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East Michigan Council of Governments Regional Traffic Safety Plan

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EMCOG
EAST MICHIGAN COUNCIL OF GOVERNMENTS
ARENAC*BAY*CLARE*GLADWIN*GRATIOT*HURON*IOSCO*ISABELLA*MIDLAND OGEMAW*ROSCOMMON*SAGINAW*SANILAC*TUSCOLA & SAGINAW CHIPPEWA INDIAN TRIBE

Acknowledgements

The 2017 Regional Traffic Safety Plan for the East Michigan Council of Governments region (Arenac, Bay, Clare, Gladwin, Gratiot, Huron, Iosco, Isabella, Midland, Ogemaw, Roscommon, Saginaw, Sanilac, and Tuscola counties) was developed with local backing and supported by the Michigan Department of Transportation and Hubbell, Roth & Clark, Inc. Thank you to the stakeholders who provided insight and guidance to complete this plan.

Jay Anderson, Bay City Area Transportation Study

Neil Belanger, Roscommon CRC

Bryan Benchley, Hampton Township

Pamela Blazo, MDOT Local Agency Programs

Trevor Block, MDOT Huron TSC

Maja Bolanowska, Midland Area Transportation Study

Bruce Bolen, Iosco CRC

Dennis Bouchard,Saginaw CRC

Kelly Bourdow, St. Mary's of Michigan Trauma

Gregg Brunner, MDOT Bay Region

Kerri Chernauckas, St. Mary's of Michigan Trauma

David Engelhardt, EMCOG

Robb Falls, Sinilac CRC

Sue Fortune, EMCOG

Phil Grimaldi, Saginaw Metropolitan Area Transportation Study

David Hoeh, MDOT Mt. Pleasant TSC

Dave Hundley, MDOT Bay City TSC

Kimberly Lariviere, MDOT Traffic & Safety

Beth London, City of Saginaw

Melissa Michaels, MADD Michigan

Dawn Miller, MDOT Traffic Incident Management

Dave Pettersch, Gladwin CRC

Lisa Radtke, MADD Michigan

Jay Reithel, MDOT Bay Region

Jenean Robbins, MDOT Bay Region

Timothy Robbins,M-CRASH Group, LLC

Nadeesha Samaratunga, MDOT Traffic & Safety

Kristen Skladd, WJRT-TV

Brian Stark, Bay City Area Transportation Study

Brandon Wegener, MDOT Mt. Pleasant TSC

Joe Wisniewski, Saginaw CRC

Michele Zawerucha, Tuscola CRC

Kim Zimmer, MDOT Bay Region

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Executive Summary

The East Michigan Council of Governments Regional Traffic Safety Plan is a framework for addressing the region's key safety needs and reducing fatalities and serious injuries on all applicable roads. The plan encompasses all counties served by the East Michigan Council of Governments and includes Arenac, Bay, Clare, Gladwin, Gratiot, Huron, Iosco, Isabella, Midland, Ogemaw, Roscommon, Saginaw, Sanilac, and Tuscola Counties. The framework is developed in conjunction with the State of Michigan Strategic Highway Safety Plan and is based on guidance provided in the Federal Highway Administration document "Developing Safety Plans: A Manual for Local Rural Road Owners". The development of the safety plan is a data-driven and coordinated multi-disciplinary effort involving multiple local, regional, and state agencies, and is guided by a cyclical six-step process which includes:

1. Establish Leadership
2. Analyze Safety Data
3. Determine Emphasis Areas
4. Identify Strategies
5. Prioritize and Incorporate Strategies
6. Evaluate and Update Regional Safety Plan

This report presents the first five steps of the process. In comparison, the final step consists of regular evaluation and plan updates. As such, the intent of this safety plan is to be a living and breathing document.

A key component of this safety plan is the identification of key emphasis areas which contribute to crashes in the region. Their identification is based on thorough analysis of regional and local safety conditions, historical trends, and significant stakeholder input. Four high priority and eleven additional emphasis areas were identified throughout this process. These include:

High priority emphasis areas:

- Lane Departure
- Intersection Safety
- Pedestrian and Bicycle Safety
- Drivers Age 24 and Younger

Additional emphasis areas:

- Traffic Incident Management
- Commercial Motor Vehicle Safety
- Occupant Protection
- Access Management
- Distracted Driving
- Impaired Driving
- Senior Mobility Age 65 and Older
- Motorcycle Safety
- Speed Management
- Traffic Safety Engineering
- Traffic Records and Information Systems

Potential countermeasures and strategies listed for each identified emphasis area are developed using the 4 E's of Safety approach (engineering, enforcement, education, and emergency services). Detailed information on select countermeasures can be found in the appendices listed at the end of this report.

Several statistical and geographic information systems techniques were additionally undertaken to assist in the prioritization and implementation process of this safety plan. This resulted in the identification of potential high risk areas, segments and intersections based on crash frequency and crash rate methods. Detailed information on each of these can be found in the accompanying appendices.

1.0 Introduction

1.1 Background

The purpose of the East Michigan Council of Governments (EMCOG) Regional Traffic Safety Plan (RTSP) is to develop a framework for addressing the region's key safety needs and reduce fatalities and serious injuries on all applicable roads. The occurrence of these events is not only a personal tragedy, but also impacts the region's economy and wellbeing. According to the Michigan Traffic Crash Facts, in 2015, one out of 10,303 people in Michigan were killed in a traffic crash, and one out of every 132 was injured[1]. These numbers tend to occur disproportionately in rural areas despite the fact that approximately 25% of the Michigan population lives in rural regions[2]. The area under this plan encompasses all counties served by EMCOG and includes Arenac, Bay, Clare, Gladwin, Gratiot, Huron, Iosco, Isabella, Midland, Ogemaw, Roscommon, Saginaw, Sanilac, and Tuscola Counties. **Figure 1** illustrates the geographic extent of the study area. Because Roscommon, Ogemaw and Iosco Counties work more closely with MDOT's North Region, they will only be covered in general terms in this plan and will be analyzed more thoroughly in the Northeast Michigan Council of Governments RTSP.

Figure 1: EMCOG Regional Traffic Safety Study Area

The EMCOG RTSP has been developed in concert with a comprehensive list of local and regional partners, in conjunction with the State of Michigan Strategic Highway Safety Plan (SHSP) and the U.S. Department of Transportation (DOT) Federal Highway Administration (FHWA) guidance on developing local safety plans. The region's key safety needs are data-driven and identified via coordination with local, regional, and state agencies. Safety needs are addressed by incorporating appropriate engineering, enforcement, education, and emergency services measures, also known as the 4 E's of Safety. The 4 E's of Safety represent the base framework of this study. The intent of the safety plan is to be a living document which is continuously evaluated and maintained to address the changing transportation safety needs of the region. Its proper implementation can be an effective tool for saving lives, reducing injuries and minimizing economic loss in the region's transportation network.

1.2 Mission, Vision, & Goals

The vision of the EMCOG is to:

> *"…unite the region's elected officials, planning professionals, and the public around a common vision of making a great region even greater. EMCOG strives to build consensus on enhancing the economy, improving transportation, protecting the environment, promoting placemaking and expanding its focus into other areas that are consistent with the provisions of its enabling legislation".*
>
> - Sources: East Michigan Council of Governments, http://www.emcog.org/about.asp, Accessed May, 2017

EMCOG recognizes that transportation is critical to connecting and moving people, goods and services. Given the wide umbrella of transportation, EMCOG has identified the following transportation issues affecting the region:

> *"…congestion, rural traffic safety, maintaining mobility and growth in the region, balancing the need for travel with the quality of life in communities, providing accessible travel options, sustainable funding to maintain and expand our transportation system, connecting communities through non-motorized trails and maintaining our environment."*
>
> - Sources: East Michigan Council of Governments, http://www.emcog.org/transportation.asp, Accessed May, 2017

This vision is consistent with MDOT's general mission to *"Provide the highest quality integrated transportation services for economic benefit and improved quality of life"* and the State of Michigan SHSP vision of moving *"Toward Zero Deaths on Michigan Roadways".*

2.0 Safety Partners/Stakeholders

The development of this safety plan was a coordinated effort involving multiple local, regional, and state agencies. Throughout the course of a year several meetings were held with interested stakeholders to identify the needs and develop the core foundation of this safety plan. The following is a list of the agencies which were consulted throughout the development process of this plan. This list is by no means exhaustive and should be updated throughout the implementation and maintenance of the safety plan.

- Bay City Area Transportation Study
- City of Mt. Pleasant
- City of Saginaw
- East Michigan Council of Governments
- Gladwin County Road Commission
- Hampton Township
- Iosco County Road Commission
- M-CRASH Group, LLC
- MDOT Bay City Transportation Service Center
- MDOT Bay Region
- MDOT Huron Transportation Service Center
- MDOT Local Agency Programs
- MDOT Mt. Pleasant Transportation Service Center
- MDOT Traffic & Safety
- MDOT Traffic Incident Management
- Midland Area Transportation Study
- Mothers Against Drunk Driving (MADD) Michigan
- Roscommon County Road Commission
- Saginaw Chippewa Indian Tribe of Michigan
- Saginaw County Road Commission
- Saginaw Metropolitan Area Transportation Study
- Sanilac County Road Commission
- St. Mary's of Michigan Trauma
- Tuscola County Road Commission
- WJRT-TV

3.0 Methodology

The EMCOG RTSP is a data-driven and coordinated multi-disciplinary effort involving multiple local, regional, and state agencies. The process is guided by a six-step process as identified in the FHWA guide on developing safety plans (**Figure 2**). At the inception of this process lies the identification of the leadership to guide the safety plan process. This is followed by extensive safety data analysis, determination of regional emphasis areas, identification of countermeasures and strategies as it pertains to the identified emphasis area, prioritization of the strategies, and evaluation and updates to the regional safety plan. This development process is cyclical, thus following the evaluation of the safety plan the process reverts backs to the first step. This development process was followed throughout the creation of this report. The primary components were both data-driven and involved significant stakeholder input.

Figure 2: EMCOG Regional Traffic Safety Plan Development Process

In order to realize the intent of the data-driven section, traffic crash data was obtained from MDOT for 2010-2014 and was supplemented with data obtained from the Michigan Traffic Crash Facts. These five years represent the most recent years of available crash data during the beginning phases of the development of this report. Only non-deer, non-animal related crashes were considered in the analysis to minimize the element of randomness associated with these types of crashes. Information obtained during the data analysis phase was supplemented with information and discussions occurring during the several meetings held with the various stakeholders of the multiple local, regional, and state agencies.

Several appropriate statistical and geographical techniques were used to assess traffic crashes in the EMCOG region. These included analyses of the region as a whole to develop baseline data, as well as a per county basis assessment of each of the fourteen counties to identify potential location specific trends in the data. Historical tendencies were also examined to assess any changes in the roadway safety in the region. In these cases, moving rolling averages were utilized to minimize random yearly fluctuations in the traffic crashes. Geographical Information Systems (GIS) methods were also utilized to identify location specific patterns or hot spots, as well as to identify those segments or intersections most susceptible to traffic crashes. When applicable and/or feasible, crashes were assessed in terms of crash frequency, crash rate, and differentiated between the various types of crashes to present a holistic representation of transportation safety in the region.

Identification of potential safety countermeasures and strategies based on the data analysis and stakeholder involvement was established using the 4 E's of Safety as the base framework. The 4 E's of Safety include engineering, enforcement, education, and emergency services. Their definition is presented in **Figure 3**.

Engineering	• Infrastructure design and improvements to prevent and/or minimize crashes and crash severities
Enforcement	• Enforcement of laws utilizing visible police presence and/or supplemented by technology to deter motorists from unsafe drivign behavour
Education	• Provide drivers and related parties with information on roadway safety such as the benefits of wearing seatbelts, risks associated with alchol consumption and driving and related
Emergency	• Improve safety and minimize injury severity by providing adequate response and quality care when responding to traffic incidents

Figure 3: The 4 E's of Safety

The subsequent chapters present a regional traffic safety assessment, detailed description of the identified emphasis areas, safety plan implementation and evaluation, and next steps. Additional information is provided in the appendices at the end of this report. These include a regional crash type matrix, summary of select engineering countermeasures, lists of those segments and intersections most susceptible to traffic crashes, and county crash density maps of various crash patterns.

4.0 Regional Analysis

The regional analyses section is presented to provide a historical context to the traffic crash characteristics in the region, as well as a baseline condition for the region as a whole. The former is of particular importance in order to allow agencies to track progress following the implementation of the identified countermeasures and/or strategies. Five primary traffic crash characteristics presented as five-year rolling averages are provided under this section. These include:

- Number of fatalities
- Rate of fatalities per 100 million vehicle mile traveled (VMT)
- Number of serious injuries
- Rate of serious injuries per 100 million VMT
- Number of non-motorized fatalities and non-motorized serious injuries

In addition to these five primary measures, additional type crashes were assessed for the region. These were identified upon discussions with stakeholders at the various meetings held throughout this process. Similar to the data throughout this report, deer or animal involved crashes are excluded from the regional crash data assessment. In certain scenarios, historical crash data from 2005-2014 was included to provide a more holistic approach towards the historical trends.

4.1 Regional Crash Analysis

Figure 4 below illustrates the number of 2005-2014 fatal and injury crash frequencies in terms of five-year rolling averages for the EMCOG region. The data indicates that the region has experienced almost linear monotonic decreases in both fatal and serious injury crashes between 2005 and 2014. On average the five-year rolling average reductions were approximately 3.4% for fatal and 9.2% for serious injury crashes.

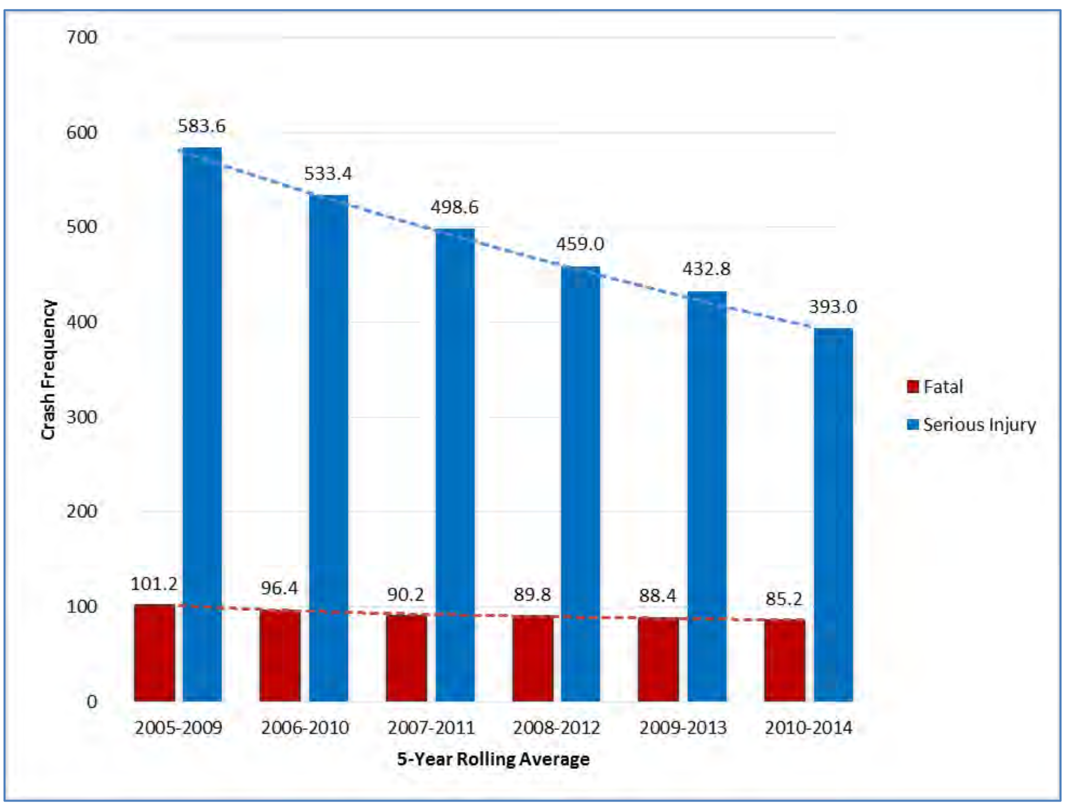


Figure 4: Number of Fatal and Injury Crashes for EMCOG, 2005-2014 Five-Year Rolling Average

The crash rate of the fatal and serious injury crashes in the EMCOG region between 2005 and 2014 is presented in **Figure 5**. The crash rate in this case is expressed in terms of 100 million Vehicle Miles Traveled (VMT) and is presented in terms of five-year rolling averages. Similar to the regional crash frequencies, serious injury crashes per 100 million VMT declined linearly between 2005 and 2014 with an average reduction of approximately 8.6%. Fatal crashes per 100 million VMT followed a similar though less linear relationship with an average reduction of approximately 5.8%.

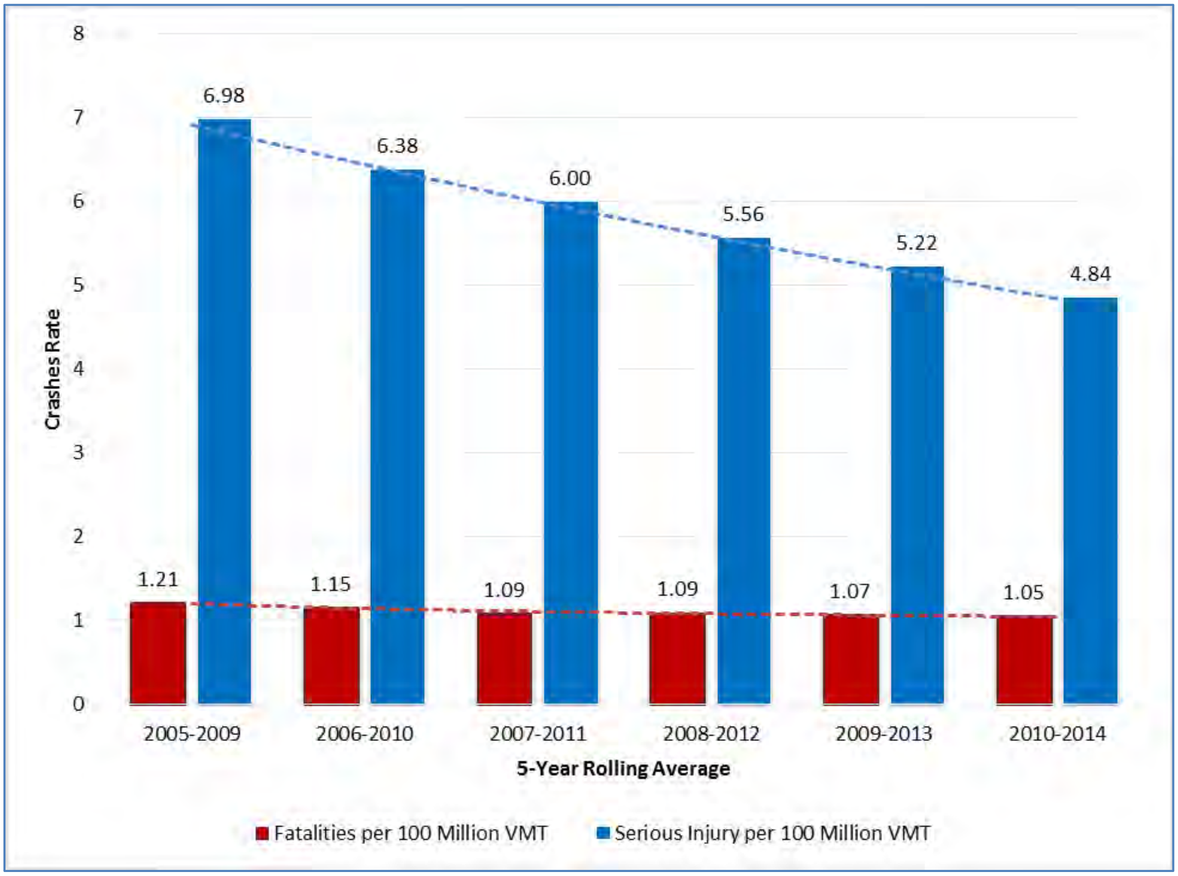


Figure 5: Fatal and Injury Crashes per 100 Million VMT for EMCOG, 2005-2014 Five-Year Rolling Average

Lastly, **Figure 6** illustrates the frequency of non-motorized fatal and serious injury crashes in the EMCOG region. Similar to the crash frequency and crash rate per 100 million VMT figures, non-motorized fatal and injury crashes have experienced an almost constant logarithmic decline between 2005 and 2014. These crashes declined with an average rate of 4.7% between the historical time period, with the largest drop occurring between the 2005 and 2006 rolling average.

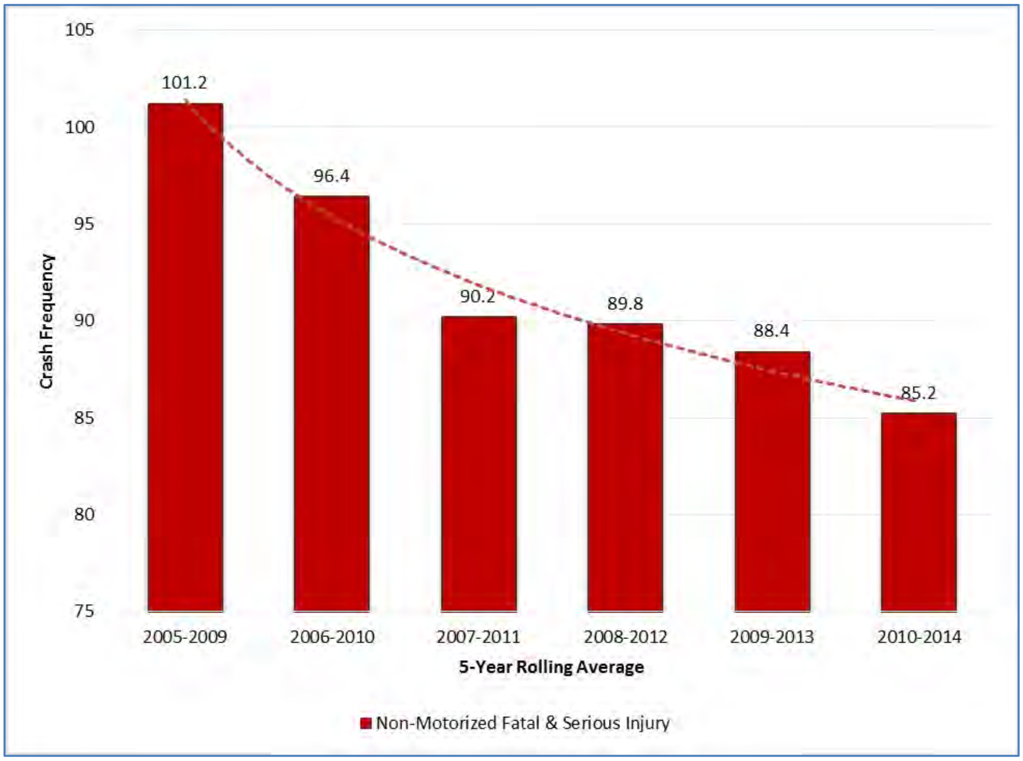


Figure 6: Non-Motorized Fatal and Injury Crashes for EMCOG, 2005-2014 Five-Year Rolling Average

4.2 Supplementary Regional Crash Analysis

In addition to the primary historical traffic crash characteristics, the supplementary regional crash section presents additional benchmark statistics to help provide context to the current crash statistical conditions in the EMCOG region. These include regional and county based crash severity distributions assessments, descriptive statistics on lane departure crashes, and alcohol related crashes. **Figure 7** illustrates the crash severity distribution for the EMCOG region between 2010 and 2014. The data illustrates that 0.6% of the crashes were fatal crashes, 2.6% were serious injury crashes, 20.9% were crashes involving other levels of injuries, while the remaining 75.9% were property damage only (PDO) crashes.

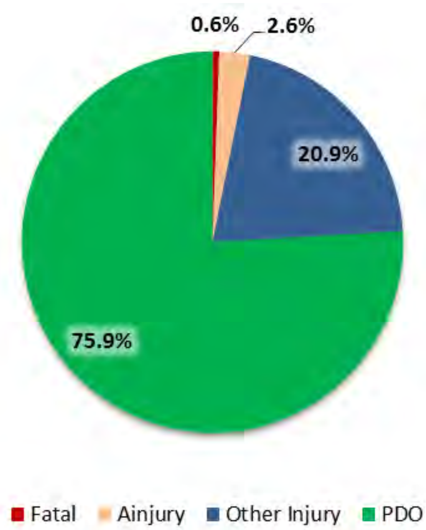


Figure 7: EMCOG Crash Severity Distribution, 2010-2014

In terms of crash distribution within the region, the data shows variability between each county (**Table 1**). As expected, counties with the higher VMT on their roadway network generally share the highest proportion of total, fatal and/or injury crashes. Out of the fourteen counties in the EMCOG region, Saginaw, Bay, Midland, and Isabella Counties experienced almost 70% of the total crashes, 52% of the fatalities, and 48% of the serious injuries occurring in the region between 2010 and 2014.

Table 1: EMCOG Crash Distribution by County, 2010-2014

County	Total Crashes		Fatal Crashes (K)		Serious Injury Crashes (A)	
	No.	Percent	No.	Percent	No.	Percent
Arenac	1,530	2.0%	16	3.8%	83	4.2%
Bay	12,051	16.0%	61	14.3%	219	11.1%
Clare	2,689	3.6%	19	4.5%	116	5.9%
Gladwin	1,529	2.0%	14	3.3%	109	5.5%
Gratiot	3,408	4.5%	24	5.6%	121	6.2%
Huron	2,581	3.4%	19	4.5%	69	3.5%
Iosco	1,796	2.4%	17	4.0%	62	3.2%
Isabella	8,514	11.3%	38	8.9%	228	11.6%
Midland	8,627	11.4%	33	7.7%	136	6.9%
Ogemaw	1,807	2.4%	18	4.2%	94	4.8%
Roscommon	2,081	2.8%	20	4.7%	79	4.0%
Saginaw	22,585	29.9%	91	21.4%	356	18.1%
Sanilac	2,211	2.9%	18	4.2%	100	5.1%
Tuscola	4,093	5.4%	38	8.9%	193	9.8%
EMCOG (compared to Michigan)	**75,502**	**6.4%**	**426**	**10.1%**	**1,965**	**9.0%**

The distribution of the crashes by county within the EMCOG region can be best illustrated by crash rates. Crash rate is a measure of safety which normalizes crash data by taking into account traffic volume. Similar to the previous primary crash rate measures, crash rates on a by county basis are presented in terms of 100 million VMT. Values are presented for both fatal and serious injury crashes combined. **Figure 8** illustrates the fatal and serious injury crashes by county for 100 million VMT between 2010 and 2014. The regional and statewide average crash rate are indicated in the figure as well for comparative purposes.

The data illustrates that the average county-based regional crash rate for fatal and serious injuries is slightly higher than the statewide average. On a per county basis, ten of the fourteen EMCOG counties exceed the regional average. Among these, Gladwin, Tuscola, Isabella, Ogemaw, Clare, and Arenac Counties reported the highest combined fatal and serious injury rate.

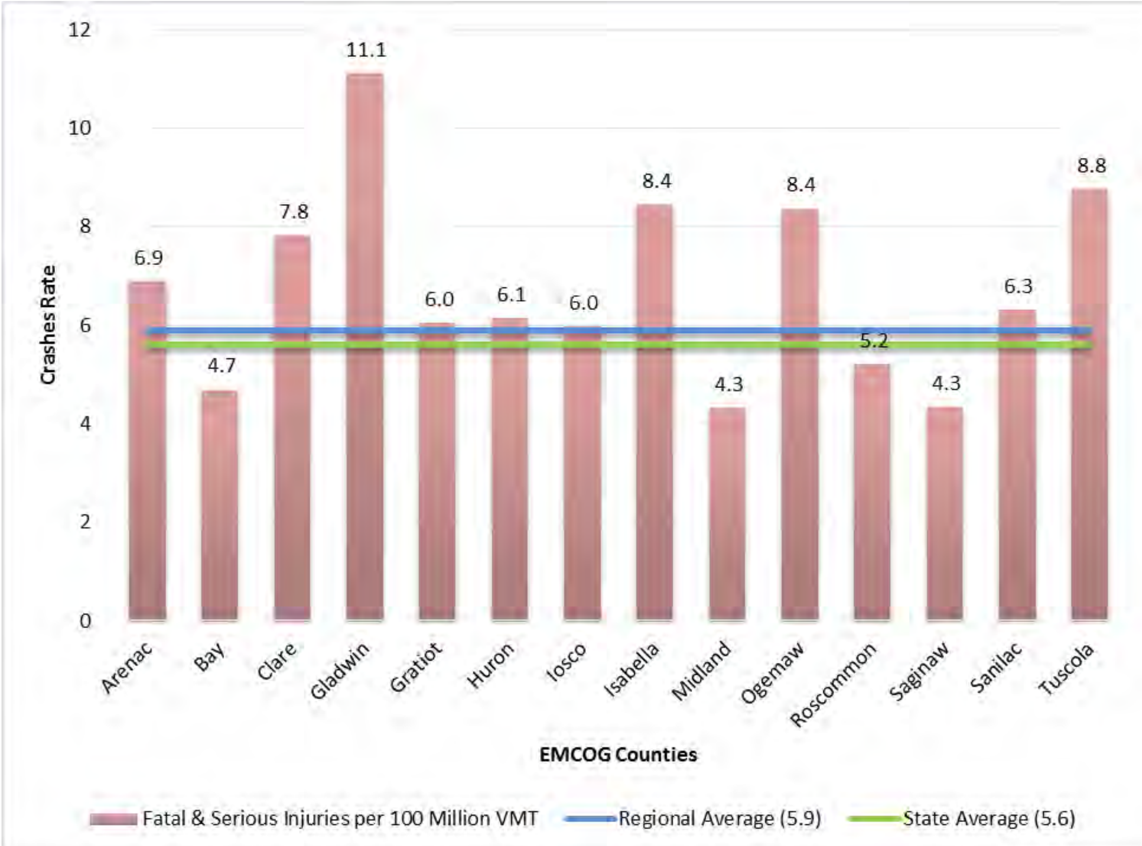


Figure 8: EMCOG Counties Fatal and Injury Crashes per 100 Million VMT, 2010-2014

In addition to the overall fatal and serious injury crashes, regional individual crash types were examined based on the comments and discussions from the several stakeholder meetings. These include single vehicle lane departure crashes and impaired driving crashes involving alcohol consumption. **Figures 9** and **10** illustrate single vehicle lane departure and alcohol involved crashes for the EMCOG region between 2005 and 2014.

