

# Strategic Highway Safety Plan for the City of St. Louis, Missouri

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*Presented to the Missouri Department of Transportation,  
the St. Louis Region of the Missouri Coalition for Roadway Safety,  
and the City of St. Louis Safety Stakeholders*

*Prepared by Leidos*

August 11, 2014

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## **Introduction**

In the past several years, Missouri’s roadway fatalities have declined from a high of 1,257 in 2005 to 786 in 2011. This decline is due in large part to implementing key strategies outlined in the state’s evolving strategic highway safety plan (SHSP).

SAFETEA-LU established the requirement for states to develop such plans and to report fatality and serious injury data on both the state and local roadway systems. The provisions of the latest highway reauthorization bill, Moving Ahead for Progress in the 21<sup>st</sup> Century (MAP-21), continue to require that states develop SHSPs and use the basic plan elements established in SAFETEA-LU, i.e. all roads, data-driven, involvement of multidisciplinary stakeholders, etc.

In 2004, Missouri completed its first SHSP, *Missouri’s Blueprint for Safer Roadways*. Then, the plan was updated in 2008 and 2012. Each plan establishes a fatality reduction goal, and both of the 2004 and 2008 goals were met earlier than expected. The 2012 version, *Missouri’s Blueprint to Save More Lives*, includes a vision, mission, fatality reduction goal, and recommended strategies to reduce roadway fatalities and serious injuries. The vision is part of a national effort, Toward Zero Deaths (TZD), to recognize any roadway death as too tragic to ignore.

### **Blueprint Vision**

Continuously Moving Missouri Toward Zero Deaths

### **Blueprint Mission**

To make travel on Missouri’s roadways safer through a partnership of committed local, state, federal, public, and private organizations

### **Blueprint Goal**

700 or fewer roadway fatalities by 2016

The Missouri Coalition for Roadway Safety (MCRS) is responsible for implementing the plan and monitoring its success. The Coalition is organized into an executive committee, 12 state-level subcommittees and 7 regional coalitions. The collective efforts of the MCRS and safety partners throughout the State are driving fatalities and serious injuries down on Missouri roadways.

Figures 1 and 2 show the decline of roadway fatalities and serious injuries on Missouri roadways. Between 2005 and 2011 Missouri experienced 6 consecutive years of decline in traffic crash fatalities and a 34 percent overall reduction. Traffic crash serious injuries declined for the sixth straight year in 2011 from 8,624 in 2005 to 5,644 in 2011.

**Since the establishment of the Blueprint, the Coalition and its partners have seen a reduction of roadway fatalities to its lowest point since the year 1947.**

Figure 1. 2005 – 2011 Missouri Traffic Crash Fatalities.  
Source: Missouri Coalition for Roadway Safety, 2012.

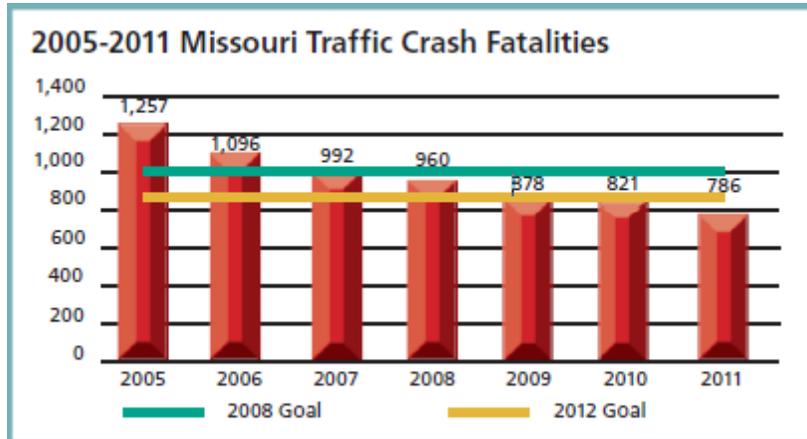
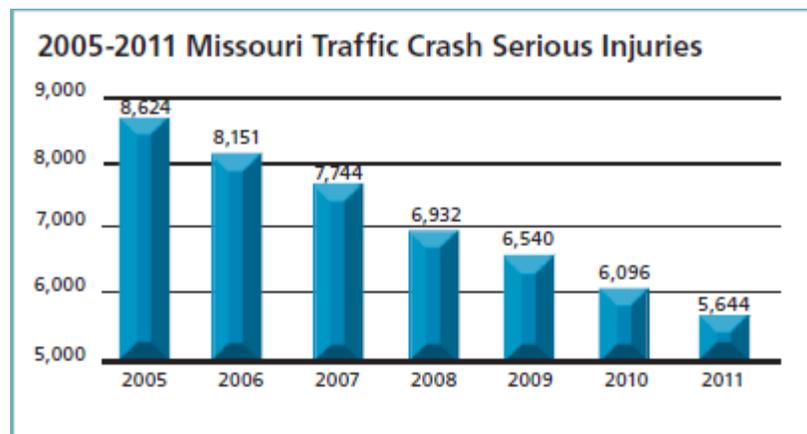


Figure 2. 2005 – 2011 Missouri Traffic Crash Serious Injuries.  
Source: Missouri Coalition for Roadway Safety, 2012.

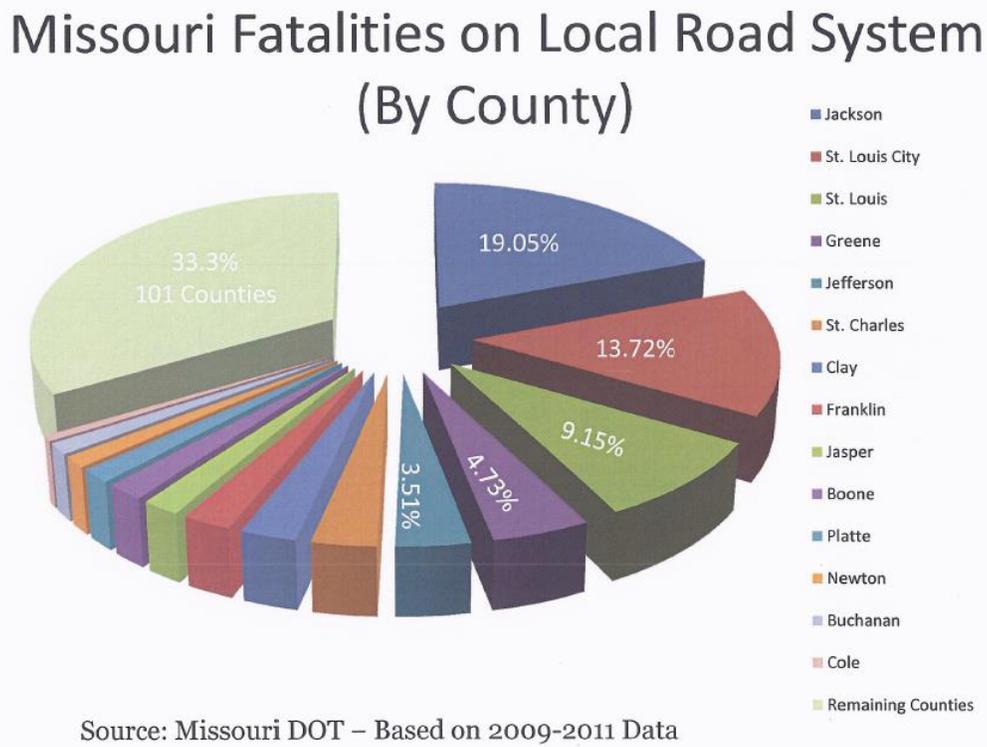


### Next Generation for Roadway Safety: County Safety Plans

Missouri’s roadways are made up of both a state and locally owned system. The state-owned system is approximately 33,500 miles and is the responsibility of MoDOT. The remaining 96,000 miles are locally owned. About 73 percent of the traffic fatalities occur on the state-owned system. In order to reach 700 or fewer fatalities by 2016, key strategies must be implemented on targeted roadways throughout each system.

Data analysis revealed that 67 percent of the local roadway fatalities occurred in 14 counties while the other 101 counties accounted for the remaining 33 percent. Table 1 lists the 14 counties with the highest number of local roadway fatalities and serious injuries, and Figure 3 displays the percentage of roadway fatalities occurring in the top 5 counties and the remaining 101 counties.

Figure 3. Percentage of Roadway Fatalities by County



To achieve fatal and serious injury reductions on the local roadway system, county-specific SHSPs must be developed and implemented. These plans tie directly to MAP-21 and *Missouri's Blueprint to Save More Lives*, which places emphasis on improving safety specifically on local roads. Initial county-specific SHSP development will focus on the counties with the highest number of fatal injuries.

The City of St. Louis has opportunities to compete for project funding to improve transportation safety on the local system. The countermeasures and locations identified in this plan can be used to aid in developing safety projects on the City's road network.

Each of the 14 counties listed in Table 1 may have the opportunity to work with MoDOT and the consultant team, along with their representative safety stakeholders, to develop an implementable safety plan for local roads within the county. **This plan is for the City of St. Louis only.**

**Table 1. Missouri Counties Sorted by Fatalities. Source: MoDOT.**

Years 2009 to 2011	Fatalities	Serious Injuries
Jackson	125	1111
<b>City of St. Louis</b>	<b>90</b>	<b>440</b>
St. Louis County	60	663
Greene	31	280
Jefferson	23	252
St. Charles	21	243
Clay	17	189
Franklin	15	100
Jasper	12	123
Boone	13	82
Platte	10	34
Newton	8	71
Buchanan	8	292
Cole	4	116
<b>Total</b>	<b>437</b>	<b>3,996</b>

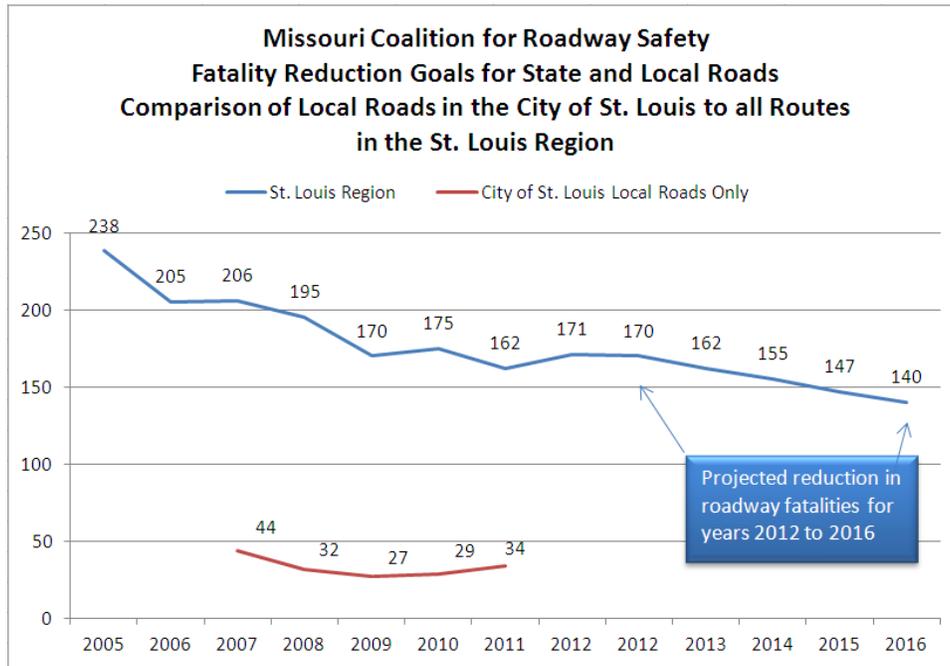
### St. Louis Region

The St. Louis Region encompasses four counties, in addition to the City of St. Louis: St. Louis, St. Charles, Franklin, and Jefferson.<sup>1</sup> These four counties and St. Louis City represent one of the seven MCRS regions across the state. Since 2005, the St. Louis Region has seen a 29 percent reduction in fatalities. Figure 4 shows the number of roadway fatalities that occurred within the St. Louis Region on all roads and on the City of St. Louis local roads for 2005-2011. The second line represents the number of roadway fatalities on local roads within only the City of St. Louis from the years 2007 to 2011.

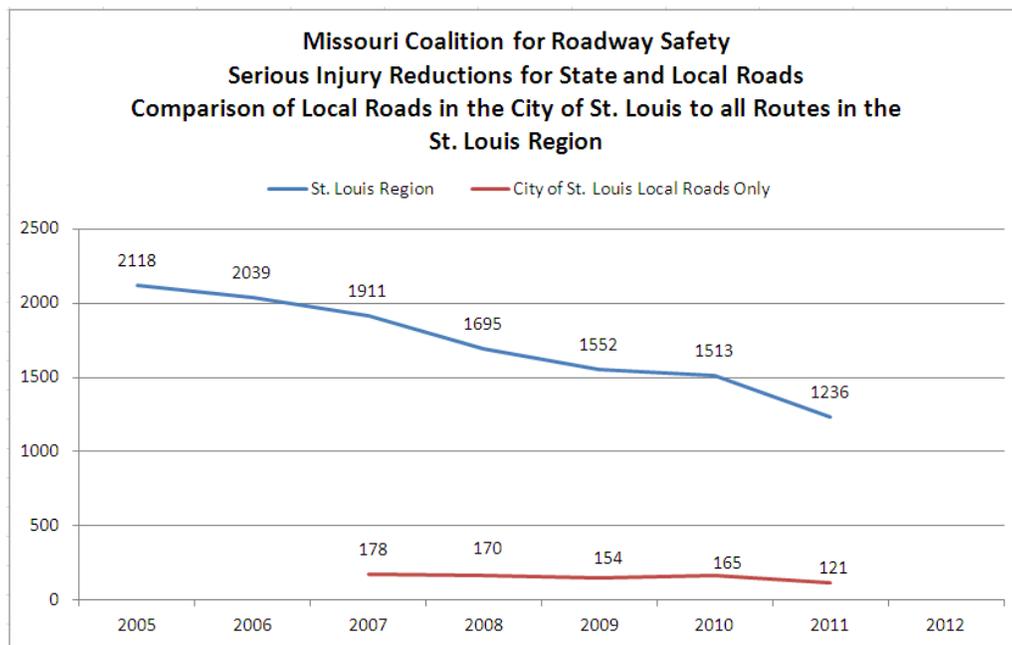
To accomplish the statewide goal of 700 or fewer fatalities by 2016, MCRS has established a fatality reduction goal for each region, using the 2008 fatality reduction goal of 850 or fewer fatalities by 2012 as the baseline. Figure 4 shows the projected annual fatality reduction numbers in the St. Louis Region through 2016.

Figure 5 shows the reductions in serious injuries attained by the St. Louis Region and the City of St. Louis through 2011.

<sup>1</sup> It should be noted that the City of St. Louis SHSP is for St. Louis, Missouri only and does not include strategies for other counties in the St. Louis Region.



**Figure 4. MCRS Fatality Reduction Goals in the St. Louis Region and the City of St. Louis**



**Figure 5. MCRS Serious Injury Reductions in the St. Louis Region and the City of St. Louis**

According to the graph, the St. Louis Region needs to reduce fatalities to 140 by 2016. To meet this goal, the St. Louis Region must implement safety countermeasures on both the state and local roadway systems. To complement the St. Louis Region goal and fatal and serious injury reduction trend, the City of St. Louis needs to save at least 5 lives and 18 serious injury crashes per year until 2016 on their local roads.

## City of St. Louis SHSP

It will take a united, sustained effort among the safety stakeholders in the City of St. Louis to save lives on local roadways. The transportation safety stakeholders each have the similar goal of reducing fatalities and serious injury crashes; however, each has identified various means of reaching that goal. Safety experts identify safety issues or assess safety goals using different measurements and qualification methods. For example, one agency may identify safety concerns and progress measurements using crash rates, while another uses crash frequency. In addition, a disparate level of crash and roadway information is known across the various agencies in the county. To make strides in reducing fatalities and serious injury roadway crashes, agencies need to combine the strengths of law enforcement, emergency medical service providers, educational outreach efforts, and infrastructure improvements.

The following sections highlight the plan for the City of St. Louis to reduce fatalities and serious injury crashes. The information contained in these sections results from a straw man<sup>2</sup> outline consisting of the roadway locations selected, proposed countermeasures, and the estimated cost of implementation on the City's local roads. One important component of the plan is the use of low-cost countermeasures as a systemic approach to reduce roadway fatalities. MoDOT has successfully used the systemic process to reduce intersection-related and roadway departure-related crashes and Missouri's Intersection Plan is found on FHWA's Office of Safety website.<sup>3</sup>

### Transportation Safety Goals:

1. The fatality and serious injury reduction goal for the City of St. Louis SHSP is to save at least 5 lives per year and prevent 18 serious injury crashes from occurring.
2. Lower the annual number of pedestrian fatalities such that St. Louis is no longer a Pedestrian Focus City (fewer than 20 average annual pedestrian fatalities or a pedestrian fatality rate less than 2.33 per 100,000 population).

<sup>2</sup> A straw man is a crude plan or document that serves as a starting point in the evolution of a project. A straw man is not expected to be the last word; it is refined until a final model or document is created that resolves all issues concerning the scope and nature of the project. In this context, a straw man can take the form of an outline, a set of charts, a presentation or a paper. Source: <http://searchcrm.techtarget.com/definition/strawman>

<sup>3</sup> Federal Highway Administration, Office of Safety, Example Data Analysis Package and Straw Man Outline, <http://safety.fhwa.dot.gov/intersection/resources/edapsmo0709/>

### **Action Plan**

In the City of St. Louis, more than 63,200 roadway crashes occurred on local roads in the five-year period between 2007 through 2011. The development and implementation of a local SHSP can reduce fatalities and serious injury crashes. Missouri has successfully used four approaches to reduce roadway fatalities, as outlined in Table 2. They include systemic, traditional, standards-based and comprehensive. Each approach has its role in improving roadway safety. The City's plan focuses on systemic and comprehensive improvements, as these have the best potential to reduce fatalities and serious injury crashes in the immediate future.

The City currently uses red light enforcement cameras at intersections that experience significant crashes associated with red light running. This continues to contribute to the reduction of fatal and serious injuries on the City's road network.

The City is in the process of finalizing a Pedestrian Safety Action Plan that will be added to this plan once completed in Appendix F.

**Table 2. Approaches to Improving Roadway Safety**

Approach Name	Description	Benefits	Disadvantages
<b>Systemic</b>	Identifies the select crash types and risk factors that generate the highest fatalities and serious injuries. Low-cost countermeasures are implemented over several locations with similar crash characteristics.	Systemic solutions can reduce overall severe crashes of certain types within a jurisdiction more effectively than choosing a small number of spot installations. This approach allows an agency to compensate for incomplete and lower-quality crash history and/or roadway data, as it is less vital for that information to be perfect when many locations/segments are addressed with low cost treatments.	Implementation must be widespread to make a region-wide impact. Also, it can be difficult to convince stakeholders to apply safety treatments (even if low-cost) at locations that do not have a history of crashes.
<b>Traditional</b>	Locates “black spots” or the highest frequency of crashes and is location-based.	Easily located using roadway and crash data.	This approach does not adequately deal with the randomness of the location of fatalities. An agency may apply a countermeasure using frequency or rate but may not address the most prevalent crash types.
<b>Standards-based</b>	Incorporates countermeasures not as a reactive measure but within the agency’s day-to-day business policies.	The standards-based approach ensures that noteworthy practices become ingrained into the culture over time.	Benefits may lag as the number of applications move from individual sites to widespread use.
<b>Comprehensive<sup>4</sup></b>	Incorporates all aspects of roadway safety, going beyond just infrastructure countermeasures.	This approach addresses the human element of traffic safety, factoring in the reality that even a “perfect roadway” can experience crashes if people make unsafe personal decisions. Agencies can target corridors with enforcement, associated education initiatives, and engineering infrastructure to combat a wide-range of issues.	Agencies may view this as “extra” effort in addition to daily duties.

<sup>4</sup> The comprehensive approach is one that accounts for both infrastructure and behavioral components that can be deployed on a corridor level or regional basis.

In order to concentrate resources where they will best achieve safety goals, a focused approach is necessary to isolate the most severe crash types from the 63,200 crashes that occurred on local roads in the City of St. Louis between 2007 through 2011. Though fatal and serious injury crashes tend to occur at random locations over time, identifying the most common contributing circumstances, or crash types (e.g., vulnerable users, environmental factors, high-risk drivers, roadway characteristics, special vehicles), associated with fatal and serious injury crashes can help us to identify emphasis areas on which to focus.

The consultant team began developing the City’s plan by using the MCRS emphasis areas for the City’s local roads. The emphasis areas listed in Table 3 cover the common crash types contributing to fatalities and serious injuries on local roads in the City of St. Louis from 2007–2011. This list is ranked using the number of fatalities and serious injuries and identifies high-risk behaviors, vulnerable users, and special vehicles. Focusing implementation resources on the areas with most need determines which countermeasures will achieve the highest results. MCRS uses these emphasis areas for all regions, agencies, and roadway networks.

**The State of Missouri is a nationally recognized leader for using a systemic approach to improve roadway safety. Two early uses of the systemic approach reduced fatal and serious injury crashes specific to intersections and roadway departure.**

**Table 3. Emphasis Areas on City of St. Louis Local Roads for 2007-2011<sup>5</sup>**

Fatalities Involving:						
Description	2007	2008	2009	2010	2011	Total
Aggressive Driving						
Following too close	0	0	0	0	0	0
Too fast for conditions	1	3	3	1	4	12
Speed limit exceeded	23	16	12	13	13	77
TOTAL for 3 conditions	24	19	15	14	17	<b>89</b>
Unrestrained Occupants <sup>6</sup>	16	16	10	8	10	<b>60</b>
Intersection crashes						
Unsignalized	7	6	1	6	2	22
Signalized	14	4	9	7	4	38
TOTAL for Intersection Fatalities	21	10	10	13	6	<b>60</b>
Run-off-Road crashes	10	11	8	9	14	<b>52</b>
Pedestrians killed	12	7	9	8	12	<b>49</b>
Unlicensed drivers	8	9	3	9	9	<b>38</b>
Young Drivers – 15-20	5	8	4	5	7	<b>29</b>
Motorcyclists killed	7	2	3	6	6	<b>24</b>
Alcohol and/or other drugs	9	0	2	5	5	<b>21</b>
Commercial Motor Vehicles	10	6	3	2	2	<b>23</b>
Distracted Drivers	1	8	2	3	3	<b>17</b>
Collision with Tree	1	1	3	4	7	<b>16</b>
Horizontal Curves	5	1	4	2	3	<b>15</b>
Head-on Crashes						
Head-on – Non-Interstate	5	2	1	1	2	<b>11</b>
TOTAL Head-on	5	2	1	1	2	<b>11</b>
Older Drivers – 65-74	6		1	1	1	<b>9</b>
Older Drivers – 75 or older	1	1	1	0	1	<b>4</b>
Collision with Utility Pole	1	1	0	0	2	<b>4</b>
School Buses/School bus signal <sup>7</sup>	2	1	0	0	0	<b>3</b>
Bicyclists Killed	0	1	0	1	0	<b>2</b>
Work Zones	0	0	0	0	0	<b>0</b>

Serious Injuries Involving:						
Description	2007	2008	2009	2010	2011	Total
Intersection crashes						
Unsignalized	44	52	33	29	23	181
Signalized	44	58	55	61	34	252
TOTAL for Intersection Serious Injuries	88	110	88	90	57	<b>433</b>
Aggressive Driving						
Following too close	6	6	5	7	3	27
Too fast for conditions	20	21	16	21	9	87
Speed limit exceeded	27	41	20	27	23	138
TOTAL for 3 conditions	53	68	41	55	35	<b>252</b>
Distracted Drivers	49	36	27	41	28	<b>181</b>
Pedestrians Seriously Injured	36	39	38	34	34	<b>181</b>
Run-off-Road crashes	40	36	35	30	30	<b>171</b>
Young Drivers – 15-20	28	30	34	27	22	<b>141</b>
Unlicensed drivers	22	18	18	31	14	<b>103</b>
Motorcyclists Seriously Injured	24	14	23	11	9	<b>81</b>
Unrestrained Occupants <sup>1</sup>	14	13	12	15	12	<b>66</b>
Head-on Crashes						
Head-on – Non-Interstate	15	9	13	8	13	58
TOTAL Head-on	15	9	13	8	13	<b>58</b>
Horizontal Curves	14	8	8	11	8	<b>49</b>
Alcohol and/or other drugs	9	6	8	8	11	<b>42</b>
Commercial Motor Vehicles	13	9	10	6	3	<b>41</b>
Collision with Tree	9	9	9	9	5	<b>41</b>
Bicyclists Seriously Injured	9	7	5	9	4	<b>34</b>
Older Drivers – 65-74	7	6	9	7	3	<b>32</b>
Older Drivers – 75 or older	5	9	5	3	2	<b>24</b>
Collision with Utility Pole	6	4	3	3	3	<b>19</b>
School Buses/School bus signal <sup>2</sup>	4	1	1	1	1	<b>8</b>
Work Zones	1	1	0	0	1	<b>3</b>

<sup>5</sup> Fatalities and serious injuries may account for and be included in multiple crash types.

<sup>6</sup> The numbers shown are for drivers and occupants.

<sup>7</sup> Calculated using crashes occurring under “School Zone” in the “Traffic Control Zone” variable in the vehicle table.

Based on Table 3, the emphasis areas contributing to the majority of fatal and serious injuries in the City are:

- Aggressive driving<sup>8</sup>—54% of roadway fatalities and 32% of serious injuries
- Intersections—36% of roadway fatalities and 55% of serious injuries
- Unrestrained occupants—36% of roadway fatalities and 8% of serious injuries
- Run-off-road (roadway departure) —31% of roadway fatalities and 23% of serious injuries
- Distracted drivers—10% of roadway fatalities and 24% of serious injuries
- Pedestrians—30% of roadway fatalities and 23% of serious injuries
- Unlicensed drivers—23% of roadway fatalities and 13% of serious injuries

The fatal and severe crash locations for each emphasis area in the City of St. Louis are found in Appendix A.

### Approach

Missouri's *Blueprint to Save More Lives* presents the vision and direction for establishing a statewide and county SHSP. The City of St. Louis SHSP carries that vision forward while specifically defining safety projects that help meet the state's goal of 700 or fewer fatalities by 2016.

Developing the City's SHSP requires numerous steps. They included:

1. Holding a safety champions meeting
2. Reviewing literature review and interviewing stakeholders
3. Analyzing data
4. Matching crash types with locations
5. Identifying potential countermeasure
6. Selecting countermeasures with local safety stakeholders
7. Developing a Draft SHSP
8. Distributing the Draft SHSP for review by stakeholders
9. Revising the draft and preparing the final SHSP

The following steps detail the process that the consultant team used to develop the City of St. Louis SHSP.

**Step 1: Hold Safety Champions Meeting.** A safety champions meeting was held on February 3, 2014 at the MoDOT Hampton Avenue facility to discuss:

- A high-level overview of the City's local road crash data
- The process by which the county would support and implement the SHSP
- Potential attendees of the data/countermeasure workshop

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<sup>8</sup> Aggressive driving is defined in Missouri as: (1) driving too close, (2) driving too fast for conditions, and (3) driving over the speed limit.

- The City's expectations of the SHSP and development process

**Step 2: Conduct literature review and conduct stakeholder interviews.** The consultant team gathered information through a combination of agency interviews and document reviews from agency websites. The consultant team then conducted a literature review of the available relevant safety-related data (e.g., crash history and roadway inventory) and existing plans for the City of St. Louis, East-West Gateway (EWG), MoDOT, advocacy groups, and local agencies within the county. The resources consisted of documented enforcement efforts, marketing plans, major safety initiatives, program accomplishments, capital improvement plans, and long-range transportation plans. Appendix B provides a complete list of reviewed documents and findings, which was provided to the City of St. Louis safety stakeholders on November 12, 2013.

**Step 3: Perform basic analyses to review the accuracy of the data and isolate overrepresented crash types.** Data sets were used to identify and isolate overrepresented locations, crash types, and contributing circumstances that are most likely to contribute to fatal and serious injury crashes in the City. The emphasis areas were used to begin categorizing locations of concentration. These “clusters” of crash types were located by roadway segment or intersection.

Table 4 provides an example of cluster data pertaining to signalized intersection crashes on the City's roads. According to the data, at least 272 crashes occurred at 16 signalized intersections from 2007 to 2011. These 16 signalized intersections represent 2.58 percent of the signalized intersections on the City's local roads; however, more than 45 percent of the total crashes occurred at these locations. Cluster data such as this are used in the next step to determine the level of implementation needed to reduce the total number of crashes, including fatalities.

Table 4. Example of Cluster Data for Signalized Intersection Crashes in the City of St. Louis

NUMBER OF CRASHES PER SECTION	NUMBER OF INTERSECTIONS	CUMULATIVE		CUMULATIVE	
		SECTIONS	PERCENT	CRASHES	PERCENT
1739	1	1	0.16%	1,739	9.22%
1205	1	2	0.32%	2,944	15.60%
997	1	3	0.48%	3,941	20.89%
484	1	4	0.64%	4,425	23.45%
463	1	5	0.81%	4,888	25.91%
432	1	6	0.97%	5,320	28.20%
382	1	7	1.13%	5,702	30.22%
370	1	8	1.29%	6,072	32.18%
367	1	9	1.45%	6,439	34.13%
353	1	10	1.61%	6,792	36.00%
351	1	11	1.77%	7,143	37.86%
322	1	12	1.93%	7,465	39.56%
316	1	13	2.09%	7,781	41.24%
304	1	14	2.25%	8,085	42.85%
295	1	15	2.42%	8,380	44.41%
272	1	16	2.58%	8,652	45.86%
261	1	17	2.74%	8,913	47.24%
258	2	19	3.06%	9,429	49.97%
259	-	19	3.06%	9,429	49.97%
244	1	20	3.22%	9,673	51.27%
241	1	21	3.38%	9,914	52.54%
239	1	22	3.54%	10,153	53.81%
238	1	23	3.70%	10,391	55.07%
217	1	24	3.86%	10,608	56.22%
205	1	25	4.03%	10,813	57.31%

2.58 percent of the City's signalized intersections are responsible for 45.86 percent of signalized intersection crashes.

