMC members are well informed of these issues and yield to the expertise of law enforcement.

1.1 PURPOSE

The primary purpose of this document is to identify locations on GVMC highway network system where safety issues may exist and where countermeasures, when applied, can lead to a reduction in the number of crashes at specified locations, thus improving the overall safety of the transportation system in the GVMC region. This effort and indirectly the collaborative efforts of GVMC and its member communities focus on the transportation infrastructure. With this in mind this study focuses on aspects related to transportation infrastructure improvements.

1.2 BACKGROUND

The transportation department of the Grand Valley Metropolitan Council (GVMC) is charged with implementing the Metropolitan Planning Organization (MPO) planning process as included in US code 23. The transportation planning process is a multi-modal process. All modes of transportation are planned for including: Highways, Transit, Non-motorized, Aviation, Rail and Freight.

A variety of tools and programs are used to plan for the Grand Rapids metropolitan area including a Congestion Management Process (capacity issues), Asset Management System (system conditions), and this regional strategic safety planning process.

According to the National Highway Traffic Safety Administration, 37,461 people died in US motor vehicle crashes in 2016. Nationwide, motor vehicle traffic crashes are the eighth leading cause of death among Americans of all ages and the number one cause of death for every age from 3 through 33.

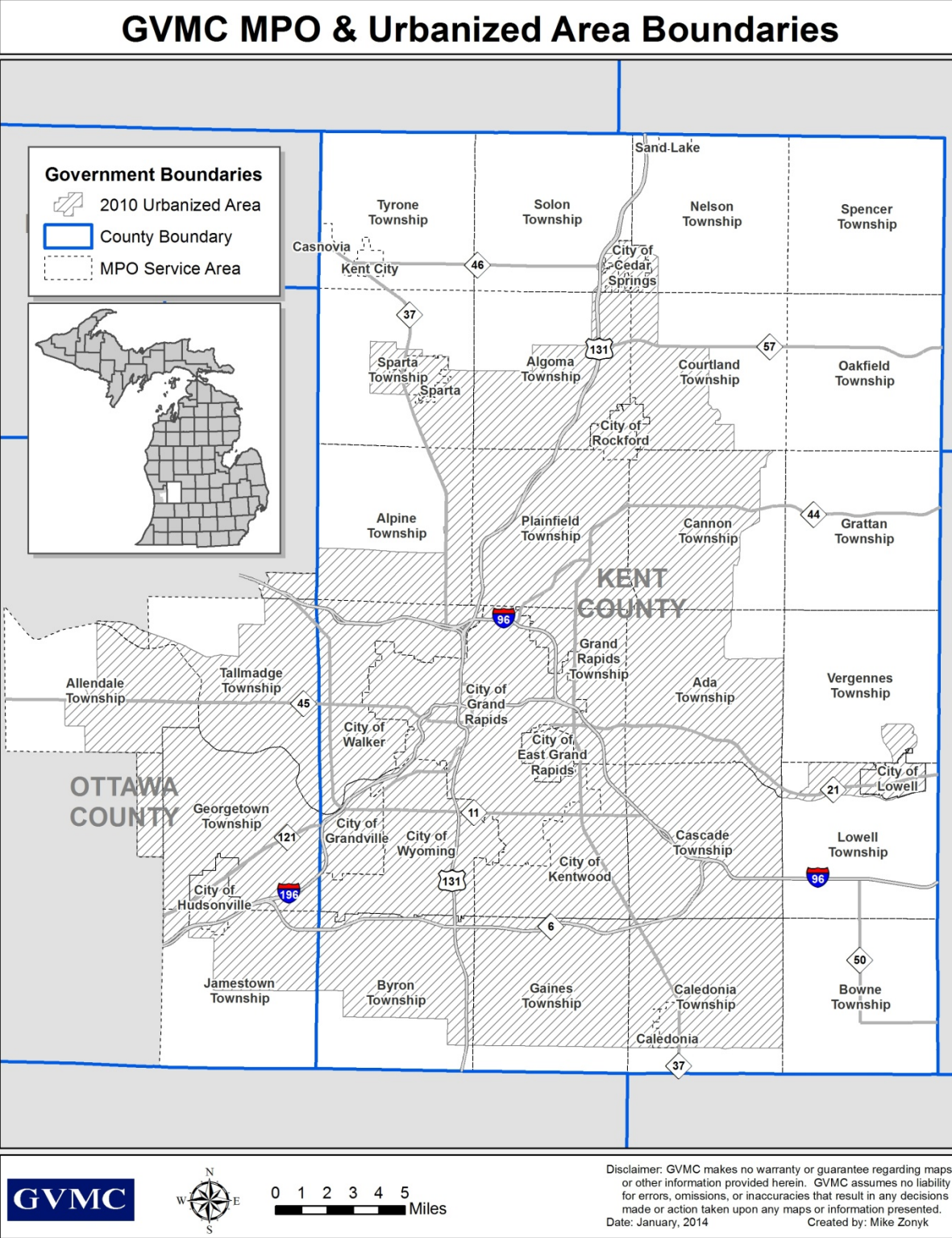
In the Grand Valley Metro Council (GVMC) study area (Figure 1), there are an average of about 20,000 traffic crashes each year. In 2016 alone, there were 62 traffic fatalities and 471 serious injuries in the GVMC area, as shown in Figure 2 through Figure 4.

Toward Zero Deaths (TZD): The Federal Highway Administration (FHWA) rolled out a National Strategy on Highway Safety in 2015. The TZD initiative provides the national vision for driving the decline in fatal and serious injury crashes.

The Governor's Traffic Safety Advisory Commission (GTSAC) developed the Michigan Strategic Highway Safety Plan (SHSP). The Strategic Highway Safety Plan (SHSP) is a statewide-coordinated safety plan that provides a comprehensive framework for reducing highway fatalities and serious injuries on all public roads. The SHSP allows highway safety programs and partners in the State to work together in an effort to align goals, leverage resources and collectively address the State's safety challenges. In Michigan, TZD is at the basis of the SHSP, MDOT, in coordination with the GTSAC, is leading promoting TZD in the state.

With these statistics in mind, GVMC has undertaken an effort to focus planning resources on traffic crashes in an effort to minimize the impact they have on the economy of the region as well as the loss of human life. This focused effort will ensure that safety planning is integrated into the GVMC overall transportation planning process.

Figure 1 GVMC Study Area Map



1.3 VISION and Targets

To guide the development of the 2045 Long Range Transportation Plan, the GVMC Policy Committee adopted the following vision:

“Establish a sustainable multimodal transportation system for the mobility and accessibility of people, goods, and services; it will provide an integrated system that is safe, environmentally sound, socially equitable, economically viable, and developed through cooperation and collaboration.”

This recognition of the importance of safety and subsequent inclusion of safety in the overall planning process allows GVMC to meet requirements in the MAP-21 legislation. MAP-21 established safety as a core funded program and revised the regulations governing metropolitan and state transportation plans. The new planning rule requires MPOs to consider the State’s Strategic Highway Safety Plan (SHSP) when developing their transportation plans.

The Safety Performance Management Final Rule issued by FHWA require the use of five year rolling average for each of the five safety performance measures shown below:

- Number of fatalities
- Rate of fatalities per 100 million VMT
- Number of Serious Injuries
- Rate of Serious Injuries per 100 million VMT
- Number of Non-motorized Fatalities and Non-motorized Serious Injuries

MPOs are required to establish safety targets by either

1. Agreeing to plan and program projects so that they contribute to the accomplishment of the State DOT safety targets for the performance measures; or
2. Committing to a quantifiable target for the performance measures for their metropolitan planning area

MPOs are required to establish targets no later than 180 days after the state DOT established the state safety targets. MDOT has published its safety targets on August 31, 2017, which is shown in Table 1 below. The traffic safety performance data in

GVMC area from 2008-2016 are shown in Table 2. Both GVMC technical committee and policy committee have approved in February 2018 to support MDOT's safety target by planning and programming projects to contribute to improving traffic safety in GVMC area.

Michigan State Traffic Safety Target- **Calendar Year 2018 Targets in Red**

Year	Fatality	Serious Injury	5yr Moving Average		VMT*	Fatality Rate	Serious Injury Rate	5yr Moving Average		Bike Ped Fatality/Serious Injuries	Bike Ped Fatality/Serious Injuries 5yr MA
			Fatality	Serious Injuries				Fatality Rate	Serious Injury Rate		
2008	980	6,725			1,009	0.97	6.67			786	
2009	872	6,511			959	0.91	6.79			789	
2010	942	5,980			976	0.97	6.13			743	
2011	889	5,706			948	0.94	6.02			742	
2012	940	5,676	924.6	6,119.6	942	1.00	6.03	0.96	6.33	682	748.4
2013	947	5,283	918.0	5,831.2	951	1.00	5.56	0.96	6.10	743	739.8
2014	901	4,909	923.8	5,510.8	974	0.93	5.04	0.96	5.75	687	719.4
2015	963	4,865	928.0	5,287.8	978	0.98	4.97	0.97	5.52	755	721.8
2016	1,064	5,634	963.0	5,273.4	982	1.08	5.74	1.00	5.47	742	721.8
2017	1,058	5,243	986.6	5,186.8	986	1.07	5.32	1.01	5.32	782	741.8
2018	1,030	5,031	1,003.2	5,136.4	990	1.04	5.08	1.02	5.23	752	743.6

*Vehicle Miles Traveled (VMT) are shown in 100 million miles traveled. Calendar year 2017 and 2018 estimates are made by determined the percent change in VMT for the prior two years of actual data and estimating future years by applying the percent change

Table 1 Michigan State Traffic Safety Target

GVMC Safety Performance Data											
Year	Fatality	Serious Injury	5yr Moving Average		VMT	Fatality Rate	Serious Injury Rate	5yr Moving Average		Bike Ped Fatality/ Serious Injuries	Bike Ped Fatality/ Serious Injuries 5yr MA
			Fatality	Serious Injuries				Fatality Rate	Serious Injury Rate		
2008	60	387			69.94	0.86	5.53			51	
2009	60	353			70.50	0.85	5.01			40	
2010	68	327			71.07	0.96	4.6			52	
2011	43	346			71.36	0.6	4.85			43	
2012	49	340	56	350.6	71.65	0.68	4.75	0.79	4.95	58	48.8
2013	50	324	54	338	71.94	0.7	4.5	0.76	4.74	61	50.8
2014	58	298	53.6	327	72.23	0.8	4.13	0.75	4.57	47	52.2
2015	71	370	54.2	335.6	72.53	0.98	5.1	0.75	4.67	72	56.2
2016	62	471	58	360.6	72.82	0.85	6.47	0.8	4.99	64	60.4
2016 Michigan State								1.00	5.47		
2018 State Target								1.02	5.23		

Table 2 GVMC Traffic Safety Performance Data

Chapter 2 Analyze Traffic Safety Data

Traffic crash data collection is performed statewide by law enforcement agencies at every level. This yearly compilation and analysis of statewide crash data is a valuable web tool for government agencies, researchers, and the general public. The data is provided by the Michigan Department of State Police from their Michigan Traffic Crash Forms (UD-10). Crash data for this report and the subsequent annual report will come from the “Michigan Traffic Crash Data Facts” website (<http://www.michigantrafficcrashfacts.org/datatool/build>).

Some analysis for specific locations will be completed using the “Roadsoft” program provided by The Center for Technology Training (CTT). The CTT provides and supports the Roadsoft program as a means to efficiently collect, manage and analyze data for public agencies. The CTT established in 1994 is part of the Michigan Tech Transportation Institute at Michigan Technological University.

Traffic crash data are the most useful to identify safety issues, select appropriate countermeasures, and evaluate performance. It also allows agencies to track progress in implementing safety measures. Five years of crash data from 2012 to 2016 were used to identify trends.

There are several methods when measuring crash data. This chapter focuses on crash frequency and crash rate. Additional crash data analysis can be found in Appendix A.

2.1 Crash Frequency

Crash frequency is the sum of all traffic crashes in an area or at a specific location. Figure 2 to 4 show the total number and severity of the region’s traffic crashes. There were around 20,000 traffic crashes occurred each year in the GVMC area from 2007 and 2016. In 2016, there were 62 people killed and 471 seriously injured in traffic crashes in the GVMC area. Figure 5 and 6 outlines the five-year moving average for the frequency of K and A crashes, respectively. The five-year moving average is decreasing, but went up slightly in 2012-2016 for fatalities and serious injuries. Table 3 illustrates the percentage distribution of crashes for K and A crashes.