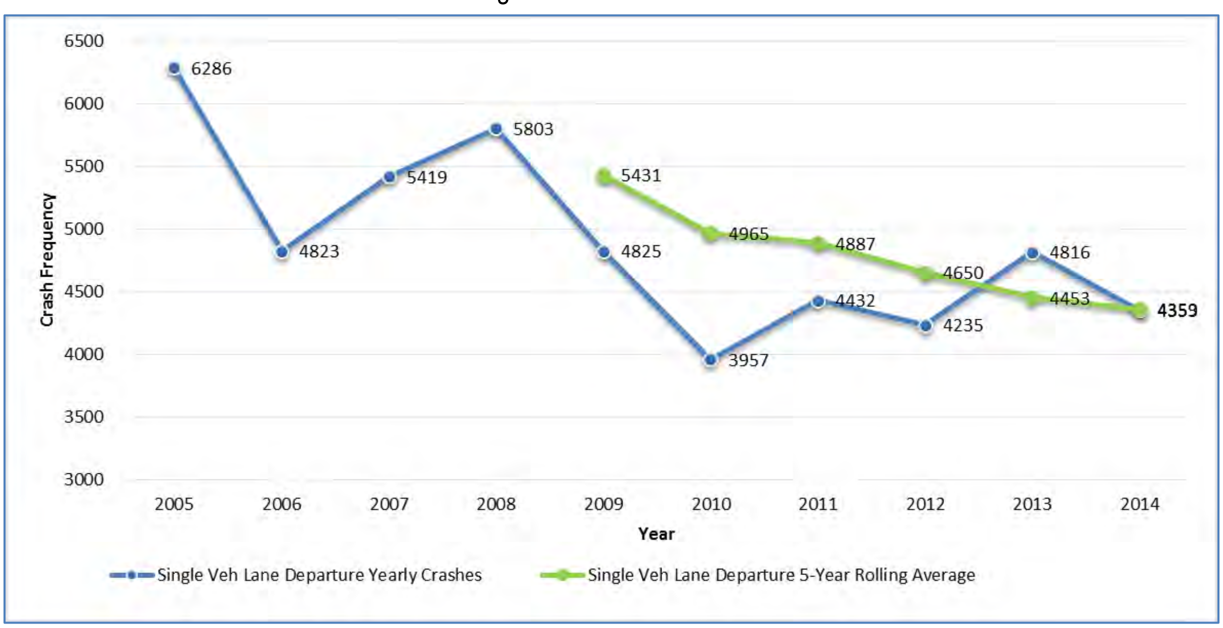


Figure 9: EMCOG Single Vehicle Lane Departure Crashes, 2005-2014

Figure 10: EMCOG Alcohol Related Crashes, 2005-2014

The data illustrates that crashes involving single vehicle lane departures as well as impaired driving crashes as a result of alcohol consumption have been declining between 2005 and 2014. The decline is highest for impaired driving crashes involving alcohol as opposed to single vehicle lane departure crashes. While trends for both crash types are pointing towards a positive direction, caution should be used when projecting the future results, in particular for single vehicle lane departure crashes which are characterized by significant yearly variations.

5.0 Emphasis Areas

A key component of this traffic safety plan is to identify key emphasis areas which contribute to crashes in the region. An emphasis area is an area of opportunity to improve safety through comprehensive strategies using the 4-Es approach (engineering, enforcement, education, and emergency services)[3]. The emphasis areas for this RTSP were identified based on an inclusive process which consisted of information collected at stakeholder meetings, crash data analysis (**Table 2**), as well as coordination with the emphasis areas identified in the existing Michigan Strategic Highway Safety Plan (SHSP).

Four high priority and 11 additional emphasis areas were identified throughout this process, all of which are also included in the Michigan SHSP[4]. This chapter presents a list of the identified high priority and additional emphasis areas. Each subsection provides additional information for each emphasis area along with specific applicable countermeasures, which if implemented can have a positive impact on safety and further the objectives outlined within this plan. Additional information for each of the potential countermeasures is provided in **Appendix B**. It should be noted that countermeasures listed under an emphasis area are not exclusive to a particular emphasis area, but may also have an impact on additional ones. To limit the repetitiveness of information, those countermeasures applicable to multiple emphasis areas are defined initially and are only listed in subsequent mentions throughout this chapter.

High priority emphasis areas:

- Lane Departure
- Intersection Safety
- Pedestrian and Bicycle Safety
- Drivers Age 24 and Younger

Additional emphasis areas:

- Traffic Incident Management
- Commercial Motor Vehicle Safety
- Occupant Protection
- Access Management
- Distracted Driving
- Impaired Driving
- Senior Mobility Age 65 and Older
- Motorcycle Safety
- Speed Management
- Traffic Safety Engineering
- Traffic Records and Information Systems

Table 2: EMCOG Emphasis Area Crash Percentages, 2010-2014

Involvement	Total Crashes	Fatal Crashes (K)	Serious Injury Crashes (A)
Alcohol	6%	34%	19%
Bicycle	1%	3%	2%
Intersection	38%	26%	30%
Intersection - Signal	14%	4%	7%
Intersection - Stop-controlled	11%	17%	15%
Intersection - Yield	0%	0%	0%
Lane departure	32%	55%	49%
Lane departure - Single Vehicle	29%	42%	41%
Lane departure - Multi Vehicle	2%	12%	7%
Lane departure - Parked Vehicle	1%	1%	1%
Motorcycle	2%	11%	10%
Pedestrian	1%	9%	6%
Senior driver (65 and older)	18%	28%	18%
Truck/Bus	5%	7%	4%
Young driver (24 and younger)	40%	30%	34%

5.1 Lane Departure

Background

A lane departure crash, also known as a roadway departure crash, is defined as a crash which occurs after a vehicle crosses an edge line, center line, or otherwise leaves the travel away. While lane departure crashes generally comprise a relatively moderate number crashes, they result in a disproportionate percentage of fatalities and severe injuries. As of 2015, lane departure crashes comprised more than half of all traffic fatalities in the United States. The most severe types occur when a vehicle crosses into the opposing lane and strikes an oncoming vehicle[5]. The severity is further compounded given the vehicle speeds at the time collision. **Table 3** and **Table 4** provide the single vehicle lane departure and multiple vehicle lane departure crashes respectively occurring in the EMCOG region by county.

Single Vehicle Lane Departure

Table 3: Single Vehicle Lane Departure Crashes by County, 2010-2014

Location	Total		Fatal (K)		Serious Injury (A)	
	No.	Percent	No.	Percent	No.	Percent
Arenac	765	50%	8	50%	49	59%
Bay	2,727	23%	19	31%	79	36%
Clare	1,340	50%	11	58%	55	47%
Gladwin	819	54%	8	57%	62	57%
Gratiot	1,230	36%	12	50%	45	37%
Huron	1,083	42%	4	21%	35	51%

Table 3 (cont'd)

Iosco	703	39%	8	47%	39	63%
Isabella	2,020	24%	16	42%	77	34%
Midland	2,009	23%	9	27%	51	38%
Ogemaw	870	48%	11	61%	46	49%
Roscommon	970	47%	14	70%	35	44%
Saginaw	4,496	20%	35	38%	114	32%
Sanilac	911	41%	4	22%	38	38%
Tuscola	1,850	45%	20	53%	82	42%
EMCOG	**21,793**	**29%**	**179**	**42%**	**807**	**41%**
Michigan	**222,710**	**19%**	**1,448**	**34%**	**7,076**	**32%**

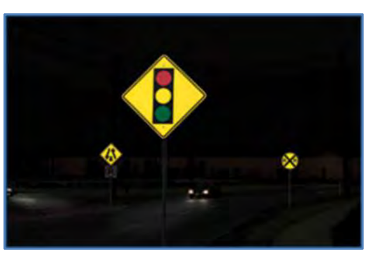
Key observations:

- 42% and 41% of all fatal and serious injuries in the region are a result of single vehicle lane departures.
- More than ½ of all crashes in Arenac, Clare, and Gladwin counties involve a single vehicle lane departure.
- More than ½ of all fatal crashes in Arenac, Clare, Gladwin, Gratiot, Ogemaw, Roscommon, and Tuscola Counties involve a single vehicle lane departure.
- More than ½ of all serious injury crashes in Arenac, Gladwin, Huron, and Iosco Counties involve a single vehicle lane departure crash.
- Single vehicle lane departure crashes and resulting fatalities and serious injuries in the region are on average greater than the overall statewide average.
- Approximately 73% of single vehicle lane departure crashes involve a fixed-object.

Countermeasures and Strategies

Advanced curve warning signs: Horizontal curves are part of the roadway geometry. However depending on the sharpness of the curve and other associative conditions they can be correlated with a disproportionate number of crashes. To improve the safety of these curves, advanced warning signs are typically placed prior to the horizontal curve to alert drivers of a sudden change in geometry which may not be expected or visible, thus prevent potential lane departures. Typical advanced curve warning signage includes the W1-1, W12, W1-3, W1-4, and W1-5.

Centerline and shoulder rumble strips: Rumble strips are a road safety countermeasure which warn drivers of potential danger via vibration and noise transmitted from the wheel of the vehicle to the vehicle's interior. They are particularly useful in reducing lane departure crashes. They can be installed over centerlines or on the shoulder. When installed over a centerline, rumble strips alert drivers that they are crossing on the opposing direction lane and thus help avoid head-on or sideswipe opposite collisions. When installed on a shoulder, rumble strips alert drivers that they have drifted from the travel way and thus help reduce run-off-the-road crashes.



Fluorescent yellow sheeting on warning signs: The use of fluorescent yellow sheeting in place of the standard yellow sheeting on warning signs is a relatively inexpensive method to increase the luminance and visibility of the applicable traffic signs on the roadway. Thus drivers may be better informed and alerted of potential hazardous conditions along the roadway. The improved visibility is applicable in both daytime and particularly nighttime conditions, and for drivers of all ages.

Paved shoulders: Paved shoulders provide additional room for vehicle recovery along a roadway. They allow the driver to correct the vehicle's path after leaving the lane but before the vehicle runs off the road.

Pilot Areas: Pilot areas consist of potential countermeasure or strategies still in the research stage.

Cable barrier on shoulder: Cable barriers consist of high-tension steel cables supported by a weak post which prevent vehicles from departing the travel way. While traditionally cable barriers are installed along medians to prevent median crossover accidents, they may be also installed along shoulders to protect vehicles from colliding with fixed objects and/or avoiding steep slopes in the clear zone. Unlike rigid barriers or semi-rigid barriers such as guardrails, cable barriers include low installation and maintenance costs, and allow for a soft impact upon collision with adequate redirection capabilities. While situational, depending on the type, speed, and force of impact the cable barrier may not be able to fully prevent a lane departure crash and may become ineffective following a high speed, high force impact. Thus the installation of cable barriers along a shoulder may still require adequate offsets from a fixed object or steep slopes.

Connected vehicle technologies:

Connected vehicle technology is arguably the most promising technology advancement with the potential to revolutionize all elements of the transportation system. By making use of innovations in technology such as wireless communications, advanced sensors, GPS navigation, and smart infrastructure elements, connected vehicles will have the capability to identify threats on the roadway and disseminate the information not only to the driver, but also share the information among all vehicles occupying a specific space in the roadway so that every vehicle would be aware of the location of other nearby vehicles. While connected vehicle technology is still in the early phases of implementation, the National Highway Traffic Safety Administration (NHTSA) estimates that's connected vehicles may reduce up to 80% of crashes not involving an impaired driver[6], and could be particularly effective in reducing crashes associated with human error.

Safety edge pavement treatments: Safety edge is the reshaping of the edge of the pavement into a 30 degree angle during installation. The angled safety edge avoids vertical drop offs if the granular shoulder shifts from the pavement edge. Safety edges are a simple and effective way to reduce fatal crashes on high speed roadways as the angle makes it safer and easier for drivers to reenter the roadway following a roadway departure.

Wet reflective pavement markings: Water can significantly reduce pavement marking retroflectivity which affects the ability of the drivers to stay in their lane or on the roadway. The effect is particularly exacerbated during nighttime. To rectify or ameliorate this condition, wet reflective pavement markings are applied on top of existing pavement markings of standard material, consisting of paint, tape or thermoplastic material.

Multiple Vehicle Lane Departure

Table 4: Multiple Vehicle Lane Departure Crashes by County, 2010-2014

Location	Total		Fatal (K)		Serious Injury (A)	
	No.	Percent	No.	Percent	No.	Percent
Arenac	38	2%	0	0%	5	6%
Bay	255	2%	6	10%	13	6%
Clare	113	4%	3	16%	11	9%
Gladwin	35	2%	1	7%	5	5%
Gratiot	85	2%	4	17%	12	10%
Huron	60	2%	3	16%	0	0%
Iosco	55	3%	0	0%	3	5%
Isabella	200	2%	4	11%	12	5%
Midland	198	2%	6	18%	16	12%
Ogemaw	45	2%	1	6%	2	2%
Roscommon	55	3%	0	0%	6	8%
Saginaw	490	2%	19	21%	29	8%
Sanilac	71	3%	4	22%	5	5%
Tuscola	119	3%	2	5%	17	9%
EMCOG	**1,819**	2%	**53**	**12%**	**136**	**7%**
Michigan	**30,970**	3%	**514**	**12%**	**1,365**	**6%**

Key observations:

- Multiple vehicle lane departure crashes for the EMCOG region are similar to the statewide average.
- More than 20% of fatal crashes in Saginaw and Sanilac Counties involve multiple vehicle lane departures.
- Approximately 54% of multiple vehicle lane departures are side-swipe opposite crashes.
- Approximately 41% of multiple vehicle lane departures are head-on crashes.

Countermeasures and Strategies

Advanced curve warning signs

Centerline and shoulder rumble strips

Fluorescent yellow sheeting on warning signs

Paved shoulders

Safety edge pavement treatments

Wet reflective pavement markings

5.2 Intersection Safety

Background

Intersections are planned points of conflict in a transportation network where motorized and non-motorized users cross paths as they use the facility or turn from one route to another. While intersections comprise a minor portion of the physical roadway network, they account for more than 25% of all crashes in the United States[7]. Since intersections are also a major cause for user delay among other roadway characteristics, they are a critical point in terms of roadway operations in addition to safety. **Table 5** and **Table 6** provide descriptive statistics on intersection related crashes for the EMCOG region by county.

Table 5: Intersection Crashes by County, 2010-2014

Location	Total		Fatal (K)		Serious Injury (A)	
	No.	Percent	No.	Percent	No.	Percent
Arenac	255	17%	2	13%	13	16%
Bay	4,354	36%	20	33%	71	32%
Clare	528	20%	2	11%	22	19%
Gladwin	302	20%	1	7%	18	17%
Gratiot	935	27%	2	8%	25	21%
Huron	626	24%	6	32%	22	32%
Iosco	539	30%	3	18%	14	23%
Isabella	3,275	38%	14	37%	88	39%
Midland	3,954	46%	10	30%	45	33%
Ogemaw	489	27%	5	28%	29	31%
Roscommon	450	22%	3	15%	14	18%
Saginaw	10,880	48%	22	24%	136	38%
Sanilac	613	28%	6	33%	30	30%
Tuscola	1,307	32%	14	37%	65	34%
EMCOG	**28,507**	**38%**	**110**	**26%**	**592**	**30%**
Michigan	**420,766**	**36%**	**1,096**	**26%**	**7,428**	**34%**

Table 6: Crashes by Intersection Types, 2010-2014

Location		Total		Fatal (K)		Serious Injury (A)	
		No.	Percent	No.	Percent	No.	Percent
EMCOG	Total Intersection	28,507	38%	110	26%	592	30%
	Signalized Intersection	10,728	14%	19	4%	133	7%
	Stop-controlled Intersection	8,468	11%	73	17%	297	15%
Michigan	Total Intersection	420,766	36%	1,096	26%	7,428	34%
	Signalized Intersection	205,923	18%	375	9%	3,129	14%
	Stop-controlled Intersection	96,150	8%	403	10%	2,337	11%

Key observations:

- 26% of all fatal crashes in the EMCOG region occur at an intersection.
- 30% of all serious injury crashes in the EMCOG region occur at an intersection.
- Approximately 66% of all fatal intersection crashes in the region occur at stop-controlled intersections.

Countermeasures and Strategies

Connected vehicle technologies

Intersection signage: Intersection signs can inform drivers of what lies downstream of particular location, conditions of a downstream intersection, or additional information related to the intersection location. Consequently, depending on the information the signs are relaying and physical aspects of the site, intersection signage can play an important safety role.

Advanced intersection signage: Advanced intersection signs provide advance warnings to drivers of an upcoming intersection downstream of the roadway. They can consist of static signs (i.e. stop ahead or signal ahead signs) or dynamic signs such as advance warning flashers typically mounted on a warning sign to further alert drivers of upcoming conditions. The latter can flash regardless of the status of the downstream signal, or alert drivers of a potential signal change in the downstream signal.

Overhead street name signs: Overhead street name signs at an intersection provide the driver with information regarding the intersection's cross streets. While existing literature has examined the safety impacts of advanced street name signs upstream of an intersection, there is currently no literature available examining the impact of these types of signs on safety. Nonetheless, given the very low cost involved in implementing this strategy and the potential to further enhance way-finding, their use could be warranted.

Road Safety Audits: A Road Safety Audit (RSA) is a comprehensive safety performance examination of an existing or future roadway location by an independent and multidisciplinary team. The objective of the RSA is to identify opportunities for safety improvements on the subject location for all potential road users. RSA's contribute to road safety by providing an unbiased assessment of a segment or intersection to identify safety concerns and potential countermeasures. Continuous screening of the network can help ensure that a proactive approach is taken to identify and alleviate any problem safety areas.

Roundabout (mini or standard): Roundabouts reduce vehicle speeds as well as the number of conflict points found in a typical intersection. In terms of crashes, roundabouts reduce head-on, left-turn and angle type crashes which frequently result in serious or fatal injuries. They also create a safer environment for pedestrians using the facility by slowing vehicles and dividing the crossing into two stages. The design of a roundabout is crucial to fostering a safe environment for drivers and pedestrians alike. When the design and geometry force traffic to enter and circulate slowly, roundabouts operate safely and effectively handle turning traffic.

While the number of roundabouts is steadily increasing in Michigan, in certain regions of the state they are still a relatively new design feature. Consequently education on roundabout usage is a key component of their success. MDOT and other communities often hold informational sessions during which they have shown feeds of existing roundabouts and traffic simulation models, hand out brochures, and display posters. MDOT has the following information available to aid in educating the public on roundabouts:

- http://www.michigan.gov/documents/mdot/MDOT_RoundaboutBrochure_312721_7.pdf
- https://www.youtube.com/watch?v=ONacAiKXe-8

When educating the public on new roadway features, the following could be taken into consideration:

- Explain why this fix is needed in this location by using criteria and/or warrants
- Show video on how a roundabout works
- Post videos on web sites to educate public
- Use social media
- Know the audience
- Visual aids are critical

Signal upgrades: While each intersection is unique, general signal improvements and upgrades can result in significant improvement in terms of not only safety but also the operations of the subject intersection. The following is a list of applicable signal upgrades.

Backplates: MDOT has found that traditional traffic signals can be difficult for drivers to see. By adding either a black backplate or a backplate with a reflectorized border, signal visibility is increased. The combination of a black backplate and all black face has increased signal visibility during the day by 33 percent. By making the backplate reflective, visibility increased even more, especially at night. Both backplates and retroreflective borders are low-cost safety treatments that can be easily added systematically to existing span and mast arm assemblies as long as the structural capacity of the supports is evaluated.

Box span and Mast arm: Box span and mast arm signal layouts provide safety improvements over diagonal span, pedestal, or post mounted signal displays. The safety benefits are associated with factors such as increased signal visibility and decreases in the angle of collision. While safety benefits are applicable for both cases, the use of one over the other is dependent on the existing intersection conditions and proposed layout configuration. Box span layouts can typically accommodate larger intersections, are more flexible in the placement of span wire poles, and have a lower overall cost as opposed to mast arms. Mast arm layouts in comparison are characterized by a higher overall cost and are more aesthetically pleasing than box span layouts. Maintenance on mast arms is also expected to be lower as opposed to box span layouts[8].

Left turn signal phasing: Left turn movements represent a high risk intersection movement. Thus when a left turn phase is warranted it must be provided. This decision is not only a function of through volumes and left-turn volumes and delay, but it may also be based on left-turn crash frequency. The addition of a left turn signal phasing can significantly reduce left-turn crashes.

Signal optimization: While intersections by their nature increase stop and go traffic, a poorly optimized intersection can increase driver aggression, and result in unsafe acceleration and deceleration maneuvers. Thus optimizing the signal not only improves the intersection operational efficiency, but can also reduce crashes.

5.3 Pedestrian and Bicycle Safety

Background

While pedestrian and bicycle related crashes comprise a relatively small percentage of all crashes in the EMCOG region, these non-motorized users are a vulnerable group in the transportation system as the likelihood of the crash resulting in an injury or fatality is high. These numbers have also been on the rise recently in the United States, which stresses the need to prioritize the safety of non-motorized users as a high emphasis area. Descriptive statistics for the EMCOG region for pedestrians and bicycles are displayed in **Table 7** and **Table 8**.

Table 7: Pedestrian Crashes by County, 2010-2014

Location	Total		Fatal (K)		Serious Injury (A)	
	No.	Percent	No.	Percent	No.	Percent
Arenac	7	0%	2	13%	3	4%
Bay	101	1%	9	15%	14	6%
Clare	25	1%	0	0%	8	7%
Gladwin	24	2%	1	7%	6	6%
Gratiot	21	1%	2	8%	6	5%
Huron	22	1%	3	16%	2	3%
Iosco	13	1%	2	12%	1	2%
Isabella	89	1%	4	11%	23	10%
Midland	41	0%	3	9%	7	5%
Ogemaw	8	0%	0	0%	2	2%
Roscommon	17	1%	2	10%	3	4%
Saginaw	200	1%	8	9%	22	6%
Sanilac	22	1%	2	11%	7	7%
Tuscola	35	1%	2	5%	7	4%
EMCOG	**625**	**1%**	**40**	**9%**	**111**	**6%**
Michigan	**11,267**	**1%**	**702**	**17%**	**1,855**	**8%**

Table 8: Bicycle Crashes by County, 2010-2014

Location	Total		Fatal (K)		Serious Injury (A)	
	No.	Percent	No.	Percent	No.	Percent
Arenac	6	0%	0	0%	3	4%
Bay	133	1%	1	2%	5	2%
Clare	6	0%	0	0%	1	1%
Gladwin	12	1%	0	0%	3	3%
Gratiot	20	1%	1	4%	2	2%
Huron	13	1%	0	0%	1	1%
Iosco	23	1%	2	12%	0	0%
Isabella	85	1%	2	5%	4	2%
Midland	73	1%	1	3%	7	5%

Table 8 (cont'd)

Ogemaw	5	0%	0	0%	0	0%
Roscommon	12	1%	0	0%	3	4%
Saginaw	141	1%	5	5%	13	4%
Sanilac	14	1%	0	0%	2	2%
Tuscola	16	0%	0	0%	2	1%
EMCOG	**559**	**1%**	**12**	**3%**	**46**	**2%**
Michigan	**9,436**	**1%**	**125**	**3%**	**788**	**4%**

Key observations:

- Approximately 15% of all fatal crashes in Bay and Huron Counties involve a pedestrian.
- 12% of all fatal crashes in Iosco County involve a bicyclist.
- Serious injury pedestrian crashes in Isabella County exceed the statewide average.

Countermeasures and Strategies

Pedestrian and bicycle education programs: Historically, pedestrian and bicyclist crashes have been disproportionate relative to their share of the use of the road. Recent trends however have seen an increased focus on improving not only the safety of non-motorized users but also increasing the number of non-motorized dedicated pathways as a goal for improving connectivity and accessibility along with other benefits associated with non-motorized travel. While engineering countermeasures play an important role in both improving safety and accessibility, the role that educational programs play in this area is significant and widely recognized across Michigan. As a result, a number of pedestrian and bicycle educational programs are implemented throughout the state. These include but are not limited to:

- Safe Routes to School (SRTS) http://saferoutesmichigan.org/ – The SRTS is a federal program whose primary goal is to provide a safe, convenient and fun environment for children to walk and/or bike to school. The program achieves this goal through the coordination of various aspects of safety including education, encouragement, enforcement, engineering, evaluation, and equity. Funding for educational programs is available as well as funding for infrastructure improvements.
- Safe Kids Michigan https://www.safekids.org/coalition/safe-kids-michigan – Safe Kids Michigan is a program under the Michigan Department of Community Health whose primary goal is keeping children safe. Based on this premise, the program provides services such as care-seat checkups and safety workshops aimed at parents and caregivers. A number of these services are focused on traffic crash prevention.

A number of additional educational initiatives are undertaken throughout the state with the purpose of improving pedestrian and bicycle safety, accessibility and connectivity (i.e. Complete Streets). The State of Michigan has also developed a Pedestrian and Bicycle Safety Action Team (PBSAT) to support the vision of the Michigan SHSP as it related to pedestrian and bicycle safety. Placement of advertisements on busses and at buses stops can further help to reinforce educational safety messages.

Pedestrian bump outs: Pedestrian bump outs or bulb outs are extensions of the sidewalk and curb towards the roadway. In addition to shortening the roadway crossing distance, pedestrian bump outs also enhance pedestrian safety by increasing pedestrian visibility, and potentially reducing speeds by narrowing the roadway. Pedestrian bump outs are typically appropriate only in the presence of on-street parking lanes. When the extension is in proximity of an intersection, the turning needs of the larger vehicles using the facility must be assessed.

Pedestrian countdown timer: Pedestrian countdown timers provide pedestrians or bicyclists with the remaining time in seconds for them to cross the roadway or the pedestrian phase to end. They can be passive or active (i.e operate via a push-button). They can be installed with auditory warnings to alert pedestrians whose vision may be limited. Because of the additional information that countdown timers provide, they are associated with increased crossing compliance and may also have an impact on motorized users. They are most common in urban and subu1rban areas.

Pedestrian refuge islands: Pedestrian refuge islands are raised sections of pavement placed on streets at an intersection or midblock to provide pedestrians with a protected resting place as they generally wait for a gap in traffic to finish crossing the road. They are generally installed on wide roadways to make crossing easier by allowing pedestrians to identify gaps one approach at a time.

Installation & maintenance of bicycle lanes: The American Association of State Highway and Transportation Officials (AASHTO) defines a bike lane as the "portion of a roadway which has been designated by striping, signing, and pavement markings for the preferential or exclusive use of bicyclists". They are typically located on the right side of the roadway with pavement markings which direct bicyclists toward the direction of travel. Bicycle lane design standards vary depending upon the location and operational and geometric roadway conditions, the premise is to provide bicyclists with a safe travel path by minimizing potential conflicts with vehicles which are generally traveling at much higher speeds.

Safety path, sidewalk and crosswalk improvements: According to NHTSA and the FHWA, an average of 4,500 pedestrians are killed each year in traffic crashes in the United States. Almost 8% of these are a result of pedestrians walking along the roadway where there is a lack of delineation between pedestrian pathways and vehicles. Consequently, providing safe and separate walkways can significantly reduce these types of crashes by almost 88% [9]. Safe walkways can include sidewalks or widening and paving the shoulder so that there is more space between pedestrian or bicycle paths and the vehicle travel way. These facilities benefit the drivers and the non-motorists as they are visible reminders of both road users. Similarly, providing and/or improving crosswalks is associated with significant benefits for non-motorized users including comfort, health and recreation using these facilities.

5.4 Drivers Age 24 and Younger

Background

Drivers age 24 and younger represent a high-risk age group in the transportation system as they have a higher likelihood of being involved in a collision. These users have decision making characteristics which differ from those of more mature drivers including but not limited to driving attitude, perception of risk, hazard detection, and driving skills which are reinforced with increasing driving experience. As a result many drivers in this category may undertake risky driver behaviors such as speeding, maintaining shorter headways, using mobile devices which contribute to distracted driving conditions, and making improper responses to hazardous conditions. For these particular reasons, educational and enforcement approaches are most suitable in minimizing the risk of collisions for this particular age group. Descriptive statistics for drivers 24 and younger for the EMCOG region are presented in **Table 9**.

Table 9: Young Driver (24 and younger) Crashes by County, 2010-2014

Location	Total		Fatal (K)		Serious Injury (A)	
	No.	Percent	No.	Percent	No.	Percent
Arenac	469	31%	2	13%	17	20%
Bay	4,647	39%	23	38%	61	28%
Clare	862	32%	1	5%	27	23%
Gladwin	511	33%	5	36%	31	28%
Gratiot	1,354	40%	6	25%	53	44%
Huron	971	38%	5	26%	26	38%
Iosco	545	30%	2	12%	14	23%
Isabella	4,656	55%	13	34%	101	44%
Midland	3,657	42%	13	39%	51	38%
Ogemaw	607	34%	3	17%	28	30%
Roscommon	611	29%	5	25%	29	37%
Saginaw	8,872	39%	29	32%	119	33%
Sanilac	814	37%	5	28%	43	43%
Tuscola	1,593	39%	16	42%	76	39%
EMCOG	**30,169**	**40%**	**128**	**30%**	**676**	**34%**
Michigan	**430,120**	**37%**	**1,243**	**29%**	**7,662**	**35%**

Key observations:

- Bay, Gladwin, Isabella, Midland, Saginaw, and Tuscola Counties exceed the statewide average for fatal crashes involving drivers under the age of 24.
- Gratiot, Huron, Isabella, Midland, Roscommon, Sanilac, and Tuscola Counties exceed the statewide average for serious injury crashes involving drivers under the age of 24.