The consultant team discovered that some of the location information was missing. Locating a specific point on the road requires three attributes: milepost (log point), roadway name, and direction. A milepost is the common reference point used to locate crashes on Missouri's roadway network and within the state's crash database. For city streets, 21,173 of 63,265 (33.5%) crashes were missing log point data. These crashes consisted of property damage only or minor injury outcomes (only one was listed as a crash containing a severe injury). The crashes that were missing log point data tended to have incomplete data entries, often missing several other fields such as: road designation (CST, CRD, etc.), functional class, state system indication (blank instead of "not on system"). The incomplete records represented one-third of the total PDO/minor injury crashes in the database

**Step 4: Match crash types and locations with potential countermeasures.** Using both systemic and comprehensive approaches, the consultant team identified low-cost, proven safety countermeasures. Next, the team screened the City's local road network to find highway sections that have targeted crashes at or above a crash threshold that would ensure cost-

effective deployment of these countermeasures. Estimating deployment impacts involves projected countywide crashes prevented, annual lives saved, and overall costs to deploy the countermeasures.

Crash data drives both approaches. The systemic approach identifies crash types that specific countermeasures are designed to address and identifies clusters of locations that have targeted crashes at or above a designated threshold level. The total number of targeted crashes in these clusters is then coupled with a predicted Crash Modification Factor (CMF)<sup>9</sup> to estimate the total number of targeted crashes that could be reduced based on countermeasure implementation at each cluster. The impact of these improvements in terms of crash severity reduction is determined by multiplying these targeted crash reductions by serious injuries per 100 crashes and fatalities per 100 crashes for targeted crashes in the environment of the clusters identified.

Once the locations of the overrepresented crash types were linked by road or corridor and paired with potential countermeasures, the consultant team identified thresholds for each corridor or roadway, indicating the number of potential treatment sites (or lengths of sites). The CMF for each potential treatment was applied, which resulted in the associated fatal and serious injury crash reductions and cost of treatment installation.

Thresholds for each countermeasure were based on a combination of factors. The threshold determines the level of deployment for each countermeasure. The number of deployments usually covers 20 to 40 percent of the locations. However, these locations account for the vast majority of crashes.

For example, the number of deployments to reduce the number of crashes at signalized intersections in the City of St. Louis accounts for 12 percent of the locations, but addresses more than 52 percent of the signalized intersection crashes in the City. Another factor the team used to evaluate the deployments is the cost of saving one life and preventing one serious injury. The signalized intersection treatments will cost about \$0.22 million per life saved and \$0.04 million per serious injury prevented. A cost-effective treatment falls between \$1 and \$2 million dollars per life saved.

Using a systemic approach helps offset the missing location data mentioned in Step 4. A widely deployed countermeasure ensures the level of effort will sufficiently reduce the total number of crashes and consequently reduce the number of severest crashes as well.

**Step 5: Select countermeasures by involving local safety stakeholders.** Using the potential countermeasures associated with fatal and serious injury crash reductions and installation costs identified in Step 4, City of St. Louis safety stakeholders were invited to

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<sup>9</sup> A CMF is a multiplicative factor used to compute the expected number of crashes after implementing a given countermeasure at a specific site. The CMF is multiplied by the expected crash frequency without treatment. A CMF greater than 1.0 indicates an expected increase in crashes, while a value less than 1.0 indicates an expected reduction in crashes after implementation of a given countermeasure. For example, a CMF of 0.8 indicates an expected safety benefit; specifically, a 20% expected reduction in crashes. A CMF of 1.2 indicates an expected degradation in safety; specifically, a 20% expected increase in crashes. (Source: <http://safety.fhwa.dot.gov/tools/crf/resources/fhwasa10032/>). CMFs were identified primarily from information contained in the Crash Modification Factor clearinghouse at <http://www.cmfclearinghouse.org>.

participate in selecting the countermeasures for the City’s SHSP. Invited stakeholders included City Street Department staff, St. Louis Metro Police, Board of Public Service, the Mayor’s Office, Metro Public Transit Authority, Trailnet, Great Rivers Greenway, EWG staff, and MoDOT staff.

The consultant team conducted a Data and Countermeasure Workshop on Thursday, March 27, 2014 at the St. Louis Metro Police Department headquarters. In attendance were 17 safety stakeholders representing City engineering and law enforcement, transit, non-motorized users, and others. For a complete list of those who participated in this workshop, see Appendix C. The primary objectives of the workshop were the following:

- Introduce stakeholders to the City of St. Louis SHSP development process, including data analysis and crash factor identification, crash data trends, and potential countermeasures.
- Define the fatal and serious injury reduction goals.
- Explain potential countermeasures, their applicability to the safety issues, and obstacles associated with implementation.
- Establish a comprehensive approach including the five Es: Enforcement, Education, Engineering, Emergency Medical Services, and Everyone.
- Illustrate how the City SHSP falls under the Missouri *Blueprint to Save More Lives* umbrella and how county safety goal achievement aligns with the vision of the *Blueprint*.

**Step 6: Develop Draft City of St. Louis SHSP.** An initial action plan was developed identifying the locations of roadway segments and associated countermeasures. The consultant team used cost estimates and CMFs to assess the impact of implementation. These are contingent on actual level of implementation after field validation of the countermeasures for each location. This initial action plan is located in Appendix D, Data Package and Strategy Matrix.

The consultant team further refined the list of countermeasures to include the most effective strategies based on crash reduction, cost-effectiveness, ease of implementation, and support from City of St. Louis safety stakeholders. Table 7 lists the final recommended safety countermeasures.

**Step 7: Implementation.** Each state has a Highway Safety Improvement Program (HSIP) and receives funding from the Federal government to implement safety improvements. To obligate HSIP funds, a state must have an SHSP that identifies and analyzes highway safety issues and opportunities to reduce fatal and serious injury roadway crashes.

The safety improvements identified in the City of St. Louis SHSP are eligible for possible HSIP and Transportation Alternatives Program (TAP) funding. This county SHSP identifies implementable countermeasures related to engineering infrastructure, educational opportunities, and enforcement. To identify top priorities, the City’s safety stakeholders should collaboratively identify a few key strategies and safety implementations with which to move forward initially.

The action plan allows the agencies to make adjustments as more precise information becomes available. The City will need to field verify roadway information, determine which countermeasures are necessary, and refine costs. Discussions related to funding implementations shown in this plan are located in the Funding section on page 66.

### **Approved Countermeasures**

City safety stakeholders, MoDOT, and the consultant team discussed and supported the countermeasures that appear in Table 5 during the *Data and Countermeasure Workshop* held on March 27, 2014. Table 5 indicates the following:

- Emphasis area crash types and associated historical fatalities and serious injuries
- Recommended safety countermeasures to address the crash type
- The crash modification factor (CMF)
- Expected life of the treatment
- Average deployment or construction costs associated with each countermeasure

Table 5 is organized by descending historical fatality counts from 2007-2011 for each crash type. The exact effectiveness of each countermeasure depends both on the information shown in this table (historical fatality/injury figures, CMF, cost of implementation) and the geographic dispersion of recommended implementation locations based on historical crash locations. It should be noted that many of the countermeasures identified in Table 5 will require multiple application sites, which will increase the overall costs for each countermeasure.

Table 5. Approved Safety Countermeasures to Prevent Most Prevalent Fatal and Serious Injury Crash Types in the City of St. Louis

Emphasis Area Crash Types	Number of Fatalities (2007-2011)	Number of Serious Injuries (2007-2011)	Recommended Countermeasures	Crash Modification Factor	Expected Life	Average Unit Construction Cost (per each deployment)
Aggressive Driving	89	252	Speed Enforcement/Education	0.80 <sup>10</sup>	5-yr program	\$52k per section <sup>11</sup> for enforcement + \$50k for education
			Automated speed enforcement	0.83	ongoing	\$80,000 per deployment, \$60,000/yr ongoing support/analysis <sup>12</sup>
Intersection Crashes	22	181	<b>Unsignalized Intersections</b>			
			Replace stop signs with flashing LED-outlined stop signs	0.59	10 years	\$3,000 to \$3,500 per stop sign (30 to 36 inch)
			STOP AHEAD pavement markings	0.69	1-3 years	\$4,000 per intersection
			Reflective post sleeves	0.95	10 years	\$500 per intersection
	38	252	<b>Signalized Intersections</b>			
Run-off-Road crashes	52	171	Add Edge Line Striping	0.90	3 years	\$1,000 per mile
			Increase Clear Zone (0-5')	0.87	10 years	\$5,000 per mile
			Delineate Utility Posts	0.90	10 years	\$1,000 per mile
			High friction surface treatment	0.50	10 years	\$100,000 per segment
Unrestrained Occupants	60	66	Seatbelt Enforcement/Education	0.80	5-yr program	\$52k per section <sup>1</sup> for enforcement + \$50k for education
Alcohol and/or other	21	42	Impairment Enforcement/Checkpoints/Education	0.80	5-yr program	\$52k per section <sup>1</sup> for enforcement + \$50k for education

<sup>10</sup> The CMF for all enforcement and education countermeasures is valid as long as the enforcement/education program is continued and in place.

<sup>11</sup> Enforcement cost assumption: 1 officer \* \$40/hr \* 10 hrs/week \* 26 weeks/yr \* 5 yr program

<sup>12</sup> A significant percentage of deployment costs can be recaptured when the system becomes operational from revenue generated by tickets.

<b>Emphasis Area Crash Types</b>	<b>Number of Fatalities (2007-2011)</b>	<b>Number of Serious Injuries (2007-2011)</b>	<b>Recommended Countermeasures</b>	<b>Crash Modification Factor</b>	<b>Expected Life</b>	<b>Average Unit Construction Cost (per each deployment)</b>
drugs						
Distracted Driving	17	181	Media awareness campaigns	TBD	TBD	TBD
Pedestrians	49	181	Implement a leading pedestrian interval	0.63	Until modified	None
			HAWK beacon (as enhanced treatment)	0.71	10+ years	\$50,000
			Add mid-block pedestrian refuge (install 15' long raised median with marked crosswalk)	0.54	20+ years	\$15,000
			Add pedestrian countdown heads	0.30	10+ years	\$5,000 per intersection (assuming the intersection already has push buttons)
			Add inlaid high visibility pedestrian crosswalk pavement markings	0.80	3 years	\$5,000 per intersection
Unlicensed Drivers	38	103	Enforcement/education countermeasure	0.80	5-yr program	\$52k per section <sup>1</sup> for enforcement + \$50k for education

Table 6 discusses the details related to deploying each countermeasure and the assumptions that were used to determine the CMF shown in Table 5. Should the City modify the installation from the description provided in Table 6, the countermeasure effectiveness may vary. Additionally, the consultant team followed the guidelines for combining multiple CMFs found in the Highway Safety Manual. The formula can result in a combined CMF which may be unrealistically too low ( $CMF \leq 0.3$ ) at some spot locations. Limiting the CMFs of multiple countermeasures to 0.7 or 30% reduction is recommended for estimating purposes.

**Table 6. Countermeasure Descriptions**

<b>Countermeasure</b>	<b>Countermeasure Descriptions</b>
Speed, Seatbelt, Impairment, Enforcement/ Education	<ul style="list-style-type: none"> <li>• Involve police that patrol corridor to increase enforcement of identified driver issues (alcohol related, aggressive driving including speeding, and non-use of safety belts). Determine appropriate types and levels of enforcement needed to improve driver behavior. (At least 10 hours of active visible enforcement per 5 miles within the corridor.)</li> <li>• Once a firm commitment is made by the police to significantly increase active visible enforcement on the corridor (at least to the minimum 10 hours per week per 5 mile section) initiate a public information campaign targeting adjacent and near population areas that use the corridor advising of the driver actions that are causing many of the crashes on the corridor, the increased police activities being initiated to enforce the law, and actions drivers can take to reduce the potential for being in a corridor crash. Consider supplementing the public information campaign with targeted enforcement area signs or similar signs at the beginning of the corridor to reinforce the public information campaign and reach those drivers that are not from the local area or are infrequent users of the corridor.</li> <li>• Involve EMS personnel that service crashes within the corridor to determine enhancements to substantially improve survivability of severe crash victims within the corridor. These would include activities that will reliably get the EMS personnel to the scene quicker, training or equipment improvements to improve survivability at the scene, and activities to transport the injured to a hospital quicker.</li> </ul>
Automated Speed Enforcement	<ul style="list-style-type: none"> <li>• Install automated speed enforcement cameras along corridors with high numbers of speed-related crashes to supplement traditional enforcement operations.</li> <li>• Prior to installation, ensure that the local judiciary personnel will support and uphold the tickets issued by automated speed enforcement cameras.</li> <li>• Consider public campaigns to increase awareness and promote system acceptance.</li> </ul>
Replace stop signs with flashing LED-outlined stop signs	<ul style="list-style-type: none"> <li>• Prior to deploying this countermeasure, updated, highly-reflective stop signs and stop bars should be considered as the first level of deployment. Stop signs should agree with MUTCD size standards (minimum size: 30 inches by 30 inches).</li> <li>• Replace existing stop signs with stop signs that are enhanced with flashing LED lights on each vertex of the octagon.</li> </ul>
STOP AHEAD pavement markings	<ul style="list-style-type: none"> <li>• Provide pavement markings with supplementary messages (such as Stop Ahead) to help alert drivers on the stop-controlled approach to the presence of an intersection, as shown in MUTCD 3B.20.</li> </ul>
Reflective post sleeves	<ul style="list-style-type: none"> <li>• Provide reflective strips on sign posts that are at least 2 inches wide and install them along the full length of the post from the sign to within 2 feet above the edge of the roadway.</li> <li>• Match the color of the reflective tape to the background color of the sign except if the sign is a “yield” or “do not enter” which must have red reflective tape.</li> </ul>

<b>Countermeasure</b>	<b>Countermeasure Descriptions</b>
Reflectorized back plates, advanced dilemma system, convert late-night flash to steady operation	<ul style="list-style-type: none"> <li>• Add reflectorized back plates to each signal head or add reflectorized material to existing back plates.</li> <li>• Revise signal timing plans to eliminate late-night flash and replace it with steady operation 24 hours per day.</li> </ul>
Add Edge Line Striping	<ul style="list-style-type: none"> <li>• Consider application of edge lines on unmarked roads, which have a roadway departure crash problem and a suitable edge to apply the marking.</li> </ul>
Increase Clear Zone (0-5')	<ul style="list-style-type: none"> <li>• Remove trees, brush, and other obstacles within 5' of the edge of travel way.</li> </ul>
Delineate Utility Posts	<ul style="list-style-type: none"> <li>• As a first step, apply sign and marking upgrades consistent with the MUTCD, correction of any 2-inch or greater shoulder drop-offs, and the consideration of centerline and edge rumble strips in the section.</li> <li>• Delineation should be considered in those sections having high frequencies and proportions of nighttime single vehicle fixed object crashes. All fixed objects including head walls, trees, poles, and guide rail should be considered.</li> </ul>
Add Curve Signing (Advanced Curve Warning Signs, Speed Plaques, Chevrons, Reflective Posts)	<ul style="list-style-type: none"> <li>• Apply oversized advanced curve warning sign (MUTCD retro-reflective material compliant), both left and right, with advisory speed plate, chevrons as required in the MUTCD, with long lines (desirably 6-inch width) at least 300 feet in advance and through the curve. Speed reduction pavement markings including SLOW (optional advisory speed) and a curve symbol or use of OPTI-Bars or peripheral transverse pavement markings also included.</li> <li>• Fluorescent yellow sheeting can improve the effectiveness of curve warning and delineation signs by increasing the conspicuity of the sign, especially during dark conditions.</li> </ul>
High friction surface treatment	<ul style="list-style-type: none"> <li>• Apply epoxy-based, micro-surface, or chip seal overlays to address spot locations (e.g., a single curve, interchange ramp, bridge, or short roadway section).</li> <li>• It should be used at locations with severe slick conditions that could benefit from increased friction.</li> </ul>
Media Awareness Campaigns for distracted driving	<ul style="list-style-type: none"> <li>• To be decided</li> </ul>
Change pedestrian walk phase to lead	<ul style="list-style-type: none"> <li>• Modify signal timing plans to provide a leading pedestrian interval</li> <li>• This countermeasure assumes that pedestrian signal heads already exist at the intersection</li> </ul>

<b>Countermeasure</b>	<b>Countermeasure Descriptions</b>
Install mid-block pedestrian refuge	<ul style="list-style-type: none"> <li>• Consider installing pedestrian refuge areas where there is a significant pedestrian-to-vehicle ratio and/or in areas where the traveled speeds are high.</li> <li>• Install at least 15’ length of raised median with pedestrian refuge and a marked crosswalk.</li> </ul>
Add pedestrian countdown heads	<ul style="list-style-type: none"> <li>• Install a pedestrian countdown timer at high pedestrian crash locations</li> <li>• This countermeasure assumes that the intersection is already equipped with pedestrian push buttons</li> </ul>
Add inlaid high visibility pedestrian crosswalk pavement markings	<ul style="list-style-type: none"> <li>• Install inlaid paint or taped crosswalks onto new or repaved streets to increase reflectivity and slip-resistance.</li> <li>• Consider high visibility crosswalk marking patterns</li> <li>• This countermeasure should be used at intersections as a secondary traffic control device (other TCDs must be present at the intersection).</li> </ul>

**Develop City of St. Louis SHSP**

Table 7 provides the prioritized list of safety countermeasures that City safety stakeholders should implement to save at least 5 lives and 18 serious injury crashes per year over the next 5 years, once full implementation of safety countermeasures is reached. The estimated cost for implementing these countermeasures is \$2.98 million per year.

Table 7 uses the following terminology:

- The **description** of the countermeasure is a general title of the deployment. The countermeasures may represent a group of treatments at a location. For instance, countermeasures at signals include updated clearance timing, use of reflectorized back plates, and discontinuing late night flash (if used).
- The **approach** designates whether the deployments are systemic, traditional, standards-based, or comprehensive. This plan is focused on systemic approach by using low-cost treatments to account for the random location of fatality crashes. Agencies will have the opportunity to fold some of these treatments into their standards and policies to ensure that time-proven safety treatments are considered throughout planning, design, construction, and operations. Comprehensive treatments provide the opportunity for enforcement, emergency medical service providers, education, and engineering to collaborate to improve safety.
- **Estimated number of improvements** is the number of roadways, roadway segments, intersections, or corridors recommended for improvement.

- **Cost** is the total cost necessary to fund the number of improvements. For illustration, the deployment is shown over a five-year period and the costs can be spread over this time. Infrastructure costs represent installation only; ongoing operation or maintenance costs are not reflected. Costs for enforcement include labor costs only and do not reflect the ongoing effort needed from enforcement.
- **Annual targeted crash reduction** is the reduction of the specific crash type for the deployment. For example, center line rumble strip deployment targets roadway departure which targets head-on or different direction side-swipe crashes. These reduction numbers are reductions per year once the countermeasure has been deployed at the full number of implementation sites.
- **Annual estimated serious injury crash reductions** are the reduction in the number of serious crashes associated in injuries. This estimate is contingent on the level of deployment of the plan.
- **Annual estimated fatality reductions** are the number of lives saved per year. The targeted deployment of low-cost countermeasures over a wide area such as the City will gain reductions in total crashes and consequently reduce the number of fatalities that result from these crashes. This estimate is contingent on the level of deployment of the plan.
- The **\$(millions) required to prevent/reduce one annual severe injury** is a measure of cost-effectiveness.
- The **\$(millions) needed to save one annual life** is a measure of cost-effectiveness. A prioritized list of countermeasures was chosen from this list based on those closest to \$1.0 to \$2.0 million.

**Table 7. Recommended Safety Countermeasures – Sample 5-Year Implementation Plan**

<b>Countermeasure</b>	<b>Approach</b>	<b>Estimated Number of Improvements</b>	<b>Associated Costs (\$ Million)</b>	<b>Annual Targeted Crash Reduction</b>	<b>Annual Estimated Serious Injury Crash Reduction</b>	<b>Annual Estimated Fatality Reduction</b>	<b>\$ (million) Required to Prevent/Reduce One Annual Serious Injury</b>	<b>\$ (million) Required to Save One Annual Life</b>
<b>Local Roads</b>								
High Friction Surface Treatments	Systemic	4	\$ 0.24	27.20	0.25	0.05	0.97	5.03
Tree Removal or Clear Zone Improvements	Systemic	9	\$ 0.04	12.36	0.38	0.19	0.11	0.22
Utility Pole Delineation	Systemic	13	\$ 0.01	7.66	0.16	0.04	0.08	0.34
Enforcement and Education: Alcohol/Drug Related	Comprehensive	28	\$ 2.86	10.73	0.33	0.22	8.63	12.74
Enforcement and Education: Unrestrained Crashes	Comprehensive	18	\$ 1.80	12.17	0.60	0.54	3.01	3.31
Education and Enforcement: Aggressive Driving Related Crashes	Comprehensive	46	\$ 4.73	170.93	2.50	1.23	1.89	3.85
Speed Enforcement Cameras: Aggressive Driving Related Crashes	Systemic	6	\$ 2.28	65.13	0.95	0.47	2.39	4.87
Pedestrian Countermeasures - Signalized Intersection Package (Leading Walk Phase, Pedestrian Countdown Heads, High Visibility Pavement Markings)	Traditional	9	\$ 0.09	7.56	0.78	0.19	0.11	0.45
Pedestrian Countermeasures - Stop-Controlled Intersection Package (Inlaid High Visibility Crosswalk Pavement Markings)	Traditional	4	\$ 0.02	0.54	0.04	0.01	0.42	1.48
Pedestrian Countermeasures - Non-Intersection Package (Inlaid High Visibility Crosswalk Pavement Markings and Raised Pedestrian Refuge Island)	Traditional	19	\$ 0.31	6.51	0.75	0.24	0.42	1.29
Pedestrian Countermeasures - Non-Intersection - HAWK	Traditional	5	\$ 0.24	8.39	0.96	0.31	0.25	0.77
Signalized Intersection less than 45mph - Basic Signal Package (ITE Clearance Time, Reflectorized Back Plate, Eliminate Late Night Flash)	Traditional	11	\$ 0.32	482.22	7.57	1.44	0.04	0.22
Stop-Controlled Intersection less than 45mph - Basic Stop-Controlled Package (STOP AHEAD Pavement Markings, Reflective Post Sleeves)	Traditional	19	\$ 0.09	127.57	1.68	0.38	0.05	0.23

<b>Countermeasure</b>	<b>Approach</b>	<b>Estimated Number of Improvements</b>	<b>Associated Costs (\$ Million)</b>	<b>Annual Targeted Crash Reduction</b>	<b>Annual Estimated Serious Injury Crash Reduction</b>	<b>Annual Estimated Fatality Reduction</b>	<b>\$ (million) Required to Prevent/Reduce One Annual Serious Injury</b>	<b>\$ (million) Required to Save One Annual Life</b>
Stop-Controlled Intersection less than 45mph - Install Flashing LED-Outlined Stop Signs	Traditional	8	\$ 0.10	70.09	0.92	0.21	0.11	0.49
Licensure Enforcement of All Drivers	Comprehensive	18	\$ 1.80	35.76	1.00	0.37	1.80	4.88
<b>Total Cost and Benefit (Local Roads)</b>								
<b>Total Cost (\$Million)</b>			<b>\$14.91</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>
<b>Annual Cost (\$ Million) for 5 years; Annual Benefit</b>			<b>\$ 2.98</b>	<b>1,045</b>	<b>18.86<sup>13</sup></b>	<b>5.88<sup>11</sup></b>	<b>-</b>	<b>-</b>

<sup>13</sup> Based on full implementation of these countermeasures, the City of St. Louis can expect to save more than 5 lives and 18 serious injury crashes per year after installation is complete.

The following sections provide the suggested implementation sites for each countermeasure described in Table 7. These implementation sites were prioritized based on 2007-2011 crash data. The suggested implementation sites should be verified in field conditions using engineering judgment to determine feasibility of implementation of the recommended countermeasure. Also, to meet the goal of at least 5 lives and 18 serious injury crashes saved per year, agencies must implement the minimum “estimated number of improvements” for each countermeasure listed in Table 7.

For each implementation site table, a log mile range is given denoting where the recommended implementation should occur. The 0.0 log mile point for each route is at the furthestmost north (for primarily north-south corridors) or west (for primarily east-west corridors). Implementation sites are shown on the corresponding countermeasure implementation site maps in Appendix A.

**Countermeasure: High Friction Surface Treatments**

This countermeasure involves applying high friction surface treatments at locations with severe slick conditions that could benefit from increased friction. The treatment is an epoxy-based micro-surface or chip seal overlay to address spot locations such as a single curve, interchange ramp, bridge, intersection, or short roadway segment.

**Implementation Cost:** \$60,000 per segment

Determine specific implementation sites in the field using engineering judgment. Those wet crashes that were identified on the corridor but not specifically located along a route are included in the “route total wet crashes” groups; it is possible/likely that some un-located crashes occurred within the sections shown within each route.<sup>14</sup>

**Table 8. Recommended High Friction Surface Treatment Implementation Sites**

Route	Municipality	Route Total Wet Crashes ('07-'11)	Section Begin Log Point	Section End Log Point	Subsection Crashes ('07-'11)	Cumulative Sections for High Friction Surface Treatment Application	Ownership Notes
Kingshighway Blvd	St. Louis	867	1.3	1.9	59	1	
			2.4	2.8	56	2	
			3.2	3.6	55	3	
			3.7	4.1	94	4	
			4.2	4.5	52	5	
			5.0	5.5	49	6	
			5.9	6.2	44	7	
			6.4	6.8	44	8	
		Un-located crashes along this corridor		227	-		
Grand Blvd	St. Louis	675	0	0.1	23	9	
			0.4	0.7	19	10	
			1.8	2.2	41	11	

<sup>14</sup> While the crashes are located to the corridor but not to a specific log mile range, it is likely that some of the un-located crashes can be attributed to the crash clusters shown in the log mile ranges in the lines above the un-located crashes. For this reason, the crash clusters should be regarded as the minimum number of crashes occurring between the specified log mile ranges.

Route	Municipality	Route Total Wet Crashes ('07-'11)	Section Begin Log Point	Section End Log Point	Subsection Crashes ('07-'11)	Cumulative Sections for High Friction Surface Treatment Application	Ownership Notes
			2.2	2.3	31	12	
			2.8	3.2	21	13	
			4.1	4.7	49	14	
			Un-located crashes along this corridor		81	-	
Broadway	St. Louis	558	0.1	0.5	48	15	
			0.6	1.0	42	16	
			1.2	1.6	116	17	
			1.7	2.1	23	18	
			2.9	3.3	26	19	
			Un-located crashes along this corridor		207	-	
West Florissant Ave	St. Louis	292	5.9	6.2	49	20	
			6.9	7.4	13	21	
			Un-located crashes along this corridor		178	-	
Riverview Dr	St. Louis	145	1.3	1.8	17	22	
			2.8	3.6	37	23	
			Un-located crashes along this corridor		5	-	

**Countermeasure: Tree Removal/Increase Clear Zone**

The fixed object associated with the greatest number of roadway departure fatalities is trees. One of the challenges associated with this initiative is that tree removal alone may not be the only necessary low-cost countermeasure; also consider removal or relocation of other vulnerable fixed objects. In addition, many vulnerable trees are located 3 to 5 feet from the roadway edge and on private property. Vulnerable trees are trees that have evidence of previous collisions with vehicles and trees that are well within the clear zone for the highway. Develop processes to work with property owners to allow for removal of vulnerable trees off of the right-of-way. For example, consider replanting the tree in a less vulnerable location or replace the tree with impact-friendly shrubbery.

The following lists suggested implementation sites on routes with the largest number of tree crashes. Each entry shows the number of crashes occurring within that section of roadway.

This countermeasure involves removal of trees, brush, and other obstacles within 5' of the edge of travel way.

The following table lists suggested routes for clear zone improvements. Each entry shows the number of crashes occurring within that section of roadway and which section may benefit from tree removal.

**Implementation Cost:** \$5,000 per mile for tree removal per 1-mile segment

One implementation site equals one mile of roadway. Determine specific implementation sites in the field using engineering judgment. Those tree crashes that were identified on the corridor but not specifically located along a route are included in the “route total tree crashes” groups; it is possible/likely that some un-located crashes occurred within the sections shown within each route.<sup>15</sup>

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<sup>15</sup> While the crashes are located to the corridor but not to a specific log mile range, it is likely that some of the un-located crashes can be attributed to the crash clusters shown in the log mile ranges in the lines above the un-located crashes. For this reason, the crash clusters should be regarded as the minimum number of crashes occurring between the specified log mile ranges.

**Table 9. Recommended Tree Removal/Clear Zone Improvement Sites**

Route	Municipality	Route Total Tree Crashes ('07-'11)	Section Begin Log Point	Section End Log Point	Subsection Crashes ('07-'11)	Cumulative 1-mile Sections
Kingshighway Blvd	St. Louis	62	1.7	4.1	26	3.6
			6.0	6.4	7	4.0
			Un-located crashes along this corridor		16	-
Grand Blvd	St. Louis	57	0.0	2.0	7	8.0
			5.6	6.0	4	8.4
			Un-located crashes along this corridor		21	-
Broadway St	St. Louis	37	0.0	2.0	14	6.0
			Un-located crashes along this corridor		22	-
Arsenal St	St. Louis	24	2.3	3.0	4	9.1
			Un-located crashes along this corridor		16	-

**Countermeasure: Utility Poles and Other Fixed Objects (FO) Delineation**

Delineation should be considered in those sections having high frequencies and proportions of nighttime single-vehicle fixed-object crashes. All fixed objects including head walls, trees, poles, and guard rail should be considered.