Figure 2 GVMC Total Crashes 2007-2016

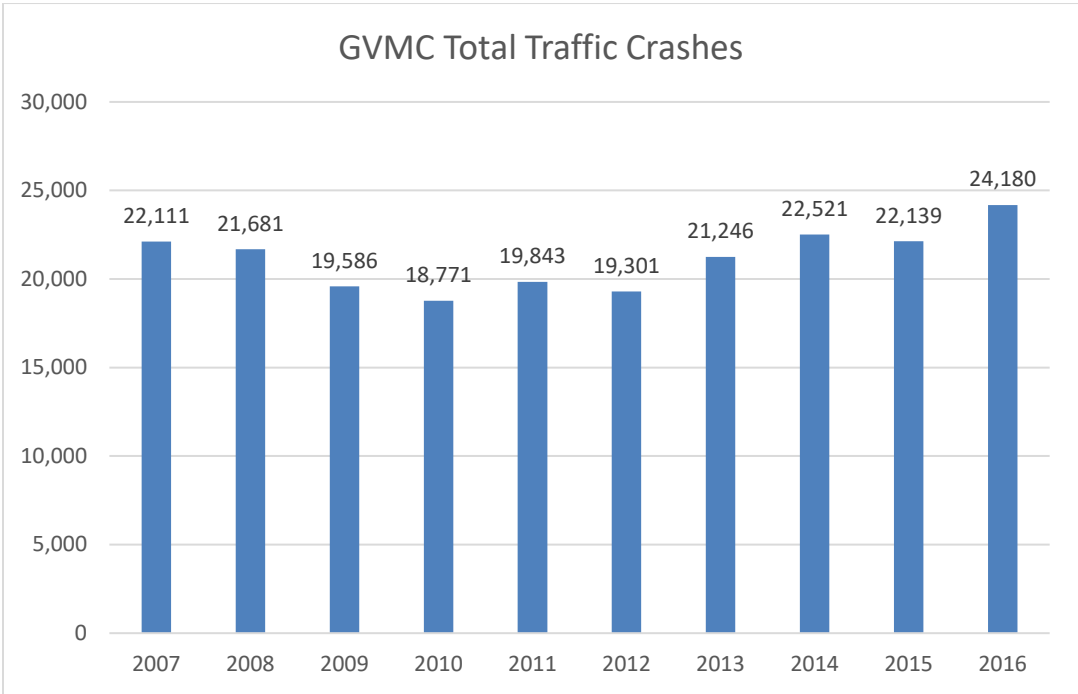


Figure 3 GVMC Traffic Crash Fatalities 2007-2016

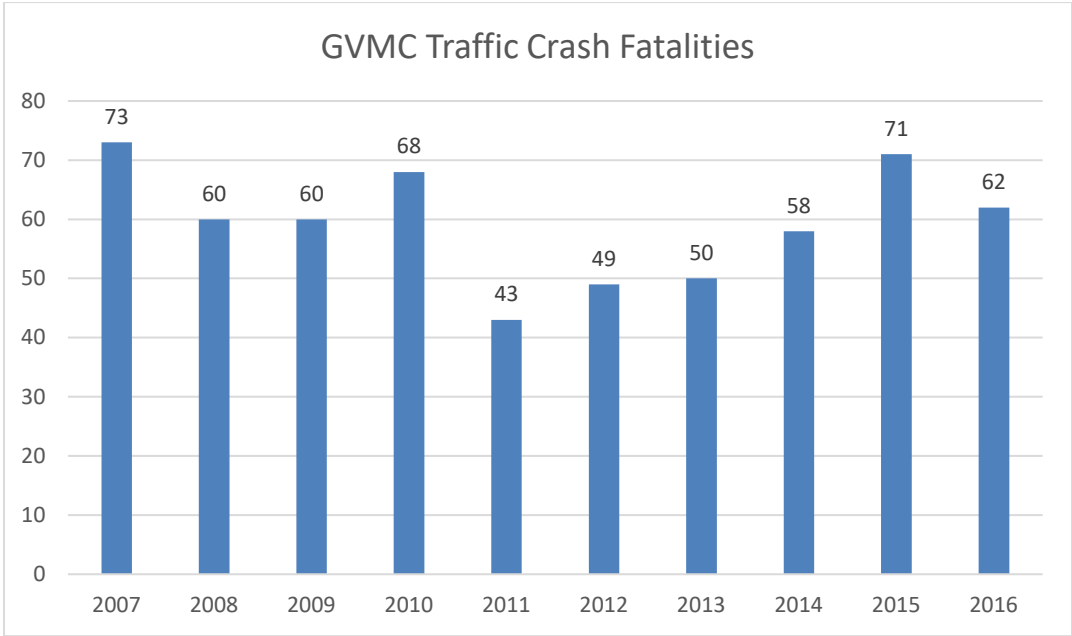


Figure 4 GVMC Traffic Crash Serious Injuries 2007-2016

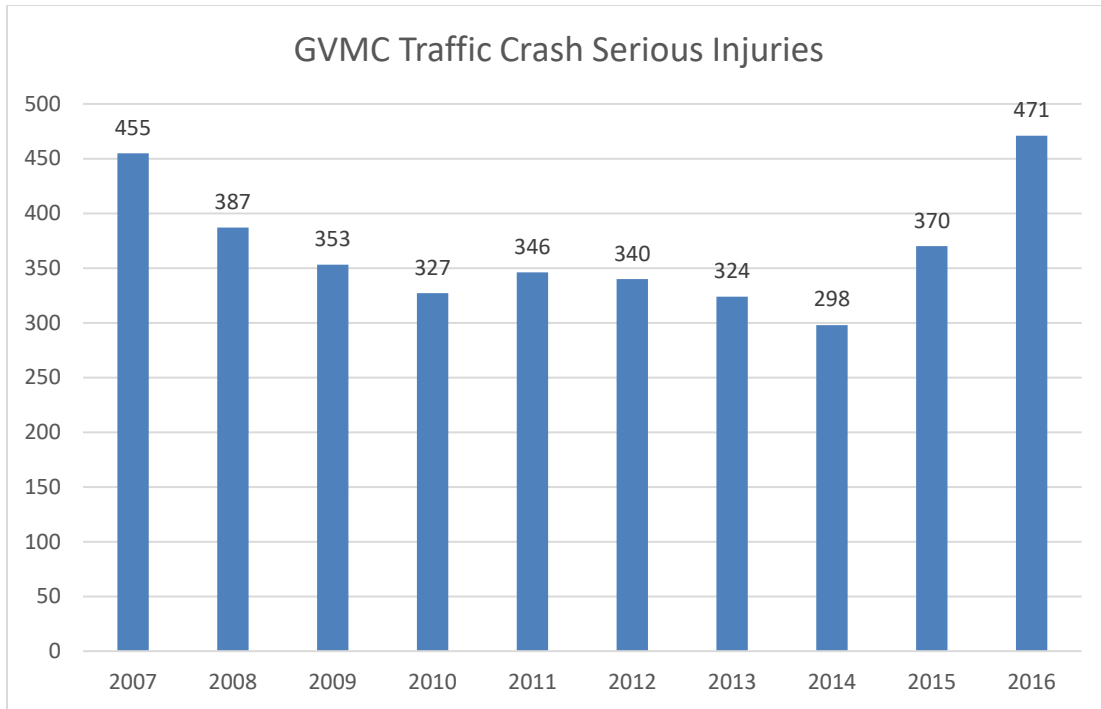


Figure 5 GVMC 5-Year Moving Average Traffic Fatalities

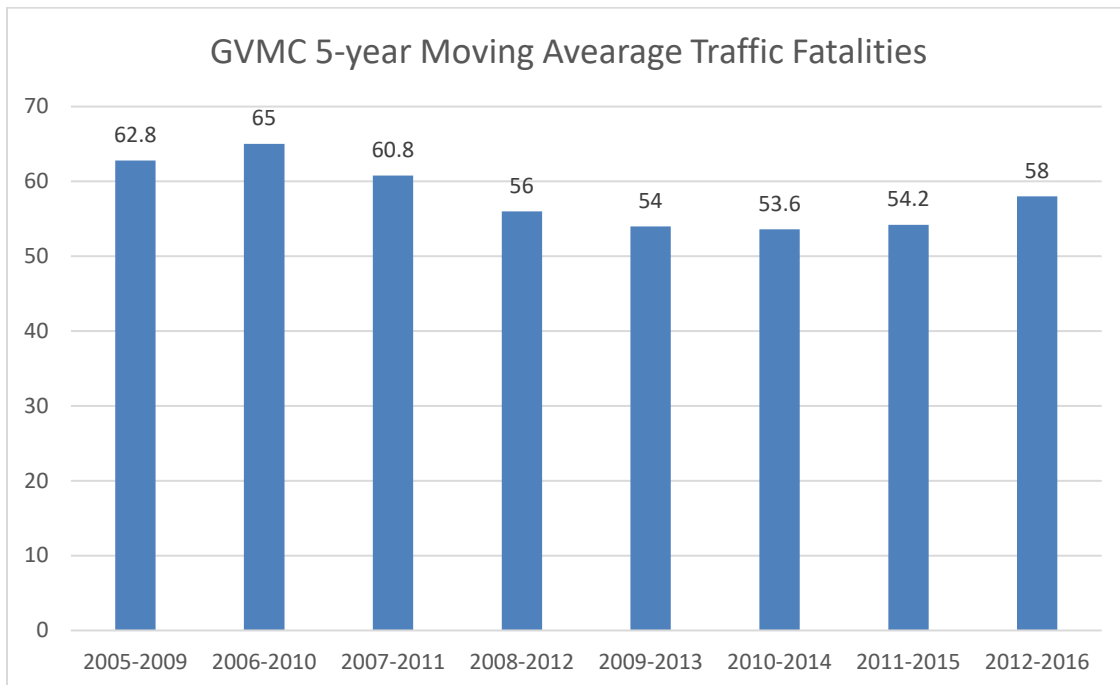


Figure 6 GVMC 5-Year Moving Average Traffic Serious Injuries

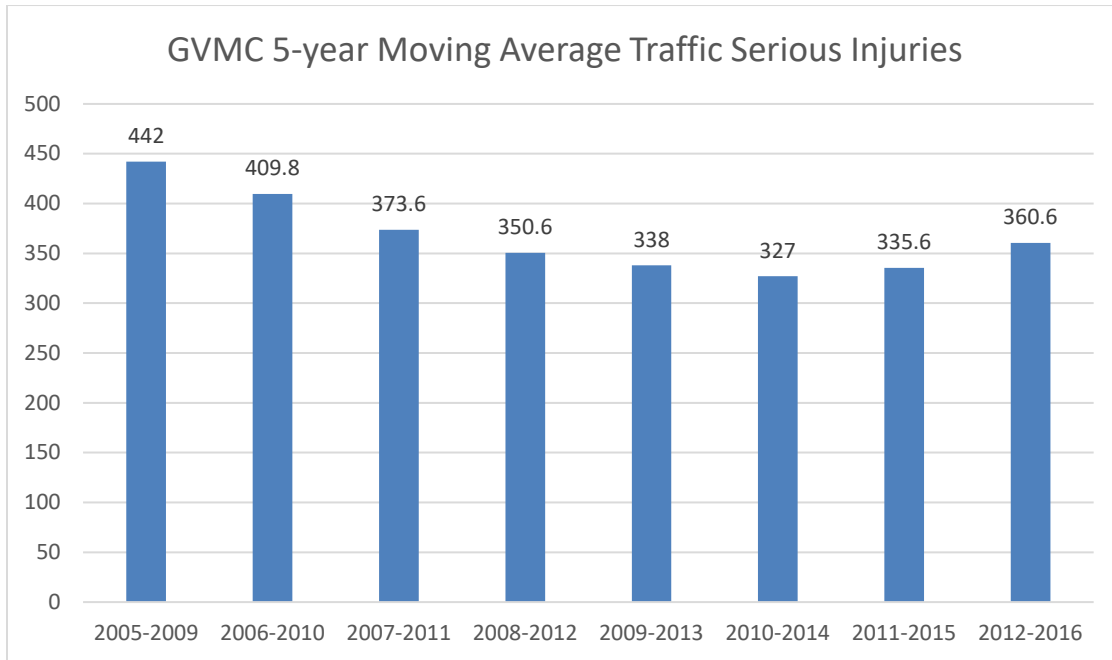


Table 3 Percentage Distribution of Crashes in GVMC, 2012-2016

Year	Total Crashes	K+A	Percent K+A
2012	19,301	321	1.66%
2013	21,246	307	1.44%
2014	22,521	308	1.37%
2015	22,139	366	1.65%
2016	24,180	445	1.84%

2.2 Crash Rates

Crash rate is a measure of safety that takes into consideration crash frequency and traffic volume. Figure 7 and 8 illustrates the 5-year moving average fatality and serious injury rate per 100 million vehicle miles travelled (MVM). Crash rates are calculated based on Michigan’s Highway Performance Management System (HPMS) and GVMC travel demand model traffic volume data. The figures show both the GVMC fatality and serious injury rates are lower than State of Michigan fatality and serious injury rates.

Figure 7 5-Year Moving Average Traffic Fatality Rate

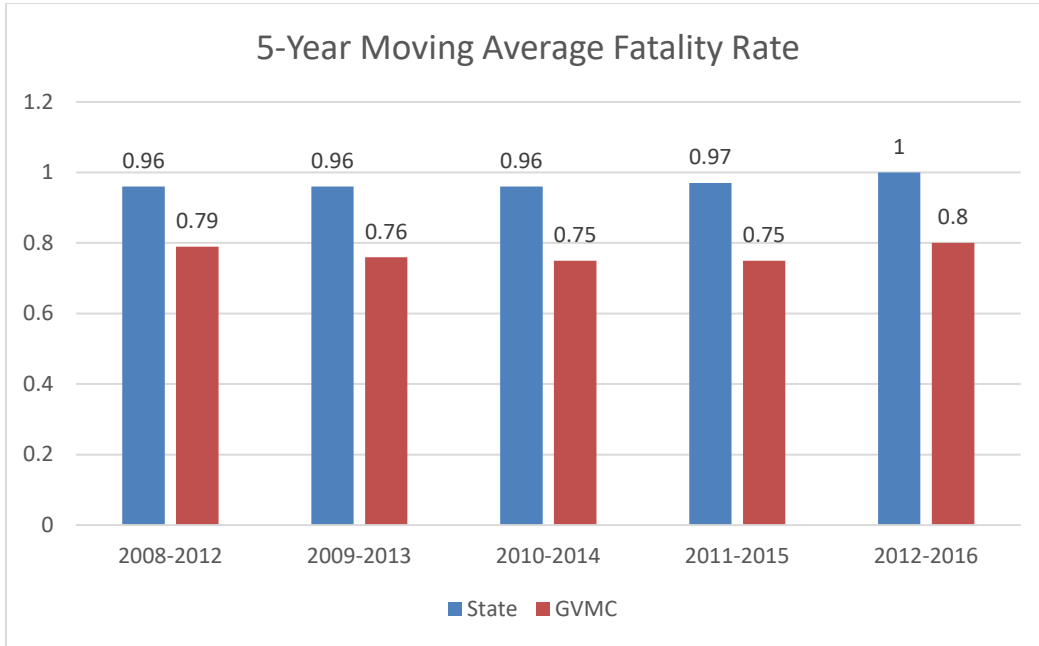
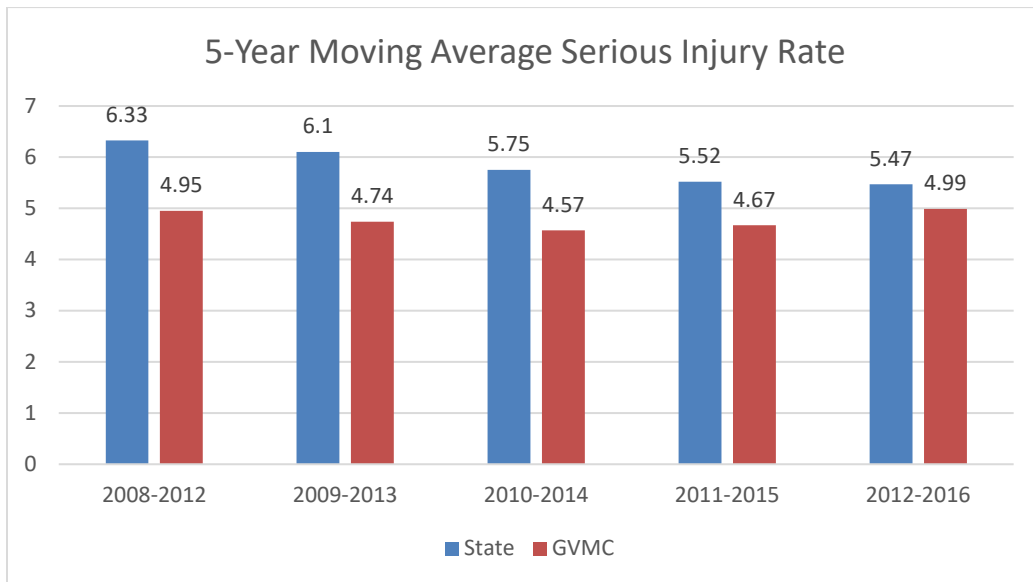


Figure 8 5-Year Moving Average Traffic Serious Injury Rate



Chapter 3 Emphasis Areas

The AASHTO Strategic Highway Safety Plan: A Comprehensive Plan to Substantially Reduce Vehicle-Related Fatalities and Injuries on the Nation’s Highways, identified 22 safety emphasis areas on a national level. The emphasis areas include populations (e.g., older and younger drivers), crash types (e.g., head-on crashes, rear end crashes), infrastructure/hazards (e.g., intersections, tree and utility pole collisions), behavior (e.g., occupant protection, distracted driver), and modes (e.g., pedestrian, bicycle, motorcycle).

After reviewing regional traffic crash data and gathering input from safety stakeholders and partners, staff selected five priority emphasis areas in GVMC MPO region, which included intersection safety, lane departure, young driver safety, pedestrian and bicycle safety, distracted driving, and impaired driving. Additional emphasis areas also are identified in this plan, including senior driver safety, traffic incident management and traffic records and information system.

Table 4 Emphasis Areas Crash Percent, 2012-2016

Crashes by Involvement	Percent Crashes			Percent K+A		
	GVMC	West MI	MI	GVMC	West MI	MI
Intersection	38.7%	31%	29%	41.8%	35%	32%
Drivers age 24 and Younger	38.3%	35%	33%	37.7%	37%	34%
Lane Departure	16.6%	20%	19%	30.9%	41%	40%
Pedestrian	1%	1%	1%	10.3%	8%	10%
Alcohol	3.9%	4%	3%	21.3%	20%	19%
Senior Driver(65 and older)	12.4%	12%	14%	15.6%	15%	16%
Motorcycle	1.1%	1%	1%	12.2%	13%	12%
Drugs	0.5%	0%	1%	4.8%	4%	6%
Truck/Bus	4.4%	4%	4%	6.4%	6%	6%
Bicycle	0.9%	1%	1%	4.1%	4%	3%

3.1 Intersection Safety

Intersections are the place in the transportation system where all roadway users – cars, trucks, buses, and vulnerable road users (pedestrians, bicyclists, motorcyclists) converge creating potential for conflict. Research indicates low-cost safety improvements such as improved sight distance, channelization, signage, and other infra-structure treatments can produce positive results.

While these infrastructure improvements can improve safety, it is often the behavior of the road user that can cause a crash, e.g., speeding, red light and stop sign running, failure to use a pedestrian crosswalk, etc. These crossing and turning movements at intersections create multiple opportunities for conflict.

In GVMC study region there were 10,392 intersection crashes in 2016 representing 42.98% of all the reported crashes. For the area defined as the MDOT Grand Region and statewide intersection crashes represented 34.56% and 33.57% of the total crashes reported, respectively, as shown in Figure 9. The GVMC region exceeded the ratio of crashes at intersections reported at the state and MDOT regional level.

These intersection crashes within the GVMC region resulted in 26 fatalities in 2016 (42% of all roadway fatalities in the region) and 3,527 injuries (56% of all roadway injuries in the region). Statewide and regional ratios for injuries in 2016 are 45.68% and 49.61%, respectively. Again GVMC region exceeded the statewide ratio for injuries.

Figure 9 GVMC Intersection Crashes

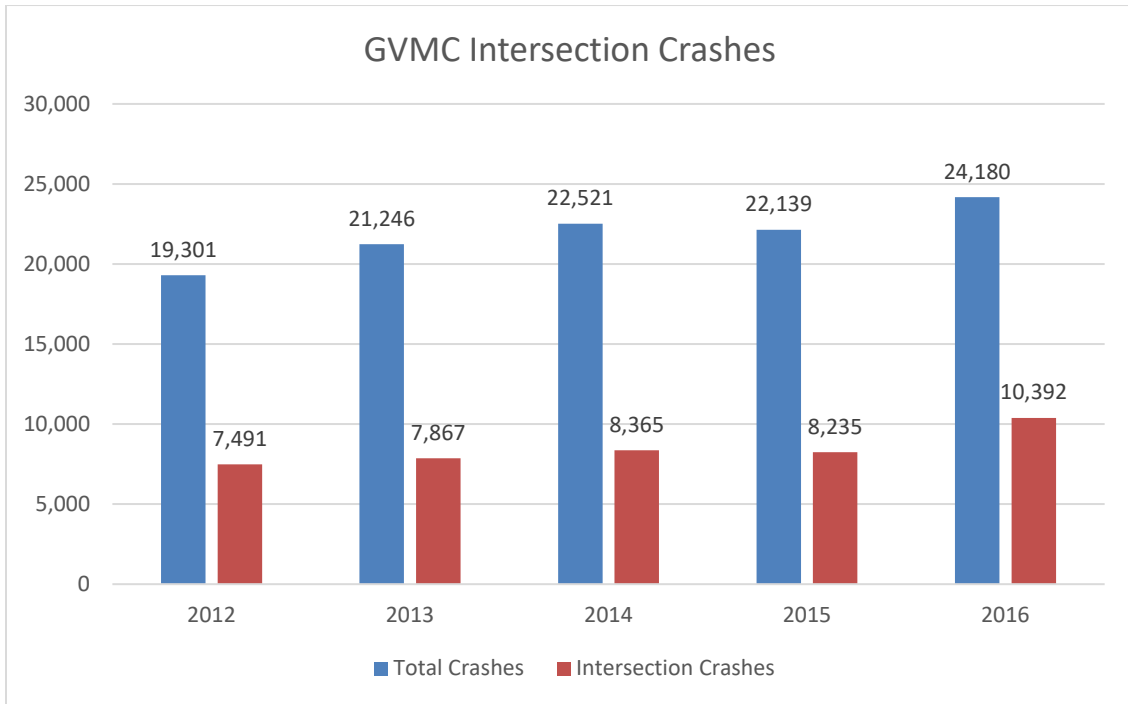
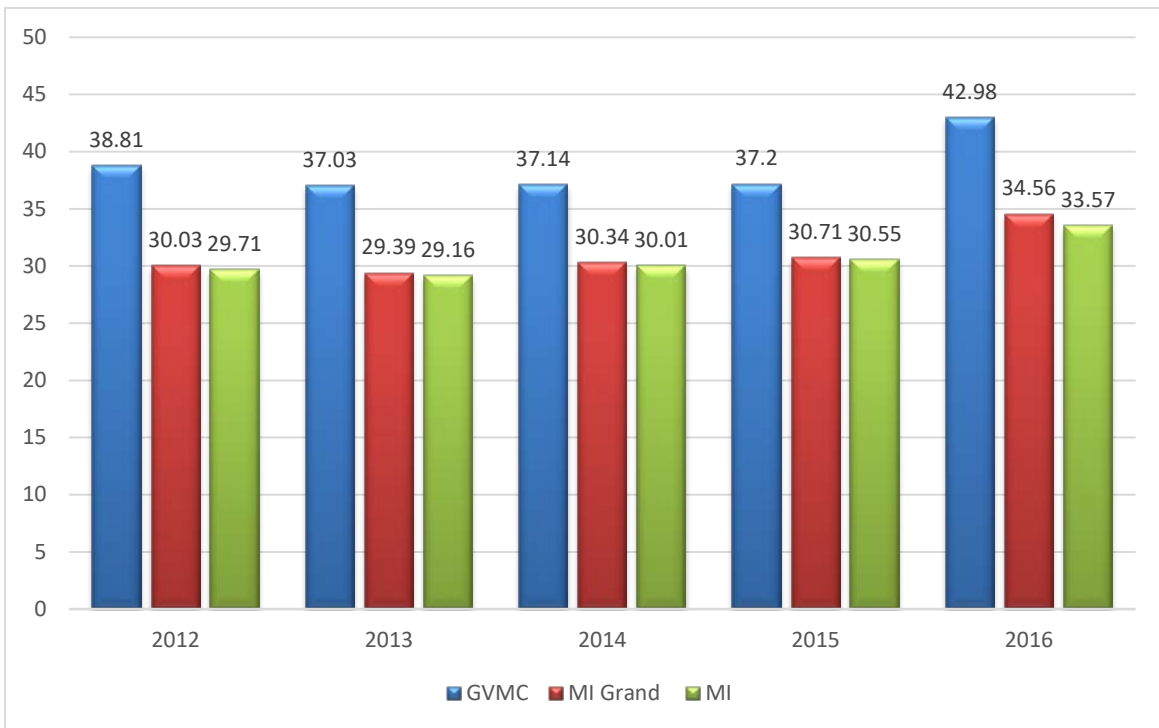


Figure 10 Intersection Crashes Percentage



Stratigies

Develop a region-wide intersection inventory. Limited roadway attribute data is available related to intersections. For the federal-aid system, data such as traffic volume, functional classification, and number of lanes is available within the FHWA HPMS. MDOT has some data related to the trunkline network. A regional intersection database should be developed to support more detailed analysis of intersection crashes utilizing MDOT's new statewide safety performance functions (SPF). Most of the data could be collected utilizing geographic information system mapping and online tools. The following is an initial list of data required for use in the new SPF, which should be considered for collection on a region-wide basis:

- Type of a traffic control
- Presence of a median
- Presence and type of pedestrian signal
- Presence of lighting
- Posted speed limit
- Presence of no turn on red prohibitions
- Presence of a left-turn lane and presence of left-turn signal phase

Implement ranked and prioritize high-risk intersections. This plan provides a ranking of signalized and unsignalized intersections with disproportionate numbers of crashes. This ranking is conducted utilizing the methods outlined in the American Association of State Highway Transportation Officials (AASHTO) *Highway Safety Manual* (HSM). This ranking also prioritizes segments utilizing the excess expected crashes performance measure. This performance measure identifies whether a site has a disproportionately high number of crashes. In addition, this plan provides rankings of intersections with total crashes and fatal and serious injury crashes, respectively. Appendix B contains a list of locations. Agencies in GVMC should use those locations to make necessary safety improvements and this should be integrated into crash analysis and prioritization efforts.