Countermeasures and Strategies

Publicize and enforce laws pertaining to young drivers: Proper enforcement can deter young drivers from undertaking hazardous maneuvers which may increase the risk of crashes. Publicizing enforcement measures is also of particular importance for this age group, to not only inform the drivers of the measures, but also provide the information to parents to allow for proactive parent engagement. Given the current trends in how young individuals obtain information, dissemination of information should also include the use of various social media formats.

Improve driver's education programs: The driver education program is typically the first time younger drivers are exposed to driving. Consequently it is important that the information presented during driver's education programs is consistently improved. Potential steps which could be undertaken to ensure continuous improvement include but are not limited to the review of current programs to ensure existing standards are met or that any new requirements are implemented and improvements in the dissemination of the information to teen drivers by advocating that teaching instructors go beyond the minimum standards.

Improve graduated driving licensing systems: The graduated driver licensing system is a tiered approach designed to teach driving to teens by gradually increasing their privileges as they move through the education system. Maintaining a proactive graduated driving licensing system can be key in reducing traffic crashes involving drivers age 24 and younger. This becomes of particular importance given the fact that fatalities and injuries involving young drivers are highest between the ages of 16 and 18. Due to the nature of teen driving, recommendations should be developed by involving various parties including parents and members of the education systems among others.

5.5 Traffic Incident Management

Background, Countermeasures and Strategies

Traffic incident management (TIM) is a multi-disciplinary approach to detect, respond, and clear traffic incidents on the roadway or roadside so that traffic flow is returned to normal and safe operations in a quick, safe and efficient manner. At the core of this initiative is the safety of not only the individuals affected by the incident, but also of secondary crashes and emergency responders. Given the complexity and situational characteristics of traffic crashes, a properly implemented TIM requires coordination among a wide variety of professions and parties including but not limited to law enforcement, fire, medical services, transportation, public safety communications, emergency management, towing and recovery, and hazardous material services. The coordination and identification of the proper traffic incident response in Michigan is typically facilitated through transportation operation centers which act as a central coordination and support center. In addition to these facilities, legislation such as the Hold Harmless and Steer it, Clear it law are designed to assist in the Traffic Incident Management Effort (TIME) process. The National Traffic Incident Management Responder Training Program (Mi-TIME) and Michigan TIME also provide training to help improve and strengthen the TIM coordination among the various parties involved.

5.6 Commercial Vehicle Safety

Background

Traffic crashes involving larger commercial vehicles such as trucks and/or buses tend to be more damaging due to trip or mechanistic characteristics associated with these types of vehicles. For example larger vehicles require greater stopping distances due to their size, weight, and lower deceleration rate. These effects are further magnified during inclement weather conditions that result in reduced visibility and pavement friction performance. Limitations during these conditions are associated not only with the physical aspects of these vehicles, but also due to trip characteristics. For example, drivers tend to perceive inclement weather conditions as dangerous and may avoid or cancel trips during such conditions. In comparison, commercial trips are business oriented thus less flexible in route time and choice. Descriptive statistics for truck and/or bus crashes for the EMCOG region are presented in **Table 10**.

Table 10: Truck/Bus Crashes by County, 2010-2014

Location	Total		Fatal (K)		Serious Injury (A)	
	No.	Percent	No.	Percent	No.	Percent
Arenac	74	5%	1	6%	2	2%
Bay	449	4%	5	8%	10	5%
Clare	95	4%	0	0%	6	5%
Gladwin	50	3%	1	7%	2	2%
Gratiot	173	5%	2	8%	9	7%
Huron	153	6%	3	16%	7	10%
Iosco	71	4%	1	6%	5	8%
Isabella	234	3%	2	5%	4	2%
Midland	263	3%	2	6%	7	5%
Ogemaw	77	4%	1	6%	2	2%

Table 10 (cont'd)

Roscommon	66	3%	0	0%	2	3%
Saginaw	758	3%	3	3%	14	4%
Sanilac	125	6%	4	22%	7	7%
Tuscola	156	4%	3	8%	9	5%
EMCOG	**2,744**	**4%**	**28**	**7%**	**86**	**4%**
Michigan	**51,852**	**4%**	**406**	**10%**	**1,095**	**5%**

Key observations:

- The percentage of crashes involving a truck or bus is on average lower for the EMCOG region than the statewide average.
- 16% and 22% of fatal crashes in Huron and Saginaw Counties involve a truck or bus.
- The percentage of serious injury crashes involving a truck or bus is on average higher for Gratiot, Huron, Iosco, and Sanilac Counties as compared to Michigan.

Countermeasures and Strategies

The 2017-2018 Michigan SHSP lists strategies which may be utilized in reducing crashes involving commercial motor vehicles. Through the leadership of the Michigan Truck Safety Commission, a combination of education and enforcement measures were developed and implemented with the aim of crash mitigation and minimization. These include training programs available through the Michigan Center for Truck Safety on topics such as hazard recognition, preventable collisions, the driving environment, and related. Additional strategies include improving commercial motor vehicle driver performance through both education and enforcement, strengthening of commercial driver license programs, identification and correction of unsafe roadway conditions, improving maintenance of heavy trucks, deployment of truck safety initiatives and best practices, and related [4].

5.7 Occupant Protection

Background, Countermeasures and Strategies.

Increased rate of proper passenger restraints is a national priority in the United States and the State of Michigan due to the significant role it plays in reducing fatalities or injuries in traffic collisions. In the most recent safety belt usage study for 2016 for the state of Michigan, the statewide safety belt usage among drivers and front seat passengers was reported at 94.5%, with fluctuations existing among various regions of the state. [4]. While this rate is higher than the nationwide use, it is imperative that its enforcement continues due to the important role proper usage of safety restraints plays in protecting passengers. In line with this statement, in 2008, Michigan enacted a booster seat law for children under 8 years of age and/or up to 4 feet and 9 inches in height. To ensure and improve the proper use of passenger restraints, potential strategies include[4]:

- Enforcement of safety belt usage.
- Support public info and education campaigns educating individuals on safety belt and child restraint use.
- Evaluate the effectiveness of occupant protection programs throughout the implementation process.

5.8 Access Management

Background

It is well established that crashes along a segment can increase with improper placement and driveway design, and increasing driveway density. Consequently in order to mitigate any potential impacts from the former, access management techniques are generally implemented. Access management consists of a set of tools established to control vehicle access into various types of roadways in order to improve the operational characteristics of the roadway and reduce the number of possible conflict points in a segment thus reducing crashes. While several crash reduction methods of access management exist, they are highly dependent on the physical and traffic conditions of the subject area. Descriptive statistics for driveway related crashes are listed in **Table 11**.

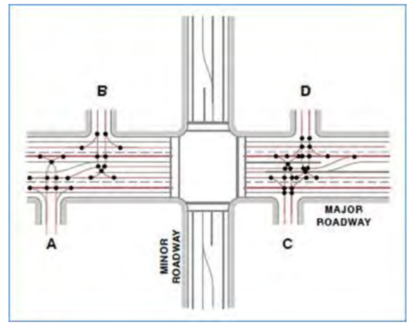


Table 11: Driveway Related Crashes by County, 2010-2014

Location	Total		Fatal (K)		Serious Injury (A)	
	No.	Percent	No.	Percent	No.	Percent
Arenac	117	8%	1	6%	2	2%
Bay	1,003	8%	1	2%	13	6%
Clare	154	6%	0	0%	2	2%
Gladwin	99	6%	0	0%	6	6%
Gratiot	360	11%	0	0%	7	6%
Huron	190	7%	0	0%	4	6%
Iosco	224	12%	1	6%	5	8%
Isabella	901	11%	1	3%	12	5%
Midland	1,109	13%	0	0%	6	4%
Ogemaw	163	9%	0	0%	6	6%
Roscommon	149	7%	0	0%	4	5%
Saginaw	2,908	13%	1	1%	25	7%
Sanilac	193	9%	1	6%	5	5%
Tuscola	372	9%	2	5%	8	4%
EMCOG	**7,942**	**11%**	**8**	**2%**	**105**	**5%**
Michigan	**104,596**	**9%**	**182**	**4%**	**1,403**	**6%**

Key observations:

- Driveway related crashes for the EMCOG region are generally similar to the statewide averages.
- Driveway related crashes for Iosco, Midland, and Saginaw are slightly higher than the regional average.

Countermeasures and Strategies

Existing literature on the impacts of driveways on crashes indicates that crashes increase with increasing driveway density. As the spacing among driveways increases, the overall number of conflict points is reduced thus providing drivers with improved merging capabilities and less risky maneuvers. The placement of the driveways is also as important as driveway density. Increasing the distance of a driveway from an intersection reduces the risk of crashes since the number of potential conflict points is reduced. This effect is particularly true for angle and rear-end crashes. Similarly, limiting the number of access point on the major roadway and shifting them to the minor can help reduce the risk of crashes. A secondary aspect of access management is also the management of turning movements in and out of the driveway. Arguably the majority of crashes at a driveway are a result of left-turning vehicles. Thus minimizing or eliminating left turns can help reduce crashes as well. One method to manage, limit, or eliminate left turning movements is through the installation of medians which can include non-traversable medians, two-way left turn lanes (TWLTL). Additionally dedicated left-turn or right-turn lanes can help further control the flow of traffic.

5.9 Distracted Driving

Background

Distracted driving refers to non-driving activities undertaken by drivers while behind the wheel. These include visual distractions, manual distractions, and cognitive distractions. Arguably because of the widespread use of communication devices in everyday life, cell phones and smart phones have become the primary reason for distracted driving. Among the uses of cell phones, texting is of particular concern because it involves all three types of distractions combined together. Depending on the speed of the vehicle, even the shortest distraction time can be of concern. According to a 2015 Eire Insurance survey, one in three drivers admitted to texting while driving. Descriptive statistics on known distracted driving crashes are presented in **Table 12**.

Table 12: Distracted Driving Crashes by County, 2010-2014

Location	Total		Fatal (K)		Serious Injury (A)	
	No.	Percent	No.	Percent	No.	Percent
Arenac	14	1%	0	0%	3	4%
Bay	332	3%	0	0%	3	1%
Clare	24	1%	0	0%	1	1%
Gladwin	21	1%	0	0%	1	1%
Gratiot	86	3%	0	0%	11	9%
Huron	58	2%	0	0%	2	3%
Iosco	36	2%	0	0%	1	2%
Isabella	188	2%	0	0%	6	3%
Midland	177	2%	0	0%	2	1%
Ogemaw	35	2%	0	0%	2	2%
Roscommon	10	0%	0	0%	0	0%
Saginaw	518	2%	0	0%	9	3%
Sanilac	40	2%	0	0%	3	3%
Tuscola	108	3%	0	0%	5	3%
EMCOG	**1,647**	**2%**	**0**	**0%**	**49**	**2%**
Michigan	**25,203**	**2%**	**93**	**2%**	**628**	**3%**

Key observations:

- 9% of serious injury crashes in Gratiot County are a result of distracted driving.
- Distracted driving crashes in the EMCOG region were on average similar to the statewide average.

Countermeasures and Strategies

In response to the increasing rates of cell phone usage while driving, the State of Michigan banned texting while operating a motor vehicle. In this regards, highly visible enforcement of the existing texting ban law can be a successful deterrence toward the use of cell phones while driving. Dissemination of educational information on the risks of cell phone usage could further help curb cell phone use behind the wheel. Engineering countermeasures can also be useful in decreasing the number of injuries and fatalities resulting from distracted driving. This includes countermeasures applicable to roadway departures such as centerline and shoulder rumble strips and cable barriers.

5.10 Impaired Driving

Background

Impaired driving refers to the condition of operating a vehicle while under the influence of alcohol and/or drugs. According to NHTSA, drivers with an alcohol level of 0.08 percent are four times more likely to be involved in a collision as opposed to sober drivers. The safety risk increases with increasing alcohol levels. Similarly, marijuana users are 25% more likely to be involved in a collision as opposed to drivers with no evidence of marijuana use[10]. These conditions are more common among young male drivers and during weekends. **Tables 13** and **14** present descriptive statistics of alcohol and drug related crashes for the EMCOG region.

Table 13: Alcohol-related Crashes by County, 2010-2014

Location	Total		Fatal (K)		Serious Injury (A)	
	No.	Percent	No.	Percent	No.	Percent
Arenac	100	7%	8	50%	10	12%
Bay	625	5%	29	48%	36	16%
Clare	146	5%	6	32%	25	22%
Gladwin	134	9%	5	36%	20	18%
Gratiot	156	5%	5	21%	13	11%
Huron	183	7%	6	32%	15	22%
Iosco	134	7%	7	41%	11	18%
Isabella	511	6%	13	34%	56	25%
Midland	365	4%	10	30%	29	21%
Ogemaw	117	6%	6	33%	15	16%
Roscommon	138	7%	6	30%	14	18%
Saginaw	1,013	4%	29	32%	72	20%
Sanilac	189	9%	3	17%	18	18%
Tuscola	374	9%	13	34%	46	24%
EMCOG	**4,185**	**6%**	**146**	**34%**	**380**	**19%**
Michigan	**48,526**	**4%**	**1,248**	**30%**	**3,708**	**17%**

Table 14: Drug-related Crashes by County, 2010-2014

Location	Total		Fatal (K)		Serious Injury (A)	
	No.	Percent	No.	Percent	No.	Percent
Arenac	6	0%	0	0%	0	0%
Bay	97	1%	1	2%	6	3%
Clare	21	1%	0	0%	1	1%
Gladwin	18	1%	0	0%	7	6%
Gratiot	19	1%	0	0%	3	2%
Huron	12	0%	1	5%	0	0%
Iosco	20	1%	0	0%	2	3%
Isabella	40	0%	1	3%	6	3%
Midland	31	0%	1	3%	1	1%
Ogemaw	21	1%	1	6%	4	4%
Roscommon	15	1%	0	0%	0	0%
Saginaw	138	1%	3	3%	4	1%
Sanilac	12	1%	0	0%	0	0%
Tuscola	30	1%	1	3%	6	3%
EMCOG	**480**	**1%**	**9**	**2%**	**40**	**2%**
Michigan	**8,717**	**1%**	**111**	**3%**	**604**	**3%**

Key observations:

- Crashes involving alcohol, including fatalities and serious injuries, are on average greater for the EMCOG as opposed to the State of Michigan.
- Fatal crashes involving alcohol in Arenac, Bay, Gladwin, and Iosco Counties are greater than the regional and statewide averages.
- 1 in 2 fatal crashes in Arenac County involve alcohol.
- More than 1 in 5 serious injury crashes in Clare, Huron, Isabella, Midland, Saginaw, and Tuscola Counties involve alcohol.
- Drug related crashes are on average lower for the EMCOG region as opposed to the State of Michigan.
- 6% of serious injury crashes in Gladwin County involve the use of drugs.

Countermeasures and Strategies

Countermeasures and strategies used to address impaired driving are primarily enforcement and education related. Continuation of high visibility enforcement can help deter alcohol and/or drug use while driving. Coordination with nationwide enforcement periods can help maximize results across a larger region. A few of the effective tools under the enforcement umbrella include sobriety checkpoints and use of alcohol ignition interlocks. Public informational and educational campaigns also play an important role in addressing the issue. A successful campaign can raise awareness on the effects of driving while under the influence of alcohol and/or drugs. Information should be targeted in particular to younger and underage drivers. Given the predominant demographics of

impaired drivers, parents should be included in the process as well. Because impaired drivers tend to be recurring offenders, assessment and treatment can be effective in minimizing repeated offenses. Additional countermeasures and strategies include improved training among the criminal justice community including law enforcement, judges, prosecutors, and probation officers and a proactive approach to improving legislation related to impaired driving.

5.11 Senior Mobility Age 65 and Older

Background

The proportion of the population in the United States over 65 of age is growing significantly. Not surprisingly, as the population is getting older and life expectancy continues to increase, the proportion of drivers age 65 and older is expected to increase as well. This particular user group represents a high-risk age group similar to younger drivers. The increased risk is associated with reductions in perception and cognitive and motor skills which may make them more prone to collisions. Descriptive statistics of drivers 65 and older for the EMCOG region are presented in **Table 15**.

Table 15: Senior Driver (Age 65 and Older) Crashes by County, 2010-2014

Location	Total		Fatal (K)		Serious Injury (A)	
	No.	Percent	No.	Percent	No.	Percent
Arenac	296	19%	7	44%	13	16%
Bay	2,269	19%	16	26%	44	20%
Clare	540	20%	5	26%	28	24%
Gladwin	317	21%	5	36%	27	25%
Gratiot	594	17%	8	33%	22	18%
Huron	502	19%	5	26%	11	16%
Iosco	445	25%	4	24%	15	24%
Isabella	1,090	13%	5	13%	37	16%
Midland	1,483	17%	12	36%	13	10%
Ogemaw	383	21%	6	33%	18	19%
Roscommon	481	23%	5	25%	21	27%
Saginaw	4,150	18%	29	32%	62	17%
Sanilac	381	17%	4	22%	20	20%
Tuscola	628	15%	10	26%	31	16%
EMCOG	**13,559**	**18%**	**121**	**28%**	**362**	**18%**
Michigan	**178,264**	**15%**	**911**	**22%**	**3,406**	**16%**

Key observations:

- The average number of crashes, fatalities and serious injuries involving senior drivers in EMCOG region is greater than the statewide average.
- More than 1 in 3 fatal crashes in Arenac, Gladwin, Gratiot, Midland, and Ogemaw Counties involve a senior driver.
- More than 1 in 5 serious injury crashes in Bay, Clare, Gladwin, Iosco, Roscommon, and Sanilac Counties involve a senior driver.

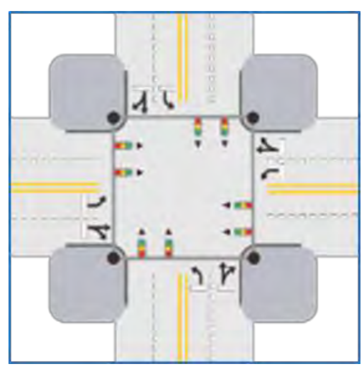
Countermeasures and Strategies

Advance guide and street name signs: Advance guide and street name signs inform drivers of their location, potential destinations, and locations of interest along the roadway. The advanced placement of the signs provides drivers with additional time to make the necessary adjustments toward their lane position or any other required response relative to the presented sign information. Advance guide and street name signs are particularly important for older drivers who may require additional time to process and respond appropriately to the information.

Advance warning signs: Advance warning signs provide drivers with information on potential hazardous conditions on a roadway prior to the hazardous site. Such signs could include advisory speed signs, signal ahead signs, upcoming work zone areas, or other maneuvers which may present a risk to the driver. While advance warnings signs are beneficial to all drivers, they are particularly important for older drivers in order to provide adequate time to process and respond appropriately to the information.

All-red clearance intervals: The all-red clearance interval is the portion of the traffic signal cycle where a red signal is displayed for all approaches of an intersection. Its purpose is to allow adequate time for vehicles which entered the intersection during a yellow interval to clear the intersection prior to the conflicting approach receiving a green. It is typically a function of the distance from the approach stop bar to the far side where a conflict does not exist, the length of a vehicle assumed at 20 feet, and the speed of approaching vehicles. Consequently, if a vehicle enters an intersection and an all-red clearance interval is not available or is inadequate in time, the risk for collisions increases. The all-red clearance interval can be particularly useful in accommodating different perception-reaction times associated with age differences. Not surprisingly studies have shown that the presence of an all-red interval has a positive effect on intersection safety. While currently signals are typically expected to operate with an all-red clearance interval, the provision of adequate all-red clearance timing also has a positive effect on intersection safety. One drawback to increasing the all-red clearance time is the increase in total intersection delay as vehicles on all approaches are experiencing a lower amount of the green interval.

Backplates



Convert traffic signals from diagonal to box span configuration: An adequate number and the proper placement of signal heads at an intersection are a recognized safety benefit. It improves the visibility of the traffic signals by providing drivers with the opportunity to quickly view the signal as opposed to searching the vicinity while approaching the intersection. This concern is magnified among older drivers to compensate for decreased head motion range and limited peripheral vision. In a diagonal span configuration the adequate number and placement of the signal heads cannot be addressed properly. Switching to a box span configuration mitigates this issue as it provides flexibility relative to the signal head's location and allows for the signal head to be placed over each lane of travel. While diagonal span configurations can still be found throughout Michigan, the box span layout is currently the preferred signal head configuration in Michigan.

Educational Programs: Additional educational programs and dissemination of information pertaining to senior drivers can assist in improving safety for this demographic. Examples include but are not limited to programs under carfit.org which offers older adults the opportunity to check how the personal vehicle fits their needs; Michigan aging driver guide which provides information with the purpose of promoting safe mobility; and the AAA aging driver course.

Fluorescent yellow sheeting on warning signs

Pedestrian countdown timer

Protected left turn phases: Left turn movements are high risk movements at an intersection. Thus when a left turn phase is warranted it must be provided. This decision is not only a function of through volumes, left-turn volumes, and delay, but it may also be based left-turn crash frequency. The addition of a left turn signal phasing can significantly reduce left-turn crashes. Depending on existing traffic and physical conditions of the intersection however, left-turn related crashes can still occur frequently. This could occur when left turns are permissive and conflicts are occurring with through traffic in the same direction and non-motorized crossing traffic. Older drivers may be more prone to these conflicts due to impaired judgement, decreased head motion range movements and limited peripheral vision. A protected left turn phase can mitigate such potential conflicts by providing left-turning vehicles with the right of way.

5.12 Motorcycle Safety

Background

Motorcycles are an important transportation mode in the United States as they can provide effective transportation as well as recreational use. However, motorcycles are arguably significantly more prone to crashes than other vehicles, with motorcycle fatal crashes occurring 27 times more often than those involving other vehicles [11]. Recent trends indicate motorcycle ridership is increasing, ridership demographics are changing, and many states are repealing their helmet laws. These facts directly relate to motorcycle safety. According to MDOT, the number of fatal crashes of motorcyclists not wearing a helmet increased by 11 times between 2011 and 2015. **Table 16** provides a summary of motorcycle related crashes in the EMCOG region.

Table 16: Motorcycle Crashes by County, 2010-2014

Location	Total		Fatal (K)		Serious Injury (A)	
	No.	Percent	No.	Percent	No.	Percent
Arenac	39	3%	4	25%	15	18%
Bay	187	2%	10	16%	35	16%
Clare	50	2%	8	42%	14	12%
Gladwin	28	2%	1	7%	10	9%
Gratiot	50	1%	1	4%	7	6%
Huron	47	2%	0	0%	6	9%
Iosco	41	2%	1	6%	5	8%
Isabella	95	1%	3	8%	13	6%
Midland	115	1%	2	6%	19	14%
Ogemaw	49	3%	0	0%	18	19%
Roscommon	38	2%	3	15%	6	8%
Saginaw	291	1%	7	8%	33	9%
Sanilac	32	1%	1	6%	7	7%
Tuscola	82	2%	4	11%	16	8%
EMCOG	**1,144**	**2%**	**45**	**11%**	**204**	**10%**
Michigan	**14,343**	**1%**	**559**	**13%**	**2,463**	**11%**

Key observations:

- More than 1 in 4 fatal crashes in Arenac and Clare Counties involve a motorcycle.
- Injury crashes involving a motorcycle in Arenac, Bay, Clare, Midland, and Ogemaw Counties are above the regional and statewide averages.

Countermeasures and Strategies

Given the recent trends affecting motorcycle safety, strategies and countermeasures are critical to ensure that crashes and in particular fatalities involving motorcycles are minimized. Potential mitigation measures currently also proposed under Michigan's SHSP include but are not limited to [4]:

- Encourage motorcyclist safety through training, use of protective and high visibility gear to help mitigate potential crashes and minimize crash severities.
- Evaluate and implement engineering countermeasures in high risk areas more prone to motorcycle crashes. Improve existing roadway conditions for motorcycle users.
- Disseminate educational material and information on motorcycle safety.
- Provide recommendations on legislation related to motorcycle safety.
- Explore educational and training opportunities for emergency personal as it relates to motorcycle involved crashes.

5.13 Speed Management

Background

Speeding is defined as driving too fast for existing conditions or in excess of the posted speed limit. Included among the adverse effects of speeding are increased likelihood of loss of vehicle control, increased stopping distance, reduced effectiveness of vehicle safety features, and greater risk for a collision that results in a serious injury or fatality. According to the FHWA, speeding is a contributing factor in nearly one in three fatal crashes[12]. **Table 17** provides descriptive statistics for speeding related crashes in the EMCOG region.

Table 17: Speeding-related Crashes by County, 2010-2014

Location	Total		Fatal (K)		Serious Injury (A)	
	No.	Percent	No.	Percent	No.	Percent
Arenac	525	34%	1	6%	27	33%
Bay	1,786	15%	11	18%	37	17%
Clare	919	34%	4	21%	30	26%
Gladwin	578	38%	6	43%	35	32%
Gratiot	871	26%	8	33%	25	21%
Huron	628	24%	3	16%	8	12%
Iosco	477	27%	3	18%	19	31%
Isabella	1,548	18%	8	21%	45	20%
Midland	1,451	17%	4	12%	30	22%
Ogemaw	664	37%	6	33%	28	30%
Roscommon	555	27%	4	20%	18	23%
Saginaw	3,366	15%	27	30%	75	21%
Sanilac	386	17%	6	33%	17	17%
Tuscola	1,105	27%	9	24%	42	22%

Table 17 (cont'd)

EMCOG	**14,859**	**20%**	**100**	**23%**	**436**	**22%**
Michigan	**159,400**	**14%**	**857**	**20%**	**3,752**	**17%**

Key observations:

- The proportion of crashes involving speeding, including fatal and serious injury crashes, is highest for the EMCOG region as opposed to the State of Michigan.
- 1 in 4 crashes in the EMCOG region involved speeding.
- More than 1 in 3 crashes in Arenac, Clare, Gladwin, and Ogemaw Counties involve speeding.
- More than 1 in 3 fatal crashes in Gladwin, Gratiot, Ogemaw, and Sanilac Counties involve speeding.
- The proportion of serious injury crashes involving speeding is highest for Arenac, Gladwin, Iosco, and Ogemaw Counties.

Countermeasures and Strategies

Speeding is a complex and widespread issue which is best addressed through a comprehensive process which can include engineering, enforcement, education, and emergency services countermeasures. Because of the prevalence of speeding, there is a large body of research dedicated to managing speeding. Engineering measures can be grouped into three primary categories. These include traffic controlling devices, roadway design, and traffic calming measures. Examples are:

- Advisory speeds
- Speed feedback signs
- Lane width reduction
- Road diet
- Raised medians or islands
- Roundabout
- Vertical traffic calming (i.e. speed humps, speed tables)
- Horizontal traffic calming (i.e. traffic circle, chicanes, chokers)
- Gateway treatments

Continuing enforcement of existing speed limits is also a powerful tool in deterring speeding behaviors. These encompass not only traditional speed enforcement activities via the use of RADAR and LIDAR, but also with fixed, mobile, and automated speed cameras which supplement the enforcement process. Educational programs and campaigns can also help inform drivers of the risks of speeding. The material should fit local needs and can target those demographics which are most prone to speeding.

5.14 Traffic Safety Engineering

Background, Countermeasures and Strategies

Traffic safety engineering encompasses the area of transportation where engineering applications are used to reduce crashes and improve safety. The Michigan SHSP identifies key objectives to further traffic safety engineering. A number of these are also applicable to local agencies. These include:

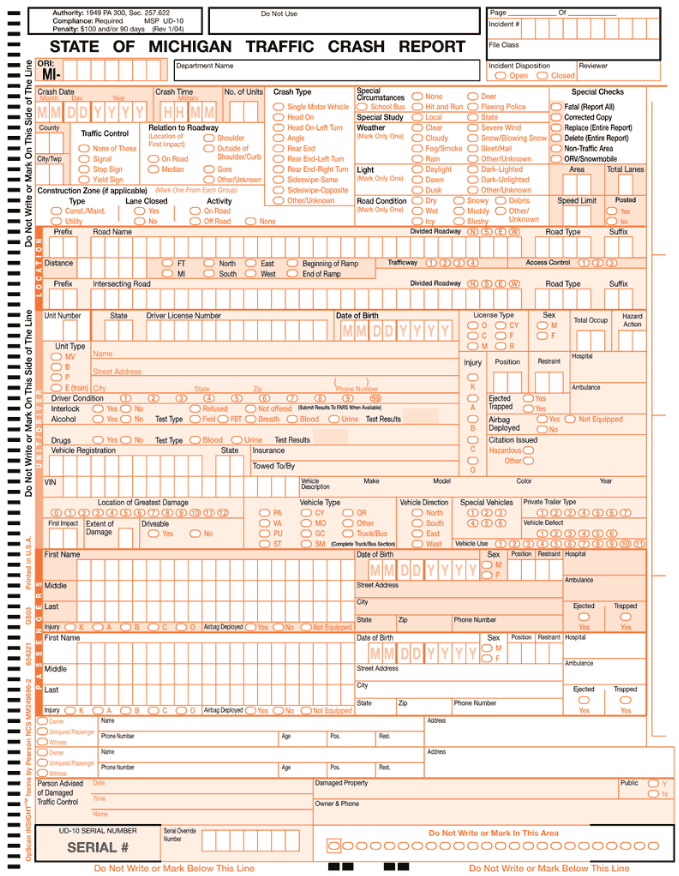
- Promote safe infrastructure through outreach and communication
- Identify and resolve issues related to safety data
- Promote and support research on safety
- Broaden the use of proven countermeasures
- Develop, research, and pilot new countermeasures
- Collaborate with various parties to identify and promote funding opportunities

5.15 Traffic Records and Information Systems

Background, Countermeasures and Strategies

Traffic records and information systems are critical to maintain and improve safety on the transportation system. Accurate and timely traffic records allow the users to provide data-driven decisions in order to identify problems, develop and implement countermeasures, evaluate methods, and efficiently allocate resources throughout the network. The primary elements of a traffic records and information systems include data collection, data management, and data analysis. While the U.S. DOT has developed guidance material on establishing and maintaining adequate traffic records and information systems such as the Model Minimum Uniform Crash Criteria (MMUCC) and Model Inventory of Roadway Elements (MIRE), the state of Michigan has long been in the forefront of this particular area. In the most recent traffic records and information systems strategic plan, Michigan has identified eight areas to support and realize the mission of this emphasis area. These areas include:

- Crash, citation/adjudication,
- Vehicle/driver
- Injury surveillance system components
- Roadway
- Data use & integration
- Traffic Records Coordinating Committee (TRCC)
- Strategic planning.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At the core of these areas is their broad integration into a single usable system. Additional strategies to improve this emphasis area can include but are not limited to recommendation for changes on UD-10 crash reports, training to improve accuracy on UD-10 crash reports and other datasets, increase coordination and communication among the various agencies involved in this topic, and integration of various datasets to improve decision making capabilities.