**Implementation Cost:** \$1,000 per 1-mile segment

Determine specific implementation sites in the field using engineering judgment. Those utility pole/FO crashes that were identified on the corridor but not specifically located along a route are included in the “route total crashes” groups; it is possible/likely that some un-located crashes occurred within the sections shown within each route.<sup>16</sup>

**Table 10. Recommended Utility Poles and Other Fixed Object Delineation Implementation Sites**

Route	Municipality	Route Total Fixed Object Crashes ('07-'11)	Section Begin Log Point	Section End Log Point	Subsection Crashes ('07-'11)	Cumulative 1-mile Sections	Ownership Notes
Broadway	St. Louis	39	0.3	2.4	16	2.1	
			Un-located crashes along this corridor		13	-	
Riverview Dr	St. Louis	20	1.3	2.9	13	7.7	MoDOT maintains SB 0-2.181
			Un-located crashes along this corridor		1	-	
Kingshighway Blvd	St. Louis	20	0.6	1.7	7	8.8	
			Un-located crashes along this corridor		3	-	
Goodfellow Blvd	St. Louis	19	3.0	3.6	8	9.4	
			4.6	5.6	5	10.4	
			Un-located crashes along this corridor		2	-	
West	St. Louis	16	6.8	7.5	5	12.1	

<sup>16</sup> While the crashes are located to the corridor but not to a specific log mile range, it is likely that some of the un-located crashes can be attributed to the crash clusters shown in the log mile ranges in the lines above the un-located crashes. For this reason, the crash clusters should be regarded as the minimum number of crashes occurring between the specified log mile ranges.

Route	Municipality	Route Total Fixed Object Crashes ('07-'11)	Section Begin Log Point	Section End Log Point	Subsection Crashes ('07-'11)	Cumulative 1-mile Sections	Ownership Notes
Florissant Ave			Un-located crashes along this corridor		10	-	
Natural Bridge Ave	St. Louis	16	8.1	9.3	6	13.3	MoDOT maintains SB 5.3-10.16
			Un-located crashes along this corridor		3	-	

**Countermeasure: Education and Enforcement – Alcohol**

Perform the following steps:

- Involve police that patrol corridor to increase enforcement of intoxicated driving. Determine appropriate types and levels of enforcement needed to improve driver behavior. (At least 10 hours of active visible enforcement per 5 miles within the corridor.)
- Once a firm commitment is made by the police to significantly increase active visible enforcement on the corridor (at least to the minimum 10 hours per week per 5 mile section) initiate a public information campaign targeting adjacent and near population areas that use the corridor advising of the driver actions that are causing many of the crashes on the corridor, the increased police activities being initiated to enforce the law, and actions drivers can take to reduce the potential for being in a corridor crash. Consider supplementing the public information campaign with targeted enforcement area signs or similar signs at the beginning of the corridor to reinforce the public information campaign and reach those drivers that are not from the local area or are infrequent users of the corridor.
- Involve EMS personnel that respond to crashes within the corridor to determine enhancements to substantially improve survivability of severe crash victims within the corridor. These would include activities that will reliably get the EMS personnel to the scene quicker, training or equipment improvements to improve survivability at the scene, and activities to transport the injured to a hospital quicker.

The following table lists suggested routes for alcohol-focused driving enforcement. Each entry shows the number of crashes occurring within that section of roadway and which section may benefit from extra enforcement and education.

**Implementation Cost:** \$102,000 per route (assumes \$50,000 lump sum education cost plus \$52,000 for one officer to work 10 hours per week for five years)

Determine specific implementation sites in the field using engineering judgment where road alignment is conducive to enforcement activities. Those alcohol-related crashes that were identified on the corridor but not specifically located along a route are included in the “route total crashes” groups; it is possible/likely that some un-located crashes occurred within the sections shown within each route.<sup>17</sup>

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<sup>17</sup> While the crashes are located to the corridor but not to a specific log mile range, it is likely that some of the un-located crashes can be attributed to the crash clusters shown in the log mile ranges in the lines above the un-located crashes. For this reason, the crash clusters should be regarded as the minimum number of crashes occurring between the specified log mile ranges.

**Table 11. Recommended Implementation Sites for Alcohol Enforcement**

Route	Municipality	Route Total Alcohol-Related Crashes ('07-'11)	Patrol Section				Details
			Section Begin Log Point	Section End Log Point	Section Crashes ('07-'11)	Potential Checkpoint Locations (Log-points; crashes)	
Grand Blvd	St. Louis	52	0.0	7.4	20	LP 0.0-2.1; 13 crashes	<p>FRI &amp; SAT Night 9:00pm (FRI) - 5:59 am (SAT) 9:00pm (SAT) - 2:59 am (SUN)</p> <p>TUE, WED, THU, FRI 6:00pm - 8:59pm</p> <p>THU &amp; SUN 9:00pm - 11:59pm</p>
			Un-located crashes along this corridor		32		
Kingshighway Blvd	St. Louis	43	0.4	8.9	29	LP 3.1-6.6; 16 crashes	
			Un-located crashes along this corridor				
Broadway	St. Louis	40	0.1	7.3	25	LP 0.1-2.1; 17 crashes	
			Un-located crashes along this corridor		15		
Gravois Ave	St. Louis	25	47.0	52.3	19	Entire corridor	
			Un-located crashes along this corridor		6		
Hampton Ave	St. Louis	24	0.6	4.9	21	Entire corridor	
			Un-located crashes along this corridor		3		
Natural Bridge Ave	St. Louis	24	5.6	9.2	21	LP 7.3-9.2; 14 crashes	
			Un-located crashes along this corridor		3		
Dr Martin Luther King Dr	St. Louis	19	10.2	14.0	19	Entire corridor	
			Un-located crashes along this corridor		-		
Jefferson Ave	St. Louis	18	1.3	5.0	16	LP 3.1-5.0; 13 crashes	
			Un-located crashes along this corridor		2		
Arsenal St	St. Louis	18	0.4	3.3	6	Entire corridor	
			Un-located crashes along this corridor		12		

Route	Municipality	Route Total Alcohol-Related Crashes ('07-'11)	Patrol Section				Details
			Section Begin Log Point	Section End Log Point	Section Crashes ('07-'11)	Potential Checkpoint Locations (Log-points; crashes)	
Delmar Blvd	St. Louis	17	0.8	7.2	17	LP 3.5-5.9; 11 crashes	<p>FRI &amp; SAT Night 9:00pm (FRI) - 5:59 am (SAT) 9:00pm (SAT) - 2:59 am (SUN)</p> <p>TUE, WED, THU, FRI 6:00pm - 8:59pm</p> <p>THU &amp; SUN 9:00pm - 11:59pm</p>
			Un-located crashes along this corridor		1		
Goodfellow Blvd	St. Louis	16	0.0	4.7	11	LP 2.2-3.7; 7 crashes	
			Un-located crashes along this corridor		5		
Page Blvd	St. Louis	15	9.4	13.0	13	Entire corridor	
			Un-located crashes along this corridor		2		
Vandeventer Ave	St. Louis	14	0.0	3.9	12	Entire corridor	
			Un-located crashes along this corridor		2		
Chippewa St	St. Louis	13	9.1	11.1	13	Entire corridor	
			Un-located crashes along this corridor		-		
Lindell Blvd	St. Louis	12	1.9	3.8	6	Entire corridor	
			Un-located crashes along this corridor		6		
Market St	St. Louis	11	0.0	1.7	7	Entire corridor	
			Un-located crashes along this corridor		4		
West Florissant Ave	St. Louis	11	5.9	9.4	4	Entire corridor	
			Un-located crashes along this corridor		7		
Skinker Blvd	St. Louis	11	0.3	2.0	9	Entire corridor	
			Un-located crashes along this corridor		2		
Loughborough Ave	St. Louis	11	0.6	2.9	8	Entire corridor	
			Un-located crashes		3		

Route	Municipality	Route Total Alcohol-Related Crashes ('07-'11)	Patrol Section				Details
			Section Begin Log Point	Section End Log Point	Section Crashes ('07-'11)	Potential Checkpoint Locations (Log-points; crashes)	
			along this corridor				
Compton Ave	St. Louis	9	0.3	4.9	7	Entire corridor	FRI & SAT Night 9:00pm (FRI) - 5:59 am (SAT) 9:00pm (SAT) - 2:59 am (SUN)  TUE, WED, THU, FRI 6:00pm - 8:59pm  THU & SUN 9:00pm - 11:59pm
			Un-located crashes along this corridor		2		
Riverview Blvd	St. Louis	9	0.2	9.0	9	LP 1.7-3.2; 4 crashes LP 7.3-9.0; 4 crashes	
			Un-located crashes along this corridor		-		
Gravois Rd	St. Louis	9	47.1	52.1	9	Entire corridor	
			Un-located crashes along this corridor		-		
Park Ave	St. Louis	8	0.5	2.0	6	Entire corridor	
			Un-located crashes along this corridor		2		
Delor St	St. Louis	7	0.0	1.2	7	Entire corridor	
			Un-located crashes along this corridor				
Morganford Rd	St. Louis	7	1.5	3.6	4	Entire corridor	
			Un-located crashes along this corridor		3		
Germania St	St. Louis	6	0.0	1.4	3	Entire corridor	
			Un-located crashes along this corridor		3		
Forest Park Pkwy	St. Louis	6	0.3	4.9	3	Entire corridor	
			Un-located crashes along this corridor		3		
Shenandoah Ave	St. Louis	6	0.0	1.1	4	Entire corridor	
			Un-located crashes along this corridor		2		

**Countermeasure: Education and Enforcement – Unbelted**

Based on MoDOT data, the City of St. Louis does not have a primary seat belt ordinance. This presents an opportunity for the City to consider passing a primary seatbelt ordinance.

Perform the following steps:

- Involve police that patrol corridor to increase restraint use enforcement. Determine appropriate types and levels of enforcement needed to improve driver behavior. (At least 10 hours of active visible enforcement per 5 miles within the corridor.)
- Once a firm commitment is made by the police to significantly increase active visible enforcement on the corridor (at least to the minimum 10 hours per week per 5 mile section) initiate a public information campaign targeting adjacent and near population areas that use the corridor advising of the driver actions that are causing many of the crashes on the corridor, the increased police activities being initiated to enforce the law, and actions drivers can take to reduce the potential for being in a corridor crash. Consider supplementing the public information campaign with targeted enforcement area signs or similar signs at the beginning of the corridor to reinforce the public information campaign and reach those drivers that are not from the local area or are infrequent users of the corridor.
- Involve EMS personnel that respond to crashes within the corridor to determine enhancements to substantially improve survivability of severe crash victims within the corridor. These would include activities that will reliably get the EMS personnel to the scene quicker, training or equipment improvements to improve survivability at the scene, and activities to transport the injured to a hospital quicker.

The following table lists suggested routes for enforcement of unrestrained occupants. Each entry shows the number of crashes occurring within that section of roadway and which section may benefit from extra enforcement and education.

**Implementation Cost:** \$102,000 per route (assumes \$50,000 lump sum education cost plus \$52,000 for one officer to work 10 hours per week for five years)

Determine specific implementation sites in the field using engineering judgment where road alignment is conducive to enforcement activities. Those unbelted-related crashes that were identified on the corridor but not specifically located along a route are included in

the “route total crashes” groups; it is possible/likely that some un-located crashes occurred within the sections shown within each route.<sup>18</sup>

**Table 12. Recommended Implementation Sites for Seatbelt Enforcement**

Route	Municipality	Route Total Unbelted-Related Crashes ('07-'11)	Patrol Section				Details
			Section Begin Log Point	Section End Log Point	Section Crashes ('07-'11)	Potential Checkpoint Locations (Log-points; crashes)	
Grand Blvd	St. Louis	75	0.0	6.9	40	Entire corridor	SAT & SUN 12:00am - 2:59am  MON - SAT 3:00pm - 5:59pm  WED - SUN 9:00pm-11:59pm  TUE - FRI 12:00pm-2:59pm
			Un-located crashes along this corridor		35		
Broadway	St. Louis	72	0.1	7.5	55	Entire corridor	
			Un-located crashes along this corridor		7		
Kingshighway Blvd	St. Louis	61	0.6	8.3	49	LP 0.9-3.3; 29 crashes	
			Un-located crashes along this corridor		12		
Natural Bridge Ave	St. Louis	49	5.7	9.5	44	Entire corridor	
			Un-located crashes along this corridor		5		
Goodfellow Blvd	St. Louis	37	0.6	5.0	29	LP 2.3-3.7; 17 crashes	
			Un-located crashes along this corridor		8		
Euclid Ave	St. Louis	19	0.1	1.4	9	Entire corridor	
			Un-located crashes along this corridor		10		
Union Blvd	St. Louis	18	0.1	3.6	13	Entire corridor	
			Un-located crashes along this corridor		5		
St. Louis Ave	St. Louis	17	0.3	4.3	12	Entire corridor	
			Un-located crashes along this corridor		5		
Arsenal St	St. Louis	16	1.9	3.24	2	Entire corridor	
			Un-located crashes along this corridor		14		
Tucker	St. Louis	14	0.5	2.5	14	Entire corridor	
			Un-located crashes along this corridor		-		

<sup>18</sup> While the crashes are located to the corridor but not to a specific log mile range, it is likely that some of the un-located crashes can be attributed to the crash clusters shown in the log mile ranges in the lines above the un-located crashes. For this reason, the crash clusters should be regarded as the minimum number of crashes occurring between the specified log mile ranges.

Route	Municipality	Route Total Unbelted-Related Crashes ('07-'11)	Patrol Section				Details
			Section Begin Log Point	Section End Log Point	Section Crashes ('07-'11)	Potential Checkpoint Locations (Log-points; crashes)	
West Florissant Ave	St. Louis	22	5.6	7.2	8	Entire corridor	SAT & SUN 12:00am - 2:59am  MON - SAT 3:00pm - 5:59pm  WED - SUN 9:00pm-11:59pm  TUE - FRI 12:00pm-2:59pm
			Un-located crashes along this corridor		14		
Gravois Ave	St. Louis	20	47.7	52.1	16	Entire corridor	
			Un-located crashes along this corridor		4		
Dr Martin Luther King Dr	St. Louis	19	2.3	13.9	19	LP 10.0-13.9; 18 crashes	
			Un-located crashes along this corridor		-		
Jefferson Ave	St. Louis	18	0.4	5.0	15	LP 4.2-5.0; 7 crashes	
			Un-located crashes along this corridor				
Riverview Dr	St. Louis	18	0.0	7.7	18	LP 2.1-3.5; 6 crashes	
			Un-located crashes along this corridor				
Page Blvd	St. Louis	15	9.4	13.0	15	Entire corridor	
			Un-located crashes along this corridor				
Delmar Blvd	St. Louis	14	3.6	6.2	10	Entire corridor	
			Un-located crashes along this corridor		4		

**Countermeasure: Education/Enforcement and Speed Enforcement Cameras – Aggressive Driving**

Perform the following steps for education and enforcement of aggressive driving:

- Involve police that patrol corridor to increase enforcement of aggressive driving. Determine appropriate types and levels of enforcement needed to improve driver behavior. (At least 10 hours of active visible enforcement per 5 miles within the corridor.)
- Once a firm commitment is made by the police to significantly increase active visible enforcement on the corridor (at least to the minimum 10 hours per week per 5 mile section) initiate a public information campaign targeting adjacent and near population areas that use the corridor advising of the driver actions that are causing many of the crashes on the corridor, the increased police activities being initiated to enforce the law, and actions drivers can take to reduce the potential for being in a corridor crash. Consider supplementing the public information campaign with targeted enforcement area signs or similar signs at the beginning of the corridor to reinforce the public information campaign and reach those drivers that are not from the local area or are infrequent users of the corridor.
- Involve EMS personnel that respond to crashes within the corridor to determine enhancements to substantially improve survivability of severe crash victims within the corridor. These would include activities that will reliably get the EMS personnel to the scene quicker, training or equipment improvements to improve survivability at the scene, and activities to transport the injured to a hospital quicker.

Perform the following steps, at a minimum, for installation of speed enforcement cameras:

- Install automated speed enforcement cameras along corridors with high numbers of speed-related crashes to supplement traditional enforcement operations.
- Prior to installation, ensure that the local judiciary personnel will support and uphold the tickets issued by automated speed enforcement cameras.
- Consider public campaigns to increase awareness and promote system acceptance.

The following table lists suggested routes for enforcement of aggressive driving maneuvers. Each entry shows the number of crashes occurring within that section of roadway and which section may benefit from extra enforcement and education.

**Implementation Cost:** \$102,000 per route (assumes \$50,000 lump sum education cost plus \$52,000 for one officer to work 10 hours per week for five years)

Determine specific implementation sites in the field using engineering judgment where road alignment is conducive to enforcement activities. Those aggressive driving-related crashes that were identified on the corridor but not specifically located along a route are

included in the “route total crashes” groups; it is possible/likely that some un-located crashes occurred within the sections shown within each route.<sup>19</sup>

**Table 13. Recommended Implementation Sites for Aggressive Driving Enforcement**

Route	Municipality	Route Total Aggressive Driving-Related Crashes ('07-'11)	Patrol Section				Details	Speed Enforcement Camera?
			Section Begin Log Point	Section End Log Point	Section Crashes ('07-'11)	Potential Checkpoint or Camera Locations (Log-points; crashes)		
Kingshighway Blvd	St. Louis	1092	0.0	9.1	808	LP 2.5-2.8; 50 crashes LP 3.6-4.4; 173 crashes LP 5.8-6.2; 56 crashes	MON - FRI 3:00pm-5:59pm  FRI & SAT Night 9:00pm (FRI) – 2:59 am (SAT); 9:00pm (SAT) – 2:59 am (SUN)	Yes
			Un-located crashes along this corridor		284			
Grand Blvd	St. Louis	771	0.0	11.1	399	LP 1.8-2.3; 73 crashes		Yes
			Un-located crashes along this corridor		372			
Broadway	St. Louis	510	0.0	7.5	320	LP 1.2-3.2; 155 crashes	TUE, THU, FRI 12:00pm-2:59pm	Yes
			Un-located crashes along this corridor		190			
Goodfellow Blvd	St. Louis	355	0.0	5.6	277	LP 2.0-3.4; 110 crashes	SAT 3:00pm - 8:59pm	Yes
			Un-located crashes along this corridor		78			
Gravois Ave	St. Louis	298	47.0	52.8	237	Entire corridor	THU, FRI 6:00pm-8:59pm	
			Un-located crashes along this corridor		61			
Natural Bridge Ave	St. Louis	258	4.3	9.4	229	LP 6.4-7.0; 45 crashes		Yes
			Un-located crashes along this corridor		29			
West Florissant	St.	246	5.4	9.0	96	LP 5.9-6.0; 50 crashes		Yes

<sup>19</sup> While the crashes are located to the corridor but not to a specific log mile range, it is likely that some of the un-located crashes can be attributed to the crash clusters shown in the log mile ranges in the lines above the un-located crashes. For this reason, the crash clusters should be regarded as the minimum number of crashes occurring between the specified log mile ranges.

Route	Municipality	Route Total Aggressive Driving-Related Crashes ('07-'11)	Patrol Section				Details	Speed Enforcement Camera?
			Section Begin Log Point	Section End Log Point	Section Crashes ('07-'11)	Potential Checkpoint or Camera Locations (Log-points; crashes)		
Ave	Louis		Un-located crashes along this corridor		150		MON - FRI 3:00pm-5:59pm	
Hampton Ave	St. Louis	241	0.1	4.9	205	Entire corridor	FRI & SAT Night 9:00pm (FRI) – 2:59 am (SAT); 9:00pm (SAT) – 2:59 am (SUN)	
			Un-located crashes along this corridor		36			
Skinker Blvd	St. Louis	212	0.0	2.0	149	LP 0.6-1.2; 95 crashes	TUE, THU, FRI 12:00pm-2:59pm	
			Un-located crashes along this corridor		63			
Vandeventer Ave	St. Louis	209	0.0	4.4	132	Entire corridor	SAT 3:00pm - 8:59pm	
			Un-located crashes along this corridor		77			
Page Blvd	St. Louis	199	9.3	13.4	191	Entire corridor	THU, FRI 6:00pm-8:59pm	
			Un-located crashes along this corridor		8			
Jefferson Ave	St. Louis	180	0.2	5.3	145	Entire corridor		
			Un-located crashes along this corridor		35			
Union Blvd	St. Louis	174	0.0	4.2	140	Entire corridor		
			Un-located crashes along this corridor		34			
Dr Martin Luther King Dr	St. Louis	163	10.0	15.2	154	Entire corridor		
			Un-located crashes along this corridor		9			
Delmar Blvd	St. Louis	152	0.2	7.1	141	LP 3.5-6.5; 127 crashes		
			Un-located crashes along this corridor		11			
Arsenal	St. Louis	148	0.0	5.5	37	Entire corridor		
			Un-located crashes		111			

Route	Municipality	Route Total Aggressive Driving-Related Crashes ('07-'11)	Patrol Section				Details	Speed Enforcement Camera?
			Section Begin Log Point	Section End Log Point	Section Crashes ('07-'11)	Potential Checkpoint or Camera Locations (Log-points; crashes)		
			along this corridor				MON - FRI	
Lindell Blvd	St. Louis	137	0.3	3.9	94	LP 2.0-3.9; 73 crashes	3:00pm-5:59pm	
			Un-located crashes along this corridor		43			FRI & SAT Night
Chippewa St	St. Louis	131	5.1	12.0	127	LP 9.1-10.1; 77 crashes	9:00pm (FRI) – 2:59 am (SAT); 9:00pm (SAT) – 2:59 am (SUN)	
			Un-located crashes along this corridor		4			
Riverview Dr	St. Louis	126	0.0	9.0	120	Entire corridor		
			Un-located crashes along this corridor		6			TUE, THU, FRI
Washington Ave	St. Louis	114	0.0	5.6	73	Entire corridor	12:00pm-2:59pm	
			Un-located crashes along this corridor		41			SAT
Market St	St. Louis	107	0.0	2.2	71	Entire corridor	3:00pm - 8:59pm	
			Un-located crashes along this corridor		36			THU, FRI
St Louis Ave	St. Louis	104	0.0	4.7	71	Entire corridor	6:00pm-8:59pm	
			Un-located crashes along this corridor		33			
Forest Park Pkwy	St. Louis	94	0.0	4.9	67	Entire corridor		
			Un-located crashes along this corridor		27			
Mc Causland Ave	St. Louis	88	0.0	2.0	12	Entire corridor		
			Un-located crashes along this corridor		76			
Tucker Blvd	St. Louis	84	0.3	2.3	70	Entire corridor		
			Un-located crashes along this corridor		14			

Route	Municipality	Route Total Aggressive Driving-Related Crashes ('07-'11)	Patrol Section				Details	Speed Enforcement Camera?
			Section Begin Log Point	Section End Log Point	Section Crashes ('07-'11)	Potential Checkpoint or Camera Locations (Log-points; crashes)		
Chouteau	St. Louis	82	117.9	121.3	17	Entire corridor	MON - FRI 3:00pm-5:59pm	
			Un-located crashes along this corridor		65			
Manchester Ave	St. Louis	77	114.4	117.9	52	Entire corridor	FRI & SAT Night 9:00pm (FRI) – 2:59 am (SAT); 9:00pm (SAT) – 2:59 am (SUN)	
			Un-located crashes along this corridor		25			
Gravois Rd	St. Louis	77	47.0	58.2	53	Entire corridor	TUE, THU, FRI 12:00pm-2:59pm	
			Un-located crashes along this corridor		24			
14 <sup>th</sup> St	St. Louis	71	0.0	2.3	44	Entire corridor	SAT 3:00pm - 8:59pm	
			Un-located crashes along this corridor		27			
Compton Ave	St. Louis	70	0.1	5.2	59	LP 0.5-2.3; 44 crashes	THU, FRI 6:00pm-8:59pm	
			Un-located crashes along this corridor		11			
Loughborough Ave	St. Louis	59	0.1	3.2	52	Entire corridor		
			Un-located crashes along this corridor		7			
Forest Park Ave	St. Louis	57	0.0	2.0	29	Entire corridor		
			Un-located crashes along this corridor		28			
Morganford Rd	St. Louis	57	0.1	3.8	42	Entire corridor		
			Un-located crashes along this corridor		15			
Forest Park Blvd	St. Louis	54	0.5	0.6	1	Entire corridor		
			Un-located crashes along this corridor		53			
Olive St	St.	53	0.0	4.1	49	Entire corridor		

Route	Municipality	Route Total Aggressive Driving-Related Crashes ('07-'11)	Patrol Section				Details	Speed Enforcement Camera?
			Section Begin Log Point	Section End Log Point	Section Crashes ('07-'11)	Potential Checkpoint or Camera Locations (Log-points; crashes)		
	Louis		Un-located crashes along this corridor		4		MON - FRI 3:00pm-5:59pm	
Bircher Blvd	St. Louis	52	0.0	0.5	15	Entire corridor	FRI & SAT Night 9:00pm (FRI) – 2:59 am (SAT); 9:00pm (SAT) – 2:59 am (SUN)	
			Un-located crashes along this corridor		37			
Taylor Ave	St. Louis	49	0.0	3.0	37	Entire corridor	TUE, THU, FRI 12:00pm-2:59pm	
			Un-located crashes along this corridor		12			
10 <sup>th</sup> St	St. Louis	48	0.0	4.6	41	LP 0.0-1.5; 40 crashes	SAT 3:00pm - 8:59pm	
			Un-located crashes along this corridor		7			
Newstead Ave	St. Louis	47	0.0	3.4	41	Entire corridor	THU, FRI 6:00pm-8:59pm	
			Un-located crashes along this corridor		6			
Euclid Ave	St. Louis	47	0.0	1.3	25	Entire corridor		
			Un-located crashes along this corridor		22			
Halls Ferry Rd	St. Louis	45	0.0	9.6	36	LP 0.0-0.9; 30 crashes		
			Un-located crashes along this corridor		9			
Bates St	St. Louis	40	0.0	2.1	29	Entire corridor		
			Un-located crashes along this corridor		11			
Park Ave	St. Louis	38	0.0	2.4	17	Entire corridor		
			Un-located crashes along this corridor		21			
20 <sup>th</sup> St	St. Louis	38	0.0	1.9	26	Entire corridor		
			Un-located crashes		12			

Route	Municipality	Route Total Aggressive Driving-Related Crashes ('07-'11)	Patrol Section				Details	Speed Enforcement Camera?
			Section Begin Log Point	Section End Log Point	Section Crashes ('07-'11)	Potential Checkpoint or Camera Locations (Log-points; crashes)		
			along this corridor					

**Countermeasure: Signalized Intersection Pedestrian Safety Package**

Install the following pedestrian safety treatments for signalized intersections:

- Leading walk phase
- Pedestrian countdown heads
- High visibility crosswalk pavement markings

The following table lists suggested routes for implementation of the pedestrian signal package. Each entry shows the number of crashes occurring within that section of roadway and which section may benefit.

**Implementation Cost:** \$10,000 per signalized intersection

One implementation site equals one signalized intersection. Determine specific implementation sites in the field using engineering judgment.

**Table 14. Recommended Implementation Sites for the Pedestrian Signalized Intersection Package**

Intersection Number	Municipality	Intersecting Streets		Total Pedestrian Crashes ('07-'11)	Ownership Notes
		Street 1	Street 2		
262069	St. Louis	Union Blvd	St Louis Ave	6	
275343	St. Louis	Grand Blvd	Forest Park Blvd	6	
273833	St. Louis	Taylor Ave	Forest Park Blvd	5	
274865	St. Louis	Grand Blvd	Laclede Ave	4	
263533	St. Louis	Natural Bridge Ave	Newstead Ave	4	Intersection maintained by MoDOT
268627	St. Louis	Skinker Blvd	Delmar Blvd	4	
(unknown)	St. Louis	Broadway	Walnut St	4	
273309	St. Louis	Lindell Blvd	Sarah St	4	
250928	St. Louis	Goodfellow Blvd	West Florissant	3	

**Countermeasure: Stop-Controlled Intersection Pedestrian Safety Package**

Install the inlaid high visibility crosswalk pavement markings at each of the four quadrants at stop-controlled intersections. The following table lists suggested stop-controlled intersections that could benefit from this application.

Implementation Cost: \$5,000 per stop-controlled intersection

One implementation site equals one stop-controlled intersection. Determine specific implementation sites in the field using engineering judgment.

**Table 15. Recommended Implementation Sites for the Pedestrian Stop-Controlled Intersection Package**

Intersection Number	Municipality	Intersecting Streets		Total Intersection Crashes ('07-'11)
		Street 1	Street 2	
293247	St. Louis	Compton Ave	Merabec St	5
275586	St. Louis	2 <sup>nd</sup> St	Laclede Landing Blvd	3
274583	St. Louis	Taylor Ave	Childrens Pl	3
262824	St. Louis	Fair Ave	Lee Ave	2

**Countermeasure: Non-Intersection Pedestrian Safety Package**

Install the following pedestrian safety treatments for non-intersection locations:

- Install inlaid paint or taped crosswalks onto new or repaved streets to increase reflectivity and slip-resistance.
- Consider high visibility crosswalk marking patterns.
- This countermeasure should be used at intersections as a secondary traffic control device (other TCDs must be present at the intersection).
- Consider installing pedestrian refuge areas where there is a significant pedestrian-to-vehicle ratio and/or in areas where the traveled speeds are high.
- Install at least 15' length of raised median with pedestrian refuge and a marked crosswalk.