Conduct road safety audits of high risk intersections. Areas demonstrating disproportionately high numbers of intersection crashes during the annual prioritization are good potential candidates for road safety audits (RSA). A RSA is a formal safety performance examination of an existing or future road or intersection

by an independent and multi-disciplinary team. MDOT currently conducts RSAs on trunklines as part of its HSIP project development efforts. Regional Planning Commissions should work with local agencies across West Michigan to develop a process and funding strategy for conducting intersection RSAs. This effort should be coordinated with similar strategies for lane departure and pedestrians/bicycles.

Enhance traffic signal configurations and equipment. Several years ago MDOT and local agencies worked together to apply the box configuration within its traffic signal designs through a systemic approach. The box configuration can be utilized either with span wire or mast arms. The box configuration replaced the use of diagonal configurations, and provides better sight lines for drivers. As a means to further enhance safety at signalized intersections across the state, it is suggested that the items listed below be considered for inclusion within the standard traffic signal layout utilized by MDOT and local agencies within GVMC:

- Add backplates with reflective yellow borders
- Provide an additional ground mounted signal head in the far left corner of each approach for permissive turns
- Provide overhead street name signs
- Provide overhead street lighting
- Signal per lane for high speed (over 40 miles per hour [mph]) roads

Implement proactive signal optimization initiatives. The regular re-timing of traffic signals is an effective method for improving intersection safety and mobility. Agencies in the GVMC area should implement a variety of programs to regularly re-time and optimize their traffic signal networks. The Georgia Department of Transportation and local agencies have partnered to develop the regional traffic operations program (RTOP) and implemented an innovative signal optimization program, which involves assigning dedicated corridor managers to actively manage signal timing. Another similar initiative is currently under way in Florida called active arterial management.

Implement intersection safety focused engineering countermeasures. Several engineering countermeasures examples to target intersection crashes that should be considered for initial or wider application across West Michigan are listed below:

- Access management near intersections
- Enhanced traffic signal layout
Intersection sight distance
- Adding cross street does not stop plaque (W4-4p) at two-way stop controlled intersections
- Advanced intersection warning signs and flashers
- Overhead flashing beacon at stop controlled intersection for high speed intersections
- Supplemental flashers on stop sign for two-way stop controlled intersection
- Visibility of stop control
- Advanced stop pavement marking lines
- Pedestrian countdown signals and signal timing for high pedestrians areas

Agencies in GVMC are encouraged to implement low-cost safety improvements to enhance visibility of signs, especially on non-freeway signing. MDOT is doing low-cost safety improvements to their non-freeway signing by adding the post reflectors to W-1 series and stop signs.

Apply roundabouts at targeted locations. An MDOT research study indicated that single and dual lane roundabouts have reduced fatal and injury crashes by more than 60 percent when they replace a signal and more than 75 percent when they replace a two-way stop controlled intersection. Road agencies should consider additional intersections for single and dual lane roundabouts. Roundabouts can provide lasting benefits and value in many ways. They are often safer, more efficient, less costly and more aesthetically appealing than conventional intersection designs. Furthermore, roundabouts are an excellent choice to complement other transportation objectives – including Complete Streets, multimodal networks, and corridor access management – without compromising the ability to keep people and freight moving through our towns, cities and regions, and across the Nation. The FHWA Office of Safety identified roundabouts as a Proven Safety Countermeasure because of their ability to substantially reduce the types of crashes that result in injury or loss of life. Roundabouts are designed to improve safety for all users, including pedestrians and bicycles.

Conduct compact-roundabout pilots. A compact or mini-roundabout has many of the same benefits as a single lane roundabout including:

- Lowering speeds
- Reducing angle and left-turn head on crashes
- Ability to improve operations in many cases

Agencies in GVMC should consider piloting compact roundabouts at intersections involving collectors and minor arterials.

Implement innovative intersection designs. There are several alternative intersection designs that could help improve safety and congestion. Endorsed by the FHWA and largely implemented by MDOT, the following are examples for consideration:

- Displaced Left-Turn Intersection
- Median U-Turn Intersection (highly utilized across Michigan)
- Restricted Crossing U-Turn Intersection
- Quadrant Roadway Intersection

More information relating to these intersections is available in the *Alternative Intersections/Interchanges: Information Report (AIIR)* by the FHWA. <http://www.fhwa.dot.gov/publications/research/safety/09060/>

Evaluate the potential to utilize red light cameras. Red light cameras have been found to be an effective method of reducing angle crashes at signalized intersections. Research has shown that red light cameras can reduce fatal and injury crashes by 12 percent. In Michigan, photo enforcement is only authorized for use at highway rail grade crossings. A study should be conducted to determine the feasibility and identify potential impacts of authorizing the use of red light cameras in Michigan. While education and engineering solutions are important in preventing red light running, automated enforcement is another effective tool. The FHWA maintains a list of resources on red light cameras.

Develop intersection outreach materials. An intersection task force or champion should review the various safety-focused countermeasures in order to prepare informational documents to inform county and local officials across the region. The

goal behind this strategy is to promote lesser known intersection alternatives to incite their usage in GVMC area.

A second benefit is this material can be used to educate the public on the operational characteristics and reasoning for implementing newer or alternative intersection designs. Due to the inherent nature of these designs, motorists are generally unfamiliar with their usage.

3.2 Lane Departure

Background

Lane departure or roadway departure crashes are the result of a vehicle leaving the roadway resulting in either crossing an edge line or centerline. These crashes tend to result mainly from fatigue, distraction, drowsy driving or in some cases speeding or aggressive driving and are compounded by the use of drugs or alcohol. Winter weather, poor traction between vehicles and road surfaces, poor visibility and other compromised pavement conditions also lead to vehicles departing the roadway. Nationally over 54 percent of all traffic fatalities are the result of lane departure crashes. Subsequently, these crashes are frequently severe, and tend to be distributed across large areas of network. As a result, the systemic approach to highway safety in many cases is an extremely effective approach to targeting lane departure.

Key Facts

Table 5 below shows that around 30 percent of all fatalities and serious injury crashes each year in GVMC area are the result of a lane departure crash, although lane departure crashes only account for about 16 percent of total crashes.

Table 5 - Percentage Distribution of Lane Departure Crashes

Year	Crashes	Fatalities	A-Injuries	K+A
2012	16.6%	57.1%	35%	37.8%
2013	18.7%	30%	31.5%	31.3%
2014	16.9%	34.5%	28.2%	29.2%
2015	15.8%	47.9%	28.4%	31.5%
2016	15.2%	37.1%	24.6%	26.1%

Strategies

Implement ranked and prioritize high-risk lane departure segments. This plan provides a ranking of roadway segments with disproportionate numbers of lane departure crashes. This ranking is conducted utilizing the methods outlined in the AASHTO HSM. This ranking also prioritizes segments utilizing the excess expected crashes performance measure. This performance measure identifies whether a site has a disproportionately high number of crashes. Appendix B contains a list of locations. GVMC also ranks segments based on total crashes, fatal and serious injury crashes, respectively, which is shown in Appendix B. Agencies in GVMC should use these locations to make necessary safety improvements and this should be integrated into crash analysis and prioritization efforts.

Conduct road safety audits of high risk segments. Segments with disproportionately high numbers of lane departure crashes identified in Appendix C are good potential candidates for road safety audits (RSA). Local agencies across West Michigan should work in tandem to develop a process and funding strategy for conducting RSAs on an annual basis focused on lane departure.

Promote and implement applicable engineering countermeasures. Since lane departure crashes are more systemic in nature, utilizing new road building techniques and implementing proven technological improvements will help reduce the amount and severity of lane departure crashes over time. Many of these countermeasures are advocated by MDOT and the FHWA and have proven track records for safety:

- Shoulder and center line rumble strips
- Retroreflective pavement markings
- Curve delineation
- Partially paved shoulders
- Provide adequate clear zone
- Safety edges on roadways
- High friction surface treatments (HFST) on high-speed horizontal curves
- Fluorescent yellow sheeting on warning signs

Partner with Statewide initiatives for new countermeasures. The Michigan Traffic Safety Engineering Action Team's (TSEAT) recent action plan champions the use of low-cost safety countermeasures, and specifically aims to reduce lane departure crashes across the state. Local agencies across West Michigan are encouraged to partner with TSEAT to further these objectives and bring value back to their communities.

Promoting tips to prevent drowsy driving is also advocated, since that is one of the major cause of lane departure crashes. The National Highway Traffic Safety Administration provides drowsy driving tips that can be packaged and promoted locally in communities.

Implement community outreach and educational programs. Agencies in GVMC are encouraged to engage drivers through educational programs in their communities. Developing new material based on existing documents or using materials provided by national organizations are cost-effective ways to facilitate driver education.

National organizations, such as the Roadway Safety Foundation (RSF), have produced materials to educate drivers on lane departure crashes. The *Recognize, Reach, Recover* educational DVD was recently made available and includes six modules to train drivers how to effectively use rumble strips, along with a PSA archive containing driving tips, brochures, and traffic safety reports.

Seek Funding Opportunities. Agencies are encouraged to collaborate with partners to identify and promote opportunities for funding to implement lane departure focused countermeasures. As mentioned previously, TSEAT provides a strong partnership at the statewide level and could assist with identifying funding opportunities for identified projects. Other opportunities may exist between county and city partnerships to improve benefits to constituents.

3.3 Young Drivers Safety

Background

It is widely known that young drivers lack basic driving experience and are more likely to engage in risky and aggressive driving behaviors (such as speeding and tailgating), they are also more likely to have more passengers in their vehicles. Therefore, young drivers are much more likely than other groups to be involved in violent traffic crashes. Younger drivers represent just 15 percent of the driving population in Michigan, yet account for 33 percent of all crashes and 37 percent of fatal and serious injury crashes combined.

Key Facts

In GVMC region, Young drivers under age 24 are involved in 31.2% of all traffic crashes and 37.5% of fatal and serious injury crashes in 2016. Table 6 below shows that young drivers were involved in about 37 percent of all fatalities and serious injury crashes from 2012 through 2016 in the GVMC area.

Table 6 - Percentage Distribution of Young Driver Crashes in GVMC area

Year	Crashes	Fatalities	A-Injuries	K+A
2012	48.2%	46.9%	41.2%	41.9%
2013	39.1%	36%	34.9%	35%
2014	37.7%	27.6%	37.9%	36.2%
2015	37.1%	38%	37.8%	37.9%
2016	31.2%	29%	38.6%	37.5%

Figure 11 Young Driver Crash

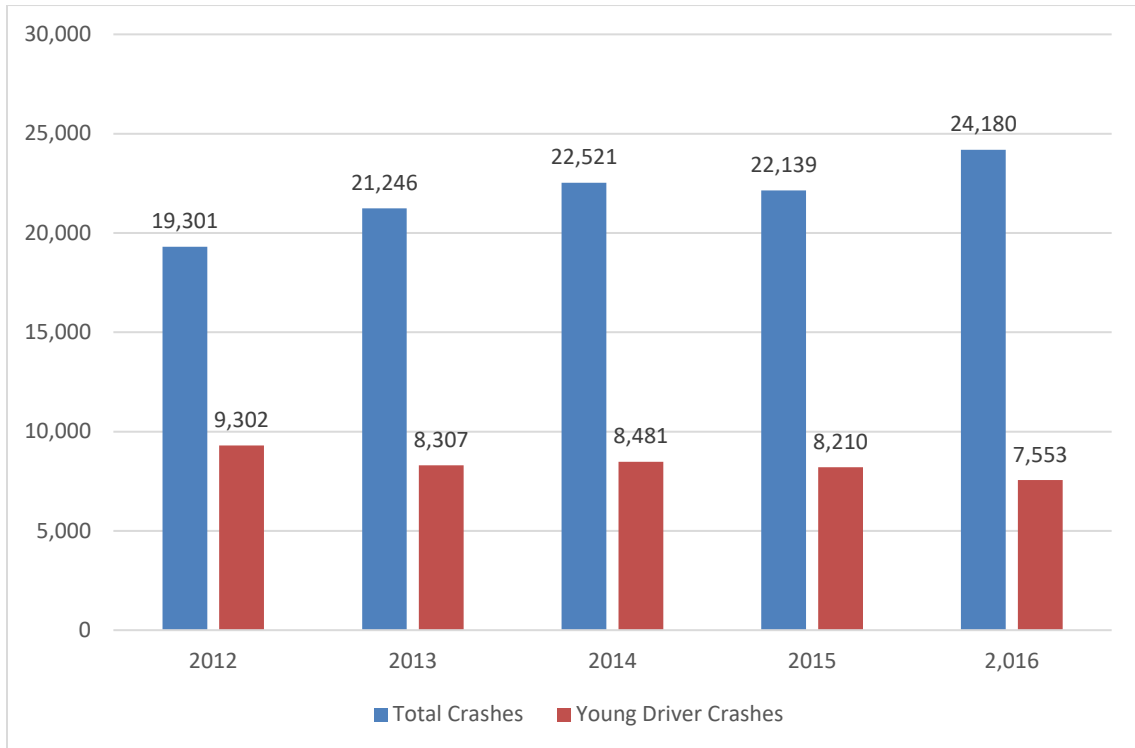
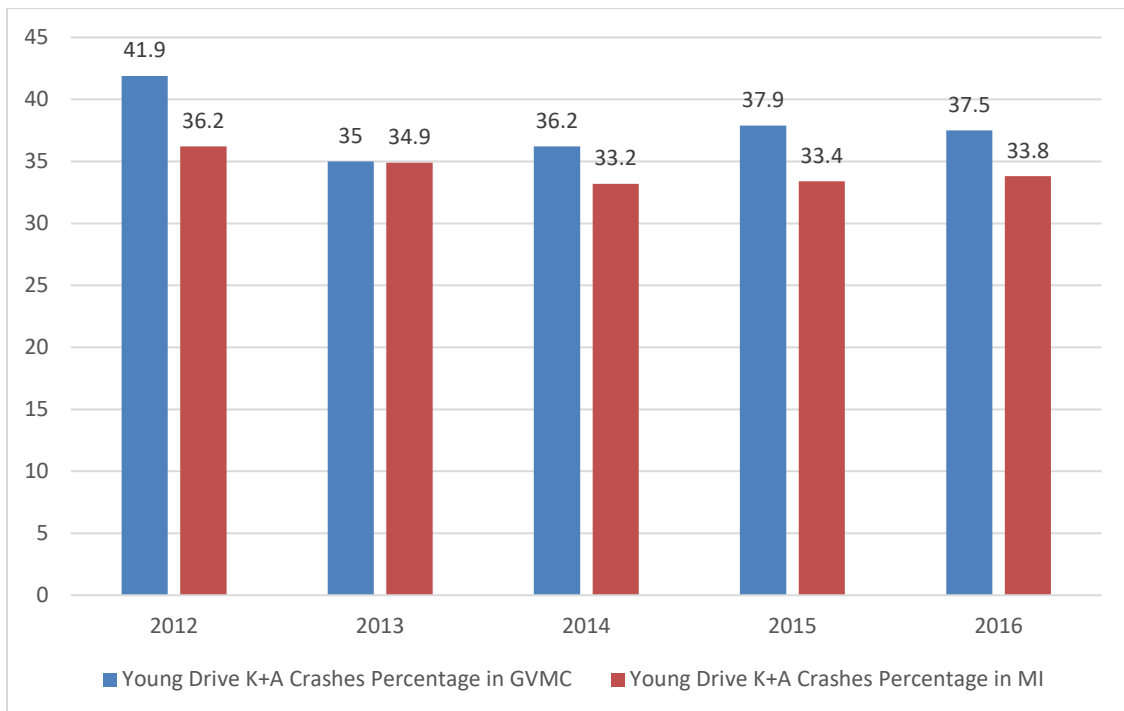


Figure 12 Young Driver Fatal and Serious Injury Crash Percentage



Strategies

Studies have shown that the most effective countermeasures involve enforcement and law restrictions. Supplementing these laws with educational programs and public media campaigns, promotes awareness among teen drivers and parents, increasing their overall effectiveness for safety. In 2011, MDOT commissioned the “*Improving Driver Safety with Behavioral Countermeasures*” study, where researchers examined five different emphasis areas, including younger drivers. The following table provides an overview of the countermeasures reviewed, along with grades for effectiveness, cost and implementation issues.

Countermeasure	Effectiveness	Cost	Implementation Issues
Graduated Driver Licensing	High	Low	Low
Driver Education	Low	Medium	Medium
Parent Involvement	Medium	Low	Medium
Licensing Age	Medium	Low	Medium
Nighttime Driving Restrictions	High	Medium	Low
Passenger Driving Restrictions	High	Medium	Low
Seat Belt Laws and Youths	Medium	Low	Low
Cell Phone Use	Medium	Low	Low
Youth Programs	Medium	Medium	Low
School Education Programs	Low	Low	Medium

Support statewide efforts to promote the benefits of graduated driving licensing.

Michigan currently has GDL laws in place with violation consequences. In Michigan, teen drivers under the age of 18 must complete two segments of drivers training education and meet the requirements for three GDL levels:

- Level 1 restricts teens to only driving with a licensed parent/guardian or designated licensed adult age 21 or older.

- Level 2 restricts the hours of operation between 10 p.m. and 5 a.m. and the number of passengers in the car to one, with some exceptions.
- Level 3 is unrestricted.

GDL requires young drivers to drive under supervision and limits their exposure to hazardous situations until they gain necessary driving skills. The GDL program can help young drivers to reduce many at-risk situations and allows them to more comfortably progress through a series of licensing levels. Agencies in GVMC Michigan should support these statewide efforts.

Publicize, enforce, and adjudicate laws pertaining to young drivers. Nighttime driving restrictions, passenger limits, seat belt laws, and cell phone use restrictions are all enforcement measures aimed at keeping young driver's safe. The Michigan Office of Highway Safety Planning (OHSP) and the Michigan Department of State (MDOS) have ongoing activities like the *Put your phone in park* campaign and articles published in the *SOS Express News* targeted at teen drivers. Agencies in West Michigan are encouraged to develop a working group to coordinate with the GTSAC *Drivers 24 and Younger Action* team, in order to communicate region specific issues and suggestions for improving safety.

Support parents in managing their teens' driving. Promote the use of tools provided by MDOS, such as the RoadReady mobile app for logging learner's permit hours and to obtain parental pointers and the Parent's Supervised Driving Guide. Also available is the Michigan Graduated Driver Licensing Parent Checklist, document targeted towards parents teaching their children to drive.

Training is available to parents for free through a grant to the University of Michigan Transportation Research Institute from the CDC's National Center for Injury Prevention and Control which is based on the latest teen driving safety research. This will help provide:

- Parents facts_about teen driving safety.
- Showing parents_what they can do to help their teens be safer drivers.
- Providing a free interactive Parent-Teen Driving Agreement that can be customized.

A working group should be developed in West Michigan to gather and disseminate information as mentioned above to all of the region's partners.

Employ school based strategies. All Michigan high schools are eligible to apply for Strive for a Safer Drive (S4SD), a teen driving initiative aimed at reducing serious traffic crashes, injuries, and fatalities among Michigan's teens drivers. It is presented by Ford Driving Skills for Life (DSFL) and the Michigan Office of Highway Safety Planning (OHSP). The goal of S4SD is to put teens in the driver seat, by providing applicants with grant money to create a traffic safety campaign. Also, all schools that participate in S4SD are eligible to attend a half-day, advanced driver training program focused on the following:

- Distracted and Impaired Driving
- Hazard Recognition
- Speed and Space Management
- Vehicle Handling

A postcard has been developed by S4SD to help promote the program. This and other material from the OHSP S4SD resource packet should be sent to school administrators and students across Michigan. Agencies across GVMC should develop a working group, and partner with OHSP and student groups such as the Michigan Association of Student Councils to promote and share this and similar programs.