6.0 Prioritization

Given the large geographical extent of the EMCOG region and the amount of travel occurring on its transportation network, the realization of the safety goals are reliant upon a well thought out prioritization system. The limited resources available to address the concerns presented in the emphasis areas also stress the importance of prioritizing high risk segments and/or intersections.

There are two components to the prioritization process. First it should be understood that certain countermeasures have the ability to simultaneously address different emphasis areas. Examples include low cost treatments such as advance warning signs, or the more variable cost methods such as RSA's which depending on the location can help mitigate multiple safety issues within a location. Thus implementing countermeasures which can address several safety issues represents an efficient use of resources.

The second component in the prioritization stage is the identification of the more high risk areas, roadway segments, or intersections in the region. Several statistical and GIS related methods are applied to the 2010-2014 crashes to identify high risk candidates within the EMCOG region. High risk areas are identified via crash pattern GIS analysis in order to pinpoint hot spots or regions which experience a high concentration of crashes. Crash pattern analysis is conducted for:

- All crashes
- Fatal crashes (K)
- Serious injury crashes (A)
- Single vehicle lane departure crashes
- Pedestrian crashes
- Bicycle crashes
- Alcohol-related fatal and serious injury crashes

High risk roadway segments are identified via a combination of statistical and GIS relationship methods which uses both crash rates and crash frequencies. In order to identify high crash rate segments, 2010-2014 crashes are applied to the road network based on the Physical Road (PR) number and mile point in which these crashes occur throughout the network. Non-deer and non-animal crashes are omitted from this list. Similarly omitted from this list are crashes coded as intersection crashes. Crash rates are then calculated for those segments where Annual Average Daily Traffic (AADT) volumes are available. AADT volumes are based on the FHWA Highway Performance Monitoring System (HPMS) 2014 data. The latter also defines the endpoints of each roadway segments. Crash rates are calculated based on the following equation:

$$CR = \frac{C * 100{,}000{,}000}{V * L * N * 365}$$

Where, CR = Segment crash rate per 100 million vehicle-miles of travel

C = Total number of non-animal crashes occurring in the segment for 2010-2014

V = 2014 AADT segment volumes

L = Segment length in miles

N = Number of years of data (5)

These results are presented in tabular and map form, where the tabular form presents the top 20 high crash rate segments in EMCOG region on a per county basis.

Because AADT volumes are only available for a select number of segments, high risk segments are also identified in terms of crash frequencies. The segment crash frequencies aim to primarily supplement the segment crash rate method and provide a measure of safety for those segments in this region where traffic volumes cannot be obtained. Crash frequencies for this method are calculated for each segment in the road network by assigning the 2010-2014 non-deer and non-animal related crashes based on the PR number and mile point in which these crashes occur. Similar to the crash rate method, crashes coded as intersection crashes are omitted from the dataset. The All Road v14 file is used as the network framework, thus segment endpoints are based upon this dataset. Akin to the crash rate methods, results are presented in tabular and map form, where the tabular form presents the top 20 high crash frequency segments in the EMCOG region on a per county basis.

The last form of prioritization identification includes high risk intersections. This method is based on crash frequencies. In the first step of this method intersections are identified in GIS Space for the entire EMCOG region roadway network. An intersection in this case is defined as any node where two or more roads intersect. Intersections are then assigned a rural or urban designation depending on their spatial relationship to the Adjusted Census Urban Boundary (ACUB). Crashes are assigned to each intersection based on their proximity to the intersection and whose spatial buffer distance is defined by the urban and rural designation of the intersection. For urban intersections, non-deer non-animal related crashes are assigned to intersections if they occur within 150 feet of an urban node and are identified as intersection related crashes in the dataset. For rural intersections, non-deer non-animal related crashes are assigned to intersections if they occur within 250 feet of a rural node and are identified with similar codes as the ones in the urban intersection list in the crash database. Results are presented in tabular and map form, where the tabular form presents the top 10 high crash frequency intersections in the EMCOG region on a per county basis.

The tabular high risk segments and intersections are presented in **Appendix C**, while the crash pattern maps and related images are presented in **Appendix D**. It should be noted that for each dataset, emphasis is placed on the local road network whenever feasible.

7.0 Implementation and Evaluation

The last step of the EMCOG RTSP is the implementation phase. While the state, regional, and local agencies have made great strides in improving safety in the region as evident by the historical crash trends, the occurrence of fatalities and serious injuries continues to be a significant safety issue. The emphasis areas outlined in this report, along with the identified countermeasures and strategies can assist in further improving safety for the region. The identified high risk areas, segments, and intersections can help prioritize treatment areas throughout the region. Based on this premise it is the intent of this report to be used as a tool in addressing safety issues of concern for the communities in the EMCOG region.

EMCOG will lead the coordination of the RTSP for the region. It is expected that ongoing communications with all interested stakeholders will foster stronger relationships which can help promote and provide solutions to the regional safety issues as outlined in the emphasis areas. Solutions should incorporate all of the 4 E's of Safety (engineering, enforcement, education, and emergency services) in order to provide a holistic approach to today's traffic safety needs.

Implementation of this report along with the appropriate countermeasures and strategies should be evaluated on a continued basis to ensure that treatments are working as expected. The evaluation process should be a coordinated effort involving various levels of public and private agencies from all applicable counties. The evaluation process should build on the level of detail and robust traffic crash reporting systems available in the state. The implementation and evaluation process should also strive to promote innovation in not only the implementation and evaluation of countermeasures and strategies, but also in the data collection, analysis, and reporting systems. Sources such as the crash modification factor (CMF) clearing house (www.cmfclearinghouse.org) and CMFs provided by the MDOT provide additional information portals which could be examined to identify, implement, and evaluate other types of countermeasures and strategies in addition to the ones provided throughout this report.

Several transportation related funding sources are also available which could be pursued to realize the safety objectives of the EMCOG region. A few of the potential funding sources include:

- **Fixing America's Surface Transportation Act (FAST)** – Enacted in 2015, the FAST Act grant program under the U.S. Department of Transportation provides funding for infrastructure planning and investment related projects encompassing all modes of transit. The Act is authorized for funding for five years between fiscal year (FY) 2016 and 2020. Funding is apportioned for six primary programs which include the National Highway Performance Program, Surface Transportation Block Grant Program, Congestion Mitigation & Air Quality Improvement, Highway Safety Improvement Program, Railway-Highway Crossing Program, Metropolitan Planning, and the National Highway Freight Program.
- **Rural Task Force Program –** The Rural Task Force Program provides funding for transportation projects in rural counties in Michigan with a population of 400,000 or less. Funding is provided through the Surface Transportation Program Rural (STP) and Transportation Economic Development Fund (TEDF) Category D sources. The program is administered through a regional task force comprised of representatives from each applicable county road commission, representatives from cities or villages with a population of 5,000 or less, and representatives of each regional transit provider.
- **Safe Routes to School (SRTS) –** The Michigan SRTS program administered by the FHWA provides funding for projects or programs whose goal is to enable and encourage children, including those with disabilities to walk and bike to school; make walking and bicycling to school safer and more appealing thus encourage healthy and active lifestyles; and facilitate the planning, development, and implementation of projects which improve safety, reduce traffic, fuel consumption and emissions in proximity to schools. The SRTS program offers federal funding structured in two ways, a mini grant and major grant. The mini grant is primarily program related, while the major grant is infrastructure improvement and program related.
- **Small Urban Program** – The Small Urban Program administered by MDOT provides funding for transportation projects within small urban areas of population of 5,000 to 50,000. Funding can be utilized only

for construction costs or capital purchases of transit vehicles. Proposed projects must be within approved federal-urbanized areas and/or located on the federal highway system.

- **State Infrastructure Bank (SIB) Loan Program** – The Michigan SIB loan program is available to Act 51 public entities for eligible transportation projects. Its primary aim is to complement traditional funding sources and address urgent project financing demands. The program priorities include accelerating the delivery of transportation projects by providing financial assistance otherwise not available in the short term; increase the financial viability of transportation projects by reducing borrowing costs; and attract new public and private investments in transportation infrastructure.
- **Transportation Alternatives Program (TAP)** – TAP is a competitive grant which funds projects which enhance intermodal transportation options and provide safe alternative transportation choices. Examples include bike paths, streetscapes, historic preservation of transportation facilities, or projects which promote walkability and improve the quality of life.
- **Transportation Economic Development Fund (TEDF)** – The TEDF provides funding opportunities for agencies with immediate transportation needs relating to economic development issues. The mission of the TEDF is to enhance the ability of the state to compete in the international economy, serve as a catalyst for economic growth in the state, and improve the quality of life of its residents. There are five categories under the TEDF program. These include economic development road projects, urban congestion relief, secondary all-season roads, forest roads, and urban areas in rural counties.

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Appendix A – Crash Type Matrix

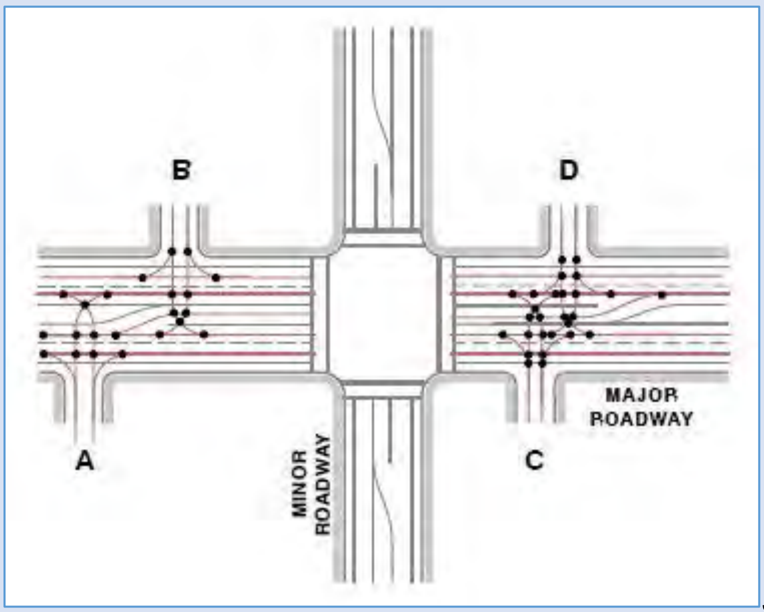
Crash Type	All Crashes	Fatal	A-injury	Single Vehicle Lane Departure	Multiple Vehicle Lane Departure	Intersection	Intersection Signalized	Intersection Stop Controlled	Pedestrian	Bicycle
Overturn	5.4%	14.8%	12.3%	17.6%	0.0%	0.6%	0.1%	0.7%	0.0%	0.0%
Hit Train	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pedestrian	0.8%	9.4%	5.5%	0.3%	0.1%	0.7%	0.8%	0.7%	95.7%	0.0%
Bicycle	0.7%	2.8%	2.2%	0.2%	0.0%	1.2%	1.2%	1.5%	0.0%	98.0%
Fixed Object	24.1%	27.7%	27.2%	73.4%	0.0%	7.6%	2.4%	9.0%	0.0%	0.0%
Other Object	1.5%	0.0%	0.3%	1.0%	0.0%	0.2%	0.1%	0.2%	0.0%	0.0%
Hit Parked Vehicle	0.5%	0.0%	0.2%	0.1%	0.0%	0.1%	0.0%	0.1%	0.5%	0.5%
Misc Single Vehicle	2.8%	1.2%	4.9%	6.7%	0.0%	0.9%	0.3%	0.8%	0.0%	0.0%
Misc Multiple Vehicle	2.9%	1.9%	2.3%	0.0%	0.0%	2.5%	2.1%	3.5%	0.0%	0.0%
Angle Straight	12.4%	18.1%	16.5%	0.0%	0.0%	26.5%	23.7%	48.4%	0.0%	0.0%
Angle Turn	3.6%	2.1%	2.9%	0.0%	0.0%	7.1%	7.3%	10.3%	0.0%	0.0%
Head On Left Turn	1.9%	1.9%	4.0%	0.0%	0.0%	4.0%	6.4%	2.0%	0.0%	0.0%
Rear End Straight	18.5%	4.0%	6.6%	0.0%	0.0%	20.5%	36.5%	9.0%	0.0%	0.0%
Rear End Left Turn	1.4%	0.9%	1.4%	0.0%	0.0%	2.1%	1.3%	0.8%	0.0%	0.0%
Rear End Right Turn	1.0%	0.2%	0.1%	0.0%	0.0%	1.5%	1.2%	1.2%	0.0%	0.0%
Dual Left Turn	0.2%	0.0%	0.0%	0.0%	0.0%	0.4%	0.7%	0.0%	0.0%	0.0%
Dual Right Turn	0.2%	0.0%	0.0%	0.0%	0.0%	0.4%	0.7%	0.3%	0.0%	0.0%
Head On	1.3%	12.0%	6.2%	0.0%	41.0%	0.7%	0.7%	0.6%	0.0%	0.0%
Side-Swipe Same	8.4%	0.5%	1.9%	0.0%	0.0%	7.1%	7.3%	2.5%	0.0%	0.0%
Side-Swipe Opposite	2.0%	0.9%	1.4%	0.0%	53.7%	1.6%	1.4%	2.1%	0.0%	0.0%
Angle Drive	3.1%	0.7%	1.6%	0.0%	0.0%	4.8%	1.0%	2.0%	0.0%	0.0%
Rear End Drive	1.7%	0.0%	0.7%	0.0%	0.0%	3.3%	3.1%	0.7%	0.0%	0.0%
Other Drive	1.0%	0.7%	0.9%	0.0%	2.1%	1.6%	0.4%	0.5%	0.0%	0.0%
Backing	4.0%	0.0%	0.3%	0.7%	2.5%	4.1%	1.3%	2.8%	3.2%	0.9%
Parking	0.6%	0.2%	0.4%	0.1%	0.5%	0.4%	0.1%	0.2%	0.6%	0.5%

2010-2014 EMCOG Regional Crash Matrix (Deer or Animal crashes are excluded)

Crash Type	Motorcycle	Truck/Bus	Young Driver <24	Senior Driver >65	Driveway Related	Distracted Driving	Alcohol Involved	Drug Involved	Speeding
Overturn	8.9%	3.4%	5.5%	1.7%	0.4%	3.6%	12.1%	6.5%	16.2%
Hit Train	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%
Pedestrian	0.2%	0.2%	0.4%	0.7%	0.5%	0.8%	2.5%	0.4%	0.1%
Bicycle	0.5%	0.2%	0.3%	0.6%	0.7%	0.4%	0.8%	0.2%	0.1%
Fixed Object	26.1%	9.9%	21.5%	11.3%	5.9%	18.8%	50.7%	47.7%	59.8%
Other Object	1.0%	0.8%	0.6%	1.0%	0.3%	0.4%	0.7%	1.0%	0.8%
Hit Parked Vehicle	0.4%	0.4%	0.2%	0.4%	0.0%	0.3%	0.4%	0.6%	0.2%
Misc Single Vehicle	16.8%	2.6%	2.2%	1.2%	0.7%	1.2%	4.6%	2.7%	4.8%
Misc Multiple Vehicle	3.1%	7.3%	2.6%	3.5%	0.1%	2.0%	1.0%	1.5%	1.4%
Angle Straight	7.0%	12.1%	13.8%	18.6%	0.0%	11.4%	5.7%	5.8%	2.7%
Angle Turn	3.3%	3.9%	4.3%	5.5%	0.0%	1.0%	1.1%	0.8%	0.6%
Head On Left Turn	3.9%	0.9%	2.3%	3.1%	0.0%	1.1%	0.8%	0.6%	0.1%
Rear End Straight	9.3%	16.7%	21.9%	19.3%	0.0%	36.9%	7.9%	12.7%	5.1%
Rear End Left Turn	2.1%	1.0%	1.9%	1.7%	3.3%	4.4%	0.6%	0.2%	0.3%
Rear End Right Turn	1.0%	0.9%	1.0%	1.1%	2.1%	2.1%	0.2%	0.0%	0.2%
Dual Left Turn	0.1%	1.1%	0.1%	0.3%	0.1%	0.1%	0.0%	0.0%	0.0%
Dual Right Turn	0.2%	1.3%	0.2%	0.3%	0.2%	0.1%	0.0%	0.0%	0.0%
Head On	1.1%	1.9%	1.3%	1.5%	0.9%	2.0%	2.6%	4.0%	1.9%
Side-Swipe Same	5.3%	18.3%	7.9%	11.9%	8.7%	4.6%	3.1%	4.8%	2.7%
Side-Swipe Opposite	2.4%	5.3%	1.7%	2.4%	0.0%	1.9%	1.8%	5.0%	2.0%
Angle Drive	3.2%	2.0%	3.6%	4.6%	29.7%	1.3%	0.7%	0.2%	0.3%
Rear End Drive	0.7%	1.2%	2.1%	1.9%	16.2%	4.0%	0.3%	1.3%	0.3%
Other Drive	2.2%	1.0%	1.1%	1.5%	9.6%	0.4%	0.5%	1.0%	0.2%
Backing	0.9%	6.7%	2.8%	5.0%	18.0%	0.9%	1.4%	2.1%	0.1%
Parking	0.3%	0.8%	0.6%	1.1%	2.7%	0.4%	0.5%	0.8%	0.1%

2010-2014 EMCOG Regional Crash Matrix (Deer or Animal crashes are excluded)

Appendix B – Countermeasures

Access Management	
4 E's Area of Focus:	Engineering
Description:	Existing literature on the impacts of driveways on crashes indicates that crashes increase with increasing driveway density. As the spacing among driveways increases, the overall number of conflict points is reduced thus providing drivers with improved merging capabilities and less risky maneuvers. The placement of the driveways is also as important as driveway density. Increasing the distance of a driveway from an intersection reduces the risk of crashes since the number of potential conflict points is reduced. This effect is particularly true for angle and rear-end crashes. Similarly, limiting the number of access point on the major roadway and shifting them to the minor can help reduce the risk of crashes. A secondary aspect of access management is also the management of turning movements in and out of the driveway. Arguably the majority of crashes at a driveway are a result of left-turning vehicles. Thus minimizing or eliminating left turns can help reduce crashes as well. One method to manage, limit, or eliminate left turning movements is through the installation of medians which can include non-traversable medians, two-way left turn lanes (TWLTL). Additionally dedicated left-turn or right-turn lanes can help further control the flow of traffic.
Photo:	 *Source: FHWA*
Affected Crashes:	Driveway related crashes
Location:	High concentration of driveway related accidents
Estimated Safety Benefit:	15% overall crash reduction with access management improvement [13]. Benefits are dependent on the treatment type.
Estimated Cost:	Medium - High

Advanced Curve Warning Signs

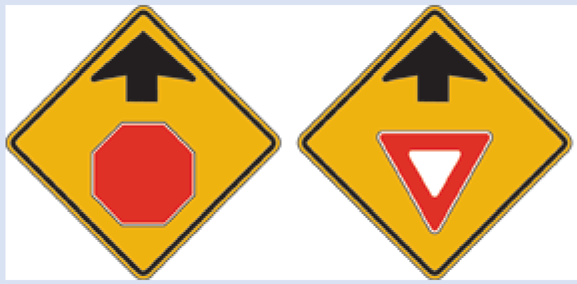
4 E's Area of Focus:	Engineering
Description:	Horizontal curves are part of the roadway geometry. However depending on the sharpness of the curve and other associative conditions they can be correlated with a disproportionate number of crashes. To improve the safety of these curves, advanced warning signs are typically placed prior to the horizontal curve to alert drivers of a sudden change in geometry which may not be expected or visible, thus prevent potential lane departures. Typical advanced curve warning signage includes the W1-1, W12, W1-3, W1-4, and W1-5.
Photo:	 *Source: FHWA*
Affected Crashes:	Single Vehicle Lane Departure, Sideswipe, Head-on, Fixed-Objects, Overturn
Location:	Unmarked roadway segments experiencing a sharp change in the horizontal curvature or a combination of horizontal and vertical curves.
Estimated Safety Benefit:	18% reduction in fatal and injury crashes [15]. 27.5% reduction in crashing occurring during dark conditions [15]. 25% reduction in lane departure crashes occurring during dark conditions [15]. 20% overall reductions in head-on, sideswipe, fixed-objects, or overturn crashes [13].
Estimated Cost:	Low

Advanced Guide and Street Name Signs	
4 E's Area of Focus:	Engineering
Description:	Advance guide and street name signs inform drivers of their location, potential destinations, and locations of interest along the roadway. The advanced placement of the signs provides drivers with additional time to make the necessary adjustments toward their lane position or any other required response relative to the presented sign information. Similar to advance warning signs, advance guide and street name signs are particularly important for older drivers who may require additional time to process and respond appropriately to the information.

Photo:

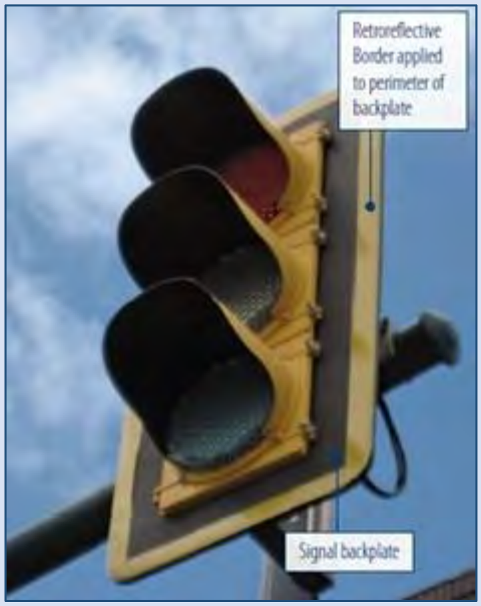
Affected Crashes:	All types of crashes (location dependent)
Location:	Placement in advance of locations requiring route selection decisions.
Estimated Safety Benefit:	1.6% overall crash reduction [16]. Benefits can be location dependent.
Estimated Cost:	Low

Advanced Intersection Signs	
4 E's Area of Focus:	Engineering
Description:	Advanced intersection signs provide advance warnings to drivers of an upcoming intersection downstream of the roadway. They consist of static signs (i.e. stop ahead or signal ahead signs) or dynamic signs such as advance warning flashers typically mounted on a warning sign to further alert drivers of upcoming conditions. The latter can flash regardless of the status of the downstream signal, or alert drivers of a potential signal change in the downstream signal.
Photo:	
Affected Crashes:	Intersection related crashes, Angle, Rear-end
Location:	Placement in advance of intersections characterized by a high frequency of rear-end and/or angle crashes, and/or affected by a limited sight distance.
Estimated Safety Benefit:	35% reduction in angle crashes when adding an advance signal warning sign ahead of a signalized intersection [17]. 36% and 62% reduction in rear-end and angle crashes respectively when installing flashing beacons on advance warning signs [18].
Estimated Cost:	Low

Advanced Warning Signs	
4 E's Area of Focus:	Engineering
Description:	Advance warning signs provide drivers with information on potential hazardous conditions on a roadway prior to the hazardous site. Such signs could include advisory speed signs, signal ahead signs, upcoming work zone areas, or other maneuvers which may present a risk to the driver. While advance warnings signs are beneficial to all drivers, they are particularly important for older drivers in order to provide adequate time to process and respond appropriately to the information.
Photo:	
Affected Crashes:	All types of crashes (location dependent)
Location:	Placement in advance of locations requiring change in speeds, hazardous geometric conditions, changes in the operational and geometric characteristics of the roadway, potential conflict areas, work zones, and other roadway or roadside hazards affecting the area.
Estimated Safety Benefit:	Benefits are location dependent.
Estimated Cost:	Low

Advisory Speeds	
4 E's Area of Focus:	Engineering
Description:	Advisory speed signs inform drivers of the appropriate speed under existing roadway conditions. They are installed upstream of the subject location. While advisory speeds are generally used to inform drivers of an upcoming lateral shift in the roadway, they can be applicable on a number of situations including to alert drivers of adverse weather conditions.
Photo:	
Affected Crashes:	Speeding related crashes
Location:	Locations where current posted speed limit is too high for existing roadway conditions.
Estimated Safety Benefit:	29% reduction in property damage only crashes when installing a horizontal alignment with advisory speed sign [19]. 13% reduction in crashes resulting injuries when installing a horizontal alignment with advisory speed sign [19].
Estimated Cost:	Low

All-Red Clearance Interval	
4 E's Area of Focus:	Engineering
Description:	The all-red clearance interval is the portion of the traffic signal cycle where a red signal is displayed for all approaches of an intersection. Its purpose is to allow adequate time for vehicles which entered the intersection during a yellow interval to clear the intersection prior to the conflicting approach receiving a green. It is typically a function of the total traversed width from the approach stop bar to the far side where a conflict does not exist, the length of a vehicle assumed at 20 feet, and the speed of approaching vehicles. Consequently, if a vehicle enters an intersection and an all-red clearance interval is not available or is inadequate in time, the risk for collisions increases. Not surprisingly studies have shown that the presence of an all-red interval has a positive effect on intersection safety. While currently signals are typically expected to operate with an all-red clearance interval, the provision of adequate all-red clearance timing also has a positive effect on intersection safety. One drawback to increasing the all-red clearance time is the increase in total intersection delay as vehicles on all approaches are experiencing a lower amount of the green interval.
Photo:	
Affected Crashes:	Intersection related crashes, Angle, Rear-end, sideswipe, Head-on
Location:	Signalized intersections with no or inadequate all-red clearance interval.
Estimated Safety Benefit:	20.2% reduction in intersection related crashes [20].
Estimated Cost:	Low

Backplates	
4 E's Area of Focus:	Engineering
Description:	MDOT has found that traditional traffic signals can be difficult for drivers to see. By adding either a black backplate or a backplate with a reflectorized border, signal visibility is increased. The combination of a black backplate and all black face has shown increased signal visibility during the day by 33 percent. By making the backplate reflective, visibility has increased even more, especially at night. Both backplates and retroreflective borders are low-cost safety treatments that can be easily added systematically to existing span and mast arm assemblies as long as the structural capacity of the supports is evaluated.
Photo:	 *Source: FHWA*
Affected Crashes:	Intersection related crashes
Location:	Intersections with traditional traffic signal with no black backplate or reflectorized sheeting on backplate. Particularly those intersections where signal visibility is poor.
Estimated Safety Benefit:	15% reductions in intersection related crashes when reflective sheeting is installed to signal backplates [21].
Estimated Cost:	Low

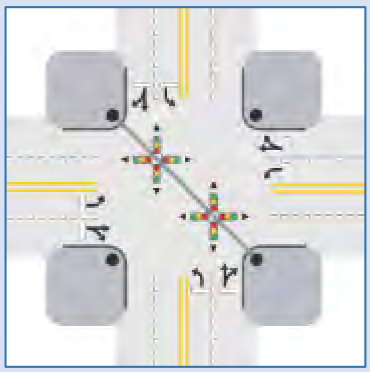
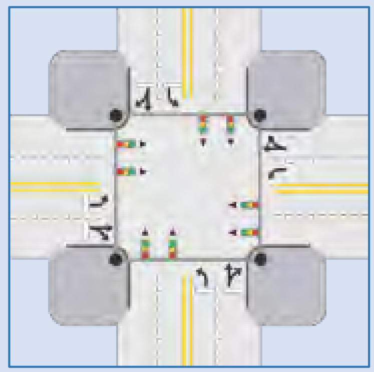
Box Span and Mast Arm	
4 E's Area of Focus:	Engineering
Description:	Box span and mast arm signal layouts provide safety improvements over diagonal span, pedestal, or post mounted signal displays. The safety benefits are associated with factors such as increased signal visibility and decreases in the angle of collision. While safety benefits are applicable for both cases, the use of one over the other is dependent on the existing intersection conditions and proposed layout configuration. Box span layouts can typically accommodate larger intersections, are more flexible in the placement of span wire poles, and have a lower overall cost as opposed to mast arms. Mast arm layouts in comparison are characterized by a higher overall cost and are more aesthetically pleasing than box span layouts. Maintenance on mast arms is also expected to be lower as opposed to box span layouts [8].
Photo:	  *Box Span* *Mast Arm*
Affected Crashes:	Angle, Rear-end, Intersection related crashes
Location:	Intersections with a high number of rear-end collisions, and/or intersections with a high number of angle crashes which could be a result of red light running.
Estimated Safety Benefit:	Safety benefits are dependent on the existing conditions of the intersection and proposed layout configuration.
Estimated Cost:	High

Cable Barrier on Shoulder	
4 E's Area of Focus:	Engineering
Description:	Cable barriers consist of high-tension steel cables supported by a weak post which prevent vehicles from departing the travel way. While traditionally cable barriers are installed along medians to prevent median crossover accidents, they may be also installed along shoulders to protect vehicles from colliding with fixed objects and/or avoiding steep slopes in the clear zone. Unlike rigid barriers, cable barriers include low installation and maintenance costs, and allow for a soft impact upon collision with adequate redirection capabilities. While situational, depending on the type, speed, and force of impact the cable barrier may not be able to fully prevent a lane departure crash and may become ineffective following a high speed high force impact. Thus the installation of cable barriers along a shoulder may require adequate offsets from a fixed object or high steep slope areas.
Photo:	
Affected Crashes:	Single Vehicle Lane Departure, Fixed-Objects, Overturns
Location:	Locations with steep slopes and/or fixed objects in the roadside.
Estimated Safety Benefit:	Existing literature does not examine safety impacts of shoulder cable barriers. Emphasis is placed on the safety benefits of median cable barriers.
Estimated Cost:	Low - Medium