**Implementation Cost:** \$16,250 per location

One implementation site equals one crosswalk application. Determine specific implementation sites in the field using engineering judgment.

**Table 16. Recommended Implementation Sites for the Non-Intersection Pedestrian Package**

Route	Municipality	Route Total Pedestrian Crashes ('07-'11)	Section Begin Log Point	Section End Log Point	Section Crashes ('07-'11)	Potential Crosswalk Locations (Log-points; crashes)	Install HAWK Beacon?	Ownership Notes
Grand Blvd	St. Louis	66	0.0	7.3	35	LP 0.5-0.8; 9 crashes LP 4.8-5.0; 4 crashes	Yes – LP 0.6	
			Un-located crashes along this corridor		31			
Broadway	St. Louis	28	0.1	7.5	17	LP 1.3-1.5; 3 crashes		
			Un-located crashes along this corridor		11			
Gravois Ave	St. Louis	24	47.0	51.5	21	LP 47.0-47.3; 4 crashes	Yes - LP 49.4	MoDOT maintains EB

Route	Municipality	Route Total Pedestrian Crashes ('07-'11)	Section Begin Log Point	Section End Log Point	Section Crashes ('07-'11)	Potential Crosswalk Locations (Log-points; crashes)	Install HAWK Beacon?	Ownership Notes
						LP 49.3-49.5; 5 crashes		47.0-52.7
			Un-located crashes along this corridor		3			
Natural Bridge	St. Louis	24	6.5	9.2	21	LP 7.8-7.9; 5 crashes LP 8.0-8.3; 6 crashes	Yes – LP 8.0	MoDOT maintains SB 5.3-10.16
			Un-located crashes along this corridor		3			
Kingshighway	St. Louis	22	1.0	7.8	18	LP 2.4-2.7; 5 crashes	Yes – LP 2.6	
			Un-located crashes along this corridor		4			
Union Blvd	St. Louis	19	0.1	3.5	16	LP 1.8-2.0; 5 crashes LP 2.5-2.7; 3 crashes LP 2.7-3.0; 4 crashes	Yes – LP 1.9	
			Un-located crashes along this corridor		3			
Jefferson Ave	St. Louis	17	0.2	5.2	13	LP 4.5-4.6; 3 crashes		
			Un-located crashes along this corridor		4			
Page Blvd	St. Louis	16	9.8	12.9	14	LP 10.4-10.7; 4 crashes		MoDOT maintains EB 9.388-15.725
			Un-located crashes		2			

Route	Municipality	Route Total Pedestrian Crashes ('07-'11)	Section Begin Log Point	Section End Log Point	Section Crashes ('07-'11)	Potential Crosswalk Locations (Log-points; crashes)	Install HAWK Beacon?	Ownership Notes
			along this corridor					
Olive St	St. Louis	15	1.6	4.1	15	LP 2.0-2.3; 8 crashes	Yes – LP 2.1	
			Un-located crashes along this corridor		-			
Dr Martin Luther King Dr	St. Louis	11	10.2	12.5	11	LP 12.2-12.5; 3 crashes		MoDOT maintains EB 10.0-13.895
			Un-located crashes along this corridor		-			
Lindell Blvd	St. Louis	11	0.9	3.5	7	LP 1.9-2.2; 3 crashes LP 2.7-3.0; 3 crashes		
			Un-located crashes along this corridor		4	(17)		
Market St	St. Louis	8	0.9	1.2	4	LP 1.0-1.2; 3 crashes		
			Un-located crashes along this corridor		4			
Manchester	St. Louis	7	117.0	117.9	7	LP 117.7-119.7; 4 crashes		MoDOT maintains EB 114.387-121.394
			Un-located crashes along this corridor		2			

**Countermeasure: Signalized Intersection (Less than 45 mph) Treatments**

Install the following treatments:

- Add reflectorized back plates to each signal head or add reflectorized material to existing back plates.
- At high speed signalized intersections, install an advanced dilemma-zone detection system to reduce the number of drivers that may have difficulty deciding whether to stop during a yellow phase.
- Convert late-night flash to steady operation.

The following table lists suggested signalized intersections for implementation of the basic signal package.

**Implementation Cost:** \$30,000-45,000 per signalized intersection

One implementation site equals one signalized intersection. Determine specific implementation sites in the field using engineering judgment.

**Table 17. Recommended Implementation Sites for the Signalized Intersection Package (Less than 45 mph)**

Intersection Number	Municipality	Intersecting Streets		Total Intersection Crashes ('07-'11)	Ownership Notes
		Street 1	Street 2		
270688	St. Louis	Skinker Blvd	Forest Park Parkway	181	
261368	St. Louis	Kingshighway Blvd	Natural Bridge Ave	176	Intersection owned by St. Louis but surface maintained by MoDOT
272232	St. Louis	Kingshighway Blvd	Lindell Blvd	136	
260402	St. Louis	Union Blvd	Natural Bridge Ave	123	Intersection owned by St. Louis but surface maintained by MoDOT
258418	St. Louis	Natural Bridge Ave	Goodfellow Blvd	116	Intersection owned by St. Louis but surface maintained by MoDOT
268627	St. Louis	Skinker Blvd	Delmar Blvd	115	
278374	St. Louis	Kingshighway Blvd	Manchester Ave	103	Intersection owned by St. Louis but surface maintained by MoDOT
282824	St. Louis	Kingshighway	Vandeventer Ave	101	

Intersection Number	Municipality	Intersecting Streets		Total Intersection Crashes ('07-'11)	Ownership Notes
		Street 1	Street 2		
		Blvd			
267045	St. Louis	Kingshighway Blvd	Page Blvd	98	Intersection owned by St. Louis but surface maintained by MoDOT
281389	St. Louis	Hampton Ave	Wilson Ave	98	
257784	St. Louis	Union Blvd	Bircher Blvd	84	

**Countermeasure: Stop-Controlled Intersection (Less than 45 mph) Treatments**

Install the following treatments for the basic stop-controlled intersection package:

- STOP AHEAD pavement markings
- Reflective sign post sleeves
- LED-outlined STOP signs at select sites

**Implementation Cost:** \$4,500 per stop-controlled intersection plus \$14,000 for LED-outlined STOP signs at each approach

**Table 18. Recommended Implementation Sites for the Stop-Controlled Intersection Package (Less than 45 mph)**

Intersection Number	Municipality	Intersecting Streets		Total Intersection Crashes ('07-'11)	Add LED-Outlined Stop Signs?	Ownership Notes
		Street 1	Street 2			
288767	St. Louis	Gravois Ave	Potomac St	33	Yes	Intersection owned by St. Louis but surface maintained by MoDOT
247718	St. Louis	Halls Ferry Cir	Riverview Drive	31	Yes	Intersection owned by St. Louis but surface maintained by MoDOT
249634	St. Louis	Goodfellow Blvd	Switzer Ave	30	Yes	
274184	St. Louis	14 <sup>th</sup> St	Cole St	27	Yes	
289617	St. Louis	Gravois Ave	Bamberger	27	Yes	Intersection owned by St. Louis but surface maintained by MoDOT
247869	St. Louis	Halls Ferry Cir	Riverview Blvd	25	Yes	Intersection owned by St. Louis but surface maintained by MoDOT
288721	St. Louis	Grand Blvd	Potomac St	25	Yes	
274700	St. Louis	Boyle Ave	Duncan Ave	20	Yes	
266214	St. Louis	Salisbury St	Blair Ave	20		
267553	St. Louis	Page Blvd	Marcus Ave	20		Intersection owned by St. Louis but surface maintained

Intersection Number	Municipality	Intersecting Streets		Total Intersection Crashes ('07-'11)	Add LED-Outlined Stop Signs?	Ownership Notes
		Street 1	Street 2			
						by MoDOT
252372	St. Louis	Goodfellow Blvd	Emma Ave	19		
289403	St. Louis	Jefferson Ave	Potomac St	18		
265978	St. Louis	Union Blvd	Ridge Ave	17		
281393	St. Louis	Compton Ave	Lafayette Ave	17		
264224	St. Louis	Dr Martin Luther King Dr	Belt Ave	16		Intersection owned by St. Louis but surface maintained by MoDOT
285769	St. Louis	California Ave	Pestalozzi St	16		
249094	St. Louis	Broadway	Hornsby Ave	16		
261910	St. Louis	Grand Ave	Broadway	16		
259244	St. Louis	Goodfellow Blvd	Selber Ct	15		

**Countermeasure: Driver Licensure Enforcement**

Establish checkpoints to enforce licensure requirements to reduce the number of crashes involving unlicensed drivers.

The following table lists suggested routes for targeting driver licensing issues. Each entry shows the number of crashes occurring within that section of roadway and which section may benefit from extra enforcement and education.

**Implementation Cost:** \$102,000 per route (assumes \$50,000 lump sum education cost plus \$52,000 for one officer to work 10 hours per week for five years)

Determine specific implementation sites in the field using engineering judgment where road alignment is conducive to enforcement activities. Those driver-related crashes that were identified on the corridor but not specifically located along a route are included in the “route total crashes” groups; it is possible/likely that some un-located crashes occurred within the sections shown within each route.<sup>20</sup>

**Table 19. Recommended Implementation Sites for Young Driver Licensure Enforcement**

Route	Municipality	Route Total Unlicensed Driver Crashes ('07-'11)	Patrol Section				Details	Ownership Notes
			Section Begin Log Point	Section End Log Point	Section Crashes ('07-'11)	Potential Checkpoint Locations (Log-points; crashes)		
Grand Blvd	St. Louis	258	0.0	7.4	142	Entire corridor	Peak day and time are shown below	
			Un-located crashes along this corridor		116			
Kingshighway Blvd	St. Louis	228	0.0	8.6	176	LP 3.7-5.1; 36 crashes		
			Un-located crashes along this corridor		52			

<sup>20</sup> While the crashes are located to the corridor but not to a specific log mile range, it is likely that some of the un-located crashes can be attributed to the crash clusters shown in the log mile ranges in the lines above the un-located crashes. For this reason, the crash clusters should be regarded as the minimum number of crashes occurring between the specified log mile ranges.

Route	Municipality	Route Total Unlicensed Driver Crashes ('07-'11)	Patrol Section				Details	Ownership Notes
			Section Begin Log Point	Section End Log Point	Section Crashes ('07-'11)	Potential Checkpoint Locations (Log-points; crashes)		
Broadway	St. Louis	145	0.0	7.5	97	LP 0.0-3.3; 82 crashes	MON-SAT 3:00pm-5:59pm  SAT & SUN 12:00am-2:59am  MON-FRI 12:00pm-2:59pm  SUN 2:00pm-5:59pm  SAT 6:00pm-11:59pm	
			Un-located crashes along this corridor		48			
Gravois Ave	St. Louis	127	47.3	52.8	108	Entire corridor		MoDOT maintains EB 47.0-52.7
			Un-located crashes along this corridor		19			
Jefferson Ave	St. Louis	99	0.9	5.3	78	Entire corridor		
			Un-located crashes along this corridor		21			
Goodfellow Blvd	St. Louis	98	0.2	5.6	80	LP 2.3-3.6; 30 crashes		
			Un-located crashes along this corridor		18			
Natural Bridge Ave	St. Louis	95	4.3	9.4	92	LP 5.6-7.1; 31 crashes LP 8.5-9.2; 25 crashes	MoDOT maintains SB 5.3-10.16	
			Un-located crashes along this corridor		3			
West Florissant Ave	St. Louis	71	5.4	9.4	25	Entire corridor		
			Un-located crashes along this corridor		46			

Route	Municipality	Route Total Unlicensed Driver Crashes ('07-'11)	Patrol Section				Potential Checkpoint Locations (Log-points; crashes)	Details	Ownership Notes
			Section Begin Log Point	Section End Log Point	Section Crashes ('07-'11)				
Dr Martin Luther King Dr	St. Louis	70	10.0	14.8	66	LP 10.0-10.9; 22 crashes	MON-SAT 3:00pm-5:59pm  SAT & SUN 12:00am-2:59am  MON-FRI 12:00pm-2:59pm  SUN 2:00pm-5:59pm  SAT 6:00pm-11:59pm	MoDOT maintains EB 10.0-13.895	
			Un-located crashes along this corridor		4				
Union Blvd	St. Louis	62	0.0	4.0	52	LP 1.5-3.0; 35 crashes			
			Un-located crashes along this corridor		10				
Page Blvd	St. Louis	62	9.4	13.4	60	Entire corridor			MoDOT maintain EB 9.388-15.725
			Un-located crashes along this corridor		2				
Chippewa St	St. Louis	61	5.1	12.0	61	LP 9.1-12.0; 59 crashes			MoDOT maintains EB 9.11-12.0
			Un-located crashes along this corridor		-				
St. Louis Ave	St. Louis	55	0.0	4.3	38	Entire corridor			
			Un-located crashes along this corridor		17				
Delmar Blvd	St. Louis	46	0.5	6.9	41	LP 4.1-6.9; 32 crashes			
			Un-located crashes along this corridor		5				

Route	Municipality	Route Total Unlicensed Driver Crashes ('07-'11)	Patrol Section				Potential Checkpoint Locations (Log-points; crashes)	Details	Ownership Notes
			Section Begin Log Point	Section End Log Point	Section Crashes ('07-'11)				
Hampton Ave	St. Louis	41	0.1	4.9	32	LP 1.0-3.0; 21 crashes	MON-SAT 3:00pm-5:59pm  SAT & SUN 12:00am-2:59am		
			Un-located crashes along this corridor		9				
Arsenal St	St. Louis	38	0.1	5.5	14	Entire corridor	MON-FRI 12:00pm-2:59pm		
			Un-located crashes along this corridor		24				
Skinker Blvd	St. Louis	32	0.0	2.0	26	Entire corridor	SUN 2:00pm-5:59pm  SAT 6:00pm-11:59pm		
			Un-located crashes along this corridor		6				

## **Funding**

Each state has a highway safety improvement plan (HSIP) and receives funding from the Federal government to implement safety improvements. To obligate HSIP funds, a state must have a strategic highway safety plan (SHSP) that identifies and analyzes highway safety issues and opportunities towards reducing fatal and serious injury roadway crashes.

Safety improvements identified in this SHSP are eligible for HSIP funding according to MoDOT's funding process. The projects listed here will be eligible for federal funding once MoDOT establishes a process for funding which may require matching funds from local agencies.

## **Next Steps**

This local SHSP identifies implementable countermeasures related to engineering infrastructure, educational opportunities, and enforcement. The City of St. Louis safety stakeholders should collaboratively identify a few key strategies and safety implementations to move forward initially, in order to focus on their top priorities.

The action plan has a proposed 5-year implementation plan to allow agencies to make adjustments due to more precise information. The City will need to field verify roadway information, determine which countermeasures are necessary, and refine costs.

Appendix E lists resources that can be used to help with implementation of this SHSP.

## **Future Recommendations**

The City of St. Louis has an opportunity to improve data collection and assessment efforts as a means to enhance future transportation safety efforts. For example, by collecting traffic volume and speed data on a regular basis and inventorying roadway features, substantial efforts may be made in identifying and applying safety treatments to the roads, corridors, and intersections most in need of safety improvements.

The City should consider evaluating corridors with successive all-way stop intersections to determine if any stop conditions on the main corridor are unnecessary. Removing unnecessary stop conditions on major approaches may result in overall improved stop-compliance as well as improve traffic flow.

Finding opportunities for improving safety of highly vulnerable users may help reduce pedestrian and bicycle-related crashes. Specifically, these activities may include the following:

- Education related to responsibility in walking and biking (i.e., texting, alcohol, following rules of the road).
- Enforcement of jaywalking, biking rules, etc.
- Data collection and analysis related to pedestrian and bicycle-related crashes

Additionally, the City may consider performing road safety audits (RSA) for corridors that appeared on numerous countermeasure lists. An RSA is the formal safety performance examination of an existing or future road or intersection by an independent, multidisciplinary team. It qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users.<sup>21</sup> The Federal Highway Administration's Road Safety Audit website (<http://safety.fhwa.dot.gov/rsa/>) gives guidance as to how to conduct RSAs, who should be involved, and the potential benefits associated with RSAs.

Those corridors include the following:

- Kingshighway Blvd
- Grand Blvd
- Broadway
- West Florissant Ave
- Riverview Drive
- Goodfellow Blvd
- Natural Bridge Ave
- Gravois
- Dr. Martin Luther King Dr
- Union Blvd
- St. Louis Ave
- Jefferson Ave

Lastly, evaluation of safety treatments that are implemented could help determine which safety treatments are most cost-effective for the City's local road network. This information could help drive recommended implementations in the future.

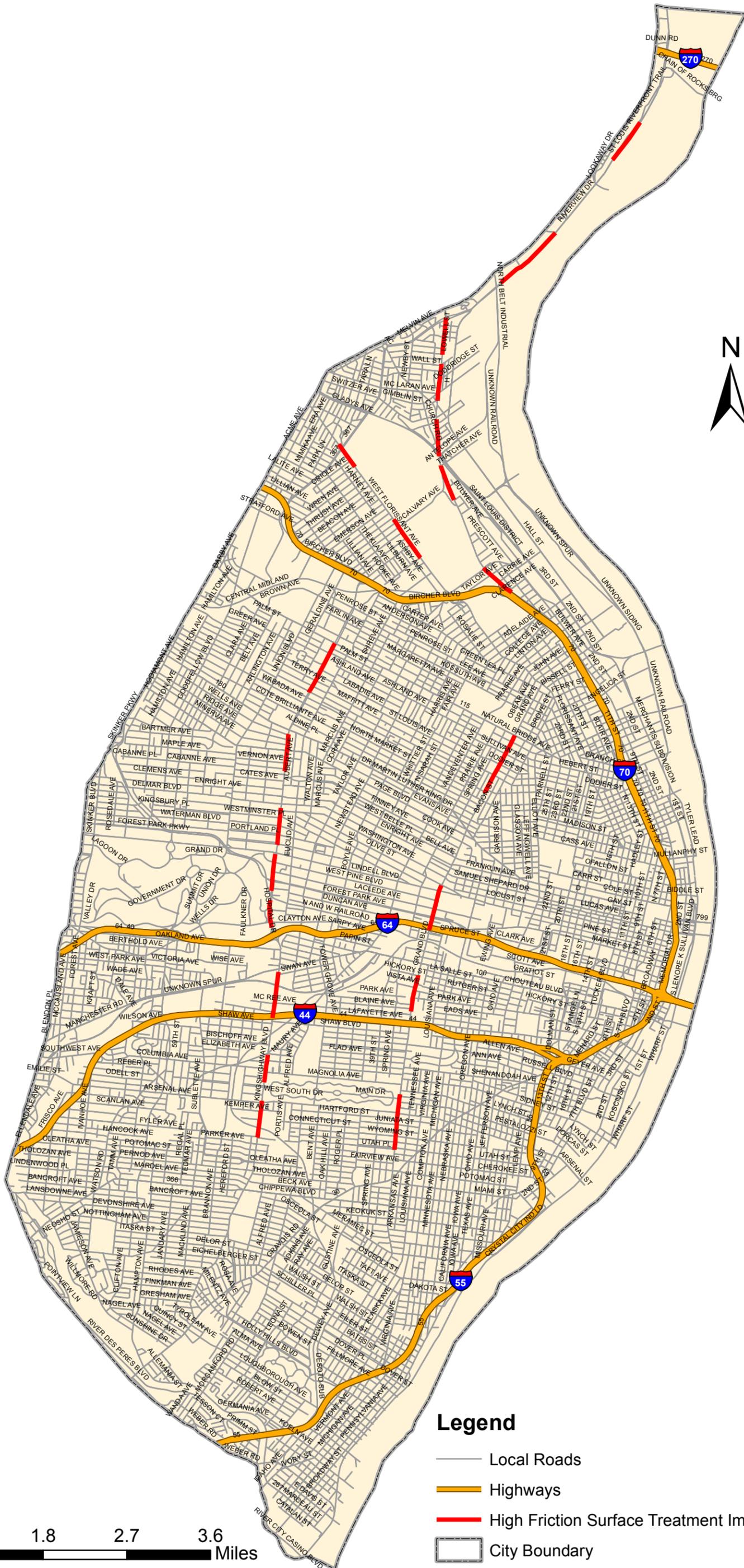
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<sup>21</sup> FHWA Road Safety Audit website. Accessed May 29, 2014.

## Appendix A: Emphasis Area and Implementation Site Maps

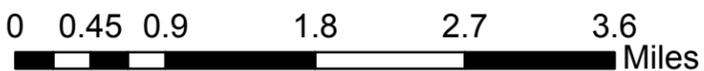
# St. Louis City

## Recommended High Friction Surface Treatment Implementation Sites



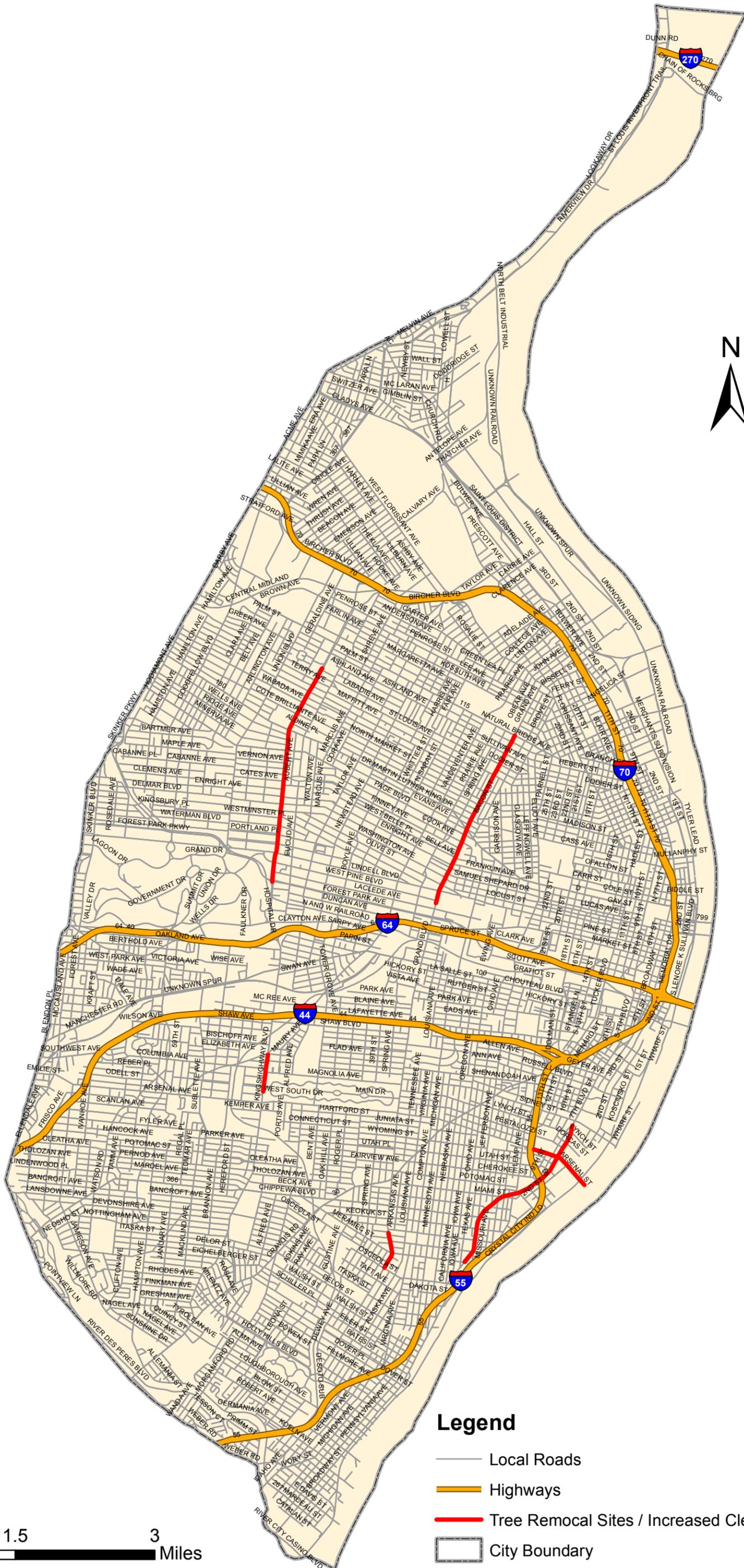
### Legend

- Local Roads
- Highways
- High Friction Surface Treatment Implementation Sites
- City Boundary



# St. Louis City

## Recommended Implementation Sites for Tree Removal and Increased Clear Zone



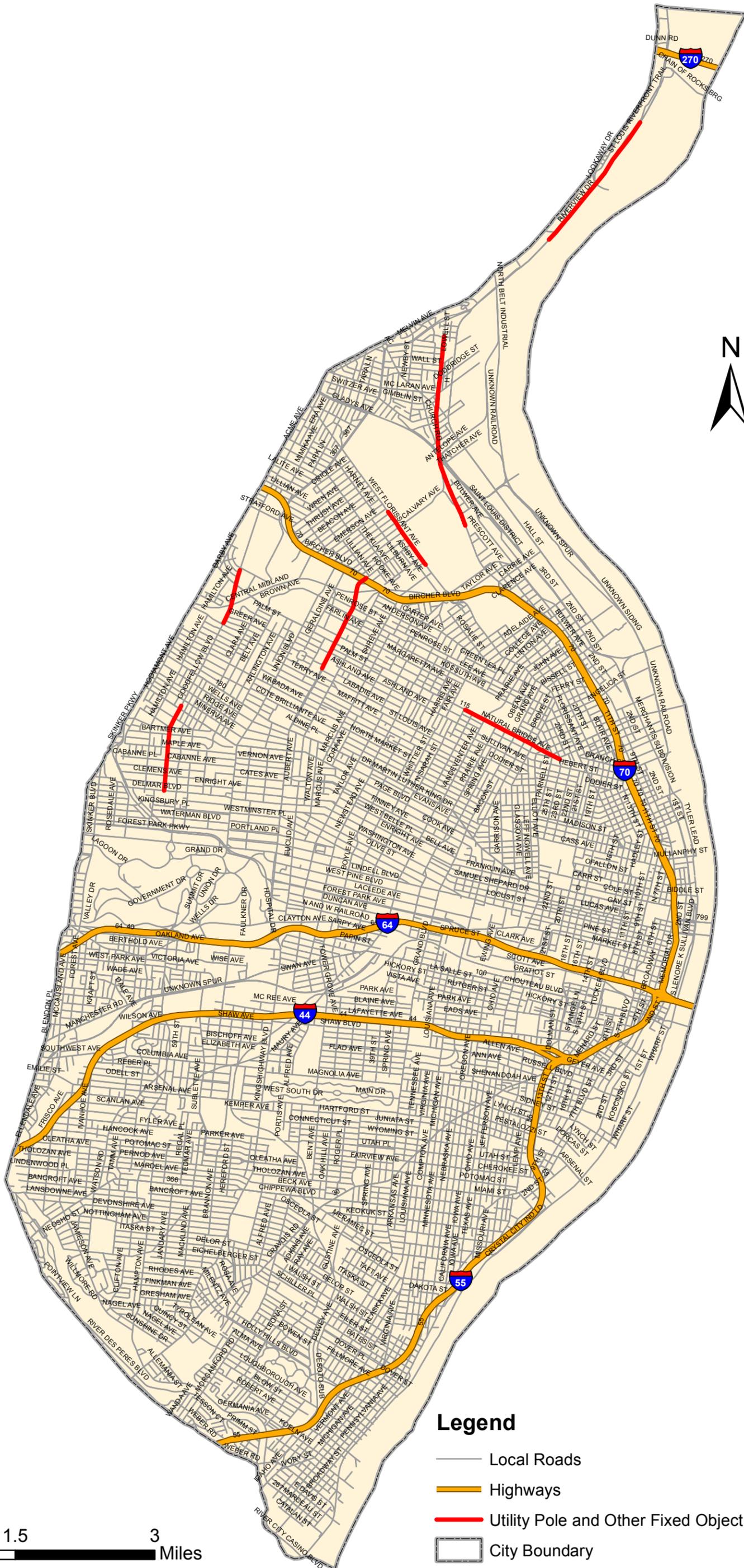
### Legend

- Local Roads
- Highways
- Tree Remocal Sites / Increased Clear Zone
- City Boundary

0 0.75 1.5 3 Miles

# St. Louis City

## Recommended Implementation Sites for Utility Pole and Other Fixed Object Removal



### Legend

- Local Roads
- Highways
- Utility Pole and Other Fixed Object Removal
- City Boundary



# St. Louis City

## Recommended Implementation Sites for Alcohol Enforcement



### Legend

- Local Roads
- Highways
- Implementation Sites for Alcohol Enforcement
- City Boundary

0 0.75 1.5 3 Miles

# St. Louis City

## Recommended Implementation Sites for Seatbelt Enforcement



### Legend

- Local Roads
- Highways
- Implementation Sites for Seatbelt Enforcement
- City Boundary

0 0.75 1.5 3 Miles

# St. Louis City

## Recommended Implementation Sites for Aggressive Driving Enforcement



### Legend

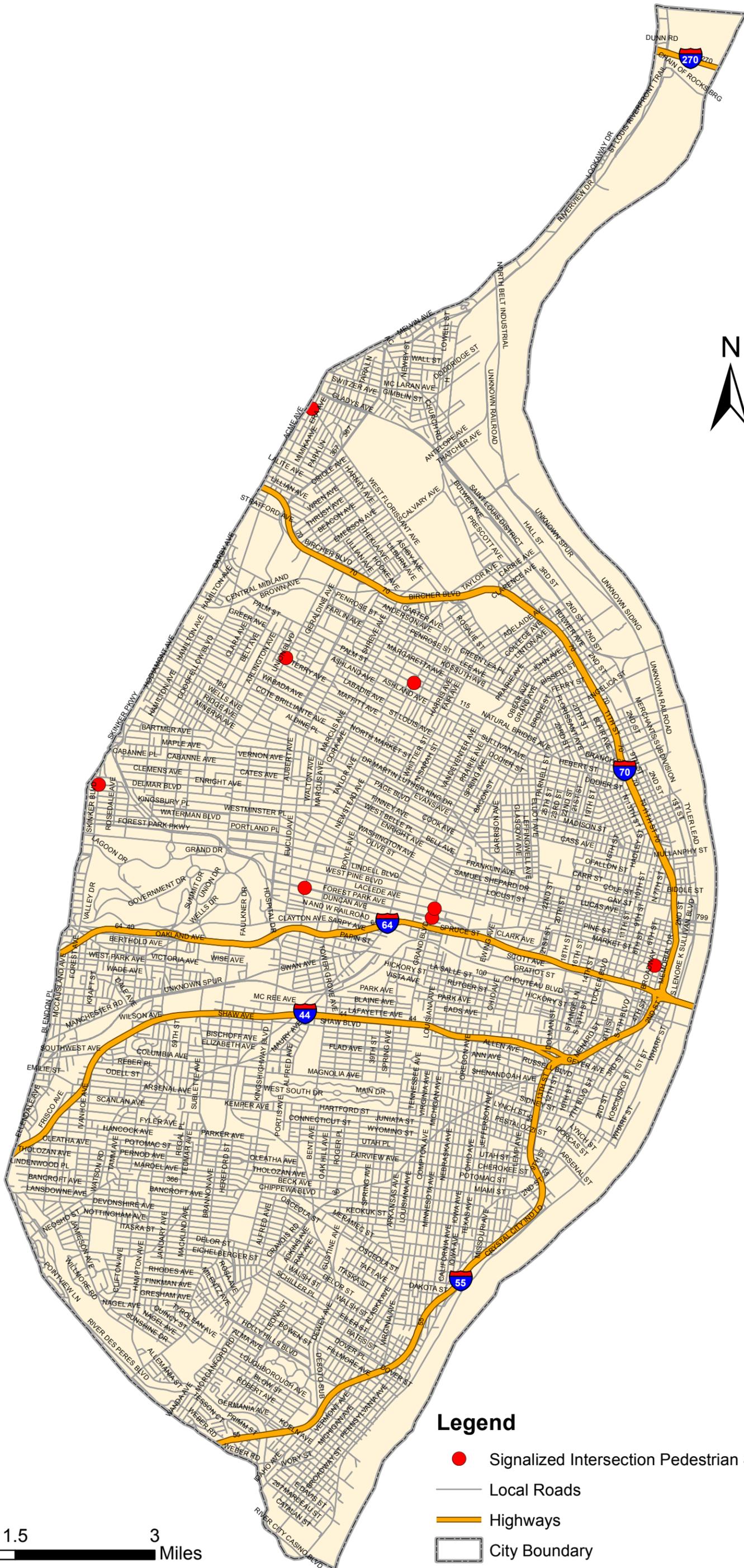
Sites for Aggressive Driving Enforcement  
Speed Enforcement Camera?