Conduct Social Media Campaigns. Delivering a coordinated message among local cities and counties will maximize the delivery and effectiveness of important messages. It is recommended that the young driver working group suggested above should work together to identify the various partners interested in assisting with the cause.

A single champion among these agencies should initiate efforts and provide a single point of contact for coordination purposes. Campaigns should be developed to highlight the dangers of unsafe behavior and spread awareness of available resources to parents and teen drivers.

3.4 Pedestrian and Bicycle Safety

Background

Nearly every trip begins and ends with walking. With this in mind GVMC is placing a renewed emphasis on providing support to local communities with a focus on non-motorized transportation safety.

On average there is nearly one crash per day that involves a motor vehicle and bike or pedestrian in the GVMC study area. (see Figure 13). Pedestrians and bicyclists are most at-risk road users, and are more vulnerable to significant injuries since they lack the protection from the steel and airbags in a vehicle when involved in traffic crashes.

Key Facts

Data in Table 8 and 9 showed that while in GVMC area traffic crashes involving pedestrian and bicyclist only accounted for about 2 percent of total traffic crashes from 2012 through 2016, more than 12 percent of traffic fatal and serious injuries in 2016 were vehicle-pedestrian/Bicycle crashes.

Appendix B contains HSM analysis with models built to determine the safety of intersections regarding pedestrian and bicycle safety in GVMC, and the ranking of high risk pedestrian crash locations.

Table 7 - Percentage Distribution of Pedestrian and Bicycle Crashes in GVMC

Year	Crashes	Fatalities	A-Injuries	K+A
2012	2.2%	14.3%	15%	14.9%
2013	1.8%	22%	15.4%	16.3%
2014	1.6%	17.2%	12.4%	13.2%
2015	2%	28.2%	14.1%	16.3%
2016	1.7%	14.5%	11.7%	12%

Figure 13 GVMC Bicycle/Pedestrian Crashes

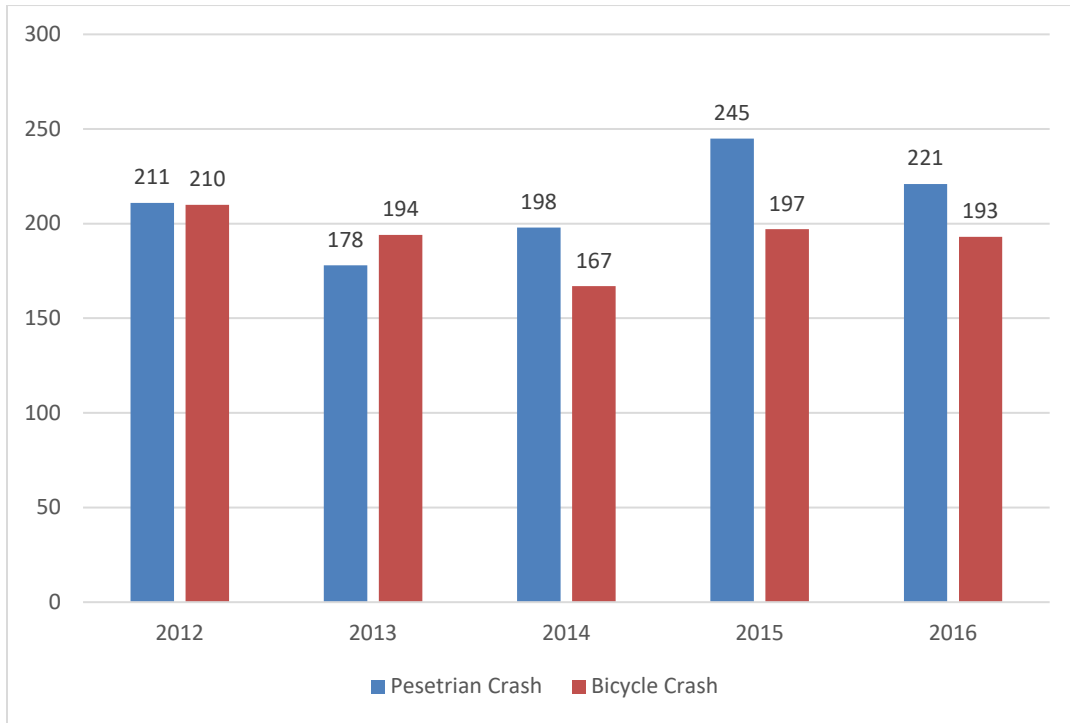
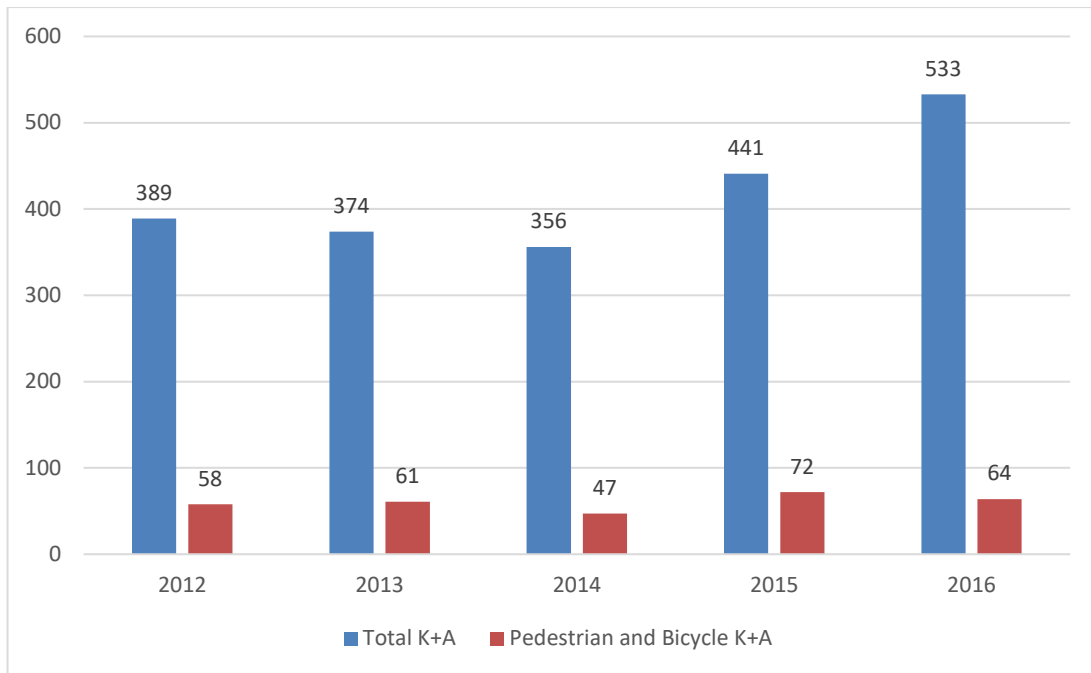


Figure 14 GVMC Bicycle/Pedestrian Fatalities and Serious Injuries



Strategies

Engineering and education countermeasures are generally the most supported and effective means for reducing crash risk among pedestrians and bicyclists. Michigan is a leader among the national *Complete Streets* initiative, which is a design and planning based approach to providing non-motorized friendly facilities.

Implement engineering focused countermeasures: Numerous countermeasures are available to reduce the risk of crashes for pedestrians and bicyclists, by providing them with discernable facilities to use alongside motorists. The following list is a high-level summary of available countermeasures:

- Sidewalks or separated walkways and paths
- Landscaped buffers for high traffic volume and high speed roads
- Pedestrian countdown signals
- Medians
- Rectangular rapid flashing beacons accompanied by marked crosswalks
- Pedestrian crossing treatments at appropriate locations
- Road diet

Implement traffic calming. Using traffic calming reduces the likelihood and severity of crashes by limiting the vehicle speed and raising a driver's awareness to the surroundings. Examples of commonly used traffic calming treatments: single lane roundabouts, lane narrowing, unique pavement markings, rumble strips, on-street parking and bump outs.

Reducing vehicle speed is crucial to improving the survival outcomes of pedestrians involved in a crash. NHTSA has compiled research in this area, and has provided data on the pedestrian injury severities related to officer estimated vehicle travel speed as shown in the figure below.

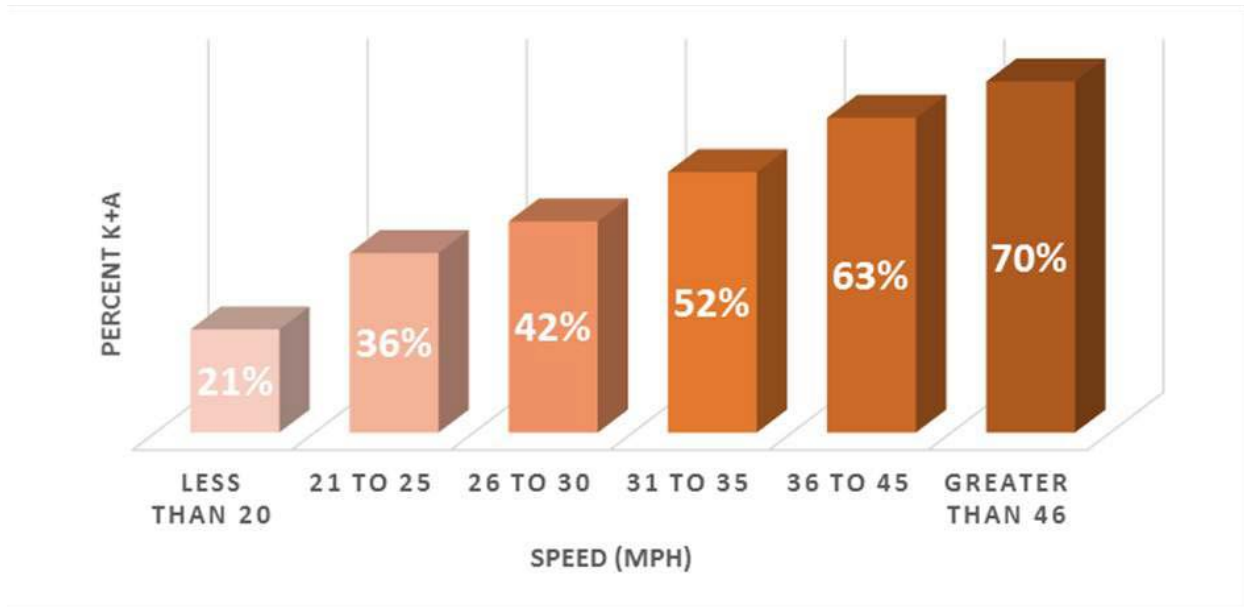


Figure 15 Fatal and Serious Injury Pedestrian Crash Percentage by Vehicle Speed

Based on the chart above, crashes with vehicle speeds greater than 46 mph result in a fatal or serious injury approximately 70 percent of the time, where the data is split 52 to 48 percent favoring fatalities. Lower speeds generally translate to less severity; however, the risk of fatal or serious injury is still prodigious above 20 mph.

Speed studies should be conducted at locations suspected of higher speeds to identify the problem and to provide a baseline measurement for evaluating treatments once implemented. Special consideration should be given to main street locations, where high-speed to low-speed transitions and pedestrian and bicycle activity are present.

Agencies in GVMC should work together to develop a region-wide process on where, when, why and how to implement traffic calming using the strategies presented in this document.

Signs and pavement markings: Signs and pavement markings are used to educate driver about the surroundings. Examples include the school advance warning sign, school speed zone and flashing speed zone signs, flashing yellow warning signals, in-street YIELD TO PEDS signs (placed mid-crosswalk), and driver speed feedback signs.

- **Parking prohibitions near intersections and crosswalks:** Parked cars decrease visibility for both pedestrians and motorists. Removing them from

areas where there is high pedestrian activity, near a crosswalk for example, would likely reduce conflict with vehicles and improve safety.

- **High visibility marked crosswalks:** Marked crosswalks are used to indicate a preferred pedestrian crossing location and to alert drivers to an often-used pedestrian crossing. However, marked pedestrian crosswalks, in and of themselves, do not slow traffic or reduce pedestrian crashes.

Targeted enforcement for all road users: Targeted enforcement near high pedestrian areas such as downtown, schools, universities, and community colleges may be helpful to improve driver behavior such as speeding or not yielding to pedestrians in crosswalks. Targeted enforcement may also help improving non-motorized behavior such as distracted, jay walking and not following traffic laws.

Public education campaigns and outreach: Equally important as infrastructure improvements, successful public campaigns educate pedestrians and bicyclists on safe practices and improve awareness for safety. The FHWA has prepared the *National Pedestrian Safety Campaign* website that provides ready-made outreach materials to states and communities that can be customized and used locally. Resources provided ranged from TV and radio public service announcements, to brochures, posters, and press releases. Also important, *A Campaign Planning Step by Step Guide* is available to help implement a successful campaign.

Another initiative called the *Pedestrian Safer Journey* provides material for educators and parents to teach kids ages 5 to 18 safe practices when walking. Included are videos, quizzes, and a resource library divided into three different age groups. A companion program titled *Bicycle Safer Journey* provides similar materials and resources.

Locally, MDOS provides pedestrian and bicycle safety tips via their website. They also have brochures available like *Be Safe Be Seen* as part of the Michigan Pedestrian Safety Program. Teaching pedestrians and bicyclists the correct way to interact with vehicle traffic should be a central theme among outreach materials. Agencies in GVMC are encouraged to promote these programs across their communities to improve safety.

Research and Pursue Safe Routes to School Programs (SRTS): Over 4,000 schools are eligible for SRTS projects in Michigan, with an average of \$3 million

per year available for funding. The program requires a planning process, which ultimately determines which infrastructure improvements are applicable within a two mile radius of the school. The follow projects are eligible for funding by the program, and should be pursued by organizations across West Michigan:

Infrastructure Projects

- Sidewalks
- On-street and off-street bicycle facilities
- Traffic calming and speed reduction Off-street pedestrian facilities
- Pedestrian and bicycle crossing improvements Traffic diversion improvements in the vicinity of schools

Non-infrastructure Projects

- Activities to encourage walking and bicycling to school
- Traffic enforcement operations in the vicinity of schools
- Public awareness campaigns, community outreach
- Student training sessions (bicycle and pedestrian safety, health, and environment)
- Traffic education Funding for training volunteers and managers of safe routes to schools programs

Promote other non-motorized safety programs: Agencies should collaborate and work together to implement non-motorized safety focused initiatives that focus on bicycle and pedestrian safety such as the following:

- AAA School Safety Patrol – the role of this program is, “to organize and teach dedicated student volunteers to direct their peers in safely interacting with school traffic.” This program benefits students through team building and other leadership skills, along with the school and community, by promoting safer and more collaborative environments surrounding transportation.
- Bicycle rodeo - a bicycle safety clinic featuring bike safety inspections and a safety lecture about the rules of the road, followed by a ride to show where and how to apply the rules. The SafeRoutes National Center for Safe Routes to School provides an organizers guide to bicycle rodeos, which outlines a step-by-step approach to designing a successful rodeo.

- Walking school buses – in communities close to schools, the use of walking school buses provides safety and fitness benefits to kids. The SR2S [website](#) provides volunteer, adult letters, and route development resources for parents and schools looking to develop a walking school bus program.

Since many of these programs are school-focused, they provide numerous benefits by teaching children the proper way to approach pedestrian and bicycle safety. Fostering pedestrian-centric attitudes will pay large dividends towards reducing fatal and serious injuries over time.

Prioritize pedestrian and bicycle crash locations and conduct pedestrian and bicycle RSAs. Locations identified in this safety plan exhibiting a high risk for pedestrian and bicycle crashes are good potential candidates for RSAs. In addition, GVMC should determine focus communities, cities, and agencies for priority assistance.

Promote information sharing across agencies: Agencies in West Michigan should exchange information about successes and failures of projects for pedestrian and bicycle safety, by using a common working group. Pooling efforts and sharing ideas will help facilitate improved facilities for all users in GVMC area.

3.5 Distract Driving

With the advent of smart devices, distracted driving has received an increased emphasis from transportation agencies across the United States. The National Highway Traffic Safety Administration (NHTSA) reports that 10 percent of fatal crashes, 18 percent of injury crashes, and 16 percent of all police-reported traffic crashes in 2013 were distraction-affected crashes. New automobile technologies are thought to reduce distraction, however, the National Safety Council (NSC) states that, “53 percent of drivers believe if manufacturers put “infotainment” dashboards and hands-free technology in vehicles, they must be safe...But in fact, these technologies distract our brains even long after you’ve used them.” Distraction is not just limited to drivers but also effects pedestrians, where studies have shown mobile phone use is correlated and parallels the same increased crash risk experienced by motorists.

Due to the variety of distractions effecting motorists, the true influence of distraction in crashes is generally considered as underreported since pre-crash distractions often leave no evidence to observe. This is confounded by the fact that drivers are typically reluctant to admit distraction as cause for a crash.

There are many sources of distracted driving, where according to the U.S. Department of Transportation, the following actions constitute distraction in an automobile:

- Texting
- Cell phone or smartphone use
- Eating or drinking
- Talking to passengers
- Grooming
- Reading, including maps
- Using a navigation system
- Watching a video
- Adjusting a radio, CD player, or MP3 player

However, since text messaging requires visual, manual, and cognitive attention from the driver, it is by far the most alarming distraction. Five seconds is the average time

eyes are taken off the road while texting. When traveling at 55 mph, that is enough time to cover the length of a football field blindfolded. (2009, VTTI)

Strategies

Enforcement and education are the primary methods of preventing distraction, with engineering providing support in reducing the severity of crashes. The GTSAC Distracted Driving Action Team has developed an action plan, which lists objectives that also serve as effective countermeasures and are detailed as follows.

Law enforcement education and training. Training for police officers to identify distracted drivers is tantamount to the enforcement of laws. According to GTSAC's Distracted Driving Action Team, as of early 2013, Michigan was one of 39 states to ban text messaging for all drivers. Michigan also prohibits cell phone use for newly licensed drivers, which includes those with a Level 1 or Level 2 license.

Conduct effective communication and outreach activities. Michigan already has laws in place aimed at reducing distracted driving, namely Kelsey's Law and a text messaging ban. Publicizing these laws across West Michigan on a local basis will remind drivers about the seriousness of the issue. To that end, the Action Team has developed a few activities to reinforce the message to younger drivers:

- Inviting high school students to create billboard designs aimed at delivering the message to drivers (part of a statewide campaign). Agencies in West Michigan can apply this model by partnering with schools in their jurisdiction.
- The Kids Driving Responsibly (KDR) Challenge is a campaign that “focuses on the youth in Michigan, educating them on the dangers of using a cell phone while driving.”
- The Remembering Ally: Distracted Driving Awareness Campaign promotes safe, non-distracted driving through resources such as posters, public service announcements, and a simulated distracted driving crash video.

The OHSP also provides free brochures, flyers, posters and other items about traffic safety laws and best practice via their Michigan Traffic Safety Materials Catalog. Items available that are specific to this emphasis area include Kelsey's Law Flyer and Thumbs on the Wheel flyers and posters.

Implement low-cost engineering countermeasures. Currently, the Action Team recommends roadway alarm systems to alert distracted drivers (in the form of rumble strips) and the removal of roadside obstacles (improved clear zone) to reduce the severity of accidents involving distracted drivers. MDOT is researching other countermeasures, including intersection warning systems and transversely mounted rumble strips in advance of stop signs at intersections. Many of the previously cited lane departure countermeasures are useful for distracted driving as well.