Centerline & Shoulder Rumble Strips	
4 E's Area of Focus:	Engineering
Description:	Rumble strips are a road safety countermeasure which warn drivers of potential danger via vibration and noise transmitted from the wheel of the vehicle to the vehicle's interior. They can be installed over centerlines or on the shoulder.
Photo:	 *Source: FHWA*
Affected Crashes:	Single Vehicle Lane Departure, Head-on, Sideswipe-opposite
Location:	Roadway segments experiencing significant lane departure crashes, and/or head-on collisions with opposing traffic.
Estimated Safety Benefit:	Centerline Rumble Strips – 55% reduction in run-of-the-road crashes, sideswipe opposite, and head-on crashes [13]. Shoulder Rumble Strips – 20% reduction in run-of-the-road crashes [13].
Estimated Cost:	Low - Medium

Clear Zone	
4 E's Area of Focus:	Engineering
Description:	Clear zones are unobstructed and traversable areas following the edge of the traveled way designed to give drivers enough room to regain control of a vehicle that has left the roadway. Examples include shoulders or recoverable slope areas. Fixed objects that may be found in the suggested clear zone include utility poles, pillars, non-breakaway mailboxes, wall/barriers, dangerous landscaping and non-breakaway fence posts. Arguably however, the biggest issue for local agencies as it relates to fixed objects in the clear zone involve trees. By creating and maintaining clear zones along the roadway, the likelihood that a roadway departure results in a collision, and/or high severity collision is reduced.
Photo:	 *Source: FHWA*
Affected Crashes:	Single Vehicle Lane Departure, Fixed-Objects, Overturns
Location:	Roadway segments with a high concentration of single vehicle lane departure crashes. Width of the clear zone is depending on vehicle speeds and volumes of the adjacent roadway.
Estimated Safety Benefit:	Increasing the distance of the clear zone from 3.3 ft to 16.7 ft reduces crashes of all types of severities by 22% [19]. Increasing the distance of the clear zone from 16.5 ft to 29.5 ft reduces crashes of all types of severities by 44% [19]. Removing or relocating fixed objects outside of clear zones reduces crashes of all types of severities by 75% [13]. Flattening the slope reduces fixed-object crashes or overturns by 15% [13].
Estimated Cost:	Low - Medium

Connected Vehicle Technologies	
4 E's Area of Focus:	Engineering Education Enforcement Emergency
Description:	Connected vehicle technology is arguably the most promising technology advancement in recent memory with the potential of revolutionizing all elements of the transportation system. By making use of innovations in technology such as wireless communications, advanced sensors, GPS navigation, and smart infrastructure among a plethora of other elements, connected vehicles can have the capability to identify threats on the roadway and disseminate the information not only to the driver, but also share the information among all vehicles occupying a specific space in the roadway so that every vehicle would be aware of the location of other nearby vehicles. While connected vehicle technology is still in the early phases of research and implementation, NHTSA estimates that's connected vehicles may reduce up to 80% of crashes not involving an impaired driver, and could be particularly effective in reducing crashes associated with human error [6].
Photo:	 *Source: U.S. DOT*
Affected Crashes:	All crashes
Location:	n/a
Estimated Safety Benefit:	80% potential reduction for all crashes not involving an impaired driver [6].
Estimated Cost:	High

Diagonal Span to Box Span Configuration	
4 E's Area of Focus:	Engineering
Description:	An adequate number and the proper placement of signal heads at an intersection are a recognized safety benefit. It improves the visibility of the traffic signals by providing drivers with the opportunity to quickly view the signal as opposed to searching the vicinity while approaching the intersection. This concern is magnified among older drivers to compensate for decreased head motion range and limited peripheral vision. In a diagonal span configuration the adequate number and placement of the signal heads cannot be addressed properly. Switching to a box span configuration mitigates this issue as it provides flexibility relative to the signal head's location and allows for the signal head to be placed over each lane of travel. While diagonal span configurations can still be found throughout Michigan, the box span layout is currently the preferred signal head configuration in Michigan.
Photo:	 *Diagonal Span*  *Box Span*
Affected Crashes:	Intersection related crashes
Location:	Diagonal span configured intersections with a high number of rear-end collisions, and/or intersections with a high number of angle crashes which could be a result of red light running.
Estimated Safety Benefit:	10% overall crash reduction [13].
Estimated Cost:	High

Fluorescent Yellow Sheeting on Warning Signs	
4 E's Area of Focus:	Engineering
Description:	The use of fluorescent yellow sheeting in place of the standard yellow sheeting on warning signs is a relatively inexpensive method to increase the luminance and visibility of the applicable traffic signs on the roadway. Thus drivers may be better informed and alerted of potential hazardous conditions along the roadway. The improved visibility is applicable in both daytime and particularly nighttime conditions.
Photo:	 *Source: FHWA*
Affected Crashes:	Lane Departure, additional crashes applicable depending on hazardous conditions
Location:	Locations in which the roadway geometry or other obstructions hide the hazard condition applicable to the sign.
Estimated Safety Benefit:	20% crash in reduction in all types of single vehicle lane departure crashes [22].
Estimated Cost:	Low

Installation & Maintenance of Bicycle Lanes	
4 E's Area of Focus:	Engineering
Description:	The American Association of State Highway and Transportation Officials (AASHTO) defines a bike lane as the "portion of a roadway which has been designated by striping, signing, and pavement markings for the preferential or exclusive use of bicyclists". They are typically located on the right side of the roadway with pavement markings which direct bicyclists toward the direction of travel. Bicycle lane design standards vary depending upon the location and operational and geometric roadway conditions, the premise is to provide bicyclists with a safe travel path by minimizing potential conflicts with vehicles which are generally traveling at much higher speeds.
Photo:	
Affected Crashes:	Bicycle crashes
Location:	Roadways used by bicyclists with improperly designed bicycle lanes or no bicycle lanes, and which pose a particularly high risk to bicyclists.
Estimated Safety Benefit:	25% reduction in bicycle crashes when installed per MDOT standards [13].
Estimated Cost:	Low - High

Lane Width	
4 E's Area of Focus:	Engineering
Description:	As the roadway narrows, drivers tend to driver at lower speeds to be able to maneuver the reduction in space. The changes are not limited to physical changes but also restriping of the pavement to reduce the lane width. The remaining space could then be used to support additional uses such bike lanes, parking lanes and related.
Photo:	
Affected Crashes:	Speeding related crashes
Location:	Speed transition areas, in proximity to schools, residential neighborhoods, or segments with speeding violations.
Estimated Safety Benefit:	5% reduction in overall crashes [23].
Estimated Cost:	Low - High

Left turn signal phasing	
4 E's Area of Focus:	Engineering
Description:	Left turn movements represent a high risk intersection movement. Thus when a left turn phase is warranted it must be provided. This decision is not only a function of through volumes and left-turn volumes and delay, but it may also be based left-turn crash frequency. The addition of a left turn signal phasing can significantly reduce left-turn crashes.
Photo:	
Affected Crashes:	Left-turn crashes
Location:	Intersections where a left-turn signal phase is warranted and/or where there is a high concentration of left-turn crashes.
Estimated Safety Benefit:	30% reductions in left-turn crashes when a left-turn signal phase is added [13].
Estimated Cost:	Medium

Paved Shoulders	
4 E's Area of Focus:	Engineering
Description:	Paved shoulders provide additional room for vehicle recovery along a roadway. They allow the driver to correct the vehicle's path after leaving the lane but before the vehicle runs off the road.
Photo:	 *Source: FHWA*
Affected Crashes:	Single Vehicle Lane Departure
Location:	Roadway segments with no paved shoulders or with minimal paved shoulder area, and that are experiencing significant single vehicle lane departure crashes and/or where non-motorized vehicles (i.e. bicycle) share the road with other vehicles.
Estimated Safety Benefit:	Up to 16% decrease in crashes. Effect varies over time [24].
Estimated Cost:	Low - High

Pedestrian Bump Outs	
4 E's Area of Focus:	Engineering
Description:	Pedestrian bump outs or bulb outs are extensions of the sidewalk and curb towards the roadway. In addition to shortening the roadway crossing distance, pedestrian bump outs also enhance pedestrian safety by increasing pedestrian visibility, and potentially reducing speeds by narrowing the roadway. Pedestrian bump outs are typically appropriate only in the presence of on-street parking lanes. When the extension is in proximity of an intersection, the turning needs of the larger vehicles using the facility must be assessed.
Photo:	 *Source: FHWA*
Affected Crashes:	Pedestrian crashes
Location:	Crossing locations with a high frequency of pedestrian crashes or where pedestrians are at elevated risks of crashes. On-street parking lanes must be present. Extension must not move into the travel way.
Estimated Safety Benefit:	30% overall crash reduction when removing parking and extending the curb [13].
Estimated Cost:	Low - Medium

Pedestrian Countdown Timer	
4 E's Area of Focus:	Engineering
Description:	Pedestrian countdown timers provide pedestrians or bicyclists with the remaining time in seconds for them to cross the roadway or the pedestrian phase to end. They can be passive or active (i.e. operate via a push-button). They can also be associated with auditory warnings to alert pedestrians whose vision may be limited. Because of the additional information that countdown timers provide, they are associated with increased crossing compliance and may also have an impact on motorized users. They are most common in urban and suburban areas.
Photo:	
Affected Crashes:	Pedestrian and/or bicycle related crashes
Location:	Intersections characterized by a high frequency of pedestrian and/or bicycle crashes.
Estimated Safety Benefit:	30% reduction in pedestrian or bicyclists related crashes when installed on intersections with no prior signals [13]. 25% reduction in pedestrian or bicyclists related crashes when upgrading existing signals [13].
Estimated Cost:	Medium

Pedestrian Refuge Island	
4 E's Area of Focus:	Engineering
Description:	Pedestrian refuge islands are raised sections of pavement placed on streets at an intersection or midblock to provide pedestrians with a protected resting place as they generally wait for a gap in traffic to finish crossing the road. They are generally installed on wide roadways to make crossing easier by allowing pedestrians to identify gaps one approach at a time.
Photo:	
Affected Crashes:	Pedestrian crashes
Location:	Marked or unmarked crosswalk locations affected by a high frequency of pedestrian crashes, or where pedestrians are at elevated risks due to minimal gaps in the traffic flow or vehicular sight distance issues.
Estimated Safety Benefit:	46% reduction in pedestrian crashes when placed at marked crosswalks [25]. 39% reduction in pedestrian crashes when placed at unmarked crosswalks [25].
Estimated Cost:	Medium - High

Protected Left Turn Phase	
4 E's Area of Focus:	Engineering
Description:	Left turn movements are high risk movements at an intersection. Thus when a left turn phase is warranted it must be provided. This decision is not only a function of through volumes, left-turn volumes, and delay, but it may also be based left-turn crash frequency. The addition of a left turn signal phasing can significantly reduce left-turn crashes. Depending on existing traffic and physical conditions of the intersection however, left-turn related crashes can still occur frequently. This could occur when left turns are permissive and conflicts are occurring with through traffic in the same direction and non-motorized crossing traffic. Older drivers may be more prone to these conflicts due to impaired judgement, decreased head motion range movements and limited peripheral vision. A protected left turn phase can mitigate such potential conflicts by providing left-turning vehicles with the right of way.
Photo:	
Affected Crashes:	Left-turn related crashes, Head-on, Angle
Location:	Signalized intersections operating permissive or permissive/protected left turn phases and characterized by a high frequency of left-turn related crashes.
Estimated Safety Benefit:	99% reduction in angle crashes when changing from permissive or permissive-protected to protected phasing [26]. 16% reduction in left-turn related crashes when changing from permissive to protected/permissive or permissive/protected phasing [27].
Estimated Cost:	Low

Reflective Sheeting for Sign Posts	
4 E's Area of Focus:	Engineering
Description:	Reflectivity is the property of the material that reflects a portion of the light back to the light source. Reflectivity improvements can be applied to the sign and/or sign posts. In both scenarios, depending on the environmental conditions, the sign becomes more visible to the drivers as it is being subjected to a vehicle's headlights.
Photo:	 *Source: FHWA*
Affected Crashes:	Dependent on specific location
Location:	Locations where sign visibility is poor and characterized by a significant concentration of crashes
Estimated Safety Benefit:	15% reduction in crashes for lollipop signs [13].
Estimated Cost:	Low

Road Safety Audit	
4 E's Area of Focus:	Engineering Education
Description:	A Road Safety Audit (RSA) is a comprehensive safety performance examination of an existing or future roadway location by an independent and multidisciplinary team. The objective of the RSA is to identify opportunities for safety improvements on the subject location for all potential road users. RSA's contribute to road safety by providing an unbiased assessment of a segment or intersection to identify safety concerns and potential countermeasures. Continuous screening of the network can help ensure that a proactive approach is taken to identify and alleviate any problem safety areas.
Photo:	 *Source: MDOT*
Affected Crashes:	Depends on specific location.
Location:	High crash risk locations or locations with a high concentration of crashes.
Estimated Safety Benefit:	Depends on specific location.
Estimated Cost:	Low – High

Roundabouts	
4 E's Area of Focus:	Engineering Education
Description:	Roundabouts reduce vehicle speeds as well as the number of conflict points found in a typical intersection. In terms of crashes, roundabouts reduce head-on, left-turn and angle type crashes which frequently result in serious or fatal injuries. They also create a safer environment for pedestrians using the facility by slowing vehicles and dividing the crossing into two stages. The design of a roundabout is crucial to fostering a safe environment for drivers and pedestrians alike. When the design and geometry force traffic to enter and circulate slowly, roundabouts operate safely and effectively handle turning traffic. While the number of roundabouts is steadily increasing in Michigan, in certain regions of the state they are still a relatively new design feature. Consequently education on roundabout usage is a key component of their success. MDOT and other communities often hold informational sessions during which they have shown feeds of existing roundabouts and traffic simulation models, hand out brochures, and display posters. MDOT has the following information available to aid in educating the public on roundabouts: • http://www.michigan.gov/documents/mdot/MDOT_RoundaboutBrochure_312721_7.pdf • https://www.youtube.com/watch?v=ONacAiKXe-8
Photo:	 *Source: MDOT*
Affected Crashes:	Head-on left turn, Angle
Location:	Intersections with a high proportion of crashes or violations.
Estimated Safety Benefit:	35% overall crash reduction [28]. 76% reduction in fatal and injury crashes [13].
Estimated Cost:	High

Safety Edge Pavement Treatments	
4 E's Area of Focus:	Engineering
Description:	Safety edge is the reshaping of the edge of the pavement into a 30 degree angle during installation. The angled safety edge avoids vertical drop offs if the granular shoulder shifts from the pavement edge. Safety edges are a simple and effective way to reduce fatal crashes on high speed roadways as the angle makes it safer and easier for drivers to reenter the roadway following a roadway departure.
Photo:	 *Source: FHWA*
Affected Crashes:	Single Vehicle Lane Departure
Location:	Roadway segments experiencing significant single vehicle lane departure crashes.
Estimated Safety Benefit:	5.6% to 9.5% decrease in crashes of all types of severities. 1.6% to 16.5% decrease in fatal and injury crashes [29].
Estimated Cost:	Low

Safety Paths, Sidewalk, and Crosswalk Improvements	
4 E's Area of Focus:	Engineering
Description:	According to NHTSA and the FHWA, an average of 4,500 pedestrians are killed each year in traffic crashes in the United States. Almost 8% of these are a result of pedestrians walking along the roadway where there is a lack of delineation between pedestrian pathways and vehicles. Consequently, providing safe and separate walkways can significantly reduce these types of crashes by almost 88% [9].Safe walkways can include sidewalks or widening and paving the shoulder so that there is more space between pedestrian or bicycle paths and the vehicle travel way. These facilities benefit the drivers and the non-motorists as they are visible reminders of both road users. Similarly, providing and/or improving crosswalks is associated with significant benefits for non-motorized users including comfort, health and recreation using these facilities.
Photo:	 *Source: FHWA*
Affected Crashes:	Pedestrian and/or bicyclist related crashes
Location:	Locations characterized by a high frequency of non-motorized users and/or pedestrian/bicyclist crashes with no or low visible safe pathways, crosswalks, sidewalks.
Estimated Safety Benefit:	88% reduction in pedestrian crashes when separating non-motorized user crossways from vehicular lanes [9]. 71% reduction in pedestrian crashes when installing or widening paved shoulders [30]. 40% reduction in pedestrian crashes when installing high visibility crosswalks [31]. (Crash reductions are dependent on type of treatment).
Estimated Cost:	Low - High

Signal Optimization	
4 E's Area of Focus:	Engineering
Description:	While intersections by their nature increase stop and go traffic, a poorly optimized intersection can increase driver aggression, and result in unsafe acceleration and deceleration maneuvers. Thus optimizing the signal not only improves the intersection operational efficiency, but can also reduce crashes.
Photo:	
Affected Crashes:	Intersection related crashes
Location:	Intersections with poor optimization and particularly compounded by a high crash frequency and/or crash rate.
Estimated Safety Benefit:	10% reductions in crashes associated with signal optimization or timing updates [13].
Estimated Cost:	Low

Speed Feedback Sign	
4 E's Area of Focus:	Engineering
Description:	Speed feedback signs are dynamic signs which measure and report the speed of the approaching vehicle. They can be associated with a speed limit sign to remind drivers of the posted speed limit, or warning messages to alert drivers if they are driving past the posted speed limit or recommended speed for the existing conditions. They can be particularly useful for speed transition zones, area in vicinity of schools, or residential neighborhoods.
Photo:	 *Source: FHWA*
Affected Crashes:	Speeding related crashes
Location:	Speed transition areas, in proximity to schools, residential neighborhoods, or segments with speeding violations.
Estimated Safety Benefit:	5% reduction in overall crashes [34].
Estimated Cost:	Low

Wet Reflective Pavement Markings	
4 E's Area of Focus:	Engineering
Description:	Water can significantly reduce pavement marking retroflectivity which affects the ability of the drivers to stay in the lane or roadway. The effect is particularly exacerbated during nighttime. To rectify or ameliorate this condition, wet reflective pavement markings are applied on top of existing pavement markings of standard material. These can be paint, tape or thermoplastic material.
Photo:	 *Source: FHWA*
Affected Crashes:	Lane Departure, Head-on, Sideswipe-same, Nighttime crashes, Wet-weather crashes
Location:	Locations where pavement marking visibility is an issue during wet conditions, and/or locations with a high concentration of crashes as a result of wet conditions. Effect may be higher on multilane roadways.
Estimated Safety Benefit:	18% overall crash reduction [35]. 41% reduction for injury crashes [35]. 46% reduction in run-off-the-road crashes [35]. 25% reduction in wet-road crashes [35]. 30% reduction in night time crashes [35].
Estimated Cost:	Low

Appendix C – High Risk Segments and Intersections Lists

Top Segments by Total Crash Rate (2010 - 2014)

Top 20 per County. Does not include state trunkline or segment shorter than 300ft.

Non-Deer/Non-Animal

Segment Boundary							Total Crash Rate	
Beg. X	Beg. Y	End. X	End. Y	Length (mi)	AADT	County	(100 MVM)	Total Crashes
-83.782738	43.250188	-83.775228	43.248454	0.51	62	Saginaw	43408	25
-83.774690	43.243002	-83.775228	43.248454	0.39	62	Saginaw	34344	15
-84.767295	43.575370	-84.747433	43.575378	1.00	2204	Isabella	4464	179
-82.943792	43.709792	-82.936837	43.710005	0.35	314	Huron	4012	8
-83.263163	43.729152	-83.261163	43.729188	0.10	344	Huron	3186	2
-84.610308	43.409201	-84.607159	43.409222	0.16	508	Gratiot	2731	4
-83.332565	44.415005	-83.336076	44.416084	0.19	589	Iosco	2461	5
-84.968318	43.703276	-84.968351	43.709908	0.46	199	Isabella	2410	4
-83.774812	43.235743	-83.774690	43.243002	0.50	62	Saginaw	1764	1
-84.611501	44.286441	-84.611502	44.287357	0.06	539	Roscommon	1614	1
-83.887947	43.597018	-83.887610	43.599093	0.14	5627	Bay	1488	22
-84.605580	43.407872	-84.605553	43.409221	0.09	404	Gratiot	1458	1
-83.125153	43.964261	-83.121886	43.964349	0.16	467	Huron	1449	2
-83.889850	43.599250	-83.884397	43.598833	0.28	555	Bay	1436	4
-84.389683	43.379067	-84.389581	43.388144	0.63	130	Gratiot	1347	2
-84.676413	43.524165	-84.674306	43.524165	0.11	1556	Isabella	1342	4
-84.167133	43.614271	-84.167260	43.626694	0.86	143	Midland	1335	3
-85.028198	44.105952	-85.028099	44.111521	0.39	107	Clare	1330	1
-85.007893	43.726515	-85.003739	43.726533	0.21	199	Isabella	1324	1
-84.247164	43.665502	-84.247120	43.657627	0.54	7266	Midland	1192	86
-84.774587	44.328151	-84.773025	44.328176	0.08	633	Roscommon	1124	1
-83.975489	43.480049	-83.974255	43.480035	0.06	24534	Saginaw	1117	31
-84.787418	43.582465	-84.747484	43.582749	2.01	5143	Isabella	1116	210
-84.776570	43.593504	-84.776597	43.605361	0.82	3496	Isabella	1110	58
-84.758715	43.698441	-84.755054	43.698448	0.18	819	Isabella	1097	3
-83.903494	43.602169	-83.897192	43.601917	0.32	2435	Bay	1052	15
-84.661874	43.375477	-84.661846	43.378982	0.24	4249	Gratiot	1012	19
-83.826339	44.392291	-83.825164	44.392340	0.06	934	Iosco	1011	1
-83.887610	43.599093	-83.887070	43.603023	0.27	7568	Bay	1008	38
-84.114488	43.247334	-84.111591	43.247484	0.15	406	Saginaw	918	1
-84.661798	43.385217	-84.656876	43.385207	0.25	972	Gratiot	909	4
-84.807655	44.371706	-84.801947	44.371765	0.28	215	Roscommon	904	1
-83.180783	43.811044	-83.181081	43.825492	1.00	312	Huron	881	5
-85.030206	43.661329	-84.987511	43.661308	2.14	323	Isabella	872	11
-84.369643	43.331743	-84.369643	43.335598	0.27	239	Saginaw	862	1
-83.888097	43.596022	-83.887947	43.597018	0.07	5627	Bay	847	6
-84.987662	43.651995	-84.977819	43.669782	1.42	592	Isabella	846	13
-83.896196	43.414736	-83.896127	43.416188	0.10	9715	Saginaw	846	15
-84.782321	43.604485	-84.767688	43.604484	0.73	2238	Isabella	834	25
-84.497269	43.190358	-84.483772	43.190152	0.68	291	Gratiot	830	3
-84.711765	44.276793	-84.712329	44.298551	1.50	440	Roscommon	829	10
-83.965193	44.080879	-83.966325	44.083885	0.22	1521	Arenac	826	5
-83.884978	43.594788	-83.867163	43.593383	0.90	1282	Bay	809	17
-84.111347	43.429823	-84.111471	43.430618	0.06	1192	Saginaw	806	1
-85.018087	44.147595	-85.020061	44.163183	1.11	186	Clare	799	3

Segment Boundary				Length (mi)	AADT	County	Total Crash Rate (100 MVM)	Total Crashes
Beg. X	Beg. Y	End. X	End. Y					
-84.241040	43.143039	-84.227236	43.143142	0.70	394	Saginaw	798	4
-83.700630	44.234436	-83.682863	44.234539	0.88	157	Iosco	791	2
-84.388788	43.799236	-84.387589	43.799212	0.06	1176	Midland	790	1
-84.666773	43.385769	-84.661818	43.385756	0.25	837	Gratiot	789	3
-83.901825	43.623736	-83.899827	43.623739	0.10	29179	Bay	789	42
-84.044937	43.925497	-84.020054	43.925408	1.24	168	Arenac	788	3
-84.124569	43.524956	-84.123025	43.524936	0.08	7148	Saginaw	786	8
-85.086670	43.661091	-85.030541	43.661330	2.81	323	Isabella	784	13
-84.793527	44.305609	-84.755061	44.305777	1.91	259	Roscommon	776	7
-84.862783	43.869094	-84.862561	43.870362	0.09	2390	Clare	773	3
-83.941540	43.417894	-83.940636	43.417147	0.07	5154	Saginaw	759	5
-84.947164	44.132622	-84.908578	44.139488	2.03	107	Clare	755	3
-83.856451	43.364778	-83.854986	43.364769	0.07	996	Saginaw	743	1
-84.784012	44.330124	-84.774587	44.328151	0.54	551	Roscommon	735	4
-84.387589	43.799212	-84.381631	43.799515	0.32	1176	Midland	733	5
-84.862770	43.872035	-84.870125	43.929079	4.09	623	Clare	730	34
-84.795545	44.436048	-84.789889	44.435605	0.28	267	Roscommon	728	1
-84.767688	43.604484	-84.750848	43.604488	0.84	2238	Isabella	725	25
-84.600818	43.277188	-84.600878	43.291663	1.00	227	Gratiot	725	3
-85.087623	44.102455	-85.030342	44.103175	2.85	107	Clare	718	4
-83.700440	44.113354	-83.665857	44.113966	1.72	90	Arenac	708	2
-84.407321	43.726732	-84.396993	43.726844	0.52	1803	Midland	705	12
-84.138904	43.295629	-84.140560	43.296974	0.12	3157	Saginaw	700	5
-84.597896	43.418756	-84.596679	43.429576	0.77	407	Gratiot	699	4
-83.935941	43.418806	-83.934046	43.424741	0.43	922	Saginaw	693	5
-83.972267	43.480015	-83.970662	43.480002	0.08	24534	Saginaw	689	25
-84.750848	43.604488	-84.738692	43.604356	0.61	2238	Isabella	682	17
-83.406910	43.488678	-83.397044	43.488862	0.50	973	Tuscola	681	6
-83.474396	44.282147	-83.461012	44.280407	0.70	345	Iosco	680	3
-83.992169	43.602895	-83.992006	43.606432	0.24	1324	Bay	678	4
-84.408015	44.174988	-84.401542	44.175215	0.32	255	Ogemaw	667	1
-84.014467	43.603217	-84.011980	43.603185	0.13	3947	Bay	666	6
-84.475201	43.185454	-84.475211	43.190149	0.32	509	Gratiot	665	2
-84.946600	43.961947	-84.946432	43.965508	0.25	1005	Clare	660	3
-82.715939	43.938108	-82.712686	43.941003	0.26	328	Huron	653	1
-83.945970	43.853049	-83.926951	43.853184	0.95	718	Bay	643	8
-83.944607	43.407610	-83.942742	43.411876	0.31	1660	Saginaw	641	6
-82.834622	44.000010	-82.832521	44.027812	1.94	134	Huron	633	3
-84.223485	43.624729	-84.225223	43.626682	0.17	3164	Midland	630	6
-83.935947	43.416070	-83.935941	43.418806	0.19	922	Saginaw	629	2
-83.414521	44.446747	-83.390139	44.476261	2.69	260	Iosco	626	8
-83.934593	43.436118	-83.931427	43.435585	0.16	1613	Saginaw	621	3
-84.707237	43.803645	-84.707213	43.807875	0.29	302	Isabella	621	1
-83.874669	43.616512	-83.874501	43.619202	0.19	951	Bay	620	2
-83.914113	43.294806	-83.915216	43.298680	0.28	643	Saginaw	615	2
-83.895845	43.623827	-83.894253	43.623819	0.08	29179	Bay	610	26
-83.963458	43.479938	-83.962321	43.479922	0.06	28607	Saginaw	605	18
-84.415073	43.291945	-84.421333	43.291927	0.32	576	Gratiot	604	2
-84.019261	43.925399	-83.986433	43.925211	1.64	168	Arenac	597	3

Segment Boundary								
Beg. X	Beg. Y	End. X	End. Y	Length (mi)	AADT	County	Total Crash Rate (100 MVM)	Total Crashes
-84.788251	44.435612	-84.699813	44.421273	4.97	267	Roscommon	579	14
-84.646768	43.400647	-84.646758	43.401870	0.08	2267	Gratiot	575	2
-84.241736	43.610634	-84.239760	43.612558	0.17	6257	Midland	570	11
-85.018087	44.147595	-85.027841	44.146331	0.52	186	Clare	565	1
-84.836669	43.516365	-84.828656	43.516751	0.41	955	Isabella	558	4
-82.531012	43.268360	-82.526618	43.268511	0.22	1773	Sanilac	557	4
-84.778657	43.856469	-84.776785	43.856775	0.10	2031	Clare	556	2
-84.327815	43.871634	-84.326961	43.928116	3.90	179	Gladwin	550	7
-83.017711	43.659902	-83.017799	43.663557	0.25	404	Sanilac	536	1
-83.890009	43.598224	-83.886661	43.597965	0.17	3634	Bay	535	6
-84.468236	44.510809	-84.451042	44.509844	0.86	477	Roscommon	535	4
-83.884575	44.450802	-83.876613	44.450869	0.41	505	Iosco	531	2
-82.936717	43.710008	-82.923540	43.710331	0.66	314	Huron	528	2
-84.787875	43.552668	-84.787418	43.582465	2.06	1516	Isabella	526	30
-84.660244	43.375918	-84.660220	43.378987	0.21	1979	Gratiot	522	4
-84.691164	43.349896	-84.686192	43.349857	0.25	843	Gratiot	520	2
-83.188606	43.369223	-83.186219	43.369325	0.12	883	Tuscola	517	1
-83.422778	44.446664	-83.414521	44.446747	0.41	260	Iosco	515	1
-84.526312	43.872675	-84.525371	43.879824	0.52	1426	Gladwin	514	7
-83.340619	44.420985	-83.330215	44.420395	0.52	2296	Iosco	504	11
-84.704339	43.524181	-84.702517	43.523347	0.11	1001	Isabella	502	1
-84.421452	43.291927	-84.428960	43.291895	0.38	576	Gratiot	502	2
-83.876041	43.597145	-83.875020	43.603819	0.46	3085	Bay	498	13
-84.173927	44.176276	-84.172288	44.176277	0.08	1366	Ogemaw	495	1
-84.586466	43.756427	-84.585165	43.757852	0.12	945	Midland	491	1
-83.949697	43.624076	-83.947986	43.624052	0.09	5203	Bay	490	4
-84.069437	43.597385	-84.069365	43.603485	0.42	1333	Bay	488	5
-83.333741	44.468883	-83.323589	44.468368	0.51	1111	Iosco	487	5
-84.986679	43.552938	-84.987659	43.651834	6.84	592	Isabella	487	36
-84.871217	43.834053	-84.870933	43.835431	0.10	2348	Clare	481	2
-84.712365	44.299771	-84.702971	44.302630	0.51	447	Roscommon	478	2
-84.611595	44.293025	-84.611861	44.305379	0.85	539	Roscommon	477	4
-84.606917	44.075916	-84.606700	44.091538	1.08	214	Gladwin	475	2
-84.948905	43.963788	-84.946448	43.963740	0.12	947	Clare	470	1
-83.899268	43.623740	-83.897841	43.623802	0.07	29179	Bay	469	18
-83.125153	43.964261	-83.126357	43.996081	2.20	270	Huron	462	5
-84.770045	44.320534	-84.772584	44.328088	0.57	633	Roscommon	458	3
-83.352352	43.329490	-83.352554	43.336794	0.50	1189	Tuscola	457	5
-84.227013	43.623399	-84.224498	43.624209	0.14	7618	Midland	456	9
-84.225829	44.276257	-84.225855	44.282517	0.43	1121	Ogemaw	453	4
-84.679295	43.176092	-84.679222	43.185331	0.64	579	Gratiot	446	3
-84.073261	44.179864	-84.064272	44.183242	0.62	3374	Ogemaw	445	17
-84.777637	43.602628	-84.777673	43.604445	0.13	6885	Isabella	442	7
-84.968354	43.710140	-84.968570	43.755563	3.14	199	Isabella	439	5
-83.933731	43.623998	-83.931740	43.623992	0.10	22911	Bay	430	18
-83.913803	43.623817	-83.912667	43.623798	0.06	29179	Bay	428	13
-83.893692	43.572800	-83.886344	43.572744	0.37	2081	Bay	428	6
-84.854731	44.359581	-84.834701	44.365256	1.19	215	Roscommon	428	2
-85.028098	44.111635	-85.027841	44.146331	2.39	107	Clare	428	2