- No
- Yes
- Local Roads
- Highways
- City Boundary



# St. Louis City

## Signalized Intersection Pedestrian Safety Package



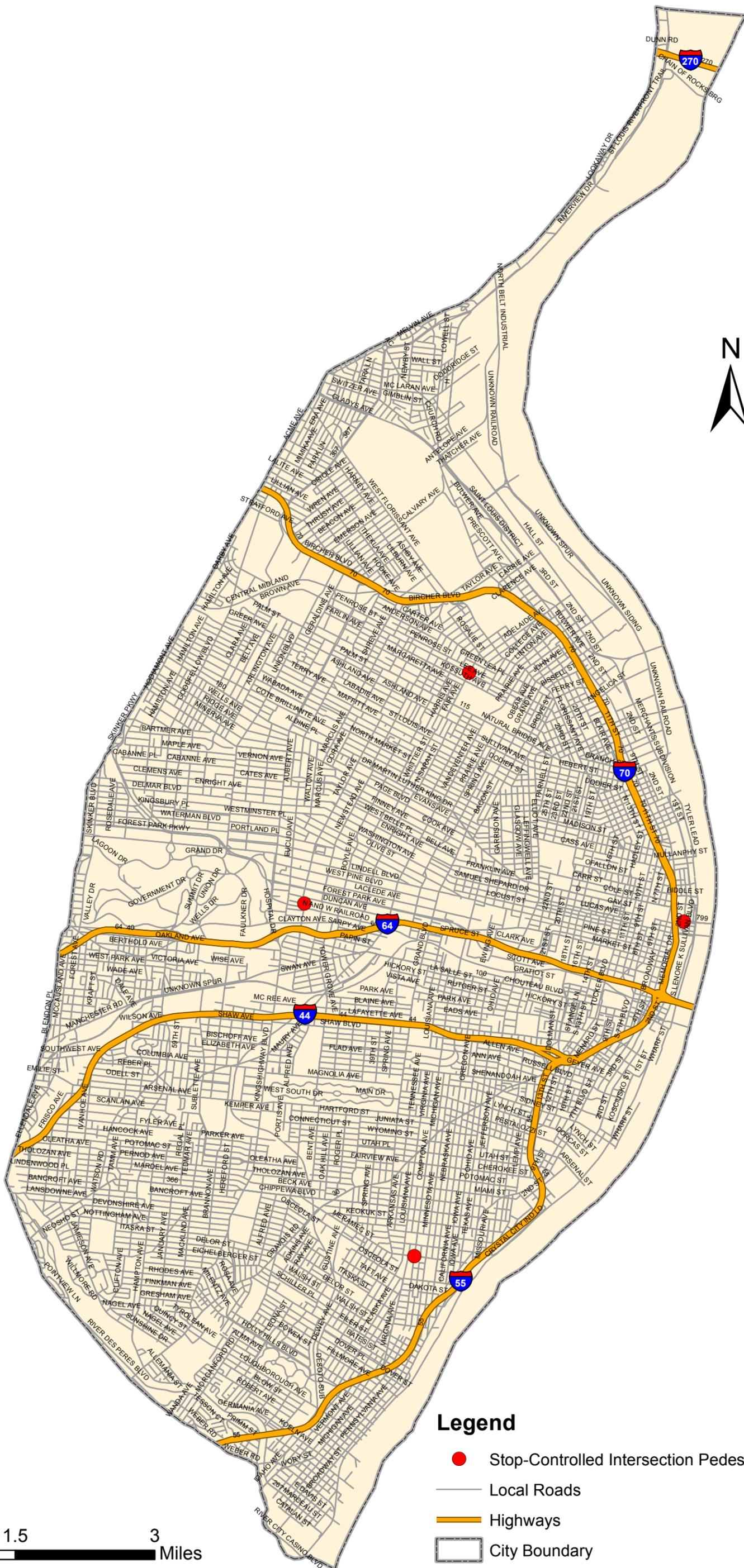
### Legend

- Signalized Intersection Pedestrian Safety Package
- Local Roads
- Highways
- City Boundary



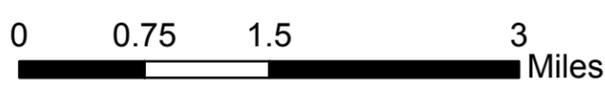
# St. Louis City

## Stop-Controlled Intersection Pedestrian Safety Package



### Legend

- Stop-Controlled Intersection Pedestrian Safety Package
- Local Roads
- Highways
- City Boundary



# St. Louis City

## Non-Intersection Pedestrian Safety Package



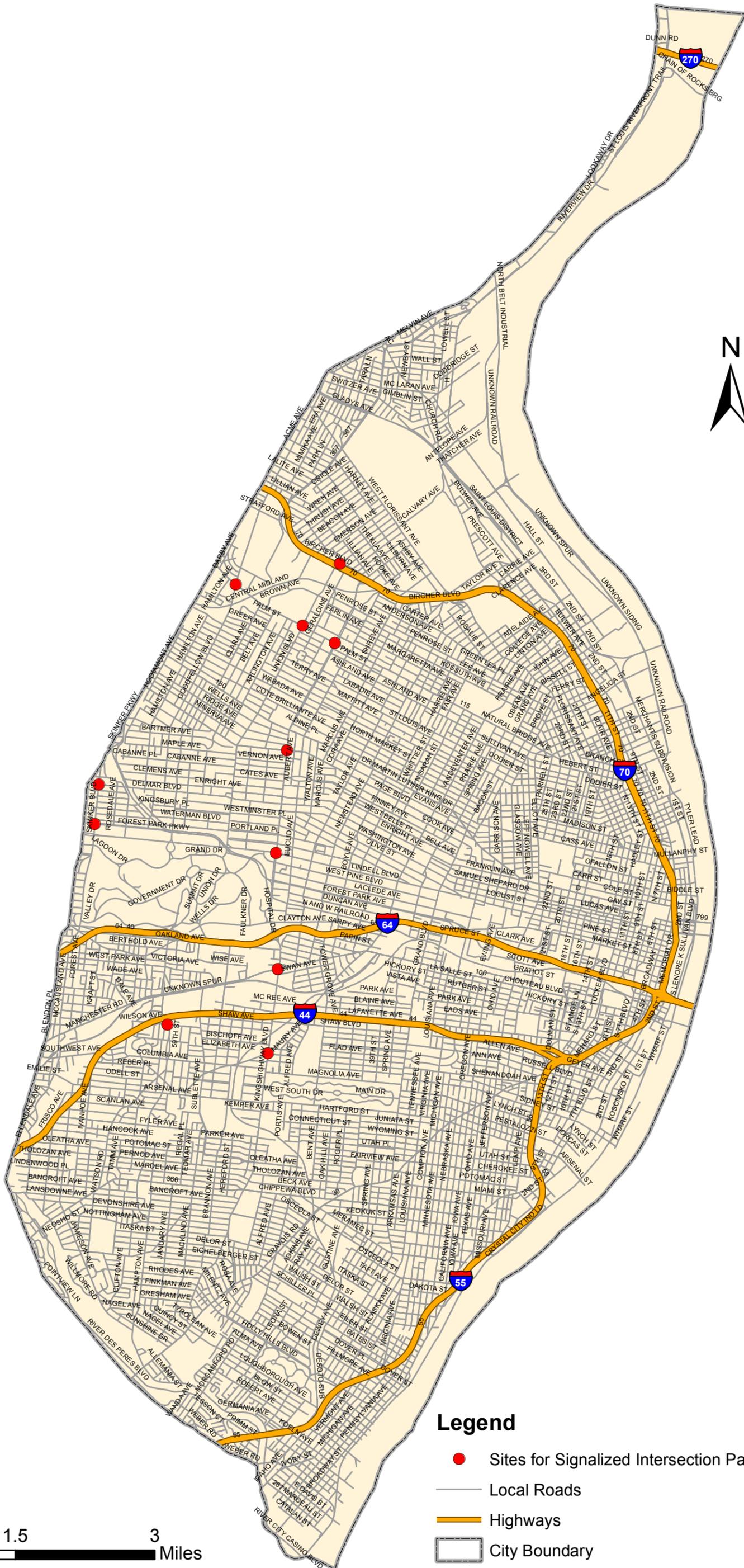
### Legend

-  Non-Intersection Pedestrian Safety Package
-  Local Roads
-  Highways
-  City Boundary

0 0.75 1.5 3 Miles

# St. Louis City

## Recommended Implementation Sites for the Signalized Intersection Package (Less than 45 mph)



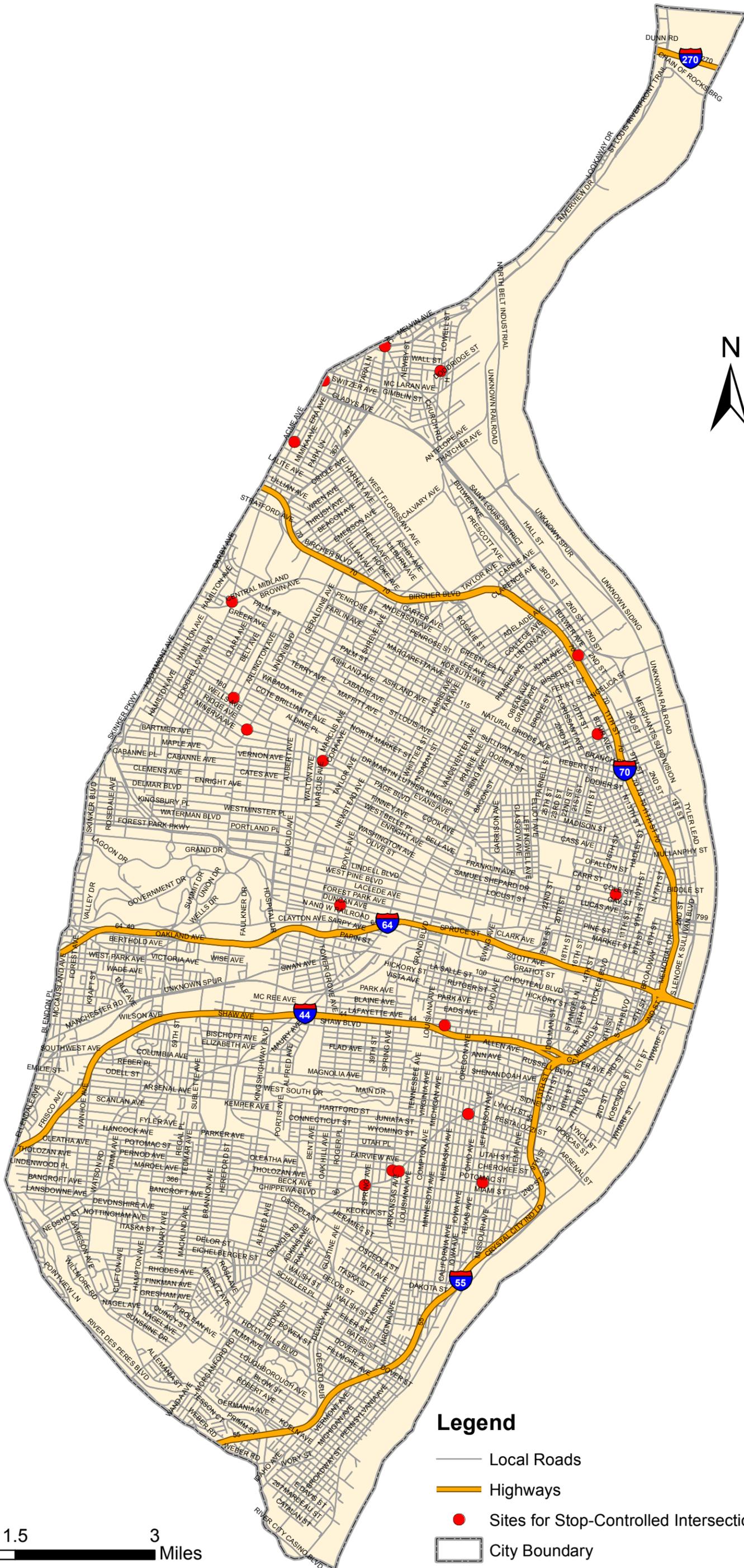
### Legend

- Sites for Signalized Intersection Package
- Local Roads
- Highways
- City Boundary

0 0.75 1.5 3 Miles

# St. Louis City

## Recommended Implementation Sites for the Stop-Controlled Intersection Package (Less than 45 mph)



### Legend

- Local Roads
- Highways
- Sites for Stop-Controlled Intersection Package
- City Boundary

0 0.75 1.5 3 Miles

# St. Louis City

## Recommended Implementation Sites for Young Driver Licensure Enforcement



### Legend

- Local Roads
- Highways
- Sites for Young Driver Licensure Enforcement
- City Boundary

## Appendix B: Literature Review

### 1. Task Overview

The Leidos Team reviewed applicable Missouri Department of Transportation (MoDOT), Missouri Coalition for Roadway Safety (MCRS), and local safety plans, programs, and policy information and safety-related research in order to apply this data directly to St. Louis City's Strategic Highway Safety Plan (SHSP). It is important to understand both the broad and specific safety practices of the State of Missouri, St. Louis City, and the safety partners within St. Louis City, and how state and local practices impact each other.

The information gathered in this task will be used to:

- Determine possible roadway fatality reduction strategies that are under-utilized.
- Recognize noteworthy strategies and the level of effort allocated to these strategies.
- Help assess possible roadway fatality reduction goals and performance measures.
- Assist in creating a balanced, comprehensive plan from the systemic implementation of enforcement, education, and enforcement strategies.
- Identify where additional data collection is necessary.
- Review the connection to Missouri's SHSP and to determine how recommended strategies could be funded through the Highway Safety Improvement Program.

### 2. Research Method

The Leidos Team gathered information through a combination of agency interviews and document reviews from agency websites. The Leidos Team conducted a literature review of relevant safety-related data (e.g., crash history, roadway inventory) and existing plans for St. Louis City, East West Gateway Council of Governments (EWG), and other relevant sources within the city. The resources consisted of documented enforcement efforts, marketing plans, major safety initiatives, program accomplishments, Capital Improvement Plans, and the long range transportation plans. A complete list of reviewed documents is found in Appendix A.

### 3. Research Findings

The Leidos Team coordinated with John Kohler, Planning and Programming Manager for the City of St. Louis; Todd Waelterman, Director of the St. Louis City Street Department; Deanna Venker, Area Engineer for St. Louis City with Missouri DOT; and Larry Grither and Anna Musial of EWG to determine the resources most applicable to the St. Louis City SHSP development process. The team reviewed each resource for content relevant to the following key areas:

- The "State of Safety" on the city's road network
- Safety partners and stakeholders
- Transportation safety policies, programs, and legislative platforms
- Goals for improving transportation safety
- Crash and roadway data sources for local roads

## Appendix B

- Emphasis areas, predominate crash types, and high-risk users on local roads within St. Louis City;
- The approved educational, enforcement, and engineering strategies identified by local agencies
- Performance measures and results from executing strategies

This report details the foundational results that will inform our data collection and analysis process, discussion topics for the stakeholder workshop, countermeasures selection, and the St. Louis City SHSP.

### 3.1. Safety Partners and Stakeholders

The Missouri Coalition for Roadway Safety is a dedicated group of safety advocates from across the state of Missouri that sets transportation safety goals and creates plans to achieve those goals. Missouri's *Blueprint to Save More Lives* is the most recent edition of the statewide transportation safety plan to reduce traffic fatalities to 700 or less by 2016. Detailed information about the *Blueprint's* safety goals, emphasis areas, and performance measures can be found in Sections 3.1, 3.3, and 3.5, respectively.

Within MoDOT, the St. Louis District includes Jefferson County, Franklin County, St. Charles County, St. Louis County, and St. Louis City. The partners and stakeholders presented in this section span not only the St. Louis District, but also include organizations and programs that serve the areas surrounding St. Louis in Illinois.

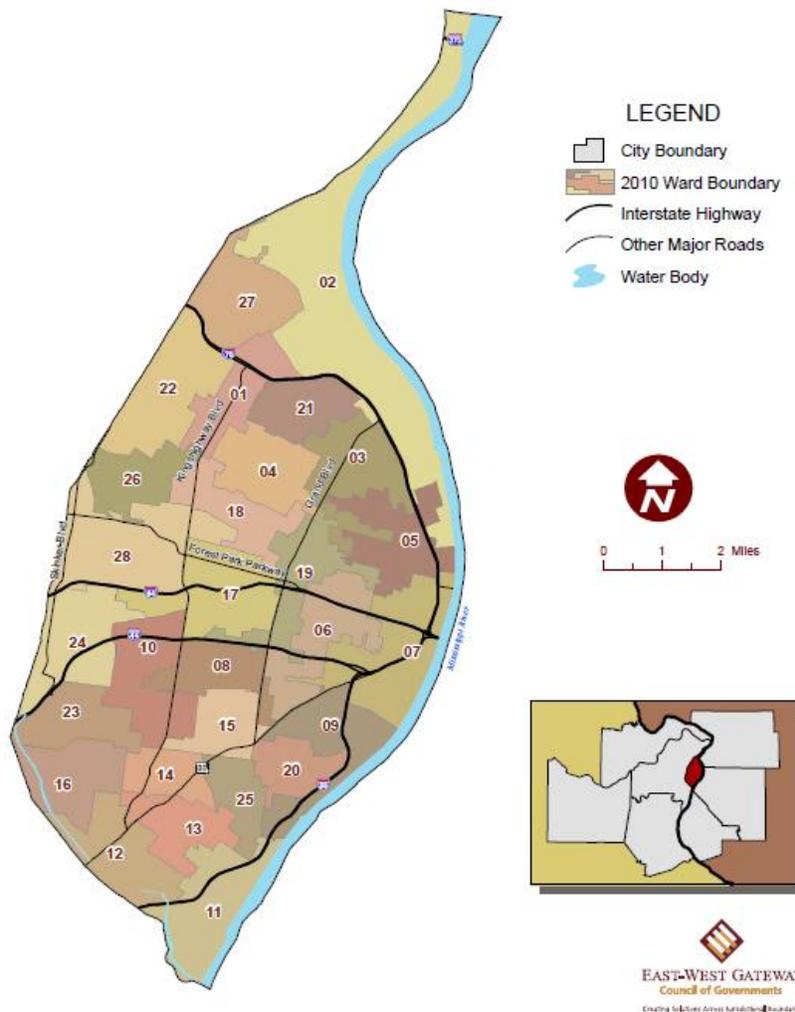
One of the primary organizations serving the St. Louis Metro area and surrounding Missouri and Illinois counties is the EWG. The EWG provides a forum for local governments of the bi-state St. Louis area to work together to solve problems that cross jurisdictional boundaries. The EWG's Board of Directors includes members from the following organizations (\* indicates a non-voting member):

- Franklin County (Missouri)
- Jefferson County (Missouri)
- St. Charles County (Missouri)
- St. Louis County (Missouri)
- City of St. Louis (Missouri)
- City of East St. Louis (Illinois)
- St. Clair County (Illinois)
- Monroe County (Illinois)
- Madison County (Illinois)
- St. Louis County Municipal League
- Southwestern Illinois Council of Mayors
- Southwestern Illinois Metropolitan and Regional Planning Commission
- Regional Citizens
- Illinois Department of Commerce and Economic Opportunity\*
- Illinois Department of Transportation\*
- Missouri Department of Transportation\*
- Missouri Office of Administration\*
- Metro\*

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The geographic region that EWG serves encompasses the City of St. Louis; Franklin, Jefferson, St. Charles, and St. Louis counties in Missouri; and Madison, Monroe, and St. Clair counties in Illinois. EWG provides the map of St. Louis shown in Figure 6.

Figure 6: Map of St. Louis City.<sup>22</sup>



the St. Louis Regional Traffic Safety Council contains members from more than 70 groups, representing corporations, businesses, and fire/police departments. It is one of the leading organizations for safety education and enforcement in the Midwest. To accomplish their mission of improving traffic safety, the Council created a program called “Operation Impact,” which focuses on providing additional police enforcement on the first Wednesday of the month to decrease speeding and intoxicated driving and to increase seat belt use. Its Board of Directors consists of members or staff from:

- Webster Groves Police Department
- St. Charles County Sheriff Department

<sup>22</sup> <http://www.ewgateway.org/pdffiles/library/pod/POD-Current.pdf>

## Appendix B

- Chesterfield Police Department
- Creve Coeur Police Department
- St. Louis County Police Department
- Missouri Department of Transportation
- Missouri State Highway Patrol
- Gateway Mothers Against Drunk Driving
- St. Charles County Prosecuting Attorney's Office/Victim Services
- Overland Police Department
- Private Consulting Firms

The St. Louis Area Regional Response System (STARRS), founded in 2003 and composed of local emergency response professionals and volunteers, coordinates the response for large-scale critical incidents in or around St. Louis.

The Gateway Affiliate of Mothers Against Drunk Driving (MADD) aims to improve transportation safety in the St. Louis area by working to prevent underage drinking and drunk driving. The Gateway MADD serves St. Louis City and the counties of St. Louis, St. Charles, Franklin, Jefferson, Lincoln, Ste. Genevieve, Warren, Pike, and St. Francois.

## Appendix B

### 3.2. Transportation Safety Policies, Programs, and Legislative Platforms

Within the boundaries of EWG's eight member counties, any transportation project that will be wholly or partially funded with federal dollars must be contained in plans that have been formally adopted by EWG Board of Directors. The EWG Council of Governments offers grants with an 80/20 funding split (80% federal funds and 20% local funds) for cities with populations greater than 7,000 that have MoDOT-approved plans for new streets.<sup>23</sup> MODOT functions as a quasi "construction manager" and oversees bidding and payments

EWG encourages a safe and efficient transportation system within their regional boundaries by, in part, performing actions in transportation safety-related areas such as transportation planning and community mobility.<sup>24</sup>

The St. Louis Region's long-range and short-range plans are contained in EWG's *Regional Transportation Plan 2040 (RTP 2040)*.<sup>25</sup> The *RTP 2040* revolves around ten transportation principles:

1. Preserve and maintain the existing system
2. Support public transportation
3. Support neighborhoods and communities throughout the region
4. Foster a vibrant downtown
5. Provide more transportation choices
6. Promote safety and security
7. Support a diverse economy throughout the region
8. Support quality job development
9. Strengthen intermodal connections
10. Link transportation planning to housing, environment, education, and energy

The St. Louis metropolitan region, shown in Figure 7, also has a schedule of planned transportation improvements as recorded in EWG's *Transportation Improvement Program (TIP)* for 2010-2014. This program includes 540 projects within Missouri and Illinois to improve the highway and public transit systems in the St. Louis area at a cost of approximately \$2.27 billion in federal, state, local and private funding. St. Louis City is slated to receive 24.2% of the Missouri-allocated funding due to MoDOT's programming of \$56 million federal and state funds for work in downtown St. Louis. Also, St. Louis City will receive 17.2% of the total federal funds in Missouri. The funding breakdown for St. Louis City is presented in Table 20.

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<sup>23</sup> <http://www.hillsboromo.org/Master%20Plan/Hillsboro%20Master%20Plan%20FINAL.pdf>

<sup>24</sup> <http://www.ewgateway.org/trans/transportation.htm>

<sup>25</sup> <http://www.ewgateway.org/pdf/files/library/trans/rtp2040/lrtp2040.pdf>

## Appendix B

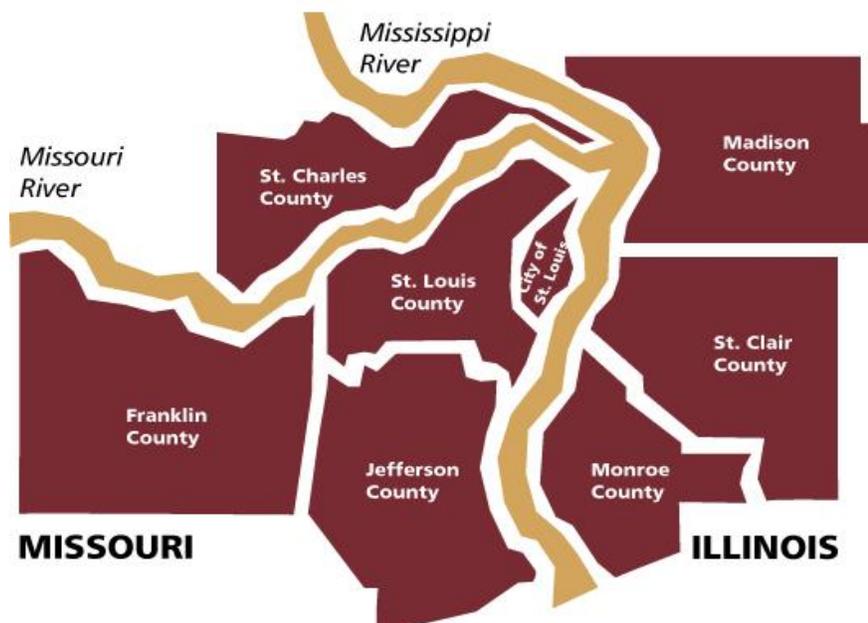


Figure 7: Counties included in the St. Louis Metropolitan Area's *Transportation Improvement Program 2010-2014*

Table 20: Funding breakdown for 2010-2014 TIP Program Projects in St. Louis City

	<b>Total Funding</b>
<b>Preservation</b>	\$80,224,000
<b>Capacity Adding</b>	\$77,650,000
<b>Operational and Safety</b>	\$1,764,078
<b>MetroLink Improvements/Expansion</b>	\$30,656,144
<b>Transit Vehicle/Equipment/Service</b>	\$3,817,448
<b>Other</b>	\$1,997,920
<b>Total</b>	<b>\$196,109,590</b>

EWG's *Coordinated Human Services Plan* was developed to help coordinate available funding and treatment options with multiple agencies. The purpose of the plan is to obtain eligibility to receive federal funding from Federal Transit Administration (FTA) programs and to address the needs of transportation users and providers, specifically including people with disabilities, older adults, and people with lower incomes. To receive federal funding for coordinated human services transportation projects, the principles must be consistent with the *RTP 2040*.

EWG's *Great Streets Initiative St. Louis* was developed to improve the overall planning and use of the streets in the St. Louis Region. The initiative focuses on making streets attractive and designing them for multi-modal use.

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EWG's *Regional Bicycling and Walking Transportation Plan* focuses on creating a complete, safe, and continuous transportation system that encourages bicycling and walking for people of all abilities. Specifically, *The Gateway Bike Plan* (in the Great Rivers Greenway District) has a mission to increase the number of people using bicycles for transportation while simultaneously reducing the number of bicycle crashes. The goals of *The Gateway Bike Plan* are presented in Section 3.1.