3.6 Impaired Driving

Background

Impaired driving crashes are disproportionately more severe than other crashes, constituting 30 percent of all fatal crashes each year in Michigan. Despite decades of efforts, impaired driving remains a devastating traffic safety and public health problem. Impaired driving is the greatest and most complex behavioral issue in Michigan traffic deaths. According to the FHWA, many of the drivers under the influence of alcohol are ‘high risk’ with one or more of the following characteristics:

- Half of drinking drivers in crashes or arrests have BACs of .15 or higher
- One-third of drinking drivers in crashes or arrests have a prior DWI conviction.
- One-quarter of drinking drivers in surveys have some indication of alcohol problems.

Implementing strategies focused on reducing the likelihood of impaired driving is crucial to reducing fatal and serious injury crash rates across Michigan. Agencies in Michigan are encouraged to implement a combination of prevention, enforcement, judicial, regulatory, and treatment countermeasures to combat impaired driving.

http://www.michigan.gov/documents/msp/Impaired_Driving_Action_Plan_Review_ed_10-14-ksf_437300_7.pdf

Key Facts

Alcohol is one of the leading causes of traffic crashes in GVMC region, in the state of Michigan, as well as in the United States. While over the course of 2012-2016 alcohol-related traffic crashes accounted for less than 5% of the total crashes in GVMC region, fatal and injury crashes involving alcohol-impaired drivers far exceeded this percentage. For this time period, alcohol-impaired drivers were involved in more than 30% of all fatal crashes and about 20% of serious injury crashes in GVMC region. Although drug-related crash only accounted for around 0.5% of the total crashes in GVMC region, the percentages of traffic fatalities and serious injuries involved drug-impaired driver in 2016 were 17.7% and 4.9%, respectively. The data in the following tables and figures showed the percentage of impaired driving crashes in total crashes, and the percentages of impaired driving fatal and serious injury crashes in GVMC.

Table 8 - Percentage Distribution of Alcohol-Related Crashes

Year	Crashes	Fatalities	A-Injuries	K+A
2012	4.7%	32.7%	25.6%	26.5%
2013	3.9%	38%	22.5%	24.6%
2014	3.7%	31%	19.1%	21.1%
2015	3.9%	29.6%	18.6%	20.4%
2016	3.6%	25.8%	14.6%	15.9%

Table 9 - Percentage Distribution of Drug-Related Crashes

Year	Crashes	Fatalities	A-Injuries	K+A
2012	0.5%	10.2%	2.9%	3.9%
2013	0.4%	4%	3.7%	3.7%
2014	0.4%	10.3%	3.4%	4.5%
2015	0.5%	11.3%	3.5%	4.8%
2016	0.7%	17.7%	4.9%	6.4%

Figure 16 GVMC Alcohol-Related Crash Percentages

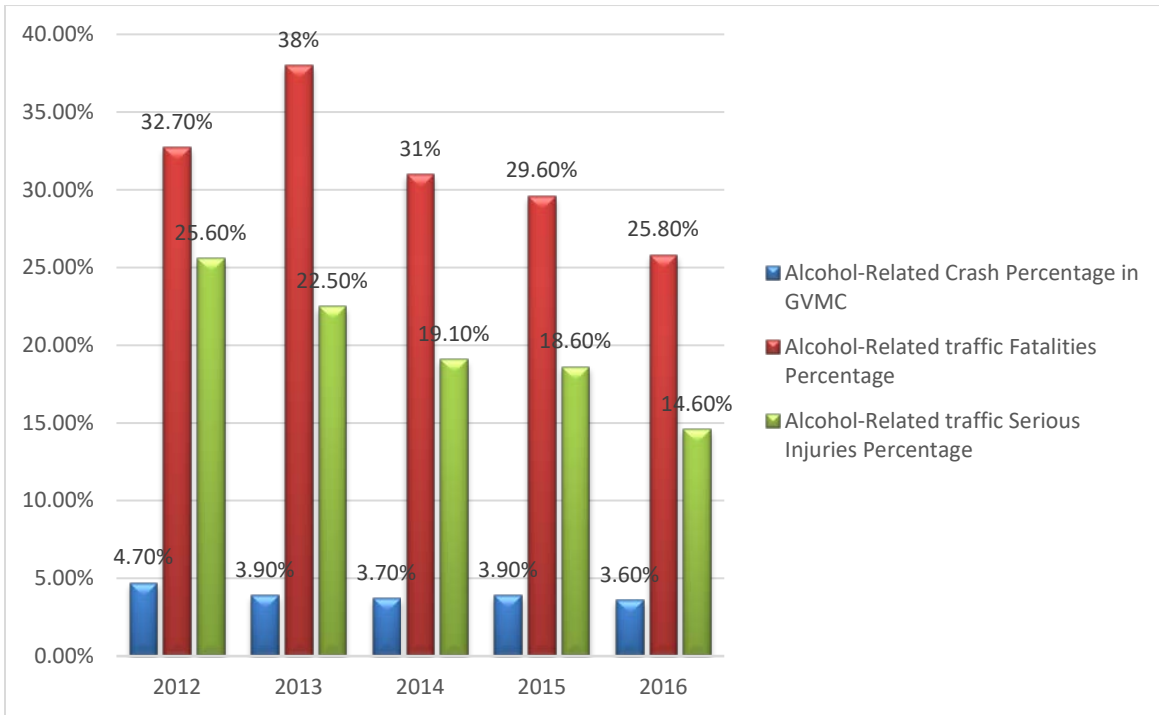
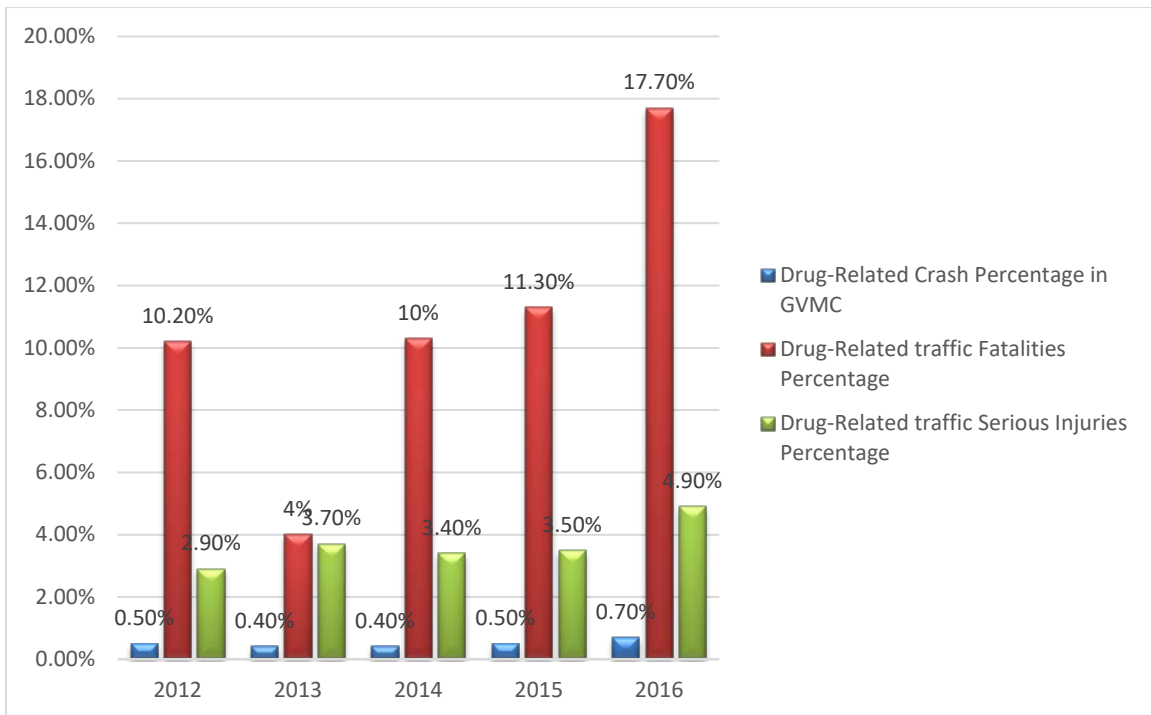


Figure 17 GVMC Drug-Related Crash Percentages



Strategies

The FHWA summarized research conducted on impaired driving and associated countermeasures in their *Highway Safety Countermeasure Guide for State Highway Safety Offices*. This guide identifies five basic strategies that are shown to reduce the likelihood and effects of impaired driving:

- Deterrence through the use of publicity, police enforcement, and the enactment of new laws placing further restrictions on impaired driving.
- Prevention and intervention efforts to dissuade drinkers from driving and reduce the consumption of alcohol.
- Communications and outreach to communicate the dangers of drinking and driving under the influence, along with establishment of new social norms that make driving impaired unacceptable.
- Alcohol treatment to reduce dependency on alcohol among addicted drivers.
- Other traffic safety measures used in concert with the previous strategies to better protect non-drinking and impaired drivers, alike.

Several countermeasures are available and applicable in Michigan. As part of deterrence, the FHWA recommends the use of Administrative License Revocation or Suspension (ALR or ALS), open container laws, BAC test refusal penalties, and High-BAC sanctions. These are laws currently enacted in the State of Michigan and their enforcement is critical in combatting impaired driving.

Use of Saturation Patrols. In states like Michigan where the use of checkpoints is not allowed, using saturation or roving patrols is recommended to help deter drunk driving. This style of patrolling consists of concentrating officers at known places for drunk driving during set times when the risks associated with impaired driving are the greatest. Publicity often accompanies these patrols and has been shown to reduce alcohol-related fatal crashes when combined with these patrolling efforts.

Pursue officer training programs. Training officers to recognize impaired drivers, under the influence of either alcohol or drugs, is essential in reducing impaired driving. The Michigan State Police (MSP) offers a multi-tiered impaired driver detection training course that includes Drug Recognition Expert (DRE), Advanced Roadside Impaired Driving Enforcement (ARIDE), and Standardized Field Sobriety Testing (SFST) training programs. These courses include a mix of lecture, hands on

instruction and field training. Local agencies in West Michigan should encourage their police departments to attend this training and increase the amount of DRE certified officers, and to remain current with the latest ARIDE and SFST techniques.

Public education and outreach. Due to the increased fatality rate among younger drivers, an effective education program through traditional outlets such as schools and news media provides a foundation for a paradigm shift among the youth. To that end, the use of social media to display public service announcements and advertisements helps target young drivers where they view content the most. Depending on the community, using billboards and posters also helps to supplement media campaigns and further reinforce the message. Communication and outreach focused on our youth helps prevent impaired driving before it even begins.

Partner with National Programs. There are several organizations promoting positive messages against drunk driving that should be partnered with on a local level across West Michigan:

- Students Against Destructive Decisions (SADD) – the goal of SADD is to educate students through, “scientific-based, peer-to-peer educational trainings, programs & events, awareness campaigns, and leadership development opportunities.”
- Mothers Against Drunk Driving (MADD) – the mission of MADD is, “to end drunk driving, help fight drugged driving, support the victims of these violent crimes and prevent underage drinking.”
- SafeRide America – is an organization that has two goals to eliminate the two main excuses people use to drive impaired: not wanting to leave their car behind and not having money to pay to get their car home.

Agencies in GVMC area should contact groups like these for assistance in developing local chapters. This will help further their positive messages and provide a vehicle for utilizing their existing networks for education and outreach.

Designated Driver programs. Incentivizing the use of designated driver programs provides a more formal approach to a typically informal concept. Examples of this include partnering with local drinking establishments and restaurants to give designated driver’s benefits, such as a free soft drinks or food. Further, reinforcing

these programs with a local publicity campaign will help increase participation and provide incentives for businesses to participate.

Support Statewide Efforts. As part of the Michigan SHSP, the statewide *Michigan Impaired Driving Action Plan* was developed. Agencies should seek support of these statewide efforts.

Support transit and ridesharing efforts. A new report completed by Mothers Against Drunk Driving (MADD) and Uber indicated that in California, a significant reduction in drunk driving crashes occurred following the introduction of ride sharing services. According to MADD a survey of attitudes about ridesharing services and their role in combating drunk driving, nearly 4 in 5 (78 percent) respondents said friends are less likely to drive home after drinking once ridesharing services like Uber and Lyft started operating in their city. In addition, 93 percent of people would recommend ridesharing as a safer way home to a friend who had been drinking. Agencies in West Michigan should promote ridesharing as a reliable alternative to impaired driving. Additionally, agencies should ensure their ridesharing ordinances take into consideration this benefit.

Identify and prioritize high-risk locations: Agencies in GVMC area should identify high risk impaired driving locations using safety data to supplement the implementation of previously mentioned programs. This data also helps drive a multidisciplinary approach including education, enforcement, and engineering such as:

- Public information and education campaigns
- Exploration of innovative countermeasures for high risk impaired driving locations
- Providing recommendations related to impaired driving legislation

Ignition interlocks program. Promote efforts to increase sobriety courts and the use of ignition interlocks.

Chapter 4. Additional Emphasis Area

4.1 Senior Mobility and Safety

Background

In the GVMC area today there are approximately 715,000 people. Of those, approximately 13% or 93,000 are over the age of 65. Based on currently available data 90% of elderly residents use a passenger vehicle as their primary source of transportation with 70% doing the driving themselves. According to the Michigan Secretary of State there are nearly 70,000 licensed drivers in the GVMC area over the age of 65. This represents nearly 15% of the total number of licensed drivers. By 2030, the elderly population in the GVMC area is expected to be 177,500 and make up more than 20% of the population.

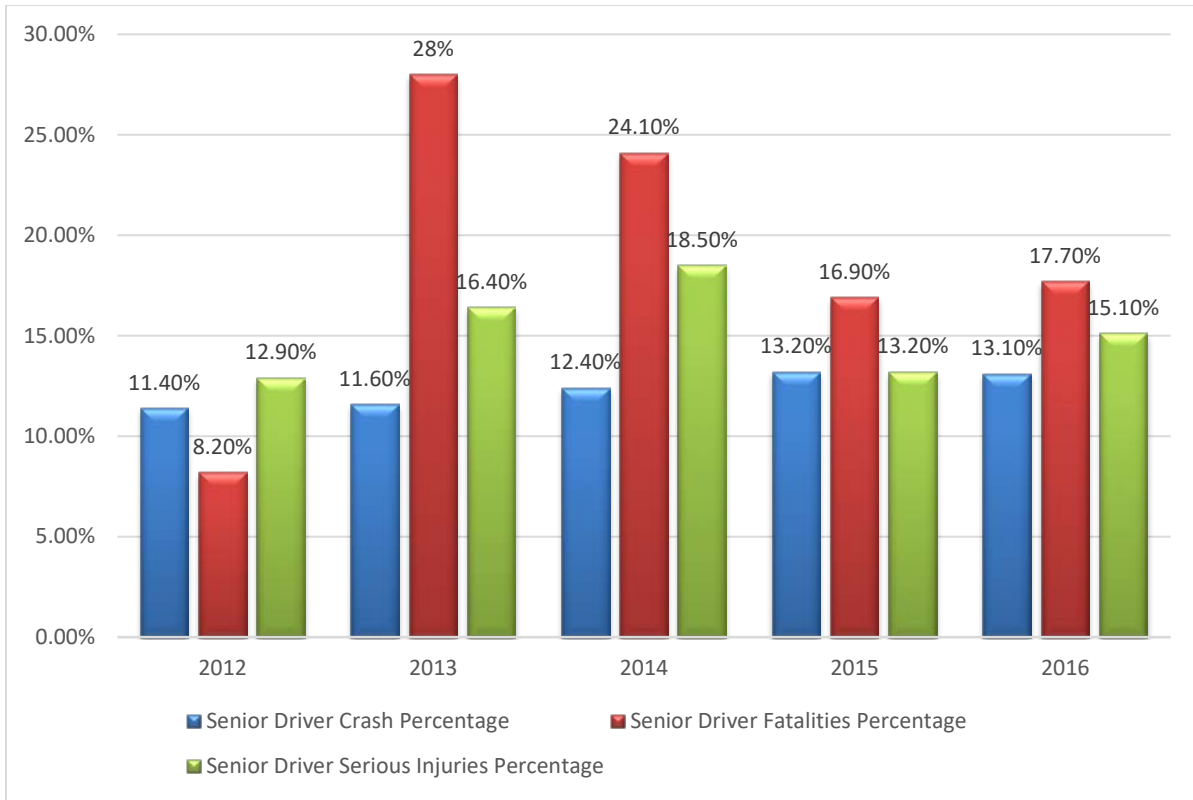
Key Facts

Crash data shows that the percentage of traffic crash involving senior drivers accounted for about 13 percent in 2016, while percentage of traffic fatalities and serious injuries for senior drivers were 17.7% and 15.4%, respectively.

Table 10 - Percentage Distribution of Senior Driver Crashes in GVMC area

Year	Crashes	Fatalities	A-Injuries	K+A
2012	11.4%	8.2%	12.9%	12.3%
2013	11.6%	28%	16.4%	17.9%
2014	12.4%	24.1%	18.5%	19.4%
2015	13.2%	16.9%	13.2%	13.8%
2016	13.1%	17.7%	15.1%	15.4%

Figure 18 Senior Driver Fatal Crash Percentage



Strategies

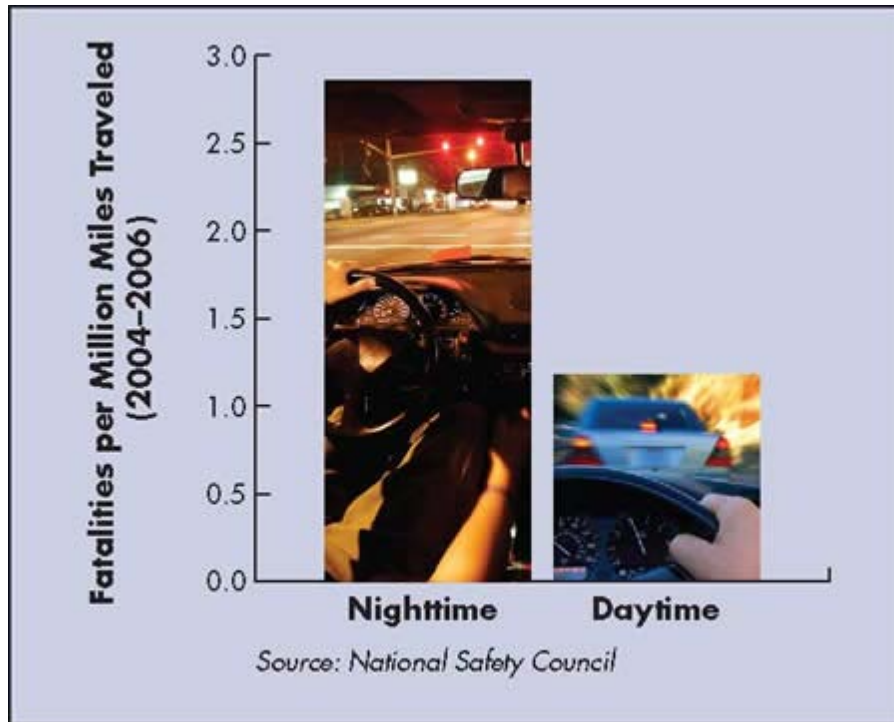
Across the United States, many different organizations and agencies are focused on creating safer roadways for the aging population. Engineering efforts are underway to design better roadways with an emphasis on visibility and ease of use. Education is an effective means of informing roadway users of the challenges presented with older age.

Corrective Actions - Roadway design can play a key role in enhancing safe driving for the elderly. Much of the existing road system was designed and built with standards that did not take into account the needs of an aging population. While retrofitting the entire highway system to accommodate elderly drivers is ideal, financial realities dictate that other approaches are warranted.

A report entitled Guidance for Implementation of the AASHTO Strategic Highway Safety Plan compiled promising strategies to improve the roadway/driving environment to better accommodate the special needs of older drivers.