Segment Boundary								
Beg. X	Beg. Y	End. X	End. Y	Length (mi)	AADT	County	Total Crash Rate (100 MVM)	Total Crashes
-84.807492	44.031488	-84.779097	44.031612	1.46	1744	Clare	410	19
-83.354418	43.322257	-83.352176	43.322311	0.11	1189	Tuscola	408	1
-84.505082	43.915662	-84.479153	43.915775	1.29	416	Gladwin	407	4
-83.824677	44.004360	-83.806722	44.004530	0.90	306	Arenac	400	2
-84.688774	43.335393	-84.602620	43.335179	4.34	222	Gratiot	398	7
-83.421641	44.511681	-83.407028	44.511690	0.72	388	Iosco	391	2
-84.426849	43.987903	-84.427003	44.107267	8.24	222	Gladwin	389	13
-84.245550	43.613191	-84.243838	43.614407	0.12	6044	Midland	378	5
-84.246584	43.612449	-84.245550	43.613191	0.07	6044	Midland	373	3
-83.589311	43.365678	-83.583412	43.372031	0.53	2228	Tuscola	368	8
-84.610277	43.405677	-84.610333	43.411835	0.43	704	Gratiot	366	2
-84.427405	44.087930	-84.409160	44.087874	0.91	668	Gladwin	361	4
-84.585165	43.757852	-84.582479	43.756574	0.16	945	Midland	360	1
-84.485451	43.857965	-84.429211	43.857552	2.81	869	Gladwin	359	16
-84.393498	43.689916	-84.396993	43.726844	2.63	1803	Midland	359	31
-83.806722	44.004530	-83.806782	44.048027	3.00	306	Arenac	358	6
-84.401421	44.175210	-84.366324	44.175508	1.80	255	Ogemaw	358	3
-84.607540	43.466006	-84.588627	43.466051	0.95	485	Gratiot	356	3
-84.662935	44.493091	-84.666331	44.511269	1.37	1256	Roscommon	351	11
-84.176557	43.869619	-84.175882	43.912236	2.94	108	Gladwin	345	2
-84.887110	43.814034	-84.877399	43.828665	1.15	2348	Clare	345	17
-84.607591	43.291650	-84.612153	43.291661	0.23	3507	Gratiot	340	5
-84.261495	43.654942	-84.247157	43.654933	0.72	4327	Midland	335	19
-83.055145	44.002132	-83.007883	44.003640	2.36	279	Huron	333	4
-83.351441	43.597333	-83.351962	43.611754	1.00	828	Tuscola	332	5
-82.619622	43.264645	-82.622379	43.286261	1.51	2232	Sanilac	326	20
-84.684097	44.421330	-84.669877	44.433137	1.17	2885	Roscommon	325	20
-84.246811	43.604913	-84.247433	43.605981	0.10	1742	Midland	324	1
-84.928803	43.954642	-84.889044	43.951532	2.06	1160	Clare	321	14
-84.706864	43.827698	-84.706128	43.918174	6.24	302	Clare	320	11
-84.706126	43.918348	-84.708229	44.075661	10.86	302	Clare	317	19
-84.428459	43.857551	-84.404488	43.857380	1.20	869	Gladwin	316	6
-83.904708	44.220093	-83.883620	44.226692	1.45	973	Iosco	312	8
-84.227100	43.619485	-84.232006	43.622839	0.34	2069	Midland	310	4
-83.769317	44.233694	-83.701033	44.234432	3.39	157	Iosco	309	3
-83.695286	43.321343	-83.652710	43.321527	2.17	2052	Tuscola	307	25
-84.654375	43.845225	-84.646346	43.927985	5.88	577	Clare	307	19
-83.279120	43.815394	-83.270070	43.815616	0.45	2394	Huron	304	6
-83.362021	44.424909	-83.341758	44.421060	1.10	2296	Iosco	303	14
-83.934921	43.910504	-83.922623	43.932737	1.68	972	Arenac	302	9
-84.165614	44.241315	-84.165586	44.247021	0.39	462	Ogemaw	301	1
-83.705985	44.084582	-83.706143	44.113334	1.99	368	Arenac	300	4
-84.887835	43.958088	-84.777462	43.956041	5.63	781	Clare	299	24
-84.126701	44.421539	-84.116211	44.421532	0.52	711	Ogemaw	297	2
-83.959725	43.982739	-83.946879	43.982605	0.64	1741	Arenac	295	6
-84.238933	43.611978	-84.238107	43.612588	0.06	3151	Midland	295	1
-84.230662	44.273013	-84.230781	44.276253	0.22	1669	Ogemaw	293	2
-83.279112	43.814177	-83.279120	43.815394	0.08	2245	Huron	291	1
-83.966195	43.925090	-83.928797	43.924883	1.87	930	Arenac	284	9

Segment Boundary								
Beg. X	Beg. Y	End. X	End. Y	Length (mi)	AADT	County	Total Crash Rate (100 MVM)	Total Crashes
-82.637551	43.362631	-82.638022	43.369860	0.50	1551	Sanilac	283	4
-83.185837	43.412961	-83.186102	43.420132	0.50	1186	Tuscola	280	3
-82.800213	43.780554	-82.800891	43.807624	1.87	421	Huron	279	4
-83.927371	44.141839	-83.797740	44.142302	6.45	368	Arenac	277	12
-84.224498	43.624209	-84.223485	43.624729	0.06	3164	Midland	275	1
-83.722950	44.205391	-83.676040	44.205855	2.33	173	Iosco	272	2
-84.508754	43.498976	-84.369612	43.565206	8.93	820	Midland	269	36
-83.583918	43.362140	-83.579985	43.370354	0.64	1283	Tuscola	266	4
-84.778168	44.031619	-84.706399	44.032024	3.57	1744	Clare	264	30
-84.480762	43.886919	-84.399056	43.886335	4.08	1331	Gladwin	262	26
-83.665857	44.113966	-83.665991	44.142349	1.96	107	Arenac	261	1
-83.103826	43.327365	-83.095116	43.327512	0.44	1442	Sanilac	260	3
-84.220660	44.258756	-84.225462	44.263035	0.38	1669	Ogemaw	259	3
-84.429624	43.466149	-84.429257	43.535839	4.85	393	Midland	259	9
-84.266843	44.349323	-84.226647	44.349082	2.00	858	Ogemaw	256	8
-84.185897	43.912320	-84.186052	43.941310	2.00	108	Gladwin	254	1
-83.443841	43.408128	-83.439278	43.449093	2.99	1809	Tuscola	253	25
-83.341664	44.440816	-83.345002	44.443008	0.23	8572	Iosco	251	9
-83.542517	44.280046	-83.531993	44.272514	0.74	1483	Iosco	251	5
-83.405981	43.481697	-83.407597	43.497767	1.13	778	Tuscola	250	4
-83.461012	44.280407	-83.442129	44.258176	2.26	390	Iosco	249	4
-83.648842	43.337083	-83.589311	43.365678	4.48	2228	Tuscola	247	45
-83.328329	44.408320	-83.331535	44.415246	0.51	441	Iosco	245	1
-83.441073	43.450225	-83.439278	43.449093	0.13	1809	Tuscola	242	1
-83.186516	43.405491	-83.186849	43.412939	0.52	883	Tuscola	241	2
-83.434287	44.436066	-83.422778	44.446664	1.00	914	Iosco	240	4
-83.826339	44.392291	-83.875038	44.422049	3.94	934	Iosco	238	16
-83.368174	43.510297	-83.348069	43.510485	1.01	1613	Tuscola	235	7
-83.282791	43.330244	-83.286178	43.428104	6.76	552	Tuscola	235	16
-84.478895	43.915774	-84.365633	43.915103	5.65	416	Gladwin	233	10
-83.957031	43.989884	-83.965275	44.080410	6.35	1521	Arenac	233	41
-84.525371	43.879824	-84.503838	43.879701	1.16	1426	Gladwin	232	7
-83.095116	43.327512	-83.069085	43.328036	1.31	1442	Sanilac	232	8
-84.206943	44.247617	-84.165586	44.247021	2.06	462	Ogemaw	230	4
-83.426932	43.494945	-83.417037	43.495059	0.50	1449	Tuscola	228	3
-83.584233	43.379121	-83.584254	43.380423	0.09	2668	Tuscola	228	1
-84.503838	43.879701	-84.486570	43.882237	0.95	2040	Gladwin	226	8
-84.487551	44.160496	-84.489317	44.222518	4.30	585	Roscommon	218	10
-84.206235	43.941450	-84.166020	43.941131	2.01	126	Gladwin	217	1
-83.096742	43.603028	-82.977012	43.606881	6.01	296	Sanilac	216	7
-84.206235	43.941450	-84.209816	43.980083	2.71	95	Gladwin	213	1
-84.711765	44.276793	-84.651570	44.276655	2.99	694	Roscommon	212	8
-83.353447	43.655118	-83.353990	43.669722	1.01	1028	Tuscola	212	4
-84.410232	44.349047	-84.410539	44.373148	1.67	1711	Roscommon	211	11
-84.206403	43.870161	-84.166509	43.869495	1.99	1460	Gladwin	207	11
-83.104934	43.935823	-83.106235	43.964727	2.00	266	Huron	206	2
-84.171945	44.176278	-84.125558	44.176395	2.30	1735	Ogemaw	206	15
-83.326912	43.336945	-83.317697	43.337423	0.47	1130	Tuscola	205	2
-83.922467	43.932870	-83.889084	43.983013	3.85	972	Arenac	205	14

Segment Boundary				Length (mi)	AADT	County	Total Crash Rate (100 MVM)	Total Crashes
Beg. X	Beg. Y	End. X	End. Y					
-82.574240	43.195462	-82.516340	43.197424	2.93	1478	Sanilac	203	16
-84.410816	44.493945	-84.410876	44.508480	1.00	543	Roscommon	201	2
-84.596706	44.494349	-84.594592	44.494333	0.10	2628	Roscommon	200	1
-82.799961	43.771711	-82.625542	43.776695	8.73	222	Huron	198	7
-82.822442	43.362973	-82.792118	43.364018	1.53	545	Sanilac	197	3
-84.525503	44.005372	-84.525217	44.009406	0.28	2003	Gladwin	196	2
-83.265454	43.671297	-83.267007	43.721905	3.49	727	Huron	194	9
-82.945041	43.825463	-82.941836	43.825562	0.16	1764	Huron	193	1
-83.007618	43.996478	-82.977889	43.997584	1.48	192	Huron	192	1
-84.027604	44.040404	-84.020347	44.072646	2.36	1578	Arenac	192	13
-82.878375	43.682770	-82.878914	43.711816	2.01	143	Huron	191	1
-84.521842	43.901721	-84.505079	43.901551	0.84	1389	Gladwin	189	4
-82.671781	43.426879	-82.672000	43.434113	0.50	588	Sanilac	186	1
-83.353990	43.669722	-83.355016	43.703060	2.30	1028	Huron	185	8
-84.585153	43.924142	-84.585224	43.987897	4.40	1470	Gladwin	178	21
-82.798276	43.684824	-82.800208	43.780410	6.60	421	Huron	177	9
-84.109255	44.421552	-84.106164	44.421551	0.15	2071	Ogemaw	173	1
-83.887627	43.985250	-83.859395	44.004428	1.97	503	Arenac	166	3
-83.706424	44.013430	-83.686677	44.013349	0.98	338	Arenac	165	1
-84.166518	44.126664	-84.136137	44.127272	1.51	222	Arenac	163	1
-83.925868	44.161833	-83.924746	44.185213	1.65	846	Ogemaw	157	4
-84.116211	44.421532	-84.109376	44.421552	0.34	2071	Ogemaw	157	2
-83.706424	44.013430	-83.706257	44.048237	2.40	1171	Arenac	156	8
-84.002487	44.033169	-83.884525	44.033394	5.87	599	Arenac	156	10
-83.923491	44.277068	-83.940452	44.361476	6.36	791	Ogemaw	153	14
-84.064272	44.183242	-84.004989	44.183611	2.99	3034	Ogemaw	145	24
-82.671449	43.419692	-82.671781	43.426879	0.50	1551	Sanilac	142	2
-84.065116	44.219703	-83.904708	44.220093	8.07	973	Ogemaw	140	20
-84.266660	44.176446	-84.173927	44.176276	4.61	1366	Ogemaw	139	16
-83.944630	44.190739	-83.924862	44.191034	0.98	819	Ogemaw	136	2
-82.776812	43.613358	-82.737373	43.614460	1.98	413	Sanilac	134	2
-82.830277	43.421298	-82.830939	43.428476	0.50	2706	Sanilac	122	3
-82.647023	43.355018	-82.637040	43.355350	0.50	954	Sanilac	114	1
-82.776812	43.613358	-82.778147	43.664141	3.51	291	Sanilac	107	2
-82.734816	43.519538	-82.735220	43.533890	0.99	2091	Sanilac	106	4
-82.623848	43.307888	-82.533869	43.311578	4.54	695	Sanilac	104	6
-83.119579	43.298936	-83.079593	43.290824	2.09	1083	Sanilac	97	4
-82.728893	43.366517	-82.731867	43.424540	4.02	989	Sanilac	97	7
-82.627069	43.355682	-82.540127	43.358210	4.38	671	Sanilac	93	5

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

Top Segments by Total Crashes (2010-2014)

Top 20 per County. Does not include state trunkline, or segments with AADT.

Non-Deer/Non-Animal

Road Name	Segment Boundary Beg. X	Beg. Y	End. X	End. Y	Length (mi)	County	Total Crashes per Year
E Wilder Rd	-83.90612	43.62375	-83.89927	43.62374	0.34	Bay	18.2
E Blue Grass Rd	-84.76640	43.57539	-84.76100	43.57538	0.27	Isabella	15.4
E Wilder Rd	-83.89927	43.62374	-83.89425	43.62382	0.25	Bay	11.4
E Broomfield Rd	-84.76746	43.58259	-84.76565	43.58261	0.09	Isabella	11.0
N Saginaw Rd	-84.21553	43.61587	-84.21157	43.61226	0.32	Midland	10.0
Tittabawassee Rd	-83.96757	43.47998	-83.96346	43.47994	0.21	Saginaw	8.2
Tittabawassee Rd	-83.96346	43.47994	-83.95979	43.47989	0.18	Saginaw	8.2
Tittabawassee Rd	-83.97549	43.48005	-83.97306	43.48002	0.12	Saginaw	7.0
E Blue Grass Rd	-84.76730	43.57537	-84.76640	43.57539	0.05	Isabella	6.2
Tittabawassee Rd	-83.97306	43.48002	-83.97066	43.48000	0.12	Saginaw	6.2
Tittabawassee Rd	-83.98583	43.48015	-83.98045	43.48010	0.27	Saginaw	5.6
E Deerfield Rd	-84.78424	43.56794	-84.77300	43.56803	0.56	Isabella	5.4
Eastman Ave	-84.24713	43.65844	-84.24712	43.65763	0.06	Midland	5.4
E Broomfield Rd	-84.76836	43.58259	-84.76746	43.58259	0.05	Isabella	5.2
N Saginaw Rd	-84.25436	43.64129	-84.24688	43.64133	0.37	Midland	5.2
Tittabawassee Rd	-83.97003	43.48001	-83.96757	43.47998	0.12	Saginaw	5.2
Encore Dr	-84.75782	43.56994	-84.75761	43.57538	0.38	Isabella	5.0
Joe Mann Blvd	-84.24713	43.66211	-84.24201	43.66121	0.27	Midland	5.0
N Center Rd	-84.01468	43.43686	-84.01476	43.43991	0.21	Saginaw	5.0
N Center Rd	-84.01508	43.45346	-84.01512	43.45839	0.34	Saginaw	5.0
S Isabella Rd	-84.74746	43.57876	-84.74748	43.58275	0.28	Isabella	4.8
E Wilder Rd	-83.91422	43.62382	-83.91267	43.62380	0.08	Bay	4.4
E Broomfield Rd	-84.72747	43.58254	-84.70776	43.58268	0.99	Isabella	4.4
S Outer Dr	-83.89620	43.41471	-83.89592	43.42045	0.40	Saginaw	4.4
E Wilder Rd	-83.93439	43.62400	-83.93164	43.62399	0.14	Bay	4.2
N Pine Rd	-83.83692	43.58707	-83.83709	43.59423	0.49	Bay	4.2
Harry S Truman Pkwy	-83.86825	43.60573	-83.87172	43.60856	0.26	Bay	4.2
E Blue Grass Rd	-84.75761	43.57538	-84.75522	43.57538	0.12	Isabella	4.2
E Blue Grass Rd	-84.75522	43.57538	-84.75055	43.57538	0.23	Isabella	4.2
N Saginaw Rd	-84.26070	43.64128	-84.25871	43.64129	0.10	Midland	4.2
Tittabawassee Rd	-83.97702	43.48007	-83.97549	43.48005	0.08	Saginaw	4.2
S Mackinaw Rd	-83.99242	43.59252	-83.99231	43.59524	0.19	Bay	4.0
N Saginaw Rd	-84.21937	43.61943	-84.21727	43.61752	0.17	Midland	4.0
W Pine River Rd	-84.42961	43.54035	-84.40950	43.54605	1.15	Midland	4.0
Tittabawassee Rd	-84.01486	43.48056	-84.00028	43.48035	0.73	Saginaw	4.0
E Wilder Rd	-83.94064	43.62401	-83.93439	43.62400	0.31	Bay	3.8
E Wilder Rd	-83.89425	43.62382	-83.88688	43.62366	0.37	Bay	3.8
Tittabawassee Rd	-83.99509	43.48028	-83.98908	43.48020	0.30	Saginaw	3.8
Tittabawassee Rd	-83.97066	43.48000	-83.97003	43.48001	0.03	Saginaw	3.8
S Mackinaw Rd	-83.99362	43.56749	-83.99297	43.58127	0.95	Bay	3.6
E Wackerly Rd	-84.25608	43.65493	-84.24716	43.65493	0.45	Midland	3.6

Road Name	Segment Boundary Beg. X	Beg. Y	End. X	End. Y	Length (mi)	County	Total Crashes per Year
Joe Mann Blvd	-84.24201	43.66121	-84.23605	43.65975	0.32	Midland	3.6
W Genesee Ave	-83.94575	43.43450	-83.94301	43.43398	0.14	Saginaw	3.6
N Michigan Ave	-83.95028	43.43127	-83.94971	43.43263	0.10	Saginaw	3.6
N Michigan Ave	-83.94960	43.45927	-83.94781	43.46237	0.23	Saginaw	3.6
Washington Ave	-83.88749	43.60007	-83.88735	43.60107	0.07	Bay	3.4
E Broomfield Rd	-84.76565	43.58261	-84.76481	43.58262	0.04	Isabella	3.4
Lawndale Rd	-84.03440	43.45135	-84.03414	43.46324	0.82	Saginaw	3.4
Washington Ave	-83.88795	43.59702	-83.88779	43.59805	0.07	Bay	3.2
Washington Ave	-83.88761	43.59909	-83.88749	43.60007	0.07	Bay	3.2
E Broomfield Rd	-84.69785	43.58273	-84.68782	43.58271	0.50	Isabella	3.2
Eastman Ave	-84.24713	43.66211	-84.24713	43.66164	0.03	Midland	3.2
Tittabawassee Rd	-83.98045	43.48010	-83.97702	43.48007	0.17	Saginaw	3.2
Frankenmuth Rd	-83.64870	43.34087	-83.64403	43.35098	0.78	Tuscola	3.2
E Wilder Rd	-83.90994	43.62378	-83.90701	43.62377	0.15	Bay	3.0
E Broomfield Rd	-84.77411	43.58256	-84.76965	43.58260	0.22	Isabella	3.0
E Broomfield Rd	-84.76255	43.58265	-84.76179	43.58265	0.04	Isabella	3.0
N Saginaw Rd	-84.25871	43.64129	-84.25687	43.64128	0.09	Midland	3.0
N River Rd	-84.08313	43.45313	-84.09656	43.46637	1.18	Saginaw	3.0
N Center Rd	-84.01481	43.41529	-84.01480	43.41901	0.26	Saginaw	3.0
E Wilder Rd	-83.91267	43.62380	-83.90994	43.62378	0.14	Bay	2.8
State Rd	-83.89425	43.62382	-83.89382	43.63132	0.52	Bay	2.8
S Main St	-84.77657	43.59350	-84.77659	43.59535	0.13	Isabella	2.8
S Crawford Rd	-84.78737	43.57714	-84.78742	43.58247	0.37	Isabella	2.8
E Broomfield Rd	-84.77738	43.58253	-84.77411	43.58256	0.17	Isabella	2.8
E Broomfield Rd	-84.73787	43.58262	-84.72892	43.58249	0.45	Isabella	2.8
E Blue Grass Rd	-84.76100	43.57538	-84.75761	43.57538	0.17	Isabella	2.8
Eastman Ave	-84.24712	43.65944	-84.24713	43.65844	0.07	Midland	2.8
E Broomfield Rd	-84.75753	43.58268	-84.75524	43.58271	0.12	Isabella	2.6
N Eastman Rd	-84.24691	43.74133	-84.24705	43.73740	0.27	Midland	2.6
E Wackerly Rd	-84.24716	43.65493	-84.24477	43.65491	0.12	Midland	2.6
Delta Rd	-83.97437	43.55202	-83.96432	43.55187	0.50	Bay	2.4
E Wilder Rd	-83.93164	43.62399	-83.92918	43.62398	0.12	Bay	2.4
E Wilder Rd	-83.88260	43.62351	-83.87949	43.62341	0.16	Bay	2.4
Harry S Truman Pkwy	-83.87303	43.61485	-83.87324	43.61686	0.14	Bay	2.4
Ashman St	-84.22845	43.62541	-84.22746	43.62612	0.07	Midland	2.4
N Saginaw Rd	-84.22286	43.62264	-84.21937	43.61943	0.28	Midland	2.4
W Burns Rd	-84.40732	43.72673	-84.39699	43.72684	0.52	Midland	2.4
N Grant Ave	-84.78822	44.03159	-84.78816	44.03904	0.52	Claire	2.2
W Washington Rd	-84.62742	43.29170	-84.64094	43.29176	0.68	Gratiot	2.2
N Meridian Rd	-84.36956	43.57046	-84.36943	43.58204	0.80	Midland	2.2
N Meridian Rd	-84.36928	43.59654	-84.36925	43.60640	0.68	Midland	2.2
Eastlawn Dr	-84.21223	43.61945	-84.20724	43.61946	0.25	Midland	2.2
Birch Run Rd	-83.61190	43.25167	-83.60199	43.25167	0.50	Tuscola	2.2
S Ringle Rd	-83.52199	43.39408	-83.52204	43.40857	1.01	Tuscola	2.2
E Dayton Rd	-83.32838	43.46818	-83.33248	43.47636	0.61	Tuscola	2.2

Road Name	Segment Boundary Beg. X	Beg. Y	End. X	End. Y	Length (mi)	County	Total Crashes per Year
Bray Rd	-83.66135	43.30880	-83.65666	43.31926	0.77	Tuscola	2.0
W Maple Grove Rd	-84.88611	43.84299	-84.91051	43.84293	1.22	Claire	1.8
Wagerville Rd	-84.46712	44.03075	-84.45716	44.03064	0.50	Gladwin	1.8
N State St	-84.66187	43.37635	-84.66185	43.37767	0.09	Gratiot	1.8
N State Rd	-84.60722	43.34960	-84.60718	43.36236	0.88	Gratiot	1.6
N State St	-84.66185	43.37767	-84.66185	43.37898	0.09	Gratiot	1.6
W Center St	-84.60566	43.29166	-84.60759	43.29165	0.10	Gratiot	1.6
Sanford St	-83.26837	43.83003	-83.26836	43.82904	0.07	Huron	1.6
Birch Run Rd	-83.59285	43.25164	-83.58364	43.25167	0.47	Tuscola	1.6
Ormes Rd	-83.68343	43.32053	-83.67903	43.32108	0.23	Tuscola	1.6
Ormes Rd	-83.67903	43.32108	-83.67305	43.32144	0.31	Tuscola	1.6
Frankenmuth Rd	-83.60441	43.35852	-83.58931	43.36568	0.97	Tuscola	1.6
S Kingston Rd	-83.18455	43.35493	-83.18994	43.36620	0.98	Tuscola	1.6
E Dayton Rd	-83.32221	43.45384	-83.32838	43.46818	1.06	Tuscola	1.6
Birch Run Rd	-83.58207	43.25169	-83.57311	43.25195	0.45	Tuscola	1.4
Ormes Rd	-83.60351	43.32185	-83.58354	43.32166	1.01	Tuscola	1.4
W Saginaw Rd	-83.55654	43.36640	-83.54147	43.36376	0.78	Tuscola	1.4
E Dayton Rd	-83.38233	43.48987	-83.37654	43.49046	0.31	Tuscola	1.4
E 1st St	-84.44631	43.98731	-84.42666	43.98727	0.98	Gladwin	1.2
Pine Ave	-84.65684	43.38784	-84.65685	43.38628	0.11	Gratiot	1.2
S Ely Hwy	-84.70921	43.20473	-84.70986	43.21124	0.46	Gratiot	1.2
S Ely Hwy	-84.70985	43.21933	-84.70974	43.23389	1.00	Gratiot	1.2
N Alger Rd	-84.66715	43.29187	-84.66687	43.30626	0.99	Gratiot	1.2
W Lincoln Rd	-84.68857	43.37908	-84.70579	43.37914	0.87	Gratiot	1.2
W Lincoln Rd	-84.70661	43.37914	-84.72666	43.37925	1.01	Gratiot	1.2
N Hanselman St	-82.99742	43.80213	-82.99752	43.80332	0.08	Huron	1.2
W South St	-83.00862	43.80066	-83.00048	43.80094	0.41	Huron	1.2
N Main St	-84.59159	44.49932	-84.59267	44.49997	0.07	Roscommon	1.2
Birch Run Rd	-83.66759	43.25125	-83.66122	43.25128	0.32	Tuscola	1.2
Sheridan Rd	-83.48245	43.39438	-83.48537	43.40885	1.03	Tuscola	1.2
S Main St	-83.58546	43.36893	-83.58409	43.37086	0.15	Tuscola	1.2
N Cemetery Rd	-83.17081	43.53191	-83.17124	43.54005	0.56	Tuscola	1.2
N Vassar Rd	-83.57989	43.53830	-83.58267	43.54533	0.58	Tuscola	1.2
E Townline Lake Rd	-84.70640	44.03202	-84.66642	44.03212	1.99	Claire	1.0
S Grant Ave	-84.78813	43.85805	-84.78812	43.86531	0.50	Claire	1.0
Hamilton Rd	-84.75822	44.04619	-84.75154	44.05745	0.86	Claire	1.0
Glidden Rd	-84.48533	43.87973	-84.48229	43.87969	0.15	Gladwin	1.0
S River Rd	-84.47492	43.93034	-84.47696	43.94478	1.02	Gladwin	1.0
N Lumberjack Rd	-84.83615	43.43010	-84.83598	43.43740	0.50	Gratiot	1.0
S Ely Hwy	-84.70876	43.19079	-84.70921	43.20473	0.97	Gratiot	1.0
W Washington Rd	-84.66715	43.29187	-84.67991	43.29193	0.64	Gratiot	1.0
W Superior St	-84.67143	43.37900	-84.67264	43.37900	0.06	Gratiot	1.0
Weaver Rd	-83.10184	43.98562	-83.07730	43.99063	1.29	Huron	1.0
S Silver St	-82.98933	43.79643	-82.98952	43.80232	0.41	Huron	1.0
N Campbell Rd	-84.14596	44.33490	-84.14609	44.34420	0.64	Ogemaw	1.0