According to MoDOT, as of September 2013, 38 municipalities in Missouri have primary seat belt ordinances, even though the state does not have a primary seat belt law. Those municipalities and the effective date of the ordinances are listed in Table 21. St. Louis City does not have a primary seat belt law.

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Table 21: Primary Seat Belt Ordinances in Missouri Municipalities (as of September 2013)

	<b>Municipality</b>	<b>County</b>	<b>Effective Date</b>
1	St. Louis County	St. Louis	2007
2	Creve Coeur	St. Louis	2008
3	Ballwin	St. Louis	2008
4	Weston	Platte	2008
5	Merriam Woods	Taney	2009
6	St. John	St. Louis	2009
7	Nixa	Christian	2009
8	Willow Springs	Howell	2009
9	Chesterfield	St. Louis	2009
10	Herculaneum	Jefferson	2009
11	Willard	Green	2009
12	Milan	Sullivan	2009
13	Clarkson Valley	St. Louis	2010
14	New Melle	St. Charles	2010
15	Edmundson	St. Louis	2009
16	Charlack	St. Louis	2010
17	Calverton Park	St. Louis	2010
18	Webster Groves	St. Louis	2010
19	Brentwood	St. Louis	2000
20	Manchester	St. Louis	Apr 2011
21	Hazelwood	St. Louis	Jul 2011
22	Foristell	St. Charles/Warren	Sep 2011
23	Weldon Spring	St. Charles	Oct 2011
24	Cottleville	St. Charles	Aug 2011
25	Fredericktown	Madison	Jun 2012
26	Mountain View	Howell	Mar 2012
27	Hartville	Wright	Jun 2012
28	Kirkwood	St. Louis	Jul 2012
29	Bloomfield	Stoddard	Aug 2012
30	Essex	Stoddard	Aug 2012
31	Clever	Christian	Dec 2012
32	Bertrand	Mississippi	Mar 2013
33	Kansas City	Jackson	Apr 2013
34	Grandview	Jackson	Jul 2013
35	Independence	Jackson	Jul 2013
36	Dexter	Stoddard	Aug 2013
37	Puxico	Stoddard	Aug 2013
38	Sugar Creek	Jackson	Sep 2013

## Appendix B

### 3.1. Goals for Improving Transportation Safety

The vision for Missouri's State SHSP (*The Blueprint to Save More Lives*)<sup>26</sup> is "Show-Me Zero Roadway-Related Deaths," which is modeled after Sweden's "Vision Zero." The new goal of Missouri's SHSP is to reduce the number of transportation fatalities to 700 or fewer by 2016. *The Blueprint* establishes the "Necessary Nine" strategies to improve traffic safety:

1. Increase Safety Belt Use
2. Expand the Installation of Rumble Strips/Stripes
3. Increase Efforts to Reduce the Number of Substance-Impaired Vehicle Drivers and Motorcycle Operators
4. Improve Intersection Safety
5. Improve Curve Safety
6. Change Traffic Safety Culture
7. Improve Roadway Shoulders
8. Increase Enforcement Efforts
9. Expand and Improve Roadway Visibility

To assist in achieving the state-wide goals, Missouri was broken up into seven regional coalitions that are tasked with developing a strategic plan based on *The Blueprint* and the crash data within each region. St. Louis City is a part of the St. Louis Region.

The *Regional Transportation Plan 2040*, the St. Louis metro area's regional plan written by the EWG, identifies several strategies for addressing the current issues related to transportation safety. These strategies include:

- Give priority to preservation in the programming of suballocated federal funds to encourage consistent improvement of locally-owned roads and bridges
- Encourage state and local governments to coordinate on projects that rehabilitate and enhance arterial road systems
- Provide added value to projects that consider access improvements, place-making, and community impacts in the programming of suballocated federal funds
- Support projects that focus on pedestrian and bicycle facilities connections and "wayfinding" in the downtown area
- Work with partners to maintain systematic planning to improve regional transportation safety, focusing on engineering, education, enforcement and emergency response
- Continue to advance education programs through the Safety Initiative that works to change unsafe driving behavior
- Support a medical communications center to coordinate communications among hospitals, EMS, public health, and emergency managers
- Prepare a transportation evacuation plan for use in major natural or man-made incidents requiring the mass movement of people

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<sup>26</sup> <http://www.savemolives.com/documents/Blueprint-2012-2016.pdf>

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The City of St. Louis has a separate plan to become more sustainable, known as the *Sustainability Plan*.<sup>27</sup> Within this plan, four of the ten most mentioned sustainable city characteristics involve transportation activities such as safe streets and neighborhoods, good public transit, bike-friendly facilities, and walkable/pedestrian-friendly facilities. To address these characteristics and become a more sustainable city, the City of St. Louis' *Sustainability Plan* sets forth eight goals related to improving transportation, infrastructure, and facilities:

1. Facilitate Affordable, Efficient, Convenient, Accessible, Safe, and Healthy Transport of People and Goods
2. Promote Energy Efficiency and Utilize Cleaner Forms of Energy
3. Reduce Greenhouse Gas Emissions
4. Minimize Landfill-Bound Waste
5. Manage Stormwater and Wastewater to Protect and Enhance Property and Natural Systems
6. Provide the Best Quality Water from Sustainable Sources
7. Advance Health and Resource Efficiency in Buildings
8. Facilitate Access to Leading Edge Information Exchange Systems

The *Sustainability Plan* includes detailed information on the numerous strategies to accomplish each objective, the expected timeframe of the strategy, and the potential partners for each strategy.

Locally, *The Gateway Bike Plan* for the Great Rivers Greenway District (which envelopes St. Louis City, St. Louis County and St. Charles County) has set five goals to achieve the plan's vision and mission to accommodate all road users and promote increased bicycle use while also reducing bicycle crashes. These goals are as follows:

1. Provide a prioritized system of routes that are contiguous and connected to other on-road and off-road facilities.
2. Improve safety for all modes of transportation through careful design and implementation of bicycle facilities.
3. Improve safety for all modes of transportation through the implementation of educational and enforcement programs.
4. Expand the public's view that bicycles are a viable and acceptable mode of transportation through encouragement programs.
5. Increase the commitment from public officials to support and/or initiate public policy for bicycling at several levels of government: state, local, and regional.

The outcomes of *The Gateway Bike Plan* will be monitored through the number of bicyclists observed at specified locations and through the number of police-reported bicycle crashes in the region.

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<sup>27</sup> <http://stlouis-mo.gov/government/departments/planning/documents/upload/130219%20STL%20Sustainability%20Plan.pdf>

## Appendix B

### 3.2. Crash and Roadway Data Sources for Local Roads

The *Regional Transportation Plan's State of the System* estimates that motor vehicle crashes cost the St. Louis region approximately \$2.7 billion in 2009.<sup>28</sup> Table 22 contains the crash data for the St. Louis Region.<sup>29</sup>

**Table 22: St. Louis Region Crash Statistics (Regional Transportation Plan's State of the System)**

Year	All Crashes	Number of Fatal Crashes	Number of Fatalities	Number of Injury Crashes
2005	82,298	289	320	19,162
2006	79,142	269	296	17,837
2007	78,270	262	289	17,344
2008	74,384	238	265	16,339
2009	70,607	216	232	15,732

On the MoDOT website, users can download region-based tables with information on the number of fatal and serious injuries resulting from motor vehicle crashes on Missouri's highway system.<sup>30</sup> Tables 23 and 24 present the total number of fatalities and serious injuries that occurred on Missouri's highway system in St. Louis City.

**Table 23: Total Fatalities on Missouri's Highway System in St. Louis City**

Year	St. Louis	State	Percent (%)
2009	39	878	4.44 %
2010	44	821	5.36 %
2011	46	786	5.85 %
<b>Total/Average</b>	129	2,845	5.19 %

**Table 24: Total Serious Injuries on Missouri's Highway System St. Louis City**

Year	St. Louis	State	Percent (%)
2009	191	6,540	2.92 %
2010	202	6,096	3.31 %
2011	167	5,643	2.96 %
<b>Total/Average</b>	560	18,279	3.06 %

Other emphasis areas that can be selected within the webform include distraction-related crashes, relationship to a signalized intersection, type of vehicle/pedestrian killed (bicyclist, pedestrian, motorcyclist), or whether the crash occurred in a work zone. Table 25 presents the number of fatalities and serious injuries caused by common crash types.

<sup>28</sup> <http://www.ewgateway.org/pdf/files/Library/Trans/RTP2040/RTP-StateOfTheSystem-2011.pdf>

<sup>29</sup> <http://www.modot.org/safety/BlueprintCrashStatistics.htm>

<sup>30</sup> <http://www.modot.org/safety/BlueprintCrashStatistics.htm>

## Appendix B

Table 25: Crash Type and Number of Fatalities or Serious Injuries in St. Louis City

Fatalities Involving					Serious Injuries Involving				
Description	2009	2010	2011	Total	Description	2009	2010	2011	Total
Aggressive Driving-Speed Exceeded Limit	17	21	23	61	Inattention	46	65	50	161
Run-off-Road Crashes	15	17	26	58	Run-off-Road Crashes	56	46	56	158
Unrestrained Occupants Killed	15	15	17	47	Signalized Intersection Crashes	56	66	36	158
Pedestrians Killed	13	11	12	36	Inattentive Drivers	32	46	32	110
Unlicensed Drivers	7	13	16	36	Pedestrians Seriously Injured	38	35	35	108
Horizontal Curves	10	7	11	28	Young Drivers - 15-20	41	30	29	100
Inattention	8	9	6	23	Aggressive Driving-Speed Exceeded Limit	26	36	28	90
Young Drivers - 15-20	4	6	12	22	Unlicensed Drivers	30	37	21	88
Collision with Tree	3	5	13	21	Unsignalized Intersection Crashes	35	29	23	87
Signalized Intersection Crashes	9	7	4	20	Aggressive Driving-Too Fast for Conditions	29	29	26	84
Alcohol and - or Other Drugs	3	9	6	18	Motorcyclists Seriously Injured	27	13	16	56
Motorcyclists Killed	4	8	6	18	Horizontal Curves	19	19	16	54
Inattentive Drivers	4	6	5	15	Unrestrained Occupants Seriously Injured	16	16	22	54
Commercial Motor Vehicle	4	5	4	13	Head-On Crashes (Non-Interstates)	14	8	13	35
Aggressive Driving-Too Fast for Conditions	6	1	4	11	Alcohol and - or Other Drugs	8	10	12	30
Unsignalized Intersection Crashes	1	6	2	9	Commercial Motor Vehicle	14	9	4	27
Older Drivers -65-75	2	2	2	6	Older Drivers -65-75	10	10	5	25
Head-On Crashes (Non-Interstates)	1	1	2	4	Aggressive Driving-Following Too Close	7	9	8	24
Collision with Utility Pole	0	1	2	3	Collision with Tree	9	10	5	24
Head-On Crashes (Interstates)	0	2	0	2	Bicyclists Seriously Injured	7	9	4	20
Older Drivers 76 or Older	1	0	1	2	Collision with Utility Pole	5	4	4	13
Bicyclists Killed	0	1	0	1	Older Drivers 76 or Older	5	3	3	11
Aggressive Driving-Following Too Close	0	0	0	0	School Buses/Bus Signal	1	1	1	3
School Buses/Bus Signal	0	0	0	0	Head-On Crashes (Interstates)	0	2	0	2
Work Zones	0	0	0	0	Work Zones	1	0	1	2

To help manage the growing number of roads in Missouri, the EWG has recently redefined their Roadway Functional Classification System. Table 26 presents the new re-stratified classification system.<sup>31</sup>

<sup>31</sup> <http://www.ewgateway.org/trans/funcclass/funcclass.htm>

## Appendix B

Table 26: New Functional Classes (EWG)

Area Type		Roadway Functional Classes		
Urban	Arterial	Principal	Interstate	
			Freeway/Expressway	
			Other Principal	
				Minor
	Collector			
	Local			
Rural	Arterial	Principal	Interstate	
			Freeway/Expressway	
			Other Principal	
				Minor
	Collector	Major		
		Minor		
Local				

Figure 8 illustrates the results of the new functional classification system in St. Louis City. Examples of the classification are as follows:

- Principal Arterial: Route 30, Route D, Route H, South Kings Highway Blvd.
- Minor Arterial: Dr. Martin Luther King Dr., Goodfellow Blvd., Washington Ave. Memorial Dr.
- Collector: Pine St., 9<sup>th</sup> St., Gustine Ave., Southwest Ave., N. Taylor Ave.
- Local Road: Locust St., Samuel Shepard Dr., W. Pine Blvd.

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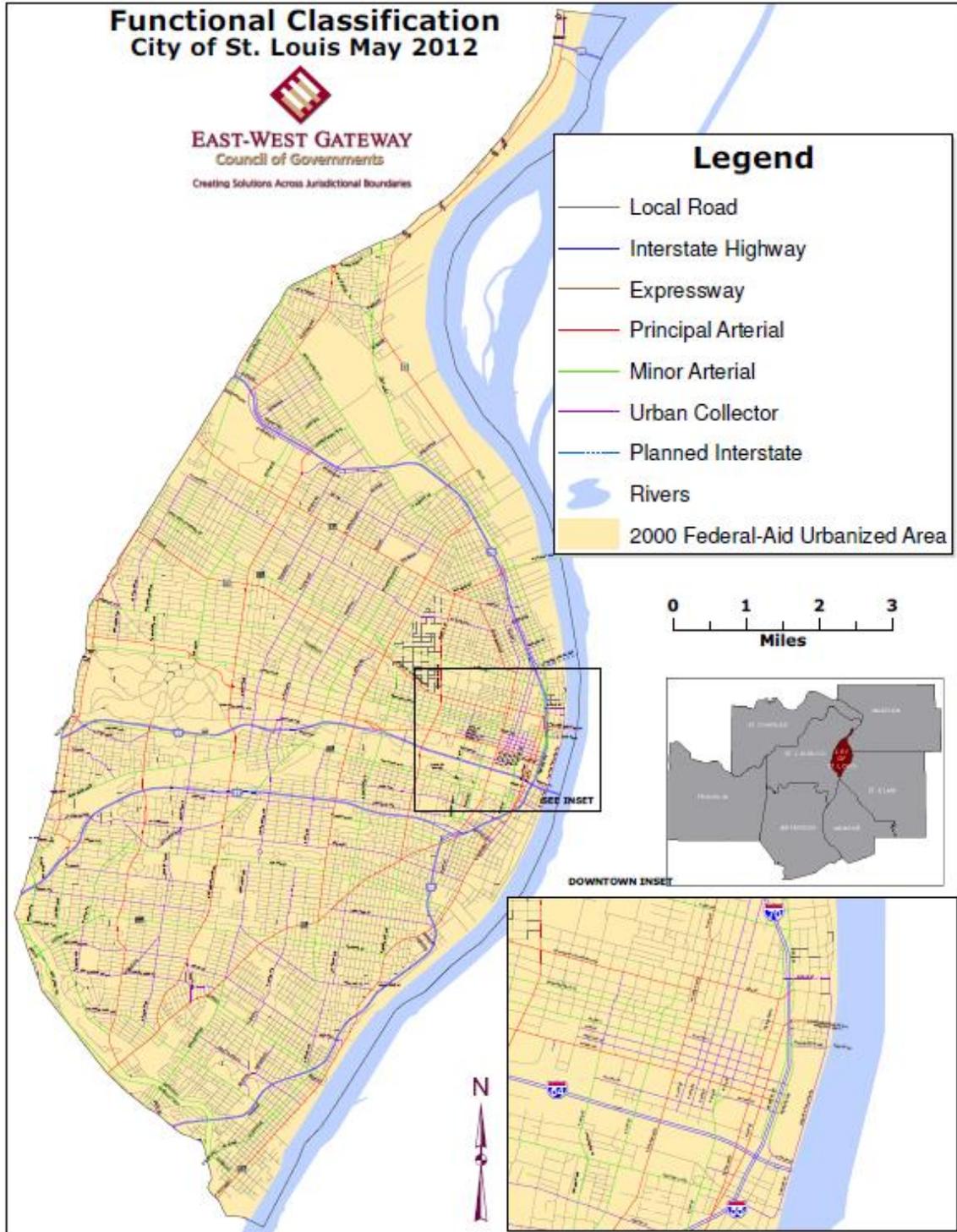


Figure 8: Map showing the functional classification of roadways throughout St. Louis City<sup>32</sup>

<sup>32</sup> <http://www.ewgateway.org/trans/funcclass/StLCityMap/StLCityMap-2012.pdf>

## Appendix B

### 3.3. Emphasis Areas, Predominate Crash Types, and High-Risk Users on Local Roads within St. Louis City

Missouri's SHSP (*Missouri's Blueprint to Save More Lives*)<sup>33</sup> provides six emphasis areas to focus on between 2012 and 2016. The emphasis areas include:

1. Serious Crash Types
2. High-Risk Drivers
3. Special Vehicles
4. Vulnerable Roadway Users
5. Special Roadway Environments
6. Data and Data System Improvements

Data from the Missouri Coalition for Roadway Safety's Arrive Alive website indicates that impaired driving, speeding, and distracted driving are the leading causes of transportation crashes in Missouri.<sup>34</sup>

Emphasis areas specific to St. Louis City, as indicated from MoDOT safety reports, can be found in Table 25.

### 3.4. Approved Educational, Enforcement, and Engineering Strategies Identified by Local Agencies

The Safe Kids St. Louis Coalition (serving St. Louis City, St. Louis County, Jefferson County, Franklin County, and Washington County) provides tips to parents, including how to install and check car seat restraints and reminders to not leave children in unattended vehicles.<sup>35</sup>

Another organization is the non-profit, non-governmental, public service organization called the Safety Council of Greater St. Louis.<sup>36</sup> Since 1916, this council has worked to improve the transportation safety needs of the Greater St. Louis Metropolitan area by offering driver improvement programs and programs on overcoming drug or alcohol abuse. Members of the Council participate in various divisions including highway/traffic safety and motor transportation.

The St. Louis Public Safety Department provides links to download public safety related news and documents such as *Bicycle Rider Safety Tips* and *School Bus Safety Information*.<sup>37</sup> It also provides direct links to the St. Louis Fire Department<sup>38</sup> and Police Department.<sup>39</sup>

Local transportation agencies can reference the *Traffic Practices: A Guidebook for City and County Agencies* to access approved engineering strategies for improving rural and urban transportation safety.<sup>40</sup> The reference guide contains information on types of treatments that address five of the "Necessary Nine" safety strategies listed in the *Blueprint to Save More Lives*:

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<sup>33</sup> <http://www.savemolives.com/documents/Blueprint-2012-2016.pdf>

<sup>34</sup> <http://www.savemolives.com/danger-zone.html>

<sup>35</sup> <http://www.safekidsstl.com/>

<sup>36</sup> <http://www.stlsafety.org/>

<sup>37</sup> <http://stlouis-mo.gov/government/departments/public-safety/index.cfm>

<sup>38</sup> <http://stlouis-mo.gov/government/departments/public-safety/fire/>

<sup>39</sup> <http://stlouis-mo.gov/government/departments/public-safety/police/index.cfm>

<sup>40</sup> <http://contribute.modot.mo.gov/safety/documents/TrafficPracticesaGuidebookforcitycountyagencies.pdf>

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1. Expand the Installation Rumble Strips/Stripes
2. Expand and Improve Roadway Visibility
3. Improve Roadway Shoulders
4. Improve Curve Safety
5. Improve Intersection Safety

### 3.5. Performance Measures and Results from Executing Strategies

Each edition of the Missouri SHSP, *The Blueprint*, has seen successful implementation of the recommended countermeasures and Missouri has been able to meet the given performance goals. Since 2005, the total number of motor vehicle fatalities per year has fallen from 1,257 to 786 in 2011. *The Blueprint's* strategies were used to reduce the fatalities in specific crash areas (serious crash types, unrestrained occupants, aggressive drivers, horizontal curves, substance-impaired drivers, distracted drivers, young drivers, and intersection crashes).

## Appendix B

### 4. Literature Resources

This appendix is a list of the resources identified and reviewed by the research team to identify relevant safety-related data (e.g., crash history, roadway inventory) and existing plans for St. Louis City and local agencies within the county.

Ref #	Resource	Year	Author(s)
1	East West Gateway Public Officials Directory 2013	2013	East West Gateway
2	Travel Safe Program	n/a	n/a
3	St. Louis City Functional Classification Map	2012	East West Gateway
4	2040 Transportation Plan	2011	East West Gateway
5	RTP 2040 State of the System	2011	East West Gateway
6	Gateway Mothers Against Drunk Driving website	n/a	MADD
7	Missouri DOT's Blueprint to Save More Lives 2012-2016	2012	Missouri DOT
8	Safe Kids St. Louis website	n/a	Safe Kids St. Louis
9	Safety Council of Greater St. Louis website	n/a	Safety Council of Greater St. Louis
10	St. Louis Regional Traffic Safety Council website	n/a	St. Louis Regional Traffic Safety Council
11	St. Louis Area Regional Response System website	n/a	St. Louis Area Regional Response System
12	Traffic Practices: A guidebook for city and county agencies	Unknown	Missouri DOT, Missouri-LTAP, Missouri Coalition for Roadway Safety
13	Community Emergency Response Teams (CERT)	n/a	St. Louis Area Regional Response System
14	Sustainability Plan	2012	East West Gateway
15	Coordinated Human Services Plan St. Louis MPO	2012	East West Gateway
16	Gateway Bike Plan	Unknown	Great Rivers Greenway (Susan Trautman)
17	St. Louis MPO Area Transportation Improvement Plan	2010	East West Gateway

## Appendix C: List of Data/Countermeasure Workshop Attendees on March 27, 2014

John Kohler	City of St. Louis – BPS	<a href="mailto:kohlerj@stlouis-mo.gov">kohlerj@stlouis-mo.gov</a>
Rich Bradley	City of St. Louis – BPS	<a href="mailto:bradleyr@stlouis-mo.gov">bradleyr@stlouis-mo.gov</a>
Stephen Gregali	City of St. Louis – Office of the Mayor	<a href="mailto:gregalis@stlouis-mo.gov">gregalis@stlouis-mo.gov</a>
Major Rocky Jones	St. Louis Metro Police Department	<a href="mailto:rdjones@slmpd.org">rdjones@slmpd.org</a>
Lt. Carlos Ross	St. Louis Metro Police Department	<a href="mailto:caross@slmpd.org">caross@slmpd.org</a>
Steve Runde	City of St. Louis	<a href="mailto:rundes@stlouis-mo.gov">rundes@stlouis-mo.gov</a>
Todd Waelterman	City of St. Louis	<a href="mailto:Waeltermant@stlouis-mo.gov">Waeltermant@stlouis-mo.gov</a>
Natalie Siebert	Metro	<a href="mailto:Nsiebert@metrostlouis.org">Nsiebert@metrostlouis.org</a>
Oscar Figueroa	Metro	<a href="mailto:ofigueroa@metrostlouis.org">ofigueroa@metrostlouis.org</a>
Meredith Klekotka	Trailnet	<a href="mailto:Meredith@trailnet.org">Meredith@trailnet.org</a>
Rachael Pawlak	EWG	<a href="mailto:Rachael.pawlak@ewgateway.org">Rachael.pawlak@ewgateway.org</a>
Anna Musial	EWG	<a href="mailto:Anna.musial@ewgateway.org">Anna.musial@ewgateway.org</a>
Larry Grither	EWG	<a href="mailto:Larry.grither@ewgateway.org">Larry.grither@ewgateway.org</a>
Deanna Venker	MoDOT	<a href="mailto:Deanna.venker@modot.mo.gov">Deanna.venker@modot.mo.gov</a>
Teresa Krenning	MoDOT	<a href="mailto:Teresa.krenning@modot.mo.gov">Teresa.krenning@modot.mo.gov</a>
John Miller	MoDOT	<a href="mailto:John.P.Miller@modot.mo.gov">John.P.Miller@modot.mo.gov</a>
Shawn Leight	CBB	<a href="mailto:sleight@cbbtraffic.com">sleight@cbbtraffic.com</a>
Matt Myers	Leidos	<a href="mailto:matthew.c.myers@leidos.com">matthew.c.myers@leidos.com</a>
Jennifer Atkinson	Leidos	<a href="mailto:jennifer.e.atkinson@leidos.com">jennifer.e.atkinson@leidos.com</a>

## Appendix D: Data Analysis and Strategy Matrix

### City of St. Louis Data Package and Strategy Matrix



#### Data Overview

The set of crashes included in this analysis is all crashes occurring on local roads in the City of St. Louis, MO between 2007 and 2011. The preliminary overview tables present information about State and Local crashes in the City and other counties to show what proportion of the problem occurs on just local roads within the City of St. Louis.

**Table 27: Total Crashes and Fatalities in the Top-14 Missouri Counties (State and Local)**

County	Crashes		Fatalities	
	Total	%	Total	%
JACKSON	110,428	20.4%	378	19.5%
ST. LOUIS	139,807	25.8%	264	13.6%
<b>ST. LOUIS CITY</b>	<b>75,618</b>	<b>14.0%</b>	<b>231</b>	<b>11.9%</b>
JEFFERSON	23,417	4.3%	164	8.4%
GREENE	41,269	7.6%	145	7.5%
ST. CHARLES	39,471	7.3%	129	6.6%
FRANKLIN	13,625	2.5%	120	6.2%
CLAY	25,740	4.7%	115	5.9%
NEWTON	5,800	1.1%	89	4.6%
BOONE	16,269	3.0%	82	4.2%
JASPER	15,616	2.9%	79	4.1%
PLATTE	11,962	2.2%	62	3.2%
COLE	8,937	1.6%	45	2.3%
BUCHANAN	14,044	2.6%	40	2.1%
<b>Top-14 Total</b>	<b>542,003</b>	<b>100.0%</b>	<b>1,943</b>	<b>100.0%</b>

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**Table 28: Total City of St. Louis Crashes and Fatalities by Locality**

MODOT_COUNTY_NM	StateLocal	Crashes		Injuries		Fatalities	
		Total	%	Total	%	Total	%
ST. LOUIS CITY	Local	63,265	83.7%	21,512	80.7%	166	71.9%
ST. LOUIS CITY	State	12,353	16.3%	5,147	19.3%	65	28.1%
ST. LOUIS CITY	Unknown	-	0.0%	-	0.0%	-	0.0%
<b>City of St. Louis Total</b>		<b>75,618</b>	<b>100.0%</b>	<b>26,659</b>	<b>100.0%</b>	<b>231</b>	<b>100.0%</b>

**Table 29: Total Local City of St. Louis Crashes and Fatalities by Year**

MODOT_COUNTY_NM	StateLocal	Totals	Year					Total
			2007	2008	2009	2010	2011	
ST. LOUIS CITY	Local	Crashes	13,385	12,829	13,169	12,380	11,502	<b>63,265</b>
		Fatalities	44	32	27	29	34	<b>166</b>
		Fatalities per 100 crashes	0.33	0.25	0.21	0.23	0.30	<b>0.26</b>

**Table 30: Total Local City of St. Louis Crashes and Fatalities by Highway Classification**

Highway Classification	Crashes		Injuries		Fatalities	
	Total	%	Total	%	Total	%
COUNTY ROAD	4,903	53.7%	2,033	67.7%	32	84.2%
CITY STREET	4,230	46.3%	972	32.3%	6	15.8%
<b>City of St. Louis Total</b>	<b>9,133</b>	<b>100.0%</b>	<b>3,005</b>	<b>100.0%</b>	<b>38</b>	<b>100.0%</b>

**Table 31: Local Crashes by Highway Classification and Year**

Designation	Totals	Year					Total
		2007	2008	2009	2010	2011	
City Street	Crashes	7,780	6,712	7,011	6,969	6,562	<b>35,034</b>
	Fatalities	38	25	20	23	27	<b>133</b>
	Fatalities per 100 crashes	0.49	0.37	0.29	0.33	0.41	<b>0.38</b>
County Road	Crashes	1	-	1	2	3	<b>7</b>
	Fatalities	-	-	-	-	-	-
	Fatalities per 100 crashes	-	#DIV/0!	-	-	-	-
State Lettered Route	Crashes	332	349	381	350	308	<b>1,720</b>
	Fatalities	2	2	4	2	3	<b>13</b>
	Fatalities per 100 crashes	0.60	0.57	1.05	0.57	0.97	<b>0.76</b>
State Numbered Route	Crashes	1,069	931	1,162	1,093	1,076	<b>5,331</b>
	Fatalities	4	5	3	4	4	<b>20</b>
	Fatalities per 100 crashes	0.37	0.54	0.26	0.37	0.37	<b>0.38</b>
Unknown	Crashes	4,203	4,837	4,614	3,966	3,553	<b>21,173</b>
	Fatalities	-	-	-	-	-	-
	Fatalities per 100 crashes	-	-	-	-	-	-

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Table 32: Injury Severity of Persons Involved in Local Crashes by Year