These include:

- Provide advance warning signs to inform drivers of existing or potentially hazardous conditions on or adjacent to the road.
- Provide advance guide signs and street name signs to give older drivers additional time to make necessary lane changes and route selection decisions, and reduce or avoid excessive or sudden braking behavior.
- Increase size and letter height of roadway signs to better accommodate reduced visual acuity of older drivers.
- Provide longer clearance intervals at signalized intersections to accommodate slower perception reaction times of older drivers.
- Provide more protected left turn signal phases at high-volume intersections to avoid difficulties older drivers have with determining acceptable gaps.
- Improve lighting at intersections, horizontal curves, and railroad grade crossings to help older drivers compensate for reduced visual acuity
- Improve roadway delineation so older drivers have better visual cues to recognize pavement markings.
- Improve traffic control at work zones to improve driver expectancy by providing adequate notice to drivers describing the condition ahead, the location, and the required response.



While only one-quarter of all travel occurs at night, about half of the traffic fatalities occur during nighttime hours. To address this disparity, the Federal Highway Administration has adopted new traffic sign retroreflectivity requirements. The rule provides additional requirements, guidance, and clarification. The rule encourages flexibility to allow agencies to choose a maintenance method that best fits their specific conditions.

Federal STP funding can be used for sign replacement to meet the new standards. GVMC does not restrict the use of federal funding for sign replacement.

Unified public education and outreach. Using educational materials, such as the Roadway Safety Institutes' *Safety Solutions for Older Drivers DVD*, help to inform drivers of safety tips related to older drivers. The Michigan OHSP has recently published *Michigan's Guide for Aging Drivers and Their Families*, which is a document aimed at promoting safe mobility, self-assessment of driving abilities, safety tips for road users, impacts of aging on driving, and how to retire from driving.

For citizens who are still driving, attending a CarFit event will ensure they have the proper fit in their car increasing their ability to drive safely. Agencies should contact the CarFit organization to help schedule an event in their area.

Planning for aging populations. The GTSAC Senior Mobility Work Group's (SMWG) current action plan reinforces the importance of planning for aging drivers on a community level. They encourage agencies to consider the aging population when planning their communities, and take into account how transportation dependent their population is. Five resources are provided to support these activities:

- *Land Use Tools and Techniques: A Handbook for Local Communities* (SEMCOG)
- *Removing Regulatory Barrier to Housing Options for the Elderly* (Cornell University)
- *Creating Walkable Communities: A Guide for Local Governments* (Mid-America Regional Council (MARC))
- *Design Guidelines for Active Michigan Communities* (Governor's Council on Physical Fitness, Health, and Sports, Michigan Department of Community Health (MDCH), and Michigan State University)
- *Michigan Community for a Lifetime: Elder Friendly Community Recognition Toolkit* (State Advisory Council on Aging, Office of Services to the Aging (OSA), MDCH, Michigan Vital Aging Think Tank, MSU extension)

Agencies are encouraged to contact the SMWG to further these objectives and assist with planning efforts across the region.

Evaluate and implement senior driver focused engineering countermeasures. Nationally, the FHWA has developed and released a *Handbook for Designing Roadways for the Aging Population*. This document contains treatments for intersections, interchanges, roadway segments, and construction/work zones. MDOT is in the process of reviewing this handbook for inclusion in their own standards.

Recently, MDOT has completed research on older driver countermeasures with their *Evaluation of Michigan's Engineering Improvements for Older Drivers* study. Nine treatments were assessed using analytical procedures with a final benefit to cost ratio provided for each. Most of the treatments were low cost involving sign modifications.

4.2 Traffic Incident Management

Background

Traffic incident management (TIM) is the planned and coordinated multi-disciplinary processes used to detect, respond, and clear traffic incidents as quickly as possible while protecting the safety of on-scene responders and the traveling public. An incident is defined as any non-recurring event that causes a reduction in roadway capacity. Such events include, but are not limited to, traffic crashes, disabled vehicles, spilled cargo, floods, and other unplanned natural or man-made events. The most common problem associated with highway incidents results in traveler delay, but the most serious problems are the risk of secondary crashes. Many times a secondary crash is more severe than the primary crash. A side effect of all incidents is the danger posed to responding personnel at the scene. The three shared objectives for TIM according to The National Unified Goal are:

- Responder Safety
- Safe, Quick Clearance
- Prompt, Reliable, Interoperable Communication

According to the FHWA, this coordinated process involves a number of public and private sector partners, including:

- Law enforcement
- Fire and rescue
- Transportation
- Public safety communications
- Emergency management
- Towing and recovery
- Hazardous materials contractors
- Traffic information media

Strategies

Promote Mi-TIME Training. Michigan Traffic Incident Management Effort (Mi-TIME) is a partnership between agencies, including the MDOT, state and local law enforcement, fire, emergency medical services (EMS), and towing services, to work together to safely and efficiently clear traffic incidents from Michigan’s highways. Mi-TIME responder training provides the responder community with TIM standards and good practices with the overall purpose of enhancing quick clearance efforts and improving responder and motorist safety.

Enhance public safety communications. Current issues as identified by the state’s 911 committee include Smart 911 and Text to 911. According to the most recent status map, the Text to 911 functionality is currently provided in the Barry, and Ionia counties in WMPR. Agencies should work to promote the proper use of this service through social media, brochures, and posters in their facilities.

Promote Hi-Viz apparel. Promote and educate the use of high-visibility apparel for first responders (including law enforcement, fire, EMS, towing, transportation, and media personnel). Michigan Manual of Uniform Traffic Control Devices (MMUTCD) Section 6D.03 Standard states all workers, including emergency responders, within the right-of-way who are exposed to traffic SHALL wear high-visibility safety apparel that meets ANSI performance class 2 or 3. Along with MDOT, the American Traffic Safety Service Association and USDOT advocate for the use of High-Visibility Safety Apparel in Highway Work Zones, and has informational sheet for quick reference (available on MDOT’s website as well). They also have issued_a construction advisory on worker visibility with specific considerations given for FHWA rules.

For emergency responders, the Emergency Responder Safety Institute (ERSI) has created the Responder Safety_website dedicated to “reducing deaths and injuries to America’s Emergency Responders.” Numerous online training modules are available for topics ranging from high-visibility innovations to planning for the long-term event. Agencies are encouraged to utilize training and resources provided by ERSI to educate their emergency responders on best practices.

Coordinate traffic incident response. Across the state MDOT operates traffic operations centers (TOC), which provide seven-days-a-week operation to effectively

monitor traffic and manage traffic incident responses. TOCs help share communication between law enforcement agencies and other transportation officials. West Michigan is currently under the jurisdiction of the West Michigan Transportation Operations Center (STOC). Agencies across West Michigan are encouraged to partner with the WMTOC to realize the traffic safety benefits they provide.

Promote public education of safe, quick clearance and Steer It Clear It & Move Over laws. Quick clearance of incidents is an effective strategy to reduce the risk of secondary crashes. To inform drivers and encourage compliance, MDOT and the MSP have partnered to publicize the new law with *Captain Clear It*.

MDOT also has strategies focused on gauging driver awareness of the *quick clearance law* and identification of strategies that are most effective in increasing understanding and compliance. Agencies in West Michigan should promote this material on behalf of MDOT and MSP.

4.3 Traffic Records and Information Systems

Background

Good traffic records, which include databases on crashes, traffic volume, and roadway attributes, are the foundation to implement most of the previously listed strategies. Over the past decade, Michigan's traffic crash database has been significantly enhanced and has become one of the most accessible and reliable systems in the country. With the Internet access to data from the HPMS, agencies have easy access to traffic volume and roadway attribute data for the federal aid road network. As a result, agencies have a much easier time accessing crash data than their peers in many other states.

Strategies

Following is a list of data enhancements as well as innovative data analytics solutions that will enhance the ability to effectively identify and address safety issues. To cost-effectively implement many of these solutions will involve collaboration between multiple agencies.

Maintenance of the traffic volume database for non-federal aid roads. Agencies in WMPR should collaborate on an effort to collect and maintain a non-federal aid traffic count database.⁵³ WEST MICHIGAN TRAFFIC SAFETY PLAN

Speed data. Vehicle probe data now has the ability to calculate 85th percentile and mean speeds on roadway segments. As a result, it is now possible to access current and historical speed profiles of large portions of the roadway network. As speed is a primary indicator of the severity of traffic crashes, agencies in WMPR should collaborate on an effort to purchase access to this speed data. It will allow agencies to make more informed traffic safety decisions.

Pedestrian and bicycle data. Pedestrian and bicycle volume data will help agencies to more effectively identify improvements targeted at vulnerable road users. Local agencies in WMPR should collaborate to develop a strategy for collecting and analyzing this type of data.

Roadway attributes. Applying data analytic tools, such as the AASHTO HSM, requires significant amounts of roadway attribute data to accurately predict the number of crashes at intersections and along segments. To advance efforts to deploy and utilize the HSM for West Michigan, it is proposed that a task force or working stakeholder group be initiated to identify the data needs to effectively apply the HSM as well as strategies to efficiently and cost-effectively collect and maintain the database.

Participate in data collection training. The Michigan State Police's *Criminal Justice Information Center* has developed the *Traffic Crash Data – Every Crash Counts* resource [guide](#) targeted at law enforcement outlines the importance of UD-10 training along with other concerns associated with crash data collection. Agencies in West Michigan should provide this information to their police departments and encourage officers to take in person and online UD-10 training courses.

Chapter 5. Implementation and Evaluation of the Plan

The next steps for GVMC are to implement the prioritized strategies provided in the safety plan and use the analysis to identify locations for funding. Implementation, evaluation, and updating the safety plan are important for accountability.

It is recommended that a single leading agency be identified and a *West Michigan Traffic Safety Working Group* encompassing the 4 E's be created or partnered with existing Traffic Safety Committee to implement the strategies of this safety plan and evaluate various ongoing transportation activities and programs in the region. This group will meet on a regular basis to exchange information, monitor the progress of implementation, and determine if the strategies used for each emphasis areas are working appropriately. This helps provide accountability and can be used to keep stakeholders informed and engaged. It is also recommended to develop short-term targets and set milestones to measure progress.

This safety plan identifies both systemic and spot locations, prioritize emphasis areas, and countermeasures so that road agencies can seek opportunities to implement them. It is also recommended that agencies work together with other agencies and MDOT to provide assistance to communities in identifying low cost fixes to improve the safety by conducting:

- Road Safety Audits
- Safe Routes to School
- MDOT Local Safety Initiative Program

To ensure the effectiveness of the projects and the overall plan, evaluation of the strategies should be ongoing. After strategies have been in place for at least one year or several years, that may be necessary for sufficient data, an agency should evaluate their effectiveness for larger-scale implementations.

Finally, this safety plan is a living document. The working group should review the safety plan, examine progress, evaluate effectiveness, and, if needed, suggest changes or modifications to the plan. This ongoing evaluation of the safety plan may present opportunities for improvement of the plan.