Road Name	Segment Boundary Beg. X	Beg. Y	End. X	End. Y	Length (mi)	County	Total Crashes per Year
S 3rd St	-84.23855	44.27492	-84.23854	44.27627	0.09	Ogemaw	1.0
Rau Rd	-84.30609	44.23304	-84.28639	44.23319	0.98	Ogemaw	1.0
N Flint Rd	-84.70376	44.37599	-84.70406	44.39231	1.13	Roscommon	1.0
Pine River Rd	-83.88569	43.98303	-83.87433	43.98317	0.63	Arenac	0.8
Davis Rd	-83.74589	44.02659	-83.74573	44.01783	0.61	Arenac	0.8
Manor Rd	-83.80680	44.02621	-83.75613	44.02656	2.52	Arenac	0.8
Sturman Rd	-83.91132	43.92501	-83.91116	43.92815	0.22	Arenac	0.8
Mostetler Rd	-84.71678	44.01022	-84.70670	44.00412	0.75	Claire	0.8
Woods Rd	-84.75758	44.06934	-84.76419	44.07459	0.64	Claire	0.8
E Stockwell Rd	-84.84949	44.05986	-84.82839	44.06018	1.05	Claire	0.8
W Larch Rd	-84.86909	43.99474	-84.84878	43.99471	1.01	Claire	0.8
W Maple Grove Rd	-84.91953	43.84286	-84.94973	43.84272	1.51	Claire	0.8
Dale Rd	-84.58379	43.85446	-84.54576	43.85819	2.15	Gladwin	0.8
Pratt Lake Rd	-84.52336	44.00936	-84.50871	44.00893	0.73	Gladwin	0.8
Dundas Rd	-84.38377	43.82310	-84.38482	43.83356	0.74	Gladwin	0.8
Butman Rd	-84.46789	44.12328	-84.46784	44.13201	0.60	Gladwin	0.8
River Rd	-84.47676	43.95197	-84.47649	43.95912	0.49	Gladwin	0.8
River Rd	-84.47649	43.95912	-84.48564	43.96931	0.97	Gladwin	0.8
S Bagley Rd	-84.56311	43.26698	-84.56306	43.26876	0.12	Gratiot	0.8
Michigan Ave	-84.61989	43.39718	-84.61594	43.39963	0.26	Gratiot	0.8
E Warwick Dr	-84.66677	43.39158	-84.66430	43.39157	0.13	Gratiot	0.8
N Begole Rd	-84.64677	43.40065	-84.64676	43.40204	0.10	Gratiot	0.8
N Begole Rd	-84.64670	43.40790	-84.64681	43.42240	1.00	Gratiot	0.8
Pointe Aux Barques Rd	-82.97004	44.05009	-82.95488	44.05632	0.88	Huron	0.8
Learman Rd	-82.94164	43.82556	-82.92516	43.82604	0.82	Huron	0.8
Sand Rd	-83.26295	43.95075	-83.24328	43.96018	1.19	Huron	0.8
W Soper Rd	-83.04071	43.79388	-83.02302	43.79424	0.89	Huron	0.8
W Soper Rd	-83.02045	43.79427	-83.01283	43.79440	0.38	Huron	0.8
E South St	-82.99892	43.80110	-82.99740	43.80111	0.08	Huron	0.8
Notter Rd	-83.25730	43.72926	-83.25739	43.73291	0.25	Huron	0.8
W Richardson Rd	-83.23093	43.83097	-83.22116	43.83140	0.49	Huron	0.8
Dwight Ave	-83.33021	44.41941	-83.32842	44.41940	0.09	Iosco	0.8
Rau Rd	-84.28639	44.23319	-84.27513	44.23329	0.56	Ogemaw	0.8
S 2nd St	-84.59492	44.49642	-84.59351	44.49561	0.09	Roscommon	0.8
Lake James Dr	-84.63974	44.29760	-84.62978	44.29160	0.90	Roscommon	0.8
W Birch Rd	-84.77489	44.45038	-84.74472	44.45029	1.49	Roscommon	0.8
W Beaver St	-83.96056	43.98383	-83.95972	43.98383	0.04	Arenac	0.6
N Main St	-83.85402	44.04966	-83.85472	44.05307	0.25	Arenac	0.6
Worth Rd	-83.91586	43.92498	-83.91132	43.92501	0.23	Arenac	0.6
Booth Rd	-83.69201	43.99208	-83.70637	44.00243	1.05	Arenac	0.6
N Michigan Rd	-83.90709	44.06217	-83.86698	44.05454	2.16	Arenac	0.6
Palmer Rd	-83.92805	43.96827	-83.90681	43.96849	1.06	Arenac	0.6
Sterling Truck Trl	-84.14672	44.05963	-84.08834	44.04760	3.90	Arenac	0.6
Schoolcrest Ave	-84.76834	43.82604	-84.76524	43.82601	0.16	Claire	0.6
E Colonville Rd	-84.72814	43.84393	-84.71216	43.84410	0.80	Claire	0.6

	Segment Boundary				Length		Total Crashes
Road Name	Beg. X	Beg. Y	End. X	End. Y	(mi)	County	per Year
S Bringold Ave	-84.94994	43.81391	-84.94974	43.82158	0.53	Claire	0.6
North Rd	-84.86160	43.85675	-84.86149	43.85761	0.06	Claire	0.6
S Grant Ave	-84.78834	43.82603	-84.78840	43.82971	0.25	Claire	0.6
Prairie St	-84.77727	43.82075	-84.77728	43.82266	0.13	Claire	0.6
Ann Arbor Trl	-84.77842	43.82389	-84.78834	43.82603	0.52	Claire	0.6
S Broad St	-84.80306	44.01872	-84.80303	44.01963	0.06	Claire	0.6
E Oak St	-84.79944	44.01870	-84.79602	44.01926	0.18	Claire	0.6
Mostetler Rd	-84.72610	44.01018	-84.71678	44.01022	0.47	Claire	0.6
W Maple St	-84.49049	43.98170	-84.48916	43.98169	0.07	Gladwin	0.6
N State St	-84.48182	43.98061	-84.48182	43.98158	0.07	Gladwin	0.6
Meredith Grade Rd	-84.55117	44.12627	-84.53529	44.12856	0.82	Gladwin	0.6
Dundas Rd	-84.38482	43.83356	-84.38584	43.84277	0.65	Gladwin	0.6
Wixom Dr	-84.34364	43.83790	-84.33625	43.84278	0.57	Gladwin	0.6
S Grout Rd	-84.54514	43.94125	-84.54515	43.95222	0.76	Gladwin	0.6
S River Rd	-84.47598	43.90103	-84.47637	43.90966	0.60	Gladwin	0.6
S River Rd	-84.47658	43.91577	-84.47492	43.93034	1.10	Gladwin	0.6
McCulloch Rd	-84.52537	43.87982	-84.52535	43.88369	0.27	Gladwin	0.6
Eastman Rd	-84.24653	43.87063	-84.24611	43.89951	2.09	Gladwin	0.6
Weale Rd	-83.33872	43.81420	-83.32877	43.81434	0.50	Huron	0.6
Learman Rd	-82.92516	43.82604	-82.92156	43.82614	0.18	Huron	0.6
S 1st St	-82.65245	43.84115	-82.65260	43.84287	0.12	Huron	0.6
Maude St	-83.18370	43.81816	-83.18364	43.81608	0.14	Huron	0.6
Lincoln Rd	-82.68314	43.82548	-82.66335	43.82617	0.99	Huron	0.6
Carpenter Rd	-82.94184	43.82570	-82.94210	43.83287	0.49	Huron	0.6
Sturm Rd	-83.26104	43.87679	-83.25862	43.88813	0.85	Huron	0.6
Ora Lake Rd	-83.88362	44.38517	-83.86527	44.38500	0.91	Iosco	0.6
E Mill St	-83.32963	44.41544	-83.32847	44.41543	0.06	Iosco	0.6
E Bay St	-83.47926	44.28136	-83.47804	44.28155	0.06	Iosco	0.6
Forest Rd	-83.33929	44.40829	-83.34292	44.39564	0.90	Iosco	0.6
Cook Rd	-84.22516	44.25489	-84.22541	44.26130	0.45	Ogemaw	0.6
S Campbell Rd	-84.14563	44.30129	-84.14575	44.31307	0.81	Ogemaw	0.6
N Campbell Rd	-84.14677	44.36615	-84.14650	44.37346	0.50	Ogemaw	0.6
W Flowage Lake Rd	-84.22898	44.26202	-84.22545	44.26204	0.18	Ogemaw	0.6
Berry Trl	-84.32906	44.42038	-84.31467	44.42035	0.71	Ogemaw	0.6
Griffin Rd	-84.23962	44.26921	-84.23558	44.26925	0.20	Ogemaw	0.6
S Dow Rd	-84.24712	44.30968	-84.24731	44.31326	0.25	Ogemaw	0.6
N Dow Rd	-84.27386	44.33431	-84.27435	44.33804	0.27	Ogemaw	0.6
W Peters Rd	-84.16597	44.33471	-84.15904	44.33475	0.34	Ogemaw	0.6
Rau Rd	-84.27513	44.23329	-84.26655	44.23338	0.43	Ogemaw	0.6
S 8th St	-84.24516	44.27494	-84.24523	44.27626	0.09	Ogemaw	0.6
Silsby Rd	-84.46792	44.51058	-84.46108	44.51030	0.34	Roscommon	0.6
Kennedy Rd	-84.80173	44.33199	-84.79598	44.33111	0.34	Roscommon	0.6
S Townline Rd	-84.73303	44.29101	-84.73334	44.29821	0.50	Roscommon	0.6
W Nestel Rd	-84.75313	44.29104	-84.73815	44.29104	0.74	Roscommon	0.6
Tower Hill Rd	-84.75259	44.27669	-84.75225	44.26767	0.62	Roscommon	0.6

Road Name	Segment Boundary Beg. X	Beg. Y	End. X	End. Y	Length (mi)	County	Total Crashes per Year
Church St	-83.08110	43.32313	-83.07984	43.32314	0.06	Sanilac	0.6
Bricker Rd	-82.74368	43.18993	-82.74436	43.20051	0.73	Sanilac	0.6
Harrington Rd	-82.57141	43.28123	-82.55151	43.28198	1.01	Sanilac	0.6
N Town Line Rd	-82.87030	43.44957	-82.87098	43.46411	1.01	Sanilac	0.6
Burns Line Rd	-82.56158	43.22499	-82.55556	43.22517	0.31	Sanilac	0.6
Packs Rd	-82.66612	43.39063	-82.66962	43.39451	0.33	Sanilac	0.6
Packs Rd	-82.66998	43.39793	-82.67022	43.40194	0.28	Sanilac	0.6
Cribbins Rd	-82.64426	43.18144	-82.64499	43.19296	0.80	Sanilac	0.6
Wells St	-82.61477	43.27589	-82.61068	43.27606	0.21	Sanilac	0.6
Black River Rd	-82.62830	43.17893	-82.62542	43.19354	1.09	Sanilac	0.6
Sagatoo Rd	-83.96060	43.95381	-83.94664	43.95361	0.70	Arenac	0.4
Conrad Rd	-83.84713	44.02597	-83.84155	44.02597	0.28	Arenac	0.4
S Arenac State Rd	-83.85104	44.01518	-83.84783	44.02597	0.77	Arenac	0.4
E Bessinger Rd	-83.67091	44.08488	-83.66590	44.08498	0.25	Arenac	0.4
S Santiago Rd	-83.70637	44.00243	-83.70641	44.01224	0.68	Arenac	0.4
E Michigan Ave	-83.69426	44.04689	-83.69229	44.04612	0.11	Arenac	0.4
Noble Rd	-83.57633	44.11458	-83.57648	44.12849	0.96	Arenac	0.4
W Main St Rd	-83.97760	44.11291	-83.97653	44.11292	0.05	Arenac	0.4
La Grant Rd	-84.04014	44.15564	-84.00768	44.16188	1.75	Arenac	0.4
Webb Rd	-83.80175	44.39248	-83.78475	44.39244	0.84	Iosco	0.4
Oak St	-83.50549	44.27514	-83.50628	44.27612	0.08	Iosco	0.4
Newman St	-83.49362	44.29081	-83.49403	44.29223	0.10	Iosco	0.4
Smith St	-83.32956	44.40641	-83.33318	44.40758	0.20	Iosco	0.4
W Michigan Ave	-83.33193	44.42142	-83.33020	44.42141	0.09	Iosco	0.4
Bank St	-83.33019	44.42239	-83.32844	44.42239	0.09	Iosco	0.4
Alabaster Rd	-83.83934	44.20497	-83.82292	44.20480	0.82	Iosco	0.4
Au Sable Rd	-83.34430	44.41009	-83.34453	44.41066	0.04	Iosco	0.4
Au Sable Rd	-83.34514	44.41223	-83.34552	44.41607	0.27	Iosco	0.4
Hughes St	-83.33389	44.43693	-83.33447	44.42989	0.49	Iosco	0.4
Galion Rd	-83.50320	44.33865	-83.49303	44.33876	0.50	Iosco	0.4
E Washington St	-83.49050	44.28451	-83.48926	44.28471	0.06	Iosco	0.4
Lake To Bay Ln	-83.43913	44.26344	-83.43574	44.26324	0.17	Iosco	0.4
Old US 23	-83.34020	44.41021	-83.33931	44.41005	0.05	Iosco	0.4
Otsego St	-83.33655	44.42314	-83.33563	44.42413	0.09	Iosco	0.4
Wickes Rd	-84.28666	44.19100	-84.27674	44.19079	0.52	Ogemaw	0.4
N Campbell Rd	-84.14650	44.37346	-84.14647	44.37839	0.34	Ogemaw	0.4
N Campbell Rd	-84.14654	44.39828	-84.14676	44.40700	0.60	Ogemaw	0.4
Borden Rd	-84.14764	44.46440	-84.12732	44.46469	1.01	Ogemaw	0.4
S 5th St	-84.24125	44.27494	-84.24126	44.27627	0.09	Ogemaw	0.4
Snowbowl Rd	-84.81318	44.26980	-84.81093	44.26977	0.11	Roscommon	0.4
Snowbowl Rd	-84.81093	44.26977	-84.80617	44.26972	0.24	Roscommon	0.4
S Lake James Rd	-84.60829	44.28088	-84.61067	44.28735	0.49	Roscommon	0.4
Guernsey Ave	-84.72695	44.29830	-84.72697	44.30032	0.14	Roscommon	0.4
Homestead Rd	-84.71743	44.29786	-84.71746	44.29847	0.04	Roscommon	0.4
Owens Dr	-84.69171	44.27694	-84.69224	44.29146	1.00	Roscommon	0.4

Road Name	Segment Boundary Beg. X	Beg. Y	End. X	End. Y	Length (mi)	County	Total Crashes per Year
Springwood Dr	-84.63441	44.30569	-84.63297	44.30100	0.36	Roscommon	0.4
N Central Dr	-84.60111	44.50494	-84.60705	44.50808	0.37	Roscommon	0.4
Lakewood Dr	-84.73562	44.39857	-84.71940	44.39958	0.84	Roscommon	0.4
W Lansing Rd	-84.65565	44.39593	-84.61944	44.42132	2.74	Roscommon	0.4
Montgomery Rd	-82.95322	43.28531	-82.92761	43.28567	1.29	Sanilac	0.4
Airport Rd	-83.07979	43.31326	-83.08858	43.31237	0.50	Sanilac	0.4
Ellsworth St	-83.07727	43.32877	-83.07613	43.32879	0.06	Sanilac	0.4
Mayville Rd	-83.10423	43.34191	-83.08699	43.34222	0.87	Sanilac	0.4
French Line Rd	-82.68786	43.36809	-82.67026	43.36872	0.89	Sanilac	0.4
Shabbona Rd	-83.01381	43.53268	-82.99807	43.53314	0.79	Sanilac	0.4
Argyle Rd	-82.97103	43.56302	-82.95593	43.56360	0.76	Sanilac	0.4
Lester St	-82.53074	43.26438	-82.52910	43.26446	0.08	Sanilac	0.4
E Burns Line Rd	-82.80438	43.21698	-82.80068	43.21710	0.19	Sanilac	0.4
Bailey Rd	-82.96009	43.21936	-82.96021	43.22136	0.14	Sanilac	0.4

Top Intersections by Total Crashes (2010 - 2014)

Top 10 per County

Non-Deer/Non-Animal

Intersection	X	Y	County	Municipality	Total Crashes per Year
State St & Center Rd	-84.01468	43.43687	Saginaw	Saginaw	34.4
Broomfield Rd & Mission Rd	-84.76746	43.58259	Isabella	Mt Pleasant	32.2
Saginaw Rd & Eastman Ave	-84.24689	43.64134	Midland	Midland	30.8
Bay Rd & Shattuck Rd	-83.97557	43.45101	Saginaw	Saginaw	23.8
Wackerly Rd & Eastman Ave	-84.24716	43.65494	Midland	Midland	23.6
State St & Wieneke Rd	-84.02964	43.43695	Saginaw	Saginaw	21.0
Tittabawassee Rd & Bay Rd	-83.97549	43.48006	Saginaw	Kochville	21.0
State St & Hemmeter Rd	-84.00486	43.43675	Saginaw	Saginaw	20.8
Wilder Rd & Euclid Ave	-83.91423	43.62383	Bay	Bangor	19.4
Blue Grass Rd & Mission Rd	-84.76730	43.57538	Isabella	Union	19.4
McCarty Rd & Bay Rd	-83.97553	43.46541	Saginaw	Saginaw	18.8
Davenport Ave & Hill St	-83.95145	43.43730	Saginaw	Saginaw	18.0
Gratiot Rd & Center Rd	-84.01481	43.41530	Saginaw	Saginaw	17.8
Midland Rd & Tittabawassee Rd	-84.09122	43.48133	Saginaw	Tittabawassee	16.8
Schust Rd & Bay Rd	-83.97547	43.47264	Saginaw	Saginaw	16.2
High St & Mission Rd	-84.76758	43.59719	Isabella	Mt Pleasant	16.0
Isabella Rd & Remus Rd	-84.74769	43.59727	Isabella	Union	14.4
Isabella Rd & Broomfield Rd	-84.74749	43.58276	Isabella	Union	14.2
Preston Rd & Mission Rd	-84.76750	43.58988	Isabella	Mt Pleasant	14.2
Ashman St & Indian St	-84.24220	43.61559	Midland	Midland	13.0
Blue Grass Rd & Blue Grass Rd	-84.75762	43.57539	Isabella	Union	12.8
Isabella Rd & Pickard St	-84.74803	43.61174	Isabella	Union	12.6
Monroe Rd & Alger Rd	-84.66676	43.40799	Gratiot	Pine River	12.4
Pickard St & Mission Rd	-84.76773	43.61181	Isabella	Mt Pleasant	12.0
Jerome St & Buttles St	-84.24548	43.61678	Midland	Midland	12.0
W Midland St & Euclid Ave	-83.91519	43.60209	Bay	Bangor	11.8
Isabella Rd & Meridian Rd	-84.36924	43.61247	Midland	Lee	11.6
Jenny St & Euclid Ave	-83.91529	43.59879	Bay	Bangor	11.2
Eastman Ave & Eastman Ave	-84.24713	43.65745	Midland	Midland	10.8
Pickard Rd & Leaton Rd	-84.70792	43.61157	Isabella	Chippewa	10.6
Westside Saginaw Rd & Delta Rd	-83.95455	43.55135	Bay	Frankenlust	10.2
Salzburg Ave & Euclid Ave	-83.91577	43.58035	Bay	Monitor	10.2
Euclid Ave & North Union St	-83.91485	43.60933	Bay	Bangor	10.2
Saginaw Rd & Saginaw Rd	-84.25688	43.64129	Midland	Midland	10.2
Wilder Rd & State Park Dr	-83.89927	43.62375	Bay	Bangor	9.8
Jerome St & Indian St	-84.24464	43.61740	Midland	Midland	9.8
State Rd & Wilder Rd	-83.89426	43.62383	Bay	Bangor	9.6
Trumbull St & Center Ave	-83.86726	43.59644	Bay	Bay City	9.4
Patrick Rd & Waldo Rd	-84.18744	43.61214	Midland	Midland	9.2
Patrick Rd & Saginaw Rd	-84.21158	43.61227	Midland	Midland	9.2
Center Rd & Pine Rd	-83.83710	43.59424	Bay	Hampton	8.4
Warwick Dr & Wright Ave	-84.66678	43.39159	Gratiot	Alma	7.8

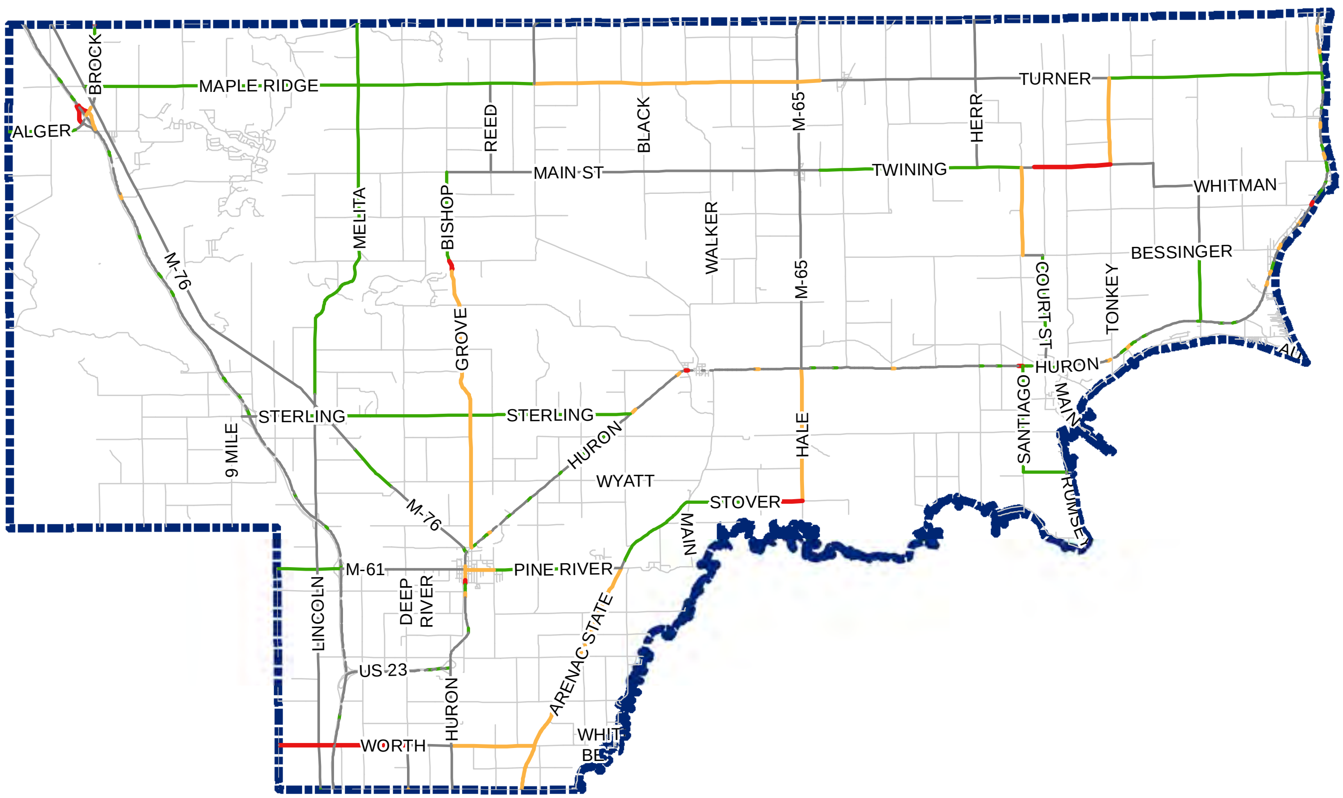
Intersection	X	Y	County	Municipality	Total Crashes per Year
Court St & Port Crescent St	-83.00048	43.80161	Huron	Bad Axe	7.2
Ellington St & State St	-83.38739	43.49539	Tuscola	Almer	6.8
Washington Ave & Main St	-84.60716	43.40788	Gratiot	St Louis	5.4
Heather Ln & Wright Ave	-84.66678	43.39528	Gratiot	Alma	5.2
State St & Almer St	-83.39704	43.48850	Tuscola	Caro	4.8
McEwan St & 5th St	-84.76833	43.81969	Clare	Clare	4.6
Monroe Rd & Begole Rd	-84.64670	43.40791	Gratiot	Pine River	4.6
Cedar Lake Rd & County Road F41	-83.33312	44.43652	Iosco	Oscoda	4.6
Cedar St & Silverleaf St	-84.48671	43.98066	Gladwin	Gladwin	4.4
Sanilac Ave & Elk St	-82.83028	43.42131	Sanilac	Sandusky	4.4
State St & Burnside St	-83.39461	43.49035	Tuscola	Caro	4.4
M 55 & Houghton St	-84.22424	44.27608	Ogemaw	West Branch	4.0
Caro Rd & Cleaver Rd	-83.38743	43.49575	Tuscola	Almer	4.0
Main St & Cedar St	-83.95973	43.98275	Arenac	Standish	3.8
Wright Ave & Superior St	-84.66679	43.37903	Gratiot	Alma	3.8
Houghton Lake Dr & Lake St	-84.65213	44.29845	Roscommon	Denton	3.8
Peck Rd & Howard St	-82.61963	43.26465	Sanilac	Croswell	3.8
Cheesman Rd & Alger Rd	-84.66677	43.40074	Gratiot	Pine River	3.4
Learman Rd & Van Dyke Rd	-83.00111	43.82364	Huron	Colfax	3.4
Lake St & Hemlock St	-83.50926	44.27359	Iosco	Tawas City	3.4
Huron St & Main St	-82.53102	43.26837	Sanilac	Lexington	3.4
Frank St & State St	-83.39653	43.48888	Tuscola	Caro	3.4
1st St & Main St	-84.79946	44.01966	Clare	Harrison	3.2
Bay St & Newman St	-83.49031	44.27939	Iosco	East Tawas	3.2
River Rd & Huron Rd	-83.33022	44.42040	Iosco	Oscoda	3.2
M 55 & M 33	-84.12566	44.27698	Ogemaw	Churchill	3.2
Harrison Rd & M 55	-84.79339	44.33586	Roscommon	Lake	3.2
Dayton Rd & Ellington St	-83.38690	43.48907	Tuscola	Caro	3.2
Superior St & Pine Ave	-84.65700	43.37897	Gratiot	Alma	3.0
Van Buren Rd & Saginaw Rd	-83.67966	43.41030	Tuscola	Denmark	3.0
McEwan St & Dwyer St	-84.76834	43.82567	Clare	Clare	2.8
Corning St & Main St	-84.87094	43.83544	Clare	Surrey	2.8
Surrey Rd & Old State Ave	-84.86689	43.85760	Clare	Surrey	2.8
Sebewaing Rd & S Beck St	-83.44584	43.72606	Huron	Sebewaing	2.8
Houghton St & 4th St	-84.23985	44.27626	Ogemaw	West Branch	2.8
Loxley Rd & Houghton Lake Dr	-84.77426	44.32220	Roscommon	Roscommon	2.8
Ormes Rd & Bray Rd	-83.65687	43.32152	Tuscola	Tuscola	2.8
Huron Rd & Robert Elliott Blvd	-83.47438	44.28197	Iosco	East Tawas	2.6
Sanilac Ave & Dawson St	-82.84012	43.42105	Sanilac	Sandusky	2.6
State St & Van Geisen Rd	-83.40673	43.48115	Tuscola	Caro	2.6
State St & Gilford	-83.38802	43.49531	Tuscola	Caro	2.6
Clare Ave & Colonville Rd	-84.76820	43.84368	Clare	Grant	2.4
Cedar St & James Robertson Dr	-84.47031	43.98067	Gladwin	Gladwin	2.4
Center St & Saint Johns St	-84.60088	43.29167	Gratiot	Ithaca	2.4
Superior St & Michigan Ave	-84.65220	43.37897	Gratiot	Alma	2.4
Lake St & Oak St	-83.50550	44.27515	Iosco	Tawas City	2.4

Intersection	X	Y	County	Municipality	Total Crashes per Year
Houghton Lake Dr & Stratford Dr	-84.69735	44.29866	Roscommon	Denton	2.4
Sanilac Rd & Van Dyke Rd	-83.08717	43.41470	Sanilac	Lamotte	2.4
Worth Rd & Huron Rd	-83.96651	43.92510	Arenac	Standish	2.2
Sagatoo Rd & Arenac State Rd	-83.90843	43.95407	Arenac	Standish	2.2
Port Crescent St & Watkins Pl	-83.00066	43.80746	Huron	Bad Axe	2.2
Buschlen Rd & Van Dyke Rd	-83.00084	43.81464	Huron	Bad Axe	2.2
I 75 BL & Austin Way	-84.22555	44.24886	Ogemaw	West Branch	2.2
Houghton St & Fairview Rd	-84.22507	44.27623	Ogemaw	West Branch	2.2
Court St & Huron St	-83.69606	44.04833	Arenac	Au Gres	2.0
Irwin St & Port Crescent St	-83.00060	43.80542	Huron	Bad Axe	2.0
Whalen St & Rex St	-83.18165	43.81824	Huron	Oliver	2.0
Michigan Ave & Huron Rd	-83.33020	44.42141	Iosco	Oscoda	2.0
Huron Rd & County Road F41	-83.33012	44.43293	Iosco	Oscoda	2.0
Houghton St & 7th St	-84.24390	44.27626	Ogemaw	West Branch	2.0
Houghton Lake Dr & Balsam Rd	-84.71233	44.29856	Roscommon	Denton	2.0
Huron St & Main St	-83.68607	44.04842	Arenac	Au Gres	1.8
McEwan St & 4th St	-84.76837	43.81880	Clare	Clare	1.8
Hemlock St & Hemlock St	-83.51001	44.27425	Iosco	Tawas City	1.8
Lake St & Roundhouse Ave	-83.50272	44.27616	Iosco	Tawas City	1.8
Cook Rd & Rau Rd	-84.22570	44.23329	Ogemaw	Horton	1.8
Houghton St & Valley St	-84.23079	44.27626	Ogemaw	West Branch	1.8
Houghton St & 3rd St	-84.23854	44.27628	Ogemaw	West Branch	1.8
Sebewaing Rd & Bay Port Rd	-83.35574	43.72751	Huron	Brookfield	1.6
Pigeon Rd & Pinnebog Rd	-83.10135	43.82196	Huron	Colfax	1.6
I 75 BL & Refinery Rd	-84.22067	44.25876	Ogemaw	West Branch	1.6
Houghton Lake Dr & Oakridge Ave	-84.70509	44.29861	Roscommon	Denton	1.6
Lake St & 5th St	-84.59250	44.49854	Roscommon	Higgins	1.6
Peck Rd & Croswell Ave	-82.62608	43.26432	Sanilac	Croswell	1.6
Boynton St & Main St	-82.53095	43.26739	Sanilac	Lexington	1.6
Chandler St & Main St	-82.67179	43.42689	Sanilac	Bridgehampton	1.6
Pine St & Main St	-83.95976	43.98128	Arenac	Standish	1.4
Cedar St & Forest St	-83.95845	43.98271	Arenac	Standish	1.4
Main St & City Limits Rd	-83.95736	43.98970	Arenac	Lincoln	1.4
State St & McEwan St	-84.76833	43.82241	Clare	Clare	1.4
McEwan St & Mary St	-84.76834	43.82646	Clare	Clare	1.4
M 30 & M 61	-84.36625	43.98042	Gladwin	Hay	1.4
Wagerville Rd & M 18	-84.48647	44.03078	Gladwin	Sage	1.4
Atwater Rd & Bad Axe Rd	-82.99839	43.70825	Huron	Bingham	1.4
Lincoln St & Elk St	-82.82988	43.42023	Sanilac	Sandusky	1.4
Sanilac Ave & Gates Rd	-82.85013	43.42089	Sanilac	Sandusky	1.4
Elm St & Main St	-83.95978	43.97833	Arenac	Standish	1.2
Beaver St & Main St	-83.95972	43.98383	Arenac	Standish	1.2
5th St & Beech St	-84.77047	43.81966	Clare	Clare	1.2
Cedar St & State St	-84.48183	43.98061	Gladwin	Gladwin	1.2
Bowery Ave & Cedar St	-84.49052	43.98071	Gladwin	Gladwin	1.2
M 61 & Hockaday Rd	-84.42639	43.98083	Gladwin	Buckeye	1.2

Intersection	X	Y	County	Municipality	Total Crashes per Year
Emery Rd & Tower Hill Rd	-84.75259	44.27669	Roscommon	Roscommon	1.2
Houghton Lake Dr & Sheridan Dr	-84.69843	44.29866	Roscommon	Denton	1.2
Tower Hill Rd & Houghton Lake Dr	-84.75335	44.30461	Roscommon	Roscommon	1.2
M 30 & Van Dyke Rd	-84.36616	43.87156	Gladwin	Billings	1.0
M 18 & Blades Rd	-84.48533	43.87246	Gladwin	Tobacco	1.0
Brown St & M 18	-84.48532	43.88224	Gladwin	Beaverton	1.0

Appendix D – High Risk Area & Related Maps

Arenac County
Segment Crash Rate (2010 - 2014)



Legend

- Urban Boundary
- Arenac County
- No Data

Segment Crash Rate (per 100 MVM)

- 100 or below
- 100 - 200
- 200 - 400
- 400 or higher

N W E S

0 1 2 4 6 8 Miles

Note:
Segments less than 300 ft are not illustrated.
Segment crash rates are expressed in 100 Million Vehicle Miles (MVM) traveled.
The first category (i.e. 100 or below) represents the regional dataset's average segment crash rates. Successive categories represent segment crash rate in multiples of two relative to the county average.