HIGHWAY_CLASS	Person Injury Level	Year					Total
		2007	2008	2009	2010	2011	
City Street	<null>	20,071	17,664	18,223	18,190	17,123	91,271
	FATAL	38	25	20	23	27	133
	SERIOUS INJURY	146	141	125	121	92	625
	EVIDENT INJURY (NOT DISABLING)	788	631	670	684	681	3,454
	PROBABLY INJURY (NOT APPARENT)	1,623	1,343	1,587	1,761	1,491	7,805
	NONE APPARENT	12,566	11,514	12,459	12,304	11,322	60,165
	UNKNOWN	190	180	162	139	194	865
	<b>City Total</b>	<b>35,422</b>	<b>31,498</b>	<b>33,246</b>	<b>33,222</b>	<b>30,930</b>	<b>164,318</b>
County Road	<null>	2		2	3	5	12
	FATAL	-	-	-	-	-	-
	SERIOUS INJURY	-	-	-	-	-	-
	EVIDENT INJURY (NOT DISABLING)	-	-	-	-	1	1
	PROBABLY INJURY (NOT APPARENT)	-	-	-	1	1	2
	NONE APPARENT	2	-	-	7	3	12
	UNKNOWN	-	-	-	-	1	1
	<b>City Total</b>	<b>4</b>	<b>-</b>	<b>2</b>	<b>11</b>	<b>11</b>	<b>28</b>
State Lettered Route	<null>	727	776	887	780	680	3,850
	FATAL	2	2	4	2	3	13
	SERIOUS INJURY	15	10	7	10	8	50
	EVIDENT INJURY (NOT DISABLING)	60	71	46	63	53	293
	PROBABLY INJURY (NOT APPARENT)	87	107	124	147	121	586
	NONE APPARENT	556	539	757	665	559	3,076
	UNKNOWN	4	12	12	8	6	42
	<b>City Total</b>	<b>1,451</b>	<b>1,517</b>	<b>1,837</b>	<b>1,675</b>	<b>1,430</b>	<b>7,910</b>
State Numbered Route	<null>	2,597	2,241	2,793	2,681	2,598	12,910
	FATAL	4	5	3	4	4	20
	SERIOUS INJURY	17	18	22	34	21	112
	EVIDENT INJURY (NOT DISABLING)	133	119	142	163	130	687
	PROBABLY INJURY (NOT APPARENT)	287	269	328	400	372	1,656
	NONE APPARENT	2,051	1,764	2,230	2,132	2,067	10,244
	UNKNOWN	24	26	37	23	25	135
	<b>City Total</b>	<b>5,113</b>	<b>4,442</b>	<b>5,555</b>	<b>5,437</b>	<b>5,217</b>	<b>25,764</b>
Unknown	<null>	10,599	12,130	11,513	10,085	9,017	53,344
	FATAL	-	-	-	-	-	-
	SERIOUS INJURY	-	1	-	-	-	1
	EVIDENT INJURY (NOT DISABLING)	349	445	424	376	342	1,936
	PROBABLY INJURY (NOT APPARENT)	790	929	923	837	825	4,304
	NONE APPARENT	6,568	8,322	8,185	6,746	6,009	35,830
	UNKNOWN	99	112	123	96	81	511
	<b>City Total</b>	<b>18,405</b>	<b>21,939</b>	<b>21,168</b>	<b>18,140</b>	<b>16,274</b>	<b>95,926</b>

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St. Louis City Local Total	60,395	59,396	61,808	58,485	53,862	293,946
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**Table 33: Local Urban Crashes by Municipality**

MODOT_COUNTY_NM	StateLocal	MUNICIPALITY	Total Crashes	Total SERIOUS Injuries	Total Fatalities	Fatalities per 100 crashes
ST. LOUIS CITY	Local	ST. LOUIS	63,201	784	166	0.26
		NON-CITY OR UNINCORPORATED	20	1	-	0.00
		KIRKWOOD	13	-	-	0.00
		WILDWOOD	3	-	-	0.00
		FLORISSANT	2	-	-	0.00
		JENNINGS	2	-	-	0.00
		KINLOCH	2	3	-	0.00
		MAPLEWOOD	2	-	-	0.00
		PAGEDALE	2	-	-	0.00
		RICHMOND HEIGHTS	2	-	-	0.00
		WELLSTON	2	-	-	0.00
		WOODSON TERRACE	2	-	-	0.00
		BALLWIN	1	-	-	0.00
		BELLEFONTAINE NEIGHBORS	1	-	-	0.00
		BERKELEY	1	-	-	0.00
		CLAYTON	1	-	-	0.00
		DES PERES	1	-	-	0.00
		HAZELWOOD	1	-	-	0.00
		OVERLAND	1	-	-	0.00
		RIVERVIEW	1	-	-	0.00
SHREWSBURY	1	-	-	0.00		
SUNSET HILLS	1	-	-	0.00		
VALLEY PARK	1	-	-	0.00		
VINITA PARK	1	-	-	0.00		
<b>Total Local Municipal Crashes and Fatalities</b>			<b>63,265</b>	<b>788</b>	<b>166</b>	<b>0.26</b>

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**Table 34: Local City of St. Louis - Severe and Fatal Local Crashes - Compared to Top 14**

MODOT_COUNTY_NM	StateLocal	SEVERITY	Year					Total
			2007	2008	2009	2010	2011	
ST. LOUIS CITY	Local	FATAL	38	28	26	27	32	<b>151</b>
TOP-14 COUNTIES			143	152	148	149	142	<b>734</b>
St. Louis County Rate (out of Top-14)			26.6%	18.4%	17.6%	18.1%	22.5%	<b>20.6%</b>
ST. LOUIS CITY	Local	SERIOUS INJURY	156	137	137	137	114	<b>681</b>
TOP-14 COUNTIES			1460	1332	1341	1225	1212	<b>6,570</b>
City of St. Louis Rate (out of Top-14)			10.7%	10.3%	10.2%	11.2%	9.4%	<b>10.4%</b>

**Table 35: Local City of St. Louis - Severe and Fatal Local Crashes - Compared to Top 14**

MODOT_COUNTY_NM	StateLocal	SEVERITY	Year					Total
			2007	2008	2009	2010	2011	
ST. LOUIS CITY	Local	FATAL	38	28	26	27	32	<b>151</b>
TOP-14 COUNTIES			143	152	148	149	142	<b>734</b>
St. Louis County Rate (out of Top-14)			26.6%	18.4%	17.6%	18.1%	22.5%	<b>20.6%</b>
ST. LOUIS CITY	Local	SERIOUS INJURY	156	137	137	137	114	<b>681</b>
TOP-14 COUNTIES			1460	1332	1341	1225	1212	<b>6,570</b>
St. Louis County Rate (out of Top-14)			10.7%	10.3%	10.2%	11.2%	9.4%	<b>10.4%</b>

**Table 36: Total Crashes and Fatalities by Speeding-Related and Locality**

Speeding Involvement	Designation	Crashes		Fatalities		Fatalities per 100 crashes		
		Total	%	Total	%			
Yes, Aggressive Driving Involved	City Street	6,761	10.7%	74	44.6%	1.09		
	County Road	2	0.0%	-	0.0%	-		
	State Lettered Route	465	0.7%	8	4.8%	1.72		
	State Numbered Route	1,003	1.6%	7	4.2%	0.70		
	Unknown	4,139	6.5%	-	0.0%	-		
	<b>Aggressive Driving-Involved Total</b>		<b>12,370</b>	<b>19.6%</b>	<b>89</b>	<b>53.6%</b>	<b>0.72</b>	
No, Aggressive Driving Not Involved	City Street	28,273	44.7%	59	35.5%	0.21		
	County Road	5	0.0%	-	0.0%	-		
	State Lettered Route	1,255	2.0%	5	3.0%	0.40		
	State Numbered Route	4,328	6.8%	13	7.8%	0.30		
	Unknown	17,034	26.9%	-	0.0%	-		
	<b>No Aggressive Driving-Involved Total</b>		<b>50,895</b>	<b>80.4%</b>	<b>77</b>	<b>46.4%</b>	<b>0.15</b>	
<b>Local Total</b>				<b>63,265</b>	<b>100.0%</b>	<b>166</b>	<b>100%</b>	<b>0.26</b>

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**Table 37: Total Crashes and Fatalities by Alcohol-Related and Locality**

Alcohol Involvement	Designation	Crashes		Fatalities		Fatalities per 100 crashes
		Total	%	Total	%	
Yes, Alcohol/Drugs Involved	City Street	591	0.9%	17	10.2%	2.88
	County Road	-	0.0%	-	0.0%	#DIV/0!
	State Lettered Route	26	0.0%	1	0.6%	3.85
	State Numbered Route	100	0.2%	4	2.4%	4.00
	Unknown	327	0.5%	-	0.0%	-
	<b>Alcohol/Drug-Involved Total</b>	<b>1,044</b>	<b>1.7%</b>	<b>22</b>	<b>13.3%</b>	<b>2.11</b>
No, Alcohol/Drugs Not Involved	City Street	34,443	54.4%	116	69.9%	0.34
	County Road	7	0.0%	-	0.0%	-
	State Lettered Route	1,694	2.7%	12	7.2%	0.71
	State Numbered Route	5,231	8.3%	16	9.6%	0.31
	Unknown	20,846	33.0%	-	0.0%	-
	<b>No Alcohol/Drug-Involved Total</b>	<b>62,221</b>	<b>98.3%</b>	<b>144</b>	<b>86.7%</b>	<b>0.23</b>
<b>Local Total</b>		<b>63,265</b>	<b>100.0%</b>	<b>166</b>	<b>100%</b>	<b>0.26</b>

**Table 38: Total Fatalities and Disabling Injuries by Restraint Use**

PERS_INJ_LVL	Restraint Use	# Persons	%	% By Inj. Sev
Fatal Injury	Restrained	8	1.4%	8.9%
Fatal Injury	Unknown Restraint Usage	22	3.9%	24.4%
Fatal Injury	Unrestrained	60	10.6%	66.7%
<b>Fatal Injury Total</b>		<b>90</b>	<b>15.8%</b>	<b>100.0%</b>
Serious Injury	Restrained	276	48.6%	57.7%
Serious Injury	Unknown Restraint Usage	136	23.9%	28.5%
Serious Injury	Unrestrained	66	11.6%	13.8%
<b>Serious Injury Total</b>		<b>478</b>	<b>84.2%</b>	<b>100.0%</b>
<b>City Local Total - Drivers and Occupants</b>		<b>568</b>	<b>100.0%</b>	-

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**Table 39: Total Crashes and Fatalities by Pedestrian Involvement and Locality**

MODOT_COUNTY_NM	Designation	# Crashes	# Fatalities	Fatalities per 100 crashes	# Injuries	Injuries per 100 crashes
Pedestrian Crashes	City Street	926	43	4.64	140	15.12
	County Road	1	-	-	-	-
	State Lettered Route	38	-	-	7	18.42
	State Numbered Route	158	6	3.80	29	18.35
	Unknown	492	-	-	-	-
	<b>Total Local Pedestrian Crashes</b>	<b>1,615</b>	<b>49</b>	<b>8</b>	<b>176</b>	<b>10.90</b>
Non-Pedestrian Crashes	City Street	34,108	90	0.26	11,744	34.43
	County Road	6	-	-	3	50.00
	State Lettered Route	1,682	13	0.77	922	54.82
	State Numbered Route	5,173	14	0.27	2,426	46.90
	Unknown	20,681	-	-	6,241	30.18
	<b>Total Local Non-Pedestrian Crashes</b>	<b>61,650</b>	<b>117</b>	<b>0.19</b>	<b>21,336</b>	<b>34.61</b>
Total Local	City Street	35,034	133	0.38	11,884	33.92
	County Road	7	-	-	3	42.86
	State Lettered Route	1,720	13	0.76	929	54.01
	State Numbered Route	5,331	20	0.38	2,455	46.05
	Unknown	21,173	-	-	6,241	29.48
	<b>Total Local</b>	<b>63,265</b>	<b>166</b>	<b>0.26</b>	<b>21,512</b>	<b>34.00</b>

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### Countermeasure(s): High-Friction Surface Treatments

Table 40: Total Wet Crashes – Local Roads - 2007-2011

LOCALITY	TOTAL CRASHES	TOTAL FATALITIES	TOTAL SERIOUS INJURY CRASHES	FATALITIES PER 100 CRASHES	SERIOUS INJURY CRASHES PER 100 CRASHES
<b>Local - Only on curves</b>	<b>510</b>	<b>1</b>	<b>7</b>	<b>0.20</b>	<b>1.37</b>
Rural	-	-	-	#DIV/0!	#DIV/0!
Urban	510	1	7	0.20	1.37
<b>Local - All wet crashes</b>	<b>10,823</b>	<b>19</b>	<b>98</b>	<b>0.18</b>	<b>0.91</b>
Rural	-	-	-	#DIV/0!	#DIV/0!
Urban	10,823	19	98	0.18	0.91
<b>Total</b>	<b>11,333</b>	<b>20</b>	<b>105</b>	<b>0.37</b>	<b>2.28</b>

Table 41: Total Wet Crashes – Local – 2007-2011 – Summary

NUMBER OF CRASHES PER SECTION	NUMBER OF SECTIONS	CUMULATIVE		CUMULATIVE		CUMULATIVE	
		SECTIONS	PERCENT	CRASHES	PERCENT	FATALITIES	PERCENT
50 and greater	2	2	18.18%	328	53.42%	12	63.16%
30 - 49	-	2	18.18%	328	53.42%	12	63.16%
20 - 29	-	2	18.18%	328	53.42%	12	63.16%
10 - 19	5	7	63.64%	511	83.22%	13	68.42%
5 - 9	1	8	72.73%	544	88.60%	18	94.74%
4	-	8	72.73%	544	88.60%	18	94.74%
3	-	8	72.73%	544	88.60%	18	94.74%
2	1	9	81.82%	568	92.51%	18	94.74%
1	2	11	100.00%	614	100.00%	19	100.00%
<b>Total</b>	<b>11</b>	<b>11</b>	<b>100.00%</b>	<b>614</b>	<b>100.00%</b>	<b>19</b>	<b>100.00%</b>

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### Countermeasure(s): Tree Removal/Safety Enhancements, Shield Tree(s)

**Table 42: Total Tree Crashes – Local Roads - 2007-2011**

LOCALITY	RD CRASHES	RD FATALITIES	TOTAL SERIOUS INJURY CRASHES	FATALITIES PER 100 CRASHES	SERIOUS INJURY CRASHES PER 100 CRASHES
<b>Local</b>	<b>1,040</b>	<b>16</b>	<b>32</b>	<b>1.54</b>	<b>3.08</b>
Rural	-	-	-	#DIV/0!	#DIV/0!
Urban	1,040	16	32	1.54	3.08
<b>Total</b>	<b>1,040</b>	<b>16</b>	<b>32</b>	<b>1.54</b>	<b>3.08</b>

**Table 43: Tree Crashes – Local – 2007-2011 – Summary**

NUMBER OF CRASHES PER SECTION	NUMBER OF SECTIONS	CUMULATIVE		CUMULATIVE		CUMULATIVE	
		SECTIONS	PERCENT	CRASHES	PERCENT	FATALITIES	PERCENT
50 and greater	1	1	0.23%	53	5.10%	-	0.00%
30 - 49	1	2	0.46%	89	8.56%	2	12.50%
20 - 29	-	2	0.46%	89	8.56%	2	12.50%
10 - 19	11	13	2.99%	262	25.19%	9	56.25%
5 - 9	32	45	10.34%	482	46.35%	12	75.00%
4	16	61	14.02%	546	52.50%	12	75.00%
3	24	85	19.54%	618	59.42%	13	81.25%
2	72	157	36.09%	762	73.27%	13	81.25%
1	278	435	100.00%	1,040	100.00%	16	100.00%
<b>Total</b>	<b>435</b>	<b>435</b>	<b>100.00%</b>	<b>1,040</b>	<b>100.00%</b>	<b>16</b>	<b>100.00%</b>

## Appendix D

### Countermeasure(s): Utility Pole Delineation/Safety Enhancements

**Table 44: Total Utility Pole Crashes – Local Roads - 2007-2011**

LOCALITY	RD CRASHES	RD FATALITIES	TOTAL SERIOUS INJURY CRASHES	FATALITIES PER 100 CRASHES	SERIOUS INJURY CRASHES PER 100 CRASHES
<b>Local</b>	<b>823</b>	<b>4</b>	<b>17</b>	<b>0.49</b>	<b>2.07</b>
Rural	-	-	-	#DIV/0!	#DIV/0!
Urban	823	4	17	0.49	2.07
<b>Total</b>	<b>823</b>	<b>4</b>	<b>17</b>	<b>0.49</b>	<b>2.07</b>

**Table 45: Utility Pole Crashes – Local – 2007-2011 - Summary**

NUMBER OF CRASHES PER SECTION	NUMBER OF SECTIONS	CUMULATIVE		CUMULATIVE		CUMULATIVE	
		SECTIONS	PERCENT	CRASHES	PERCENT	FATALITIES	PERCENT
50 and greater	-	-	0.00%	-	0.00%	-	0.00%
30 - 49	1	1	0.24%	39	4.74%	-	0.00%
20 - 29	1	2	0.47%	63	7.65%	2	50.00%
10 - 19	5	7	1.66%	143	17.38%	2	50.00%
5 - 9	21	28	6.64%	267	32.44%	2	50.00%
4	11	39	9.24%	311	37.79%	2	50.00%
3	24	63	14.93%	383	46.54%	3	75.00%
2	81	144	34.12%	545	66.22%	3	75.00%
1	278	422	100.00%	823	100.00%	4	100.00%
<b>Total</b>	<b>422</b>	<b>422</b>	<b>100.00%</b>	<b>823</b>	<b>100.00%</b>	<b>4</b>	<b>100.00%</b>

## Appendix D

### Countermeasure(s): Enforcement and Education

**Table 46: Crashes – Local Roads - Alcohol-Related - 2007-2011**

LOCALITY	TOTAL CRASHES	TOTAL FATALITIES	TOTAL SERIOUS INJURY CRASHES	FATALITIES PER 100 CRASHES	SERIOUS INJURY CRASHES PER 100 CRASHES
<b>Local</b>	<b>1,005</b>	<b>21</b>	<b>31</b>	<b>2.09</b>	<b>3.08</b>
Rural	-	-	-	#DIV/0!	#DIV/0!
Urban	1,005	21	31	2.09	3.08
<b>Total</b>	<b>1,005</b>	<b>21</b>	<b>31</b>	<b>2.09</b>	<b>3.08</b>

**Table 47: Total Crashes - Alcohol-Related - Local Roads – 2007-2011 – Summary**

NUMBER OF CRASHES PER SECTION	NUMBER OF SECTIONS	CUMULATIVE		CUMULATIVE		CUMULATIVE	
		SECTIONS	PERCENT	CRASHES	PERCENT	FATALITIES	PERCENT
50 and greater	-	-	0.00%	-	0.00%	-	0.00%
30 - 49	3	3	0.85%	103	11.59%	6	28.57%
20 - 29	1	4	1.13%	125	14.06%	7	33.33%
10 - 19	5	9	2.55%	202	22.72%	11	52.38%
5 - 9	27	36	10.20%	395	44.43%	15	71.43%
4	18	54	15.30%	467	52.53%	15	71.43%
3	34	88	24.93%	569	64.00%	16	76.19%
2	55	143	40.51%	679	76.38%	17	80.95%
1	210	353	100.00%	889	100.00%	21	100.00%
<b>Total</b>	<b>353</b>	<b>353</b>	<b>100.00%</b>	<b>889</b>	<b>100.00%</b>	<b>21</b>	<b>100.00%</b>

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**Table 48: Total Crashes – Local Roads - Speeding-Related - 2007-2011**

LOCALITY	TOTAL CRASHES	TOTAL FATALITIES	TOTAL SERIOUS INJURY CRASHES	FATALITIES PER 100 CRASHES	SERIOUS INJURY CRASHES PER 100 CRASHES
<b>Local</b>	<b>12,370</b>	<b>89</b>	<b>181</b>	<b>0.72</b>	<b>1.46</b>
Rural	-	-	-	#DIV/0!	#DIV/0!
Urban	12,370	89	181	0.72	1.46
<b>Total</b>	<b>12,370</b>	<b>89</b>	<b>181</b>	<b>0.72</b>	<b>1.46</b>

**Table 49: Total Crashes –Local Roads – Speeding-Related– 2007-2011 – Summary**

NUMBER OF CRASHES PER SECTION	NUMBER OF SECTIONS	CUMULATIVE		CUMULATIVE		CUMULATIVE	
		SECTIONS	PERCENT	CRASHES	PERCENT	FATALITIES	PERCENT
50 and greater	39	39	2.81%	6,356	51.38%	57	64.04%
30 - 49	21	60	4.33%	7,190	58.12%	60	67.42%
20 - 29	34	94	6.78%	8,079	65.31%	66	74.16%
10 - 19	71	165	11.90%	9,225	74.58%	74	83.15%
5 - 9	201	366	26.41%	10,658	86.16%	82	92.13%
4	90	456	32.90%	11,018	89.07%	86	96.63%
3	115	571	41.20%	11,363	91.86%	86	96.63%
2	192	763	55.05%	11,747	94.96%	86	96.63%
1	623	1,386	100.00%	12,370	100.00%	89	100.00%
<b>Total</b>	<b>1,386</b>	<b>1,386</b>	<b>100.00%</b>	<b>12,370</b>	<b>100.00%</b>	<b>89</b>	<b>100.00%</b>

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**Table 50: Total Crashes – Local Roads - Unbelted - 2007-2011**

LOCALITY	TOTAL CRASHES	TOTAL FATALITIES	TOTAL SERIOUS INJURIES	FATALITIES PER 100 CRASHES	SERIOUS INJURIES PER 100 CRASHES
<b>Local</b>	<b>1,348</b>	<b>60</b>	<b>66</b>	<b>4.45</b>	<b>4.90</b>
Rural	-	-	-	#DIV/0!	#DIV/0!
Urban	1,348	60	66	4.45	4.90
<b>Total</b>	<b>1,348</b>	<b>60</b>	<b>66</b>	<b>4.45</b>	<b>4.90</b>

**Table 51: Total Crashes – Local Roads – Unbelted – 2007-2011 – Summary**

NUMBER OF CRASHES PER SECTION	NUMBER OF SECTIONS	CUMULATIVE		CUMULATIVE		CUMULATIVE	
		SECTIONS	PERCENT	CRASHES	PERCENT	FATALITIES	PERCENT
50 and greater	6	6	1.28%	406	20.46%	62	43.97%
30 - 49	2	8	1.70%	481	24.24%	62	43.97%
20 - 29	7	15	3.19%	660	33.27%	71	50.35%
10 - 19	21	36	7.66%	992	50.00%	92	65.25%
5 - 9	47	83	17.66%	1,329	66.99%	107	75.89%
4	29	112	23.83%	1,445	72.83%	115	81.56%
3	52	164	34.89%	1,601	80.70%	131	92.91%
2	77	241	51.28%	1,755	88.46%	136	96.45%
1	229	470	100.00%	1,984	100.00%	141	100.00%
<b>Total</b>	<b>470</b>	<b>470</b>	<b>100.00%</b>	<b>1,984</b>	<b>100.00%</b>	<b>141</b>	<b>100.00%</b>

## Appendix D

### Countermeasure(s): Pedestrian Crossing Treatments

Table 52: Total Pedestrian Crashes – Local Roads - 2007-2011

LOCALITY	CRASHES	FATALITIES	TOTAL SERIOUS INJURY CRASHES	FATALITIES PER 100 CRASHES	SERIOUS INJURY CRASHES PER 100 CRASHES
<b>Local - Intersection</b>	<b>667</b>	<b>16</b>	<b>64</b>	<b>2.40</b>	<b>9.60</b>
Signalized	484	12	50	2.48	10.33
Stop-controlled	183	4	14	2.19	7.65
<b>Local - Non-intersection</b>	<b>887</b>	<b>33</b>	<b>102</b>	<b>3.72</b>	<b>11.50</b>
<b>Local - Other or Unknown</b>	<b>61</b>	<b>-</b>	<b>10</b>	<b>0.00</b>	<b>16.39</b>
<b>Total</b>	<b>1,615</b>	<b>49</b>	<b>176</b>	<b>3.03</b>	<b>10.90</b>

Table 53: Pedestrian Crashes – Signalized Intersections - Local Roads – 2007-2011 – Summary

NUMBER OF CRASHES PER SECTION	NUMBER OF SECTIONS	CUMULATIVE		CUMULATIVE		CUMULATIVE	
		SECTIONS	PERCENT	CRASHES	PERCENT	FATALITIES	PERCENT
50 and greater	-	-	0.00%	-	0.00%	-	0.00%
30 - 49	2	2	1.42%	85	17.56%	5	41.67%
20 - 29	-	2	1.42%	85	17.56%	5	41.67%
10 - 19	7	9	6.38%	185	38.22%	6	50.00%
5 - 9	15	24	17.02%	291	60.12%	10	83.33%
4	8	32	22.70%	323	66.74%	10	83.33%
3	13	45	31.91%	362	74.79%	11	91.67%
2	26	71	50.35%	414	85.54%	12	100.00%
1	70	141	100.00%	484	100.00%	12	100.00%
<b>Total</b>	<b>141</b>	<b>141</b>	<b>100.00%</b>	<b>484</b>	<b>100.00%</b>	<b>12</b>	<b>100.00%</b>

Table 54: Pedestrian Crashes – Stop-controlled Intersections - Local Roads – 2007-2011 – Summary

NUMBER OF CRASHES PER SECTION	NUMBER OF SECTIONS	CUMULATIVE		CUMULATIVE		CUMULATIVE	
		SECTIONS	PERCENT	CRASHES	PERCENT	FATALITIES	PERCENT
50 and greater	-	-	0.00%	-	0.00%	-	0.00%
30 - 49	-	-	0.00%	-	0.00%	-	0.00%
20 - 29	-	-	0.00%	-	0.00%	-	0.00%
10 - 19	-	-	0.00%	-	0.00%	-	0.00%
5 - 9	1	1	0.68%	6	3.28%	1	25.00%
4	3	4	2.70%	18	9.84%	1	25.00%
3	3	7	4.73%	27	14.75%	1	25.00%
2	15	22	14.86%	57	31.15%	4	100.00%
1	126	148	100.00%	183	100.00%	4	100.00%
<b>Total</b>	<b>148</b>	<b>148</b>	<b>100.00%</b>	<b>183</b>	<b>100.00%</b>	<b>4</b>	<b>100.00%</b>

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**Table 55: Pedestrian Crashes – Not At Intersections - Local Roads – 2007-2011 – Summary**

NUMBER OF CRASHES PER SECTION	NUMBER OF SECTIONS	CUMULATIVE		CUMULATIVE		CUMULATIVE	
		SECTIONS	PERCENT	CRASHES	PERCENT	FATALITIES	PERCENT
50 and greater	1	1	0.25%	52	5.86%	9	27.27%
30 - 49	-	1	0.25%	52	5.86%	9	27.27%
20 - 29	2	3	0.74%	100	11.27%	11	33.33%
10 - 19	6	9	2.21%	198	22.32%	14	42.42%
5 - 9	20	29	7.11%	331	37.32%	20	60.61%
4	19	48	11.76%	407	45.89%	22	66.67%
3	29	77	18.87%	494	55.69%	27	81.82%
2	62	139	34.07%	618	69.67%	29	87.88%
1	269	408	100.00%	887	100.00%	33	100.00%
<b>Total</b>	<b>408</b>	<b>408</b>	<b>100.00%</b>	<b>887</b>	<b>100.00%</b>	<b>33</b>	<b>100.00%</b>

## Appendix D

### Countermeasure(s): Intersection Treatments

**Table 56: Total Crashes at Intersections – Local Roads - 2007-2011**

LOCALITY	RD CRASHES	RD FATALITIES	TOTAL SERIOUS INJURY CRASHES	FATALITIES PER 100 CRASHES	SERIOUS INJURY CRASHES PER 100 CRASHES
<b>Signalized</b>	<b>12,814</b>	<b>38</b>	<b>200</b>	<b>0.30</b>	<b>1.56</b>
<45 MPH	12,746	38	200	0.30	1.57
45+ MPH	68	-	-	0.00	0.00
<b>Stop-Controlled</b>	<b>6,109</b>	<b>18</b>	<b>81</b>	<b>0.29</b>	<b>1.33</b>
<45 MPH	6,089	18	80	0.30	1.31
45+ MPH	20	-	1	0.00	5.00
<b>Total</b>	<b>18,923</b>	<b>56</b>	<b>281</b>	<b>0.30</b>	<b>1.48</b>

**Table 57: Intersection Crashes – Signalized Intersection – Under 45 mph – Local Roads – 2007-2011 – Summary**

NUMBER OF CRASHES PER SECTION	NUMBER OF SECTIONS	CUMULATIVE		CUMULATIVE		CUMULATIVE	
		SECTIONS	PERCENT	CRASHES	PERCENT	FATALITIES	PERCENT
50 and greater	69	69	11.09%	15,488	80.67%	33	86.84%
30 - 49	27	96	15.43%	16,552	86.21%	33	86.84%
20 - 29	27	123	19.77%	17,296	90.09%	36	94.74%
10 - 19	41	164	26.37%	17,917	93.32%	37	97.37%
5 - 9	94	258	41.48%	18,594	96.85%	37	97.37%
4	26	284	45.66%	18,698	97.39%	37	97.37%
3	51	335	53.86%	18,851	98.19%	37	97.37%
2	61	396	63.67%	18,973	98.82%	37	97.37%
1	226	622	100.00%	19,199	100.00%	38	100.00%
<b>Total</b>	<b>622</b>	<b>622</b>	<b>100.00%</b>	<b>19,199</b>	<b>100.00%</b>	<b>38</b>	<b>100.00%</b>

**Table 58: Intersection Crashes – Signalized Intersections – 45 mph or greater – Local Roads – 2007-2011 – Summary**

NUMBER OF CRASHES PER SECTION	NUMBER OF SECTIONS	CUMULATIVE		CUMULATIVE		CUMULATIVE	
		SECTIONS	PERCENT	CRASHES	PERCENT	FATALITIES	PERCENT
50 and greater	-	-	0.00%	-	0.00%	-	#DIV/0!
30 - 49	-	-	0.00%	-	0.00%	-	#DIV/0!
20 - 29	1	1	4.17%	28	30.43%	-	#DIV/0!
10 - 19	-	1	4.17%	28	30.43%	-	#DIV/0!
5 - 9	5	6	25.00%	63	68.48%	-	#DIV/0!
4	2	8	33.33%	71	77.17%	-	#DIV/0!
3	1	9	37.50%	74	80.43%	-	#DIV/0!
2	3	12	50.00%	80	86.96%	-	#DIV/0!
1	12	24	100.00%	92	100.00%	-	#DIV/0!
<b>Total</b>	<b>24</b>	<b>24</b>	<b>100.00%</b>	<b>92</b>	<b>100.00%</b>	<b>-</b>	<b>100.00%</b>