Appendix A: GVMC Crash Data

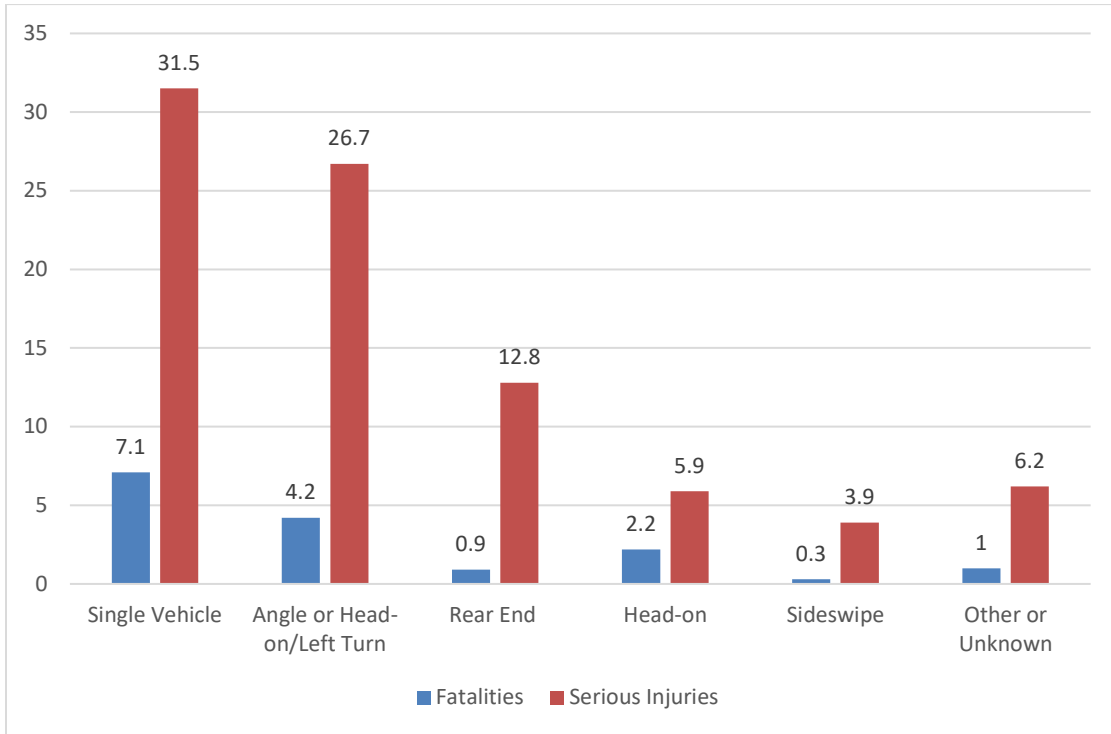


Figure A-1 Fatalities and Serious Injuries Percent Crashes by Type, 2012-2016

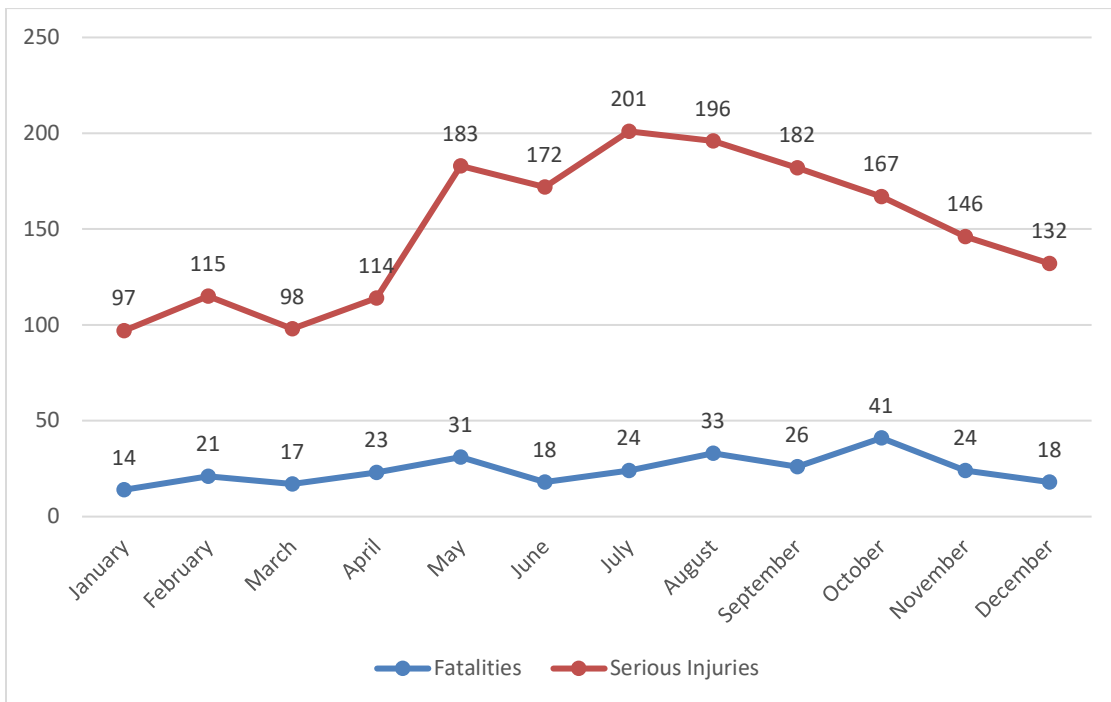


Figure A-2 Fatalities and Serious Injuries by Month, 2012-2016

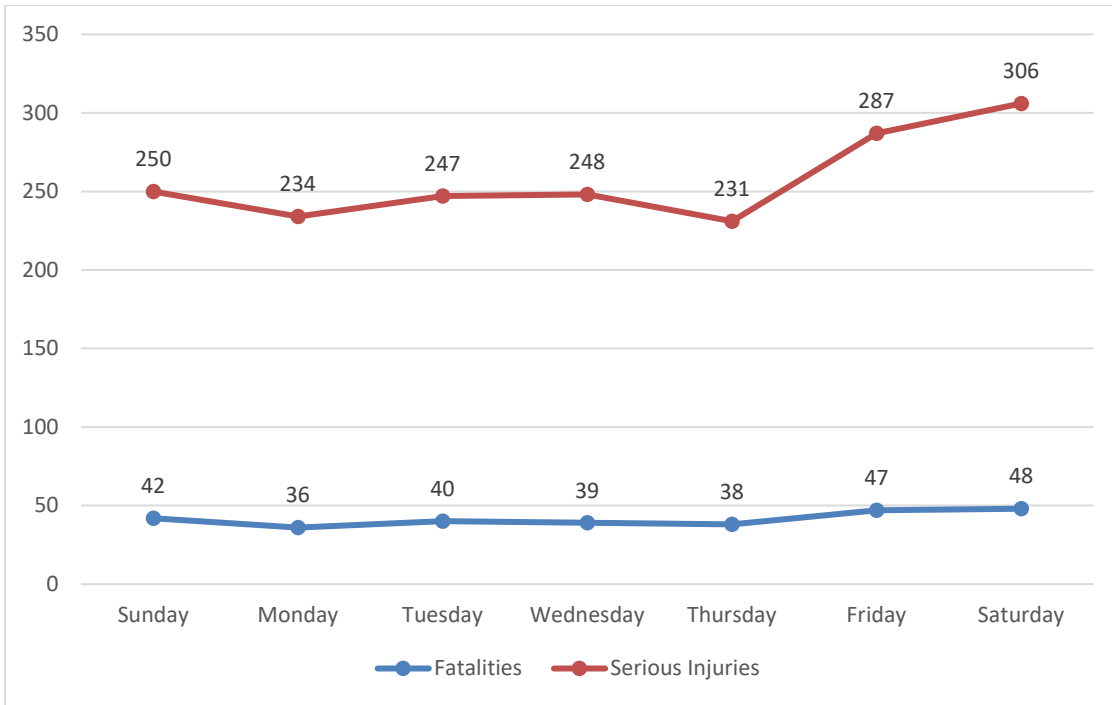


Figure A-3 Fatalities and Serious Injuries by Week, 2012-2016

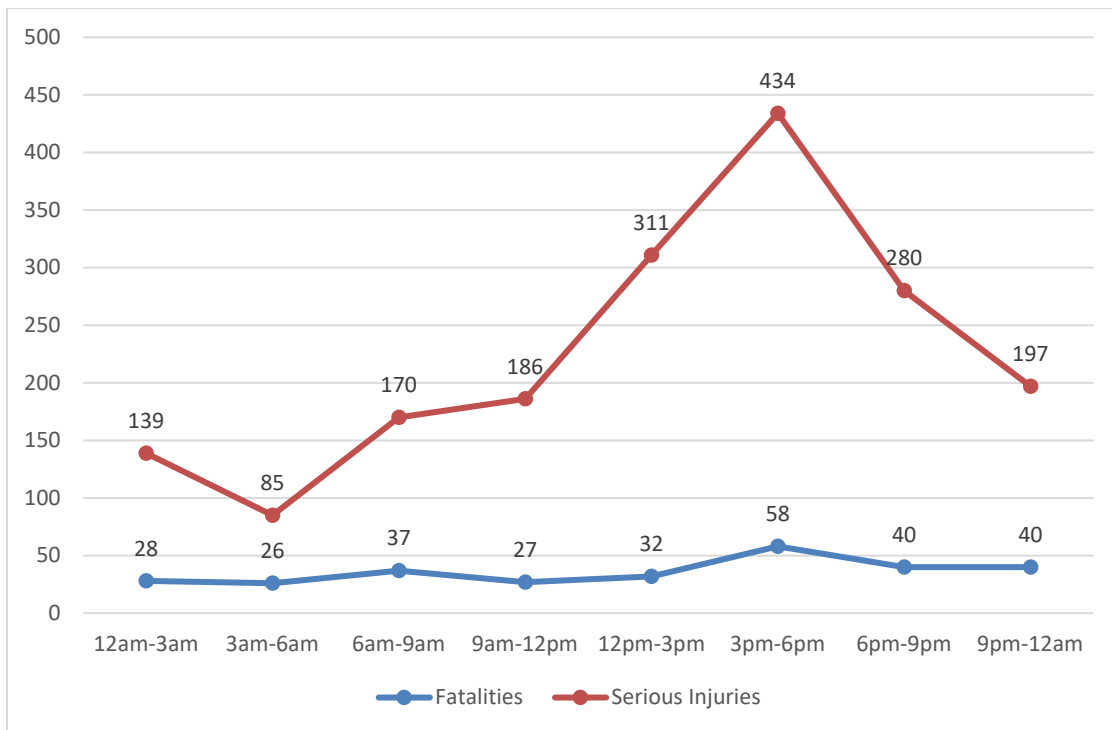


Figure A-4 Fatalities and Serious Injuries by Time, 2012-2016

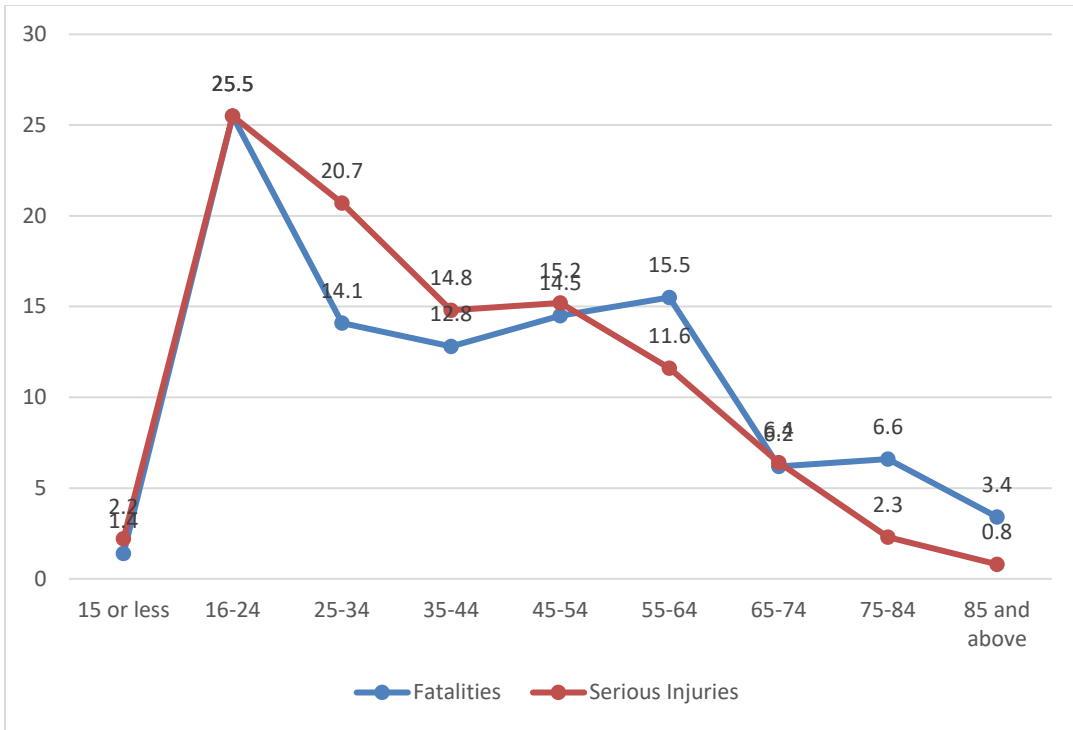


Figure A-5 Fatalities and Serious Injuries by Age Group, 2012-2016

Appendix B: Top Crash Location Lists

Table B-1: Intersections Rank by Expected Excess Fatal and Injury Crash

Rank	Street 1	Street 2	AADT Major	AADT Minor	Excess per Year
1	28th St SE	Eastern Ave SE	35,141	16,245	11.8
2	28th St SE	E Beltline Ave SE	37,177	27,360	10.1
3	28th St SW	S Division Ave	39,999	13,525	8.3
4	Alpine Ave NW	4 Mile Rd NW	34,956	10,206	7.9
5	44th St SE	Breton Rd SE	27,852	14,348	7.9
6	44th St SE	Eastern Ave SE	28,371	15,278	7.5
7	28th St SE	Breton Rd SE	35,591	16,544	7.2
8	28th St SW	Burlingame Ave SW	23,787	13,197	6.7
9	Byron Center Ave SW	44th St SW	30,358	17,831	6.4
10	S Division Ave	44th St SW	27,361	15,318	6.3
11	Kellogg Woods Dr SE	S Division Ave	26,512	14,081	5.6
12	Clyde Park Ave SW	28th St SW	29,403	12,280	5.6
13	28th St SE	Kalamazoo Ave SE	35,370	18,927	5.5
14	Eastern Ave SE	52nd St SE	15,611	12,040	5.2
15	44th St SE	Broadmoor Ave SE	25,760	13,486	5.2
16	28th St SE	East Paris Ave SE	29,066	15,630	5.0
17	Burton St SE	E Beltline Ave SE	43,313	13,325	4.9
18	Kalamazoo Ave SE	44th St SE	30,576	19,993	4.9
19	Leonard St NE	Fuller Ave NE	18,516	15,749	4.7
20	Madison Ave SE	28th St SE	35,808	7,850	4.6
21	Pearl St NW	Mount Vernon Ave NW	10,145	4,992	4.6
22	Ionia Ave NW	Michigan St NW	27,049	7,882	4.4
23	Century Ave SW	Franklin St SW	11,909	1,721	4.3
24	Dehoop Ave SW	28th St SW	24,223	9,358	4.2
25	Kalamazoo Ave	60 th St SE	20,010	13,527	3.8

Table B-2: Intersections Ranking by Total Crash (2012-2016)

Rank	Street 1	Street 2	City/Township	Total Crash	K+A Crash
1	44th St	Byron Center Ave	Wyoming	244	1
2	28th St SE	E Beltline Ave	Grand Rapids	240	2
3	Lake Eastbrook Blvd	E Beltline Ave	Grand Rapids	236	2
4	28th St SE	Eastern	Grand Rapids	231	6
5	28th St SE	Breton Rd	Grand Rapids	228	2
6	28th St SE	Kalamazoo Ave	Grand Rapids	220	1
7	Lake Michigan Dr	Wilson Ave NW	Walker	208	2
8	28th St SE	Division Ave	Grand Rapids	203	2
9	Michigan St	Ottawa Ave	Grand Rapids	202	1
10	44th St	Breton	Grand Rapids	201	2
11	28th St	Burlingame Ave	Wyoming	195	6
12	Fuller Ave	Michigan St	Grand Rapids	194	2
13	44th St SE	Division Ave	Kentwood	191	1
14	Alpine Ave	4 Mile Rd	Alpine	191	0
15	28th St	East Paris Ave	Kentwood	187	1
16	44th St SE	Eastern Ave	Grand Rapids	183	1
17	Alpine Ave	N I 296/Alpine RAMP	Walker	172	1
18	44th St	Clyde Park Ave	Wyoming	169	1
19	Alpine Ave	3 Mile Rd	Walker	167	3
20	28th St SE	Clyde Park Ave	Wyoming	165	3
21	44th St SE	Kalamazoo Ave	Grand Rapids	164	1
22	28th St	Buchanan Ave	Wyoming	155	3
23	Alpine Ave	Center Dr	Walker	149	2
24	44th St	Canal Ave	Grandville	149	1
25	28th St SE	Madison Ave	Grand Rapids	148	4

Table B-3: Intersections Ranking by Fatal and Serious Injury Crash (2012-2016)

Rank	Street 1	Street 2	City/Township	K+A Crash	Total Crash
1	28th St SE	Eastern	Grand Rapids	6	231
2	28th St	Burlingame Ave	Wyoming	6	195
3	Knapp St NE	East Beltline Ave NE	Grand Rapids	6	105
4	Lake Michigan Dr	8 th Ave	Tallmadge	5	78
5	60 th St	East Paris Ave	Gaines	5	44
6	60 th St	Patterson Ave	Kentwood	5	39
7	28th St SE	Madison Ave	Grand Rapids	4	148
8	60th St	Kalamazoo Ave	Gaines	4	103
9	Michael Ave	36 th St	Wyoming	4	53
10	Wilson Ave	Chesterfield Blvd	Walker	4	24
11	15 Mile Rd	M 37 NW	Sparta	4	14
12	17 Mile Rd	Pine Island Dr	Solon	4	10
13	6 Mile Rd	Baumhoff Ave	Alpine	4	10
14	Alpine Ave	3 Mile Rd	Walker	3	167
15	28th St SE	Clyde Park Ave	Wyoming	3	165
16	28th St	Buchanan Ave	Wyoming	3	155
17	54th St	Division Ave	Kentwood	3	147
18	Alpine Ave	Henze Dr	Alpine	3	119
19	E Beltline Ave	Burton St	Grand Rapids	3	107
20	Broadmoor Ave	44 th St	Kentwood	3	84
21	Breton Rd	Burton St	Grand Rapids	3	83
22	Wilson Ave	Remembrance Rd	Walker	3	71
23	36 th St	Eastern Ave	Wyoming	3	66
24	28 th Ave	Baldwin St	Georgetown	3	61
25	Chicago Dr	Port Shelton St	Georgetown	3	58

Table B-4: Freeway Segments Ranking by Expected Excess Fatal and Injury Crash

Rank	Name	City/Township	PR	AADT	Length (mi)	Excess Crashes
1	N US 131	City of Grand Rapids	410203	116,700	5.7	267.9
2	E I 196	City of Grand Rapids	406305	82,400	7.5	119.6
3	N US 131	City of Wyoming	410203	93,400	4.6	60.9
4	N US 131	Byron Township	410203	52,182	6.1	17.0
5	E I 196	City of Grandville	406305	59,987	4.9	16.9
6	N US 131	City of Walker	410203	98,504	2.2	15.8
7	N US 131	Plainfield Township	410203	57,821	7.2	13.6
8	E I 96	City of Walker	405406	44,240	6.8	10.3
9	E I 96	Wright Township	742410	40,056	5.4	9.5
10	N US 131	Algoma Township	410203	55,604	6.5	7.8
11	E I 96	Polkton Township	742410	34,053	6.4	7.2
12	E I 96	Grand Rapids	405406	65,234	2.3	7.2
13	E I 96	City of Grand Rapids	405406	56,651	2.0	6.3
14	E I 96	Cascade Township	405406	31,552	7.2	5.1
15	E I 96	City of Grand Rapids	405406	43,091	2.1	4.7
16	E I 96	Lowell Township	405406	30,323	6.1	4.6
17	E M 6	Byron Township	2000001	42,022	6.1	4.3
18	E I 196	City of Wyoming	406305	43,400	1.4	3.9
19	E M 6	Gaines Township	2000001	44,682	6.1	3.6
20	N US 131	Solon Township	410203	30262	3.9	2.7
21	N US 31	City of Ferrysburg	742605	39323	1.4	2.4
22	E I 196	Georgetown Township	752204	35536	3.3	2.3
23	N US 131	Nelson Township	410203	30262	2.7	1.9
24	E I 96	Grand Rapids Township	405406	46112	2.3	1.9
25	N US 31	Spring Lake Township	742605	38432	1.5	1.8

Table B-5: Non-Freeway Segments Ranking by Expected Excess Fatal and Injury Crash

Rank	Name	City/Township	PR	AADT	Length (mi)	Excess Crashes
1	28th St SE	Grand Rapids	409008	27,954	1.37	6.20
2	28th St SE	Grand Rapids	409008	34,840	3.88	4.96
3	28th St SE	Kentwood	409008	30,177	0.41	2.04
4	Alpine Ave NW	Alpine	423610	24,978	6.23	1.83
5	28th St SE	Cascade	409008	18,210	2.58	1.67
6	Patterson Ave	Cascade	3415021	7,132	4.08	1.25
7	Prairie Pkwy	Wyoming	408006	7,214	1.89	1.14
8	Rivertown Pkwy	Grandville	1833410	25,331	1.39	1.11
9	S Division Ave	Byron	3030181	4,693	5.00	1.05
10	Fillmore St	Georgetown	734004	6,813	2.98	0.96
11	54th St SW	Kentwood	410309	26,512	0.32	0.78
12	W Muskegon ST	Cedar Springs	445005	13,102	1.57	0.72
13	Shaffer Ave SE	Kentwood	409705	7,808	2.00	0.65
14	10 Mile Rd NE	Algoma	445106	6,517	5.27	0.60
15	14 Mile Rd NE	Oakfield	410710	13,200	6.96	0.60
16	Kenowa Ave	Grandville	435202	5,273	1.73	0.59
17	29th St	Kentwood	425005	6,497	1.39	0.57
18	29th St	Grand Rapids	407307	9,851	0.83	0.56
19	Alden Nash Ave	Lowell	3416247	10,751	5.08	0.51
20	Breton Rd	Kentwood	424910	11,110	1.15	0.51
21	Cottonwood Dr	Georgetown	739405	8,729	0.67	0.48
22	Lincoln Lake Ave	Grattan	3416247	5,153	6.16	0.48
23	Alpine Ave	Walker	423610	16,227	1.98	0.47
24	Spaulding Ave	Ada	442202	10,997	2.30	0.46
25	Broadmoor Ave	Caledonia	407204	25,460	3.57	0.44

Table B-6: Segments Ranking by Total Crash (2012-2016)

Rank	Segment	From	To	Length	Total Crashes	K+A Crash
1	28th St	Broadmoor Ave	Lake Eastbrook Blvd	0.424	230	4
2	Alpine Ave NW	4 Mile Rd	Alpenhorn Dr	0.436	214	4
3	28th St SW	Buchanan Ave	S Division Ave	0.25	204	6
4	E Beltline Ave	Bradford St NE	Leonard St NE	0.498	203	5
5	28th St	Breton Rd	Woodlawn Ave	0.485	201	2
6	28th St	Lake Eastbrook	East Paris Ave	0.325	189	1
7	Alpine Ave	Coventry Dr	Old Orchard Dr	0.207	185	2
8	Alpine Ave	Kingsbury St	4 Mile Rd	0.126	185	0
9	28th St	Eastern Ave	Brooklyn Ave	0.461	166	1
10	N US 131	Wealthy RAMP	Wealthy St SW	0.119	164	5
11	E Beltline Ave	28th St	Mall Dr	0.213	164	2
12	Alpine Ave	Center Dr	Coventry Dr	0.125	162	1
13	Alpine Ave	Old Orchard Dr	Kingsbury St	0.102	161	4
14	N US 131	Franklin Ramp	Franklin St	0.13	160	3
15	Wilson Ave	Lake Michigan Dr	O Brien Rd	1.001	157	3
16	N I 296 /Alpine RAMP	N US 131	Alpine Ave	0.37	153	3
17	28th St	City/Twp Line	Eastern Ave	0.199	151	7
18	Lake Michigan Dr	Ferndale Ave	Wilson Ave	0.187	149	1
19	28th St	East Paris Ave	Acquest Ave	0.501	147	2
20	E Beltline Ave	E Mall Dr	Woodland Dr	0.175	146	2
21	28th St SW	Hook Ave	Dehoop Ave	0.203	141	3
22	44th St	Applewood Dr	Breton Rd	0.289	137	4
23	54th St	Haughey Ave	Division Ave	0.319	137	4
24	28th St	Acquest Ave	Patterson Ave	0.497	137	0
25	Broadmoor Ave	29th St	28th St	0.232	135	1

Table B-7: Segments Ranking by Fatal and Serious Injury Crash (2012-2016)

Rank	Segment	From	To	Length	K+A Crash	Total Crash
1	28th St SE	City/Twp Line	Eastern Ave SE	0.198	7	151
2	W I 196	Butterworth St	I 196 Crossover	0.186	7	64
3	14 Mile Rd NE	Lappley Ave	Wabasis Ave NE	0.999	7	22
4	28th St SW	Buchanan Ave	S Division Ave	0.25	6	204
5	E Beltline Ave NE	Bradford St	Leonard St NE	0.498	5	203
6	N US 131	N US 131/Wealthy RAMP	Wealthy St SW	0.119	5	164
7	Wilson Ave SW	Burton St SW	Johnson Park SW	0.72	5	55
8	Cherry Valley Ave	108th St	Kinsey Ave SE	0.855	5	22
9	Patterson Ave	108th St SE	100th St SE	1	5	21
10	M 37 NW	15 Mile Rd	City/Twp Line	1.413	4	16
11	28th St SE	Broadmoor	Lake Eastbrook Blvd	0.424	4	230
12	Alpine Ave NW	4 Mile Rd NW	Henze Dr NW	0.436	4	214
13	Alpine Ave NW	N Center Dr	Kingsbury St NW	0.102	4	161
14	54th St SW	Haughey Ave	Kellogg Woods Dr	0.319	4	137
15	44th St SE	Applewood Dr	Breton Rd SE	0.289	4	137
16	28th St SE	Vineland Ave	Kalamazoo Ave	0.32	4	132
17	E I 96	88th Ave	I 96 Crossover	1.866	4	55
18	S US 131	S US 131/28th Ramp	S US 131/28th Ramp	0.257	4	54
19	N US 131	US 131 Crossover	N US 131/84th RAMP	0.89	4	47
20	E Fulton St	Crahen Ave SE	Forest Hill Ave	0.119	4	40
21	Lake Michigan Dr	Cheyenne Trl	14th Ave	0.844	4	33
22	84th St SW	Centre Industrial Dr	Clyde Park Ave	0.259	4	27
23	14 Mile Rd NE	Northland Dr	14 Mile Ct NE	0.99	4	25
24	Wilson Ave NW	W Grand Blvd	Chesterfield Blvd	0.145	4	19
25	M 37 NW	Oconnor St	15 Mile Rd NW	1.264	4	19

Table B-8: Intersection Ranking by Expected Excess Fatal and Injury Pedestrian Crash