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**Table 59: Intersection Crashes – Stop-controlled Intersection – Under 45 mph – Local Roads – 2007-2011 – Summary**

NUMBER OF CRASHES PER SECTION	NUMBER OF SECTIONS	CUMULATIVE		CUMULATIVE		CUMULATIVE	
		SECTIONS	PERCENT	CRASHES	PERCENT	FATALITIES	PERCENT
50 and greater	25	25	2.10%	2,229	25.18%	5	27.78%
30 - 49	38	63	5.30%	3,709	41.90%	13	72.22%
20 - 29	36	99	8.33%	4,644	52.47%	14	77.78%
10 - 19	76	175	14.72%	5,785	65.36%	15	83.33%
5 - 9	214	389	32.72%	7,370	83.27%	17	94.44%
4	87	476	40.03%	7,718	87.20%	17	94.44%
3	118	594	49.96%	8,072	91.20%	17	94.44%
2	184	778	65.43%	8,440	95.36%	17	94.44%
1	411	1,189	100.00%	8,851	100.00%	18	100.00%
<b>Total</b>	<b>1,189</b>	<b>1,189</b>	<b>100.00%</b>	<b>8,851</b>	<b>100.00%</b>	<b>18</b>	<b>100.00%</b>

**Table 60: Intersection Crashes – Stop-controlled Intersections – 45 mph or greater – Local Roads – 2007-2011 – Summary**

NUMBER OF CRASHES PER SECTION	NUMBER OF SECTIONS	CUMULATIVE		CUMULATIVE		CUMULATIVE	
		SECTIONS	PERCENT	CRASHES	PERCENT	FATALITIES	PERCENT
50 and greater	-	-	0.00%	-	0.00%	-	#DIV/0!
30 - 49	-	-	0.00%	-	0.00%	-	#DIV/0!
20 - 29	-	-	0.00%	-	0.00%	-	#DIV/0!
10 - 19	1	1	12.50%	12	44.44%	-	#DIV/0!
5 - 9	1	2	25.00%	19	70.37%	-	#DIV/0!
4	-	2	25.00%	19	70.37%	-	#DIV/0!
3	-	2	25.00%	19	70.37%	-	#DIV/0!
2	2	4	50.00%	23	85.19%	-	#DIV/0!
1	4	8	100.00%	27	100.00%	-	#DIV/0!
<b>Total</b>	<b>8</b>	<b>8</b>	<b>100.00%</b>	<b>27</b>	<b>100.00%</b>	<b>-</b>	<b>100.00%</b>

## Appendix D

### Countermeasure(s): Younger Driver Education and Enforcement

**Table 61: Total Crashes – Local Roads – Younger Drivers - 2007-2011**

LOCALITY	RD CRASHES	RD FATALITIES	TOTAL SERIOUS INJURY CRASHES	FATALITIES PER 100 CRASHES	SERIOUS INJURY CRASHES PER 100 CRASHES
<b>Local</b>	<b>8,348</b>	<b>29</b>	<b>117</b>	<b>0.35</b>	<b>1.40</b>
Rural	-	-	-	#DIV/0!	#DIV/0!
Urban	8,348	29	117	0.35	1.40
<b>Total</b>	<b>8,348</b>	<b>29</b>	<b>117</b>	<b>0.35</b>	<b>1.40</b>

**Table 62: Younger Driver Crashes – Local Roads – 2007-2011 – Summary**

NUMBER OF CRASHES PER SECTION	NUMBER OF SECTIONS	CUMULATIVE		CUMULATIVE		CUMULATIVE	
		SECTIONS	PERCENT	CRASHES	PERCENT	FATALITIES	PERCENT
50 and greater	30	30	2.81%	3,975	47.62%	14	48.28%
30 - 49	20	50	4.68%	4,800	57.50%	16	55.17%
20 - 29	21	71	6.65%	5,324	63.78%	18	62.07%
10 - 19	54	125	11.70%	6,175	73.97%	24	82.76%
5 - 9	126	251	23.50%	7,026	84.16%	27	93.10%
4	60	311	29.12%	7,266	87.04%	28	96.55%
3	84	395	36.99%	7,518	90.06%	28	96.55%
2	157	552	51.69%	7,832	93.82%	28	96.55%
1	516	1,068	100.00%	8,348	100.00%	29	100.00%
<b>Total</b>	<b>1,068</b>	<b>1,068</b>	<b>100.00%</b>	<b>8,348</b>	<b>100.00%</b>	<b>29</b>	<b>100.00%</b>

## Appendix D

### City of St. Louis, MO Candidate Countermeasures and Potential Applications

**Table 63: Candidate Countermeasures and Potential Applications/Reductions**

Countermeasure	Targeted Crashes	Typical Crash Threshold for Application	Local Urban	Local Rural	CMF b (%)	Comments
Fundamental Signs and Markings for Curves	All curve crashes	≥3	X	X	0.90	Standard advanced curve warning sign plus advisory speed plaque and curve center and edge lines; chevrons per MUTCD NPA.
Enhanced Signs and Markings for Curves	All curve crashes	AADT >5,000: ≥5 AADT <5,000: ≥3	X	X	0.70	Oversized, left, and right fluorescent yellow, advance warning signs; chevrons; slow and XX mph pavement markings; center and edge lines.
Enhanced Signs and Markings for Curves Plus Flashing Beacons	All curve crashes	AADT >5,000: ≥8 AADT <5,000: ≥6	X	X	0.51 combined	Same as enhanced signs and markings for curves except solar powered flashing beacons added to warning signs.
Enhanced Signs and Markings for Curves Plus Dynamic Curve Warning System	All curve crashes	AADT >5,000: ≥10 AADT <5,000: ≥6	X		0.49 combined	Same as enhanced signs and markings for curves except dynamic advanced warning signs added.
Reconstruct Curve, Minor to Intermediate	All curve crashes	AADT >5,000: ≥10 AADT <5,000: ≥8	X	X	Varies	High friction surface, shoulder widening; increased recovery zone. CMF depends on type of improvement.
Center Line Rumble Stripes	Head-on crashes <sup>c</sup>	≥3 in 15,000 feet and pavement widths ≥22 feet		X	0.66 (fatal & injury)	
Wider Center Line Pavement Markings	Head-on crashes <sup>c</sup>	≥3 in 15,000 feet and pavement widths ≥20 feet	X	X	5 <sup>d</sup>	Apply where center line rumble stripes cannot be installed.
Edge Line Rumble Stripes or Shoulder Rumble Strips	SVROR crashes	≥5 in 3,000 feet		X	0.71 (fatal & injury)- Local 2 Lane Roads	
Standard Edge Line Markings	ROR crashes	≥3 in 3,000 feet and no existing edge lines		X	0.90 <sup>d</sup>	
Wider Edge Line Markings	ROR crashes	≥5 in 3,000 feet	X	X	0.95 <sup>d</sup>	Apply in problem sections where edge or shoulder rumble strips cannot be applied.
Pavement Wedge or Safety Edge <sub>SM</sub>	ROR crashes	All paving operations	X	X	NA	Apply during paving operations or in areas of recurring edge drop-off.
Alignment Delineation	Night crashes	≥5 in 3,000 feet	X	X	0.85 <sup>d</sup>	
Lighting	Dark, dusk, or dawn crashes	≥15 in 3,000 feet	X	X	0.50 (night only)	

## Appendix D

Countermeasure	Targeted Crashes	Typical Crash Threshold for Application	Local Urban	Local Rural	CMF b (%)	Comments
High Friction Surface Treatments	Wet pavement crashes and high friction demand locations.	≥8 in 3,000 feet		X	0.50 (wet) 0.75 (all)	
Wider Shoulders	crashes	≥12 in 3,000 feet and existing shoulders ≤2 feet		X	Varies	CMF dependent on initial and final shoulder width. See Toolbox or Roadside Design Guide to determine.
Tree Removal	Tree crashes	≥3 in 3,000 feet	X	X	Up to 1	
Shield Tree(s)	Tree crashes	≥3 in 3,000 feet			Varies	Apply when removal is not feasible. Risk analysis will provide CMF.
Utility Pole Relocation	Utility pole crashes	≥3 in 3,000 feet	X	X		CMF dependent on initial and final distance and spacing.
Fixed Object Delineation	Night fixed object crashes	≥5 in 3,000 feet	X	X	0.90 <sup>d</sup>	

## Appendix D

### Strategy Matrix for Systemic Low-Cost Countermeasures

**Table 64: High Friction Surface Treatments – Local Roads**

Locality	Threshold Crash Level (5 Years)	Number of Local Routes	Number of Crashes in 5 Years (2008-2012)	Estimated Number of Improvements <sup>1</sup>	Construction Costs (\$ Million) <sup>2</sup>	Fatalities per 100 Crashes	Serious Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction <sup>3</sup>	Annual Estimated Serious Injury Crash Reduction	Annual Estimated Fatality Reduction
Local	25	8	544	4	\$ 0.24	0.18	0.91	27.20	0.25	0.05

<sup>1</sup> Assumes 50% of local routes can be improved and are not already covered by curve improvements.  
<sup>2</sup> Assumes an average cost of \$60,000 per location.  
<sup>3</sup> A CMF of 0.5 is used.  
 \* Need a wet to total crash ratio of at least 0.24 for Local roads.

**Table 65: Tree Relocation/Safety Enhancements – Local Roads**

Locality	Threshold Crash Level (5 Years)	Number of Local Routes	Number of Crashes in 5 Years (2008-2012)	Estimated Number of Improvements <sup>1</sup>	Construction Costs (\$ Million) <sup>2</sup>	Fatalities per 100 Crashes	Serious Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction <sup>3</sup>	Annual Estimated Serious Injury Crash Reduction	Annual Estimated Fatality Reduction
Local	3	85	618	9	\$ 0.04	1.54	3.08	12.36	0.38	0.19

<sup>1</sup> Assumes 10% of local locations can be addressed. Other improvements to reduce roadway departure frequencies in the vicinity of the struck trees, or reduced speed to reduce severity. A field review will be needed to determine the appropriate countermeasure.  
<sup>2</sup> Assumes an average cost of \$5,000 per one mile segment.  
<sup>3</sup> An average CMF of 0.5 is used.

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**Table 66: Utility Pole Delineation/Safety Enhancements – Local Roads**

Locality	Threshold Crash Level (5 Years)	Number of Local Routes	Number of Crashes in 5 Years (2008-2012)	Estimated Number of Improvements <sup>1</sup>	Construction Costs (\$ Million) <sup>2</sup>	Fatalities per 100 Crashes	Serious Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction <sup>3</sup>	Annual Estimated Serious Injury Crash Reduction	Annual Estimated Fatality Reduction
Local	3	63	383	13	\$ 0.01	0.49	2.07	7.66	0.16	0.04

<sup>1</sup> Assumes 20% of locations can be improved by pole relocation, other improvements to reduce roadway departure frequencies in the vicinity of the struck poles, or reduced speed to reduce severity. A field review will be needed to determine the appropriate countermeasure.

<sup>2</sup> Assumes an average cost of \$1,000 per route.

<sup>3</sup> An average CMF of 0.9 is used.

**Table 67. Speed Enforcement Cameras - Aggressive Driving-Related – Local Roads**

Locality	Threshold Crash Level (5 Years)	Number of Local Routes	Number of Crashes in 5 Years (2008-2012)	Estimated Number of Improvements <sup>1</sup>	Costs (\$ Million) <sup>2</sup>	Fatalities per 100 Crashes	Serious Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction <sup>3</sup>	Annual Estimated Serious Injury Crash Reduction	Annual Estimated Fatality Reduction
Local	150	12	3,831	6	\$ 2.28	0.72	1.46	65.13	0.95	0.47

<sup>1</sup> Assumes 50% of locations can be improved by incorporating speed reduction through speed enforcement cameras.

<sup>2</sup> Assumes an average annual enforcement cost of \$380,000 per deployment.

<sup>3</sup> An average CMF of 0.83 is used as an overall average for possible enhanced corridor enforcement countermeasures.

## Appendix D

### Strategy Matrix for Comprehensive Improvements

**Table 68: Enhanced Corridor Enforcement – Local Crashes – Alcohol-Related**

Locality	Threshold Crash Level (5 Years)	Number of Local Routes	Number of Crashes in 5 Years (2008-2012)	Estimated Number of Improvements <sup>1</sup>	Costs (\$ Million) <sup>2</sup>	Fatalities per 100 Crashes	Serious Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction <sup>3</sup>	Annual Estimated Serious Injury Crash Reduction	Annual Estimated Fatality Reduction
Local	6	35	447	28	\$ 2.86	2.09	3.08	10.73	0.33	0.22
<p><sup>1</sup> Assumes 80% of locations will have sufficient enforcement capabilities to implement enhanced enforcement (at least 10 hours per week of highly visible active enforcement per section)</p> <p><sup>2</sup> Assumes an enforcement plus education cost of \$102,000 per route (including a \$50,000 lump sum education cost and \$52,000 for five years of enforcement).</p> <p><sup>3</sup> An average CMF of 0.85 is used as an overall average for all possible enhanced corridor enforcement countermeasures. Estimated from speed and safety belt enforcement effectiveness information in NHTSA's Countermeasures That Work: Highway Safety Countermeasure Guide For State Highway Safety Offices.  <a href="http://www.nhtsa.gov/staticfiles/DOT/NHTSA/Traffic%20Injury%20Control/Articles/Associated%20Files/811081.pdf">http://www.nhtsa.gov/staticfiles/DOT/NHTSA/Traffic%20Injury%20Control/Articles/Associated%20Files/811081.pdf</a></p>										

**Table 69: Enhanced Corridor Enforcement – Local Crashes – Speeding-Related**

Locality	Threshold Crash Level (5 Years)	Number of Local Routes	Number of Crashes in 5 Years (2008-2012)	Estimated Number of Improvements <sup>1</sup>	Costs (\$ Million) <sup>2</sup>	Fatalities per 100 Crashes	Serious Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction <sup>3</sup>	Annual Estimated Serious Injury Crash Reduction	Annual Estimated Fatality Reduction
Local	35	58	7,122	46	\$ 4.73	0.72	1.46	170.93	2.50	1.23
<p><sup>1</sup> Assumes 80% of locations will have sufficient enforcement capabilities to implement enhanced enforcement (at least 10 hours per week of highly visible active enforcement per section).</p> <p><sup>2</sup> Assumes an average annual enforcement cost of \$102,000 per route (including a \$50,000 lump sum education cost and \$52,000 for five years of enforcement).</p> <p><sup>3</sup> An average CMF of 0.85 is used as an overall average for all possible enhanced corridor enforcement countermeasures. Estimated from speed and safety belt enforcement effectiveness information in NHTSA's Countermeasures That Work: Highway Safety Countermeasure Guide For State Highway Safety Offices.  <a href="http://www.nhtsa.gov/staticfiles/DOT/NHTSA/Traffic%20Injury%20Control/Articles/Associated%20Files/811081.pdf">http://www.nhtsa.gov/staticfiles/DOT/NHTSA/Traffic%20Injury%20Control/Articles/Associated%20Files/811081.pdf</a></p>										

## Appendix D

**Table 70: Enhanced Corridor Enforcement – Local Crashes – Unbelted**

Locality	Threshold Crash Level (5 Years)	Number of Local Routes	Number of Crashes in 5 Years (2008-2012)	Estimated Number of Improvements <sup>1</sup>	Costs (\$ Million) <sup>2</sup>	Fatalities per 100 Crashes	Serious Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction <sup>3</sup>	Annual Estimated Serious Injury Crash Reduction	Annual Estimated Fatality Reduction
Local	12	22	507	18	\$ 1.80	4.45	4.90	12.17	0.60	0.54

<sup>1</sup> Assumes 80% of locations will have sufficient enforcement capabilities to implement enhanced enforcement (at least 10 hours per week of highly visible active enforcement per section)

<sup>2</sup> Assumes an enforcement plus education cost of \$102,000 per route (including a \$50,000 lump sum education cost and \$52,000 for five years of enforcement).

<sup>3</sup> An average CMF of 0.85 is used as an overall average for all possible enhanced corridor enforcement countermeasures. Estimated from speed and safety belt enforcement effectiveness information in NHTSA's Countermeasures That Work: Highway Safety Countermeasure Guide For State Highway Safety Offices. <http://www.nhtsa.gov/staticfiles/DOT/NHTSA/Traffic%20Injury%20Control/Articles/Associated%20Files/811081.pdf>

**Table 71. Licensure Enforcement of All Drivers – Local Roads**

Locality	Threshold Crash Level (5 Years)	Number of Local Routes	Number of Crashes in 5 Years (2008-2012)	Estimated Number of Improvements <sup>1</sup>	Construction Costs (\$ Million) <sup>2</sup>	Fatalities per 100 Crashes	Serious Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction <sup>3</sup>	Annual Estimated Serious Injury Crash Reduction	Annual Estimated Fatality Reduction
Local	25	22	1,490	18	\$ 1.80	1.03	2.79	35.76	1.00	0.37

<sup>1</sup> Assumes 80% of local routes can be improved.

<sup>2</sup> Assumes \$102,000 per route (including a \$50,000 lump sum education cost and \$52,000 for five years of enforcement).

<sup>3</sup> A CMF of 0.85 is used.

## Appendix D

### Strategy Matrix for Traditional Improvements

Table 72. Pedestrian Countermeasures – Local Roads

Locality	Threshold Crash Level (5 Years)	Number of Local Intersections / Routes	Number of Crashes in 5 Years (2008-2012)	Estimated Number of Improvements <sup>1</sup>	Construction Costs (\$ Million) <sup>2</sup>	Fatalities per 100 Crashes	Serious Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction <sup>3</sup>	Annual Estimated Serious Injury Crash Reduction	Annual Estimated Fatality Reduction
Local - Signalized Intersection	7	17	252	9	\$ 0.09	2.48	10.33	7.56	0.78	0.19
Local - Stop-controlled Intersection	3	7	27	4	\$ 0.02	2.19	7.65	0.54	0.04	0.01
Local - Not at intersection - Basic	4	48	407	19	\$ 0.31	3.72	11.50	6.51	0.75	0.24
Local - Not at intersection - HAWK	9	12	228	5	\$ 0.24	3.72	11.50	8.39	0.96	0.31
Total Local		84	914	36	\$ 0.65			23.00	2.54	0.75

<sup>1</sup> Assumes 50% of signalized intersection locations, 50% of stop-controlled intersection locations and 40% of non-intersection locations can be improved.

<sup>2</sup> Assumes an average cost of \$10,000 per signalized intersection, \$5,000 per stop-controlled intersection, and \$16,250 per crosswalk.

<sup>3</sup> A CMF of 0.7 is used for signalized intersection locations, 0.8 is used for stop-controlled intersection locations and 0.8 for non-intersection locations.

## Appendix D

**Table 73. Intersection Countermeasures – Local Roads**

Locality	Threshold Crash Level (5 Years)	Number of Local Intersections	Number of Crashes in 5 Years (2008-2012)	Estimated Number of Improvements <sup>1</sup>	Construction Costs (\$ Million) <sup>2</sup>	Fatalities per 100 Crashes	Serious Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction <sup>3</sup>	Annual Estimated Serious Injury Crash Reduction	Annual Estimated Fatality Reduction
Signalized - Under 45 mph	74	53	14,183	11	\$ 0.32	0.30	1.57	482.22	7.57	1.44
Signalized - 45 or higher mph	-	-	-	-	\$ -	0.00	0.00	0.00	0.00	0.00
Stop-controlled - Under 45 mph	23	95	4,556	19	\$ 0.09	0.30	1.31	127.57	1.68	0.38
Stop-controlled - 45 or higher mph	-	-	-	-	\$ -	0.00	5.00	0.00	0.00	0.00
Total Signalized	74	53	14,183	11	\$ 0.32			482.22	7.57	1.44
Total Stop-Controlled	23	95	4,556	19	\$ 0.09			364.48	1.68	0.38
Total Local		148	18,739	30	\$ 0.40			846.70	9.24	1.81

<sup>1</sup> Assumes 20% of signalized intersections and 20% of stop-controlled intersections can be improved.

<sup>2</sup> Assumes average costs of \$30,000 per signalized intersection with speed limits under 45mph; \$45,000 per signalized intersection with speed limits greater than or equal to 45mph; \$4,500 per stop-controlled intersection with speed limits under 45mph; and \$35,000 per stop-controlled intersection with speed limits greater than or equal to 45mph.

<sup>3</sup> A CMF of 0.85 is used for signalized intersections with speed limits under 45mph; 0.85 is used for signalized intersections with speed limits greater than or equal to 45mph or higher; 0.7 is used for stop-controlled intersections with speed limits under 45mph; and 0.7 for stop-controlled intersections with speed limits greater than or equal to 45mph.

**Table 74. Stop-Controlled Intersections less than 45 mph – Install Flashing LED-Outlined STOP Signs**

Locality	Threshold Crash Level (5 Years)	Number of Local Intersections	Number of Crashes in 5 Years (2008-2012)	Estimated Number of Improvements <sup>1</sup>	Construction Costs (\$ Million) <sup>2</sup>	Fatalities per 100 Crashes	Serious Injury Crashes per 100 Crashes	Annual Targeted Crash Reduction <sup>3</sup>	Annual Estimated Serious Injury Crash Reduction	Annual Estimated Fatality Reduction
Stop-controlled - Under 45 mph	40	42	2,970	8	\$ 0.10	0.30	1.31	70.09	0.92	0.21
Total Local		42	2,970	8	\$ 0.10	0.30	1.31	70.09	0.92	0.21

<sup>1</sup> Assumes 20% of stop-controlled intersections can be improved.

<sup>2</sup> Assumes average costs of \$12,000 per stop-controlled intersection with speed limits under 45mph.

<sup>3</sup> A CMF of 0.59 is used for stop-controlled intersections with speed limits under 45mph.

## Appendix D

### Summary of Final Strategy Matrix

**Table 75: Final List of Countermeasures, Deployment Levels, Costs, and Crash Impacts to Achieve Goal**

Countermeasure	Approach	Estimated Number of Improvements <sup>1</sup>	Associated Costs (\$ Million) <sup>2</sup>	Annual Targeted Crash Reduction <sup>3</sup>	Annual Estimated Serious Injury Crash Reduction	Annual Estimated Fatality Reduction	\$ (million) Required to Prevent/Reduce One Annual Serious Injury	\$ (million) Required to Save One Annual Life
<b>Local Roads</b>								
High Friction Surface Treatments	Systemic	4	\$ 0.24	27.20	0.25	0.05	0.97	5.03
Tree Removal or Clear Zone Improvements	Systemic	9	\$ 0.04	12.36	0.38	0.19	0.11	0.22
Utility Pole Delineation	Systemic	13	\$ 0.01	7.66	0.16	0.04	0.08	0.34
Enforcement and Education: Alcohol/Drug Related	Comprehensive	28	\$ 2.86	10.73	0.33	0.22	8.63	12.74
Enforcement and Education: Unrestrained Crashes	Comprehensive	18	\$ 1.80	12.17	0.60	0.54	3.01	3.31
Education and Enforcement: Aggressive Driving Related Crashes	Comprehensive	46	\$ 4.73	170.93	2.50	1.23	1.89	3.85
Speed Enforcement Cameras: Aggressive Driving Related Crashes	Systemic	6	\$ 2.28	65.13	0.95	0.47	2.39	4.87
Pedestrian Countermeasures - Signalized Intersection Package (Leading Walk Phase, Pedestrian Countdown Heads, High Visibility Pavement Markings)	Traditional	9	\$ 0.09	7.56	0.78	0.19	0.11	0.45
Pedestrian Countermeasures - Stop-Controlled Intersection Package (Inlaid High Visibility Crosswalk Pavement Markings)	Traditional	4	\$ 0.02	0.54	0.04	0.01	0.42	1.48
Pedestrian Countermeasures - Non-Intersection Package (Inlaid High Visibility Crosswalk Pavement Markings and Raised Pedestrian Refuge Island)	Traditional	19	\$ 0.31	6.51	0.75	0.24	0.42	1.29
Pedestrian Countermeasures - Non-Intersection - HAWK	Traditional	5	\$ 0.24	8.39	0.96	0.31	0.25	0.77

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Countermeasure	Approach	Estimated Number of Improvements <sup>1</sup>	Associated Costs (\$ Million) <sup>2</sup>	Annual Targeted Crash Reduction <sup>3</sup>	Annual Estimated Serious Injury Crash Reduction	Annual Estimated Fatality Reduction	\$ (million) Required to Prevent/Reduce One Annual Serious Injury	\$ (million) Required to Save One Annual Life
Signalized Intersection less than 45mph - Basic Signal Package (ITE Clearance Time, Reflectorized Back Plate, Eliminate Late Night Flash)	Traditional	11	\$ 0.32	482.22	7.57	1.44	0.04	0.22
Stop-Controlled Intersection less than 45mph - Basic Stop-Controlled Package (STOP AHEAD Pavement Markings, Reflective Post Sleeves)	Traditional	19	\$ 0.09	127.57	1.68	0.38	0.05	0.23
Stop-Controlled Intersection less than 45mph - Install Flashing LED-Outlined Stop Signs	Traditional	8	\$ 0.10	70.09	0.92	0.21	0.11	0.49
Licensure Enforcement of All Drivers	Comprehensive	18	\$ 1.80	35.76	1.00	0.37	1.80	4.88
<b>Total Cost and Benefit (Local Roads)</b>								
<b>Total Cost (\$Million)</b>			<b>\$ 4.91</b>	-	-	-	-	-
<b>Annual Cost (\$ Million) for 5 years; Annual Benefit</b>			<b>\$ 2.98</b>	<b>1,045</b>	<b>18.86</b>	<b>5.88</b>	-	-

## Appendix E: Helpful Links

Resource Name	Author	Website
<b>A Systemic Approach to Safety – Using Risk to Drive Action</b>	Federal Highway Administration (FHWA), Office of Safety	<a href="http://safety.fhwa.dot.gov/systemic/">http://safety.fhwa.dot.gov/systemic/</a>
<b>Roadway Safety Noteworthy Practices Database</b>	FHWA, Office of Safety	<a href="http://rspcb.safety.fhwa.dot.gov/noteworthy/default.aspx">http://rspcb.safety.fhwa.dot.gov/noteworthy/default.aspx</a>
<b>FHWA Proven Safety Countermeasures</b>	FHWA, Office of Safety	<a href="http://safety.fhwa.dot.gov/provencountermeasures/">http://safety.fhwa.dot.gov/provencountermeasures/</a>
<b>Missouri’s Blueprint to Save More Lives (2012-2016)</b>	Missouri Coalition for Roadway Safety	<a href="http://www.savemolives.com/the-situation.html">http://www.savemolives.com/the-situation.html</a>
<b>Manual on Uniform Traffic Control Devices (MUTCD)</b>	FHWA	<a href="http://mutcd.fhwa.dot.gov/pdfs/2009r1r2/pdf_index.htm">http://mutcd.fhwa.dot.gov/pdfs/2009r1r2/pdf_index.htm</a>
<b>Missouri Local Public Agency Program</b>	MoDOT	<a href="http://www.modot.org/business/lpa/index.htm">http://www.modot.org/business/lpa/index.htm</a>
<b>Traffic Practices a Guidebook for Cities and Counties</b>	MoDOT, MCRS, MoLTAP	<a href="http://contribute.modot.mo.gov/safety/documents/TrafficPracticesaGuidebookforcitycountyagencies.pdf">http://contribute.modot.mo.gov/safety/documents/TrafficPracticesaGuidebookforcitycountyagencies.pdf</a>
<b>MoDOT’s Engineering Policy Guide: Category: 626 Rumble Strips</b>	MoDOT	<a href="http://epg.modot.mo.gov/index.php?title=Category:626_Rumble_Strips">http://epg.modot.mo.gov/index.php?title=Category:626_Rumble_Strips</a>
<b>Systemic Safety Project Selection Tool</b>	FHWA	<a href="http://safety.fhwa.dot.gov/systemic/about.htm">http://safety.fhwa.dot.gov/systemic/about.htm</a>
<b>Speed Enforcement Program Guidelines</b>	National Highway Traffic Safety Administration	<a href="http://www.nhtsa.gov/DOT/NHTSA/Traffic%20Injury%20Control/Articles/Associated%20Files/810915.pdf">http://www.nhtsa.gov/DOT/NHTSA/Traffic%20Injury%20Control/Articles/Associated%20Files/810915.pdf</a>
<b>Speed Enforcement Camera Systems Operational Guidelines</b>	National Highway Traffic Safety Administration	<a href="http://www.nhtsa.gov/DOT/NHTSA/Traffic%20Injury%20Control/Articles/Associated%20Files/810916.pdf">http://www.nhtsa.gov/DOT/NHTSA/Traffic%20Injury%20Control/Articles/Associated%20Files/810916.pdf</a>
<b>Guidelines for Developing a Municipal Speed Enforcement Program</b>	National Highway Traffic Safety Administration	<a href="http://www.nhtsa.dot.gov/people/injury/enforce/program.htm">http://www.nhtsa.dot.gov/people/injury/enforce/program.htm</a>

**Appendix F: Pedestrian Action Plan**

(Pedestrian Action Plan Placeholder – insert plan starting on this page)