Rank	Street 1	Street 2	AADT Major	AADT Minor	Excess per Year
1	Division	Monroe Center	13,463	2,445	0.07
2	Pearl	Monroe	20,194	3,348	0.07
3	Fulton	Monroe	13,114	11,308	0.07
4	Dehoop	28th	23,655	7,005	0.07
5	Breton	44th	30,595	15,643	0.07
6	Ransom	Fulton	22,303	7,162	0.07
7	Byron Center	36th	11,917	9,978	0.06
8	Michigan	Fuller	20,817	15,273	0.06
9	Lyon	Ottawa	6,557	4,759	0.05
10	Leonard	Ball	15,661	4,401	0.05
11	Division	Wealthy	18,654	15,061	0.05
12	Alpine	Leonard	18,412	12,802	0.05
13	Kellogg Woods	Division	16,558	9,757	0.05
14	Plainfield	4 Mile	33,473	9,527	0.05
15	28th	Kalamazoo	32,973	21,051	0.05
16	Burton	Beltline	40,718	13,259	0.05
17	Byron Center	44th	29,776	17,354	0.05
18	College	Michigan	14,722	7,898	0.04
19	Madison	Franklin	13,844	5,463	0.04
20	Eastern	Franklin	11,005	9,898	0.04
21	Eastern	32nd	17,123	9,263	0.04
22	Division	48th	17,056	5,268	0.04
23	Clyde Park	28th	35,316	13,332	0.04
24	Wilson	Lake Michigan	26,406	20,048	0.04
25	Lake Michigan	Collindale	29,207	8,456	0.04

Table B-9: Intersection Ranking by Pedestrian Crash (2012-2016)

Rank	Street 1	Street 2	City/Township	Pedestrian Crash
1	W Fulton St	Monroe Ave	Grand Rapids	9
2	S Division Ave	Weston St SE	Grand Rapids	8
3	S Division Ave	44 th St	Kentwood	7
4	Weston St SW	S Division Ave	Grand Rapids	6
5	Lyon St	Ottawa Ave	Grand Rapids	6
6	28 th St SE	Eastern	Grand Rapids	5
7	Fuller Ave	Michigan St	Grand Rapids	5
8	Lyon St	N Division Ave	Grand Rapids	5
9	Cherry St	S Division Ave	Grand Rapids	5
10	28 th St	Buchanan Ave	Wyoming	4
11	Lake Eastbrook Blvd	E Beltline Ave	Grand Rapids	4
12	Breton Rd	44 th St	Grand Rapids	4
13	Eastern Ave	52 th St	Kentwood	4
14	Lafayette Ave	Michigan St	Grand Rapids	4
15	Bridge St	Seward Ave	Grand Rapids	4
16	Monroe Center St	Monroe Ave	Grand Rapids	4
17	Ransom Ave	E Fulton St	Grand Rapids	4
18	E Fulton St	La Grave Ave	Grand Rapids	4
19	28 th St	Dehoop Ave	Wyoming	4
20	36 th St	S Division Ave	Wyoming	4
21	W Fulton St	Ionia Ave	Grand Rapids	4
22	S Division Ave	Cherry St	Grand Rapids	4
23	Leonard St	Ball Ave	Grand Rapids	4
24	28 th St	Burlingame Ave	Wyoming	3
25	Wilson Ave	Chesterfield Blvd	Walker	3

Table B-10: Intersection Ranking by Expected Excess Fatal and Injury Bicycle Crash

Ranking	Street 1	Street 2	AADT Major	AADT Minor	Excess per Year
1	Kalamazoo	44th	29,490	23,908	0.14
2	28th	Kalamazoo	32,973	21,051	0.08
3	Byron Center	44th	29,776	17,354	0.08
4	Division	44th	23,179	17,691	0.06
5	Burlingame	44th	29,971	13,427	0.06
6	Division	Burton	15,886	13,643	0.06
7	Dehoop	28th	23,655	7,005	0.06
8	Byron Center	28th	24,957	15,707	0.05
9	Lafayette	Fulton	13,405	5,925	0.05
10	Clyde Park	32nd	11,167	5,625	0.05
11	60th	Kalamazoo	24,537	12,214	0.05
12	Eastern	60th	14,951	12,101	0.05
13	Clay	54th	34,533	6,430	0.05
14	Canal	44th	28,545	6,706	0.04
15	Ransom	Fulton	22,303	7,162	0.04
16	44th	Clay	21,808	5,891	0.04
17	28th	Eastern	37,106	15,443	0.04
18	Diamond	Michigan	15,313	8,534	0.04
19	Leonard	Broadway	20,371	2,745	0.04
20	Chicago	Cottonwood	22,180	13,886	0.04
21	Division	28 th	36,764	13,345	0.04
22	Breton	44 th	28,927	15,643	0.04
23	Knapp	Plainfield	13,054	6,257	0.04
24	20 th	Baldwin	22,452	8,063	0.04
25	Ivanrest	44 th	28,578	13,086	0.04

Appendix C: Top Crash Location Maps

Figure C-1: Top 50 Intersections by Total Crashes

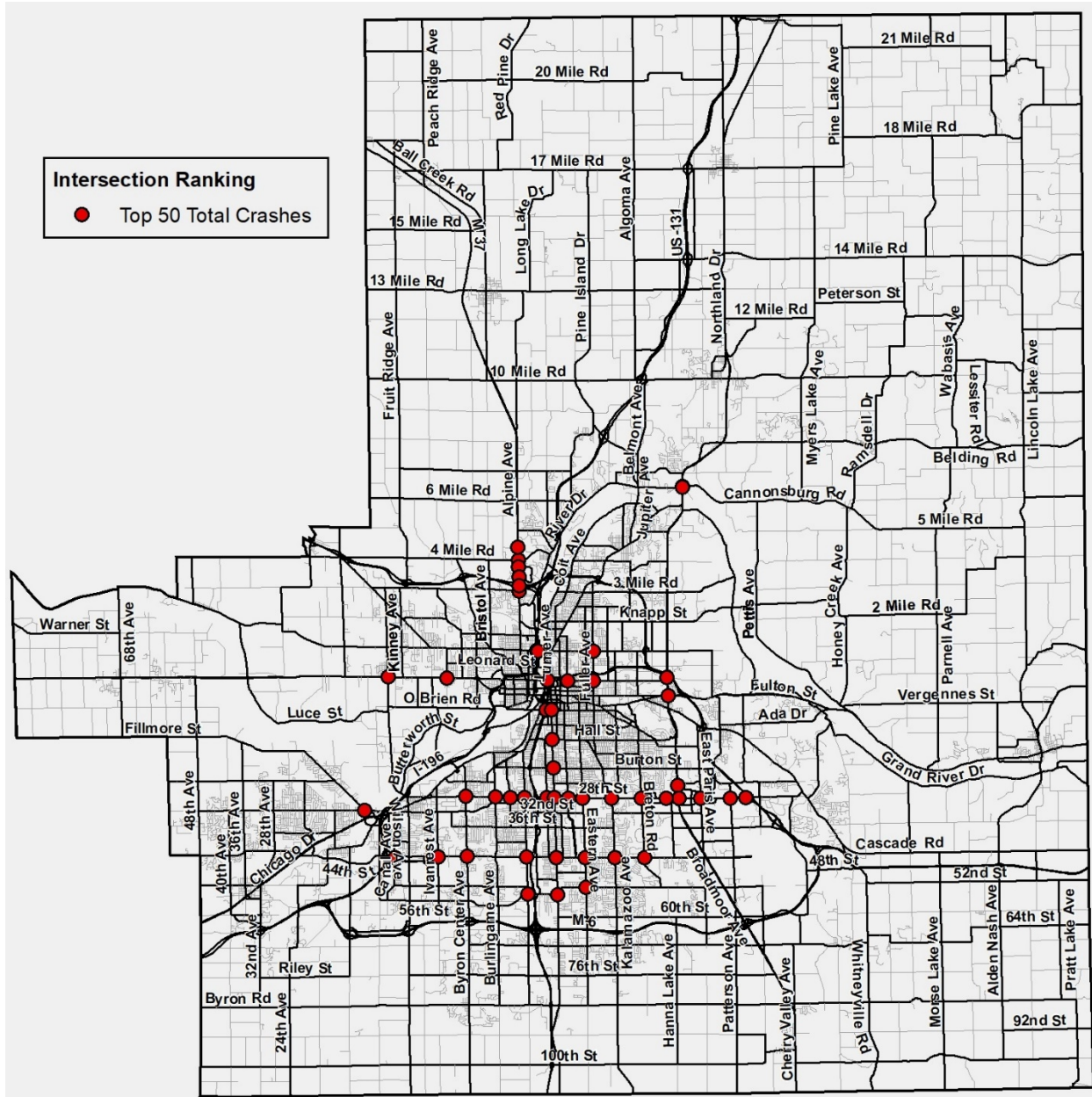


Figure C-2: Top 50 Segments by Total Crashes

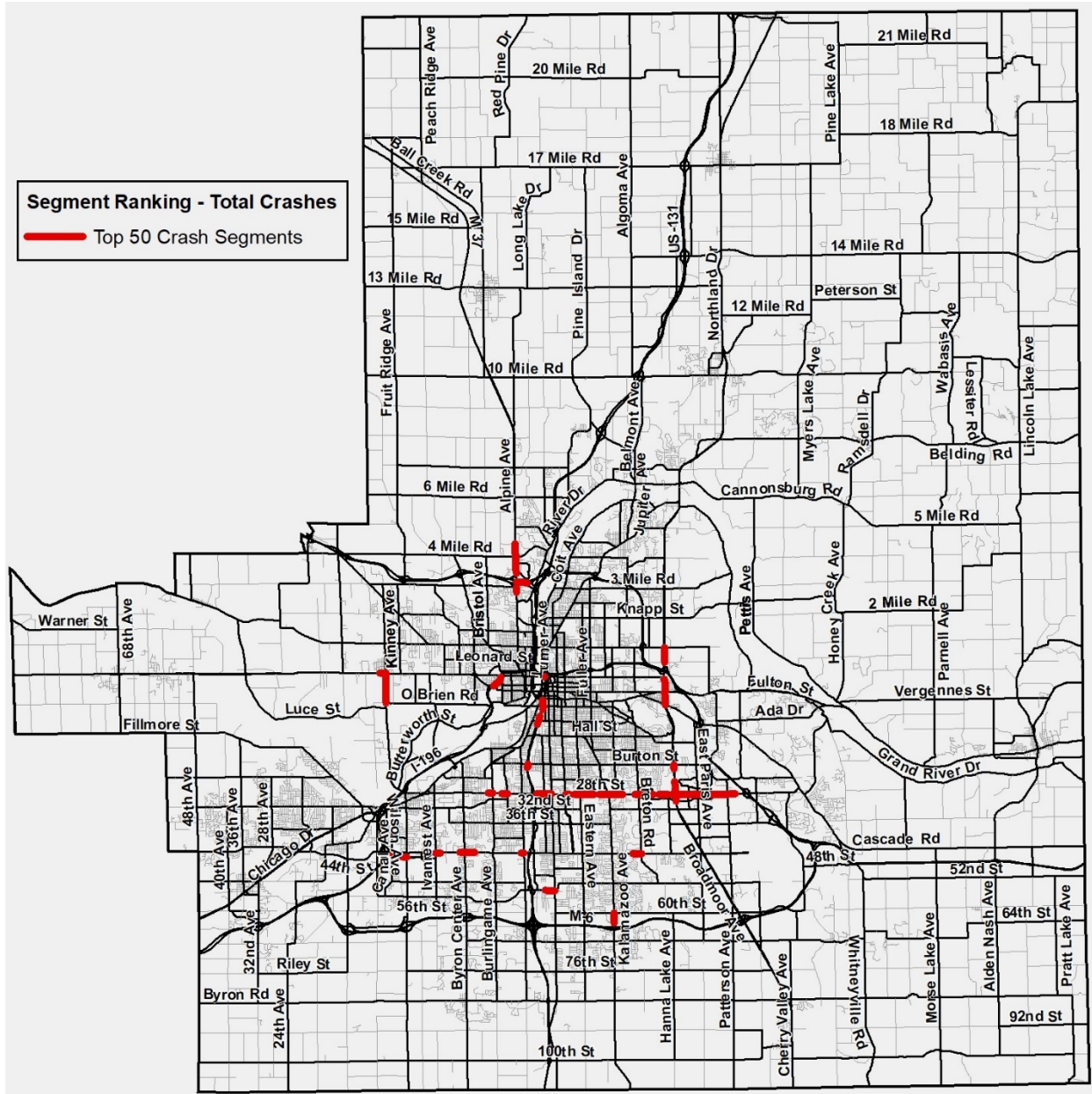


Figure C-3: Top 50 Intersections by K&A Crashes

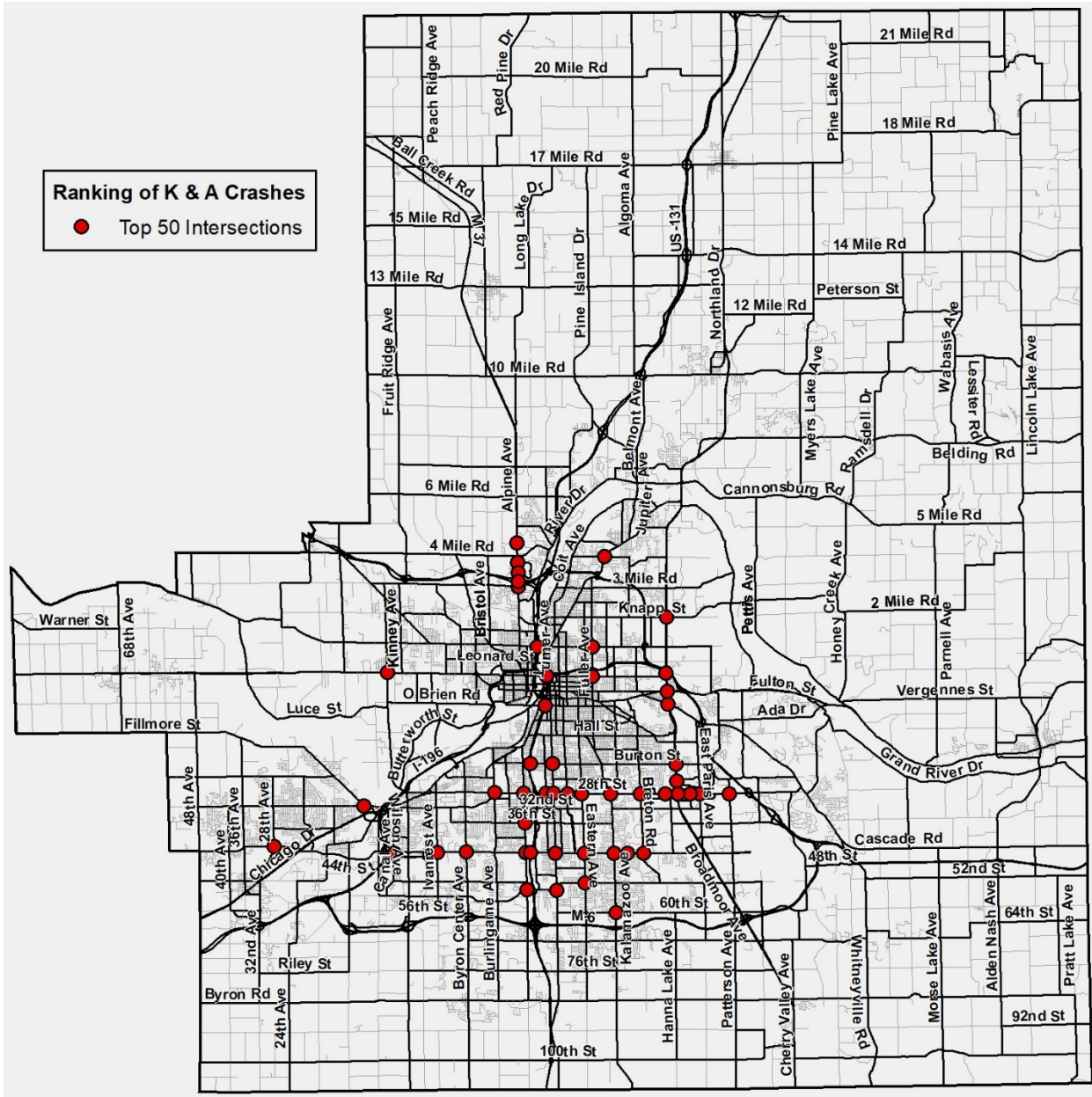


Figure C-4: Top 50 Segments by K&A Crashes

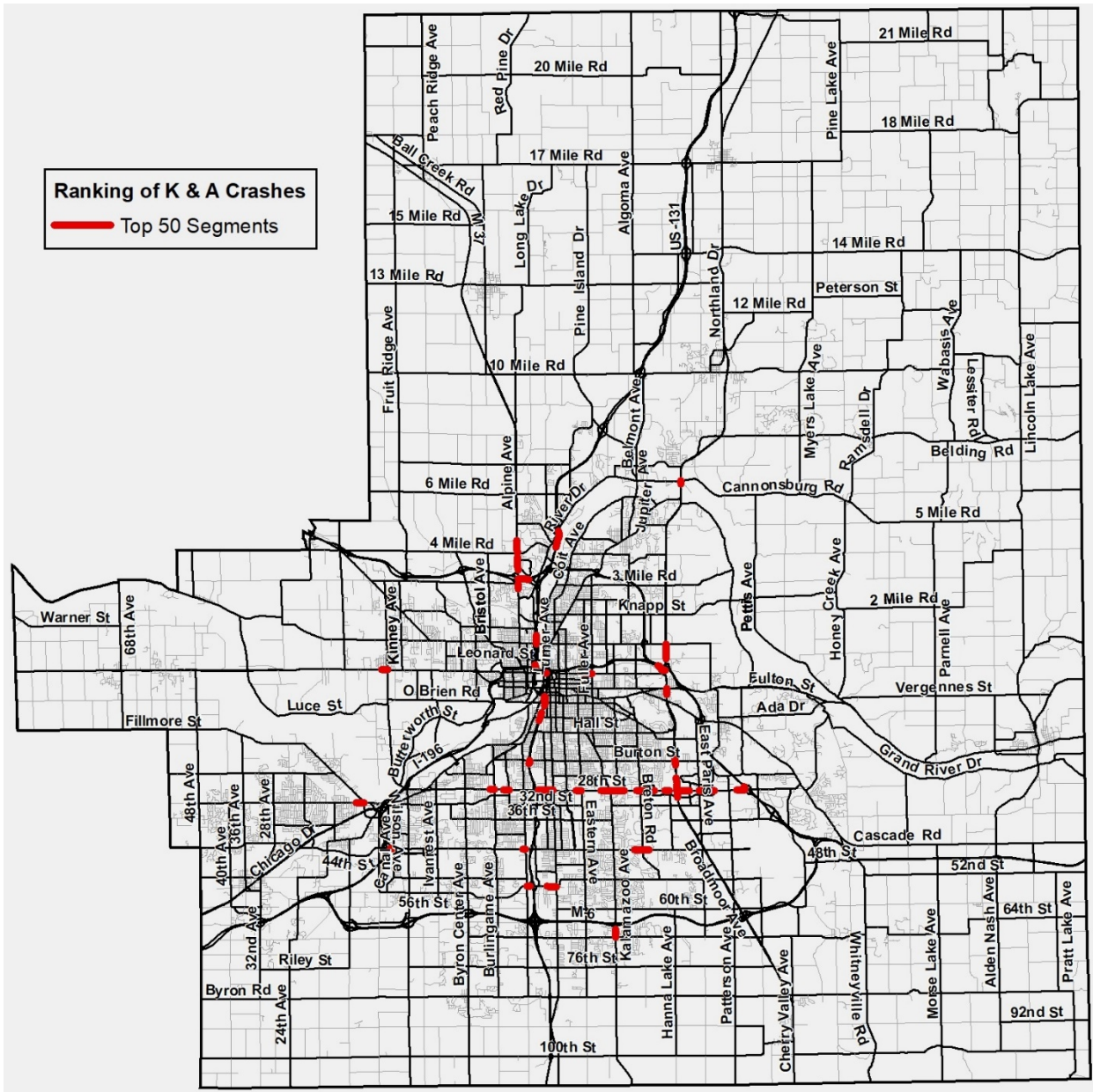


Figure C-5: Top 50 Intersections by Pedestrian Crashes