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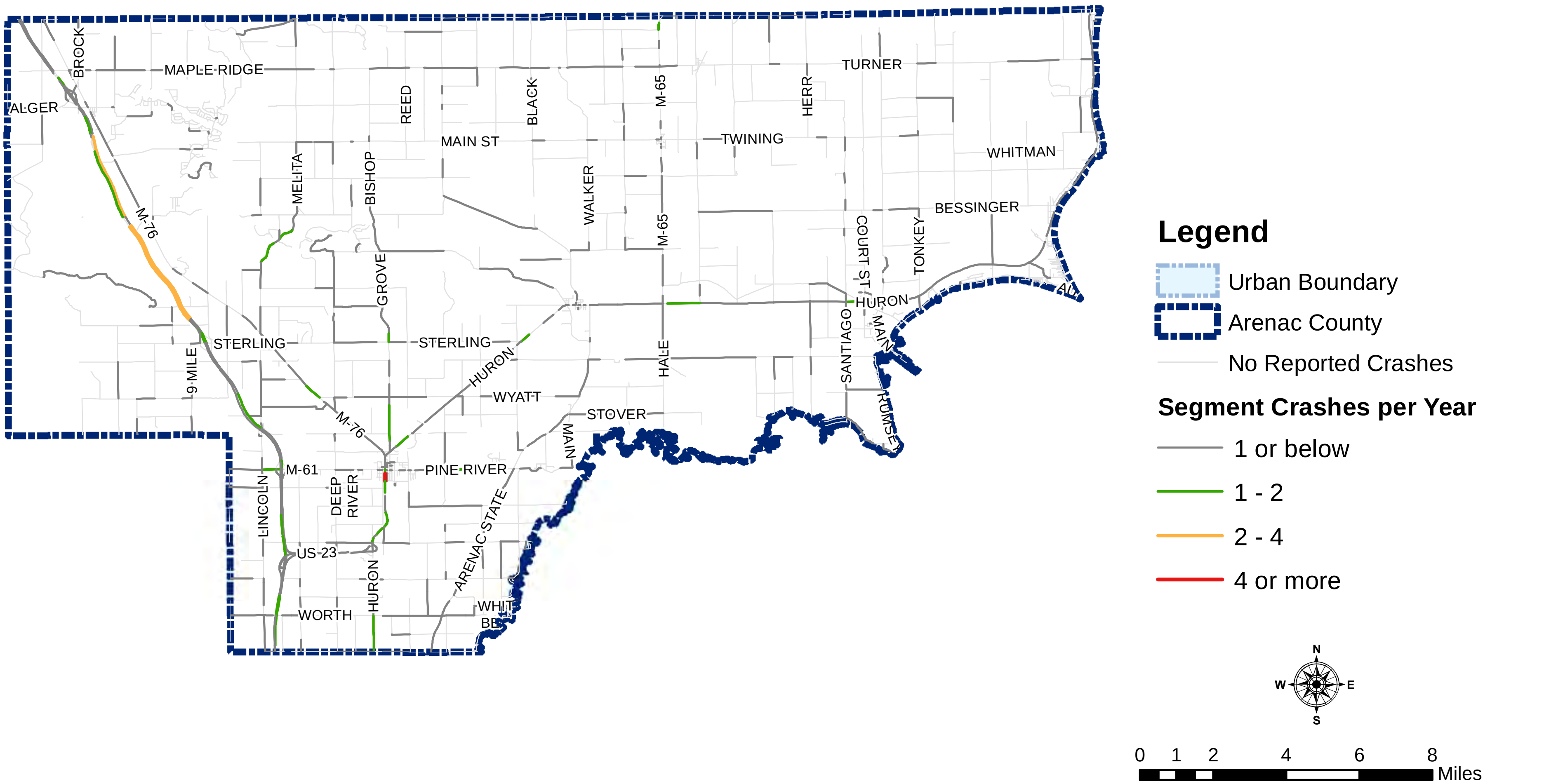
EMCOG East Michigan Council of Governments

Arenac County
Segment Crash Frequency (2010 - 2014)



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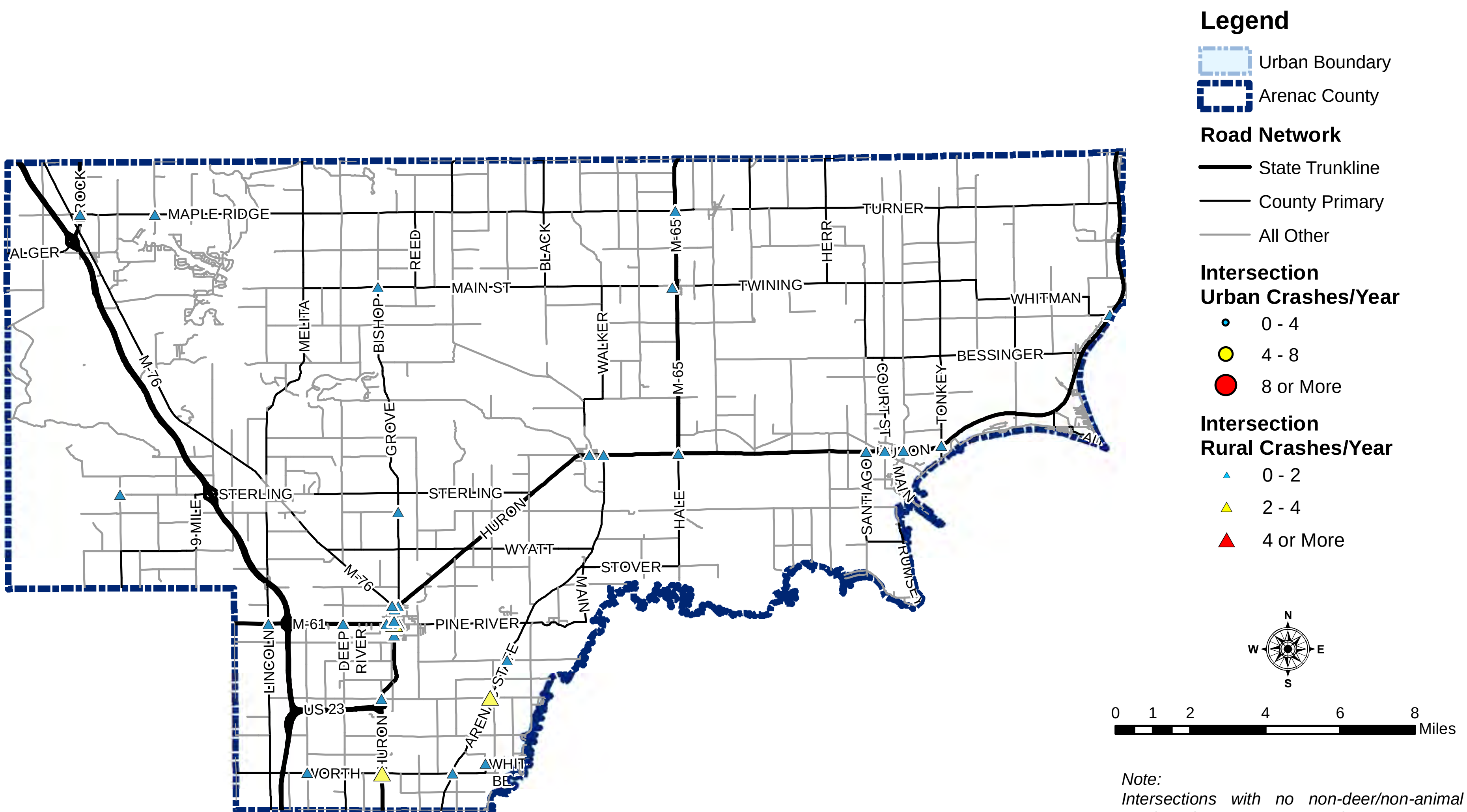
EMCOG
East Michigan Council of Governments

Arenac County
Intersection Crashes per Year (2010 - 2014)



Note: Intersections with no non-deer/non-animal crashes between 2010 and 2014 are not shown.

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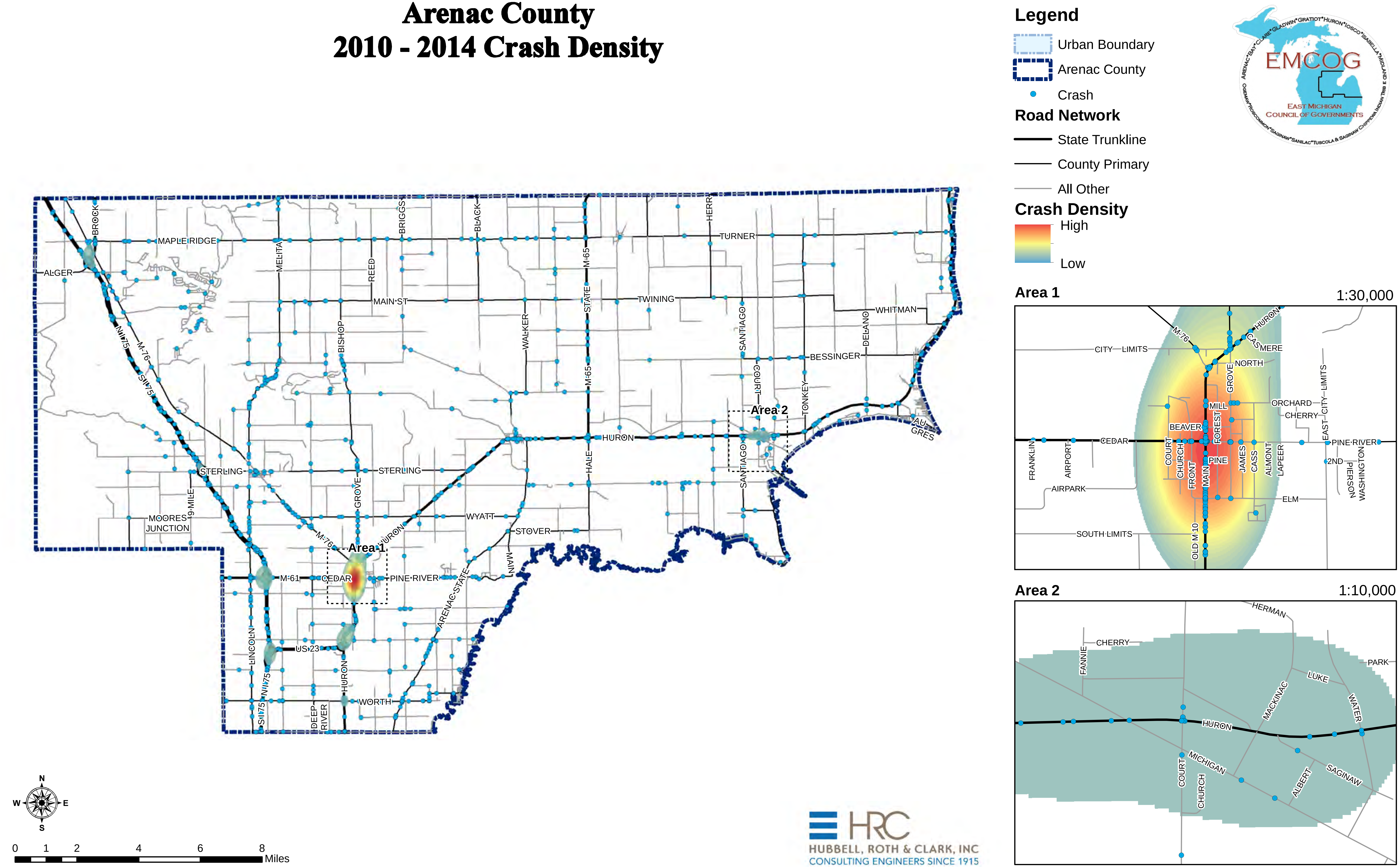
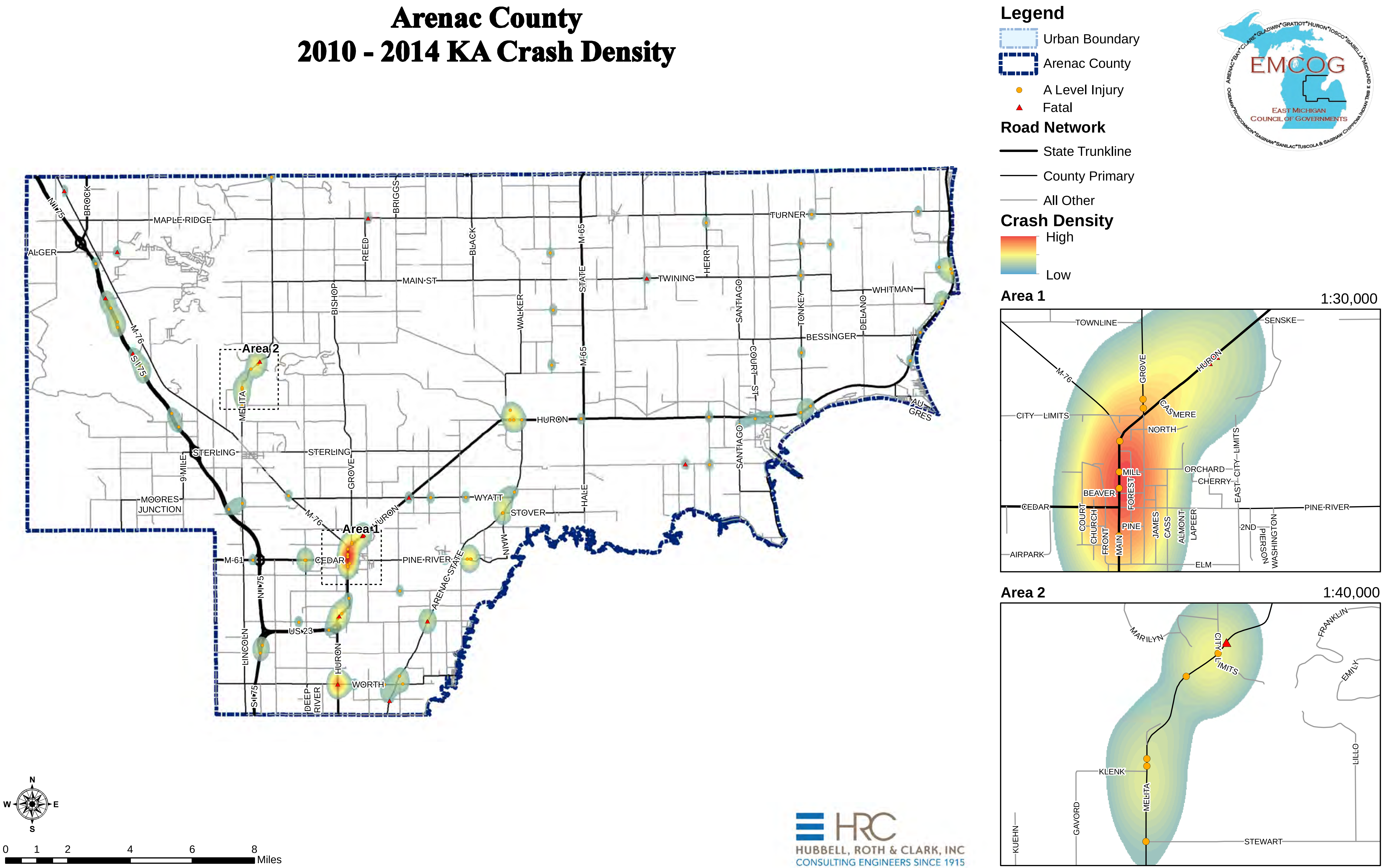
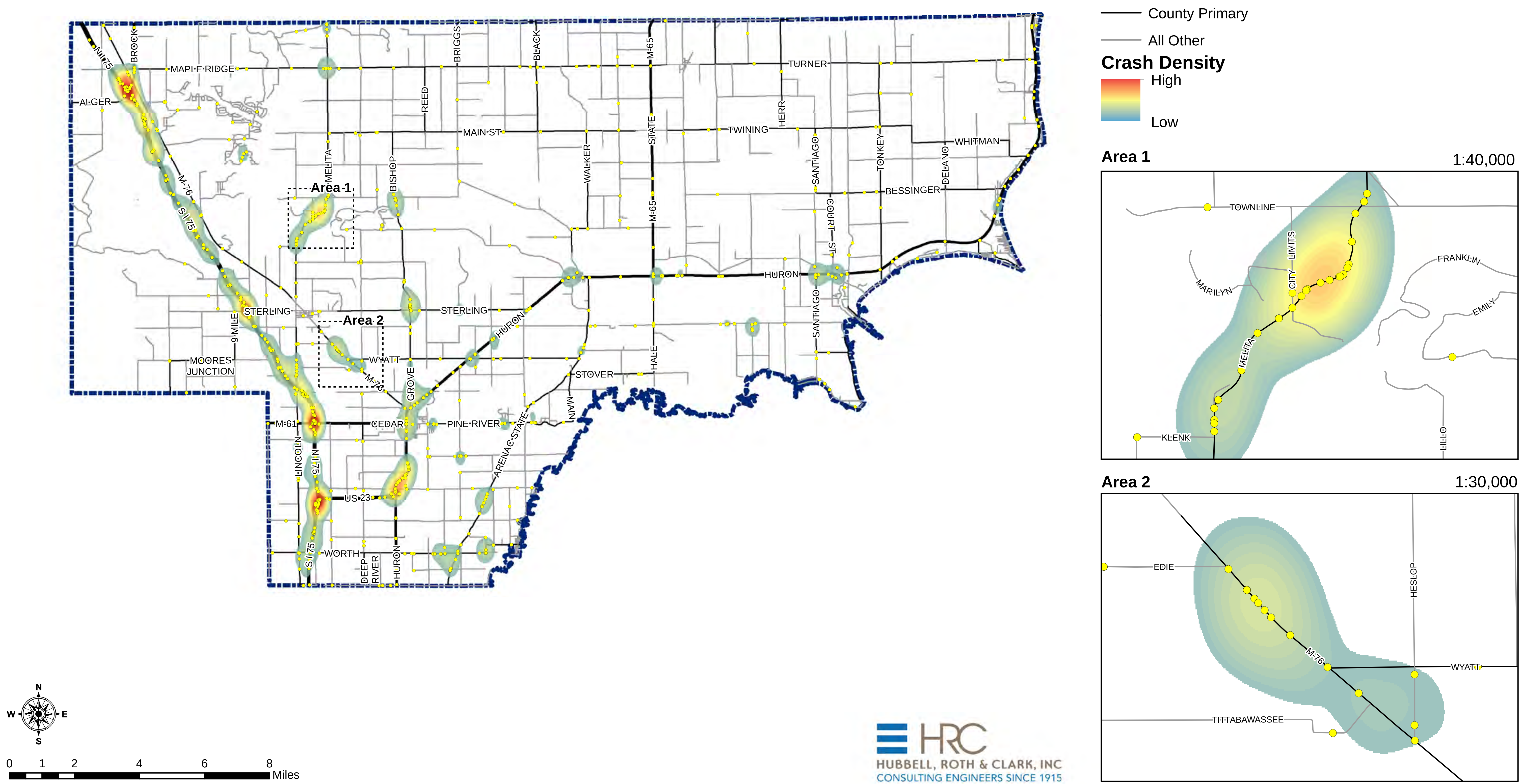
Arenac County
2010 - 2014 Crash Density



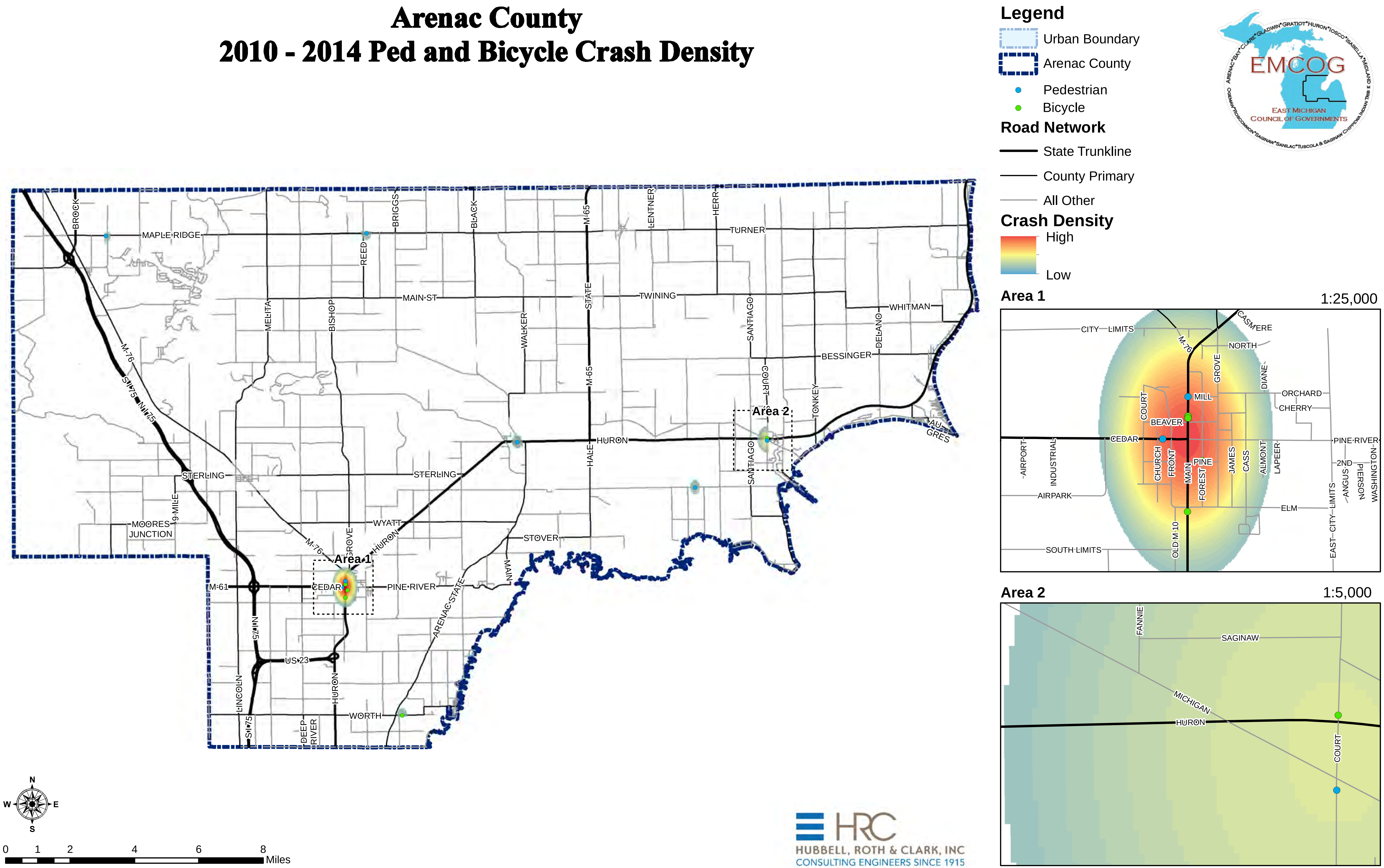
Arenac County
2010 - 2014 KA Crash Density



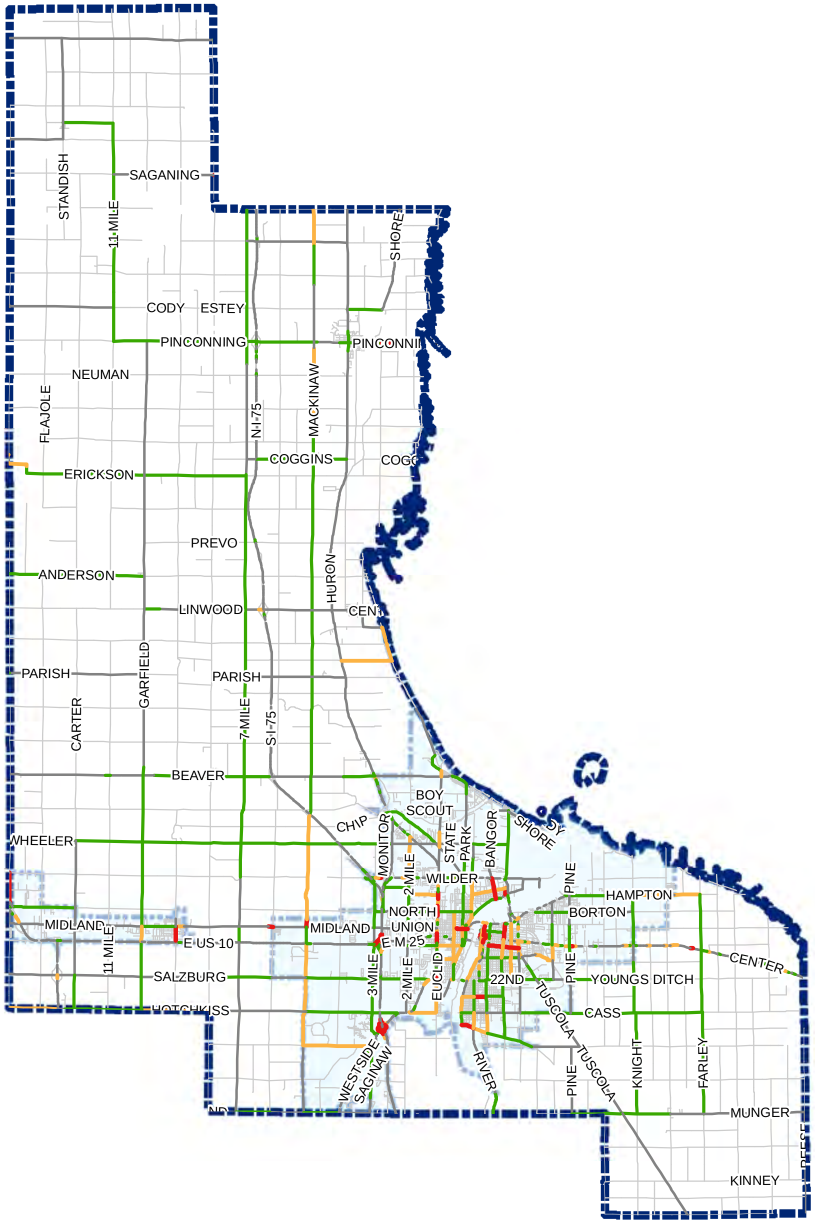
Arenac County
2010 - 2014 Single Vehicle Lane Departure Crash Density



Arenac County
2010 - 2014 Ped and Bicycle Crash Density



Bay County
Segment Crash Rate (2010 - 2014)



Legend

- Urban Boundary
- Bay County
- No Data

Segment Crash Rate (per 100 MVM)

- 100 or below
- 100 - 200
- 200 - 400
- 400 or higher

N W E S

0 1.5 3 6 9 12 Miles

Note:
Segments less than 300 ft are not illustrated.
Segment crash rates are expressed in 100 Million Vehicle Miles (MVM) traveled.
The first category (i.e. 100 or below) represents the regional dataset's average segment crash rates. Successive categories represent segment crash rate in multiples of two relative to the county average.

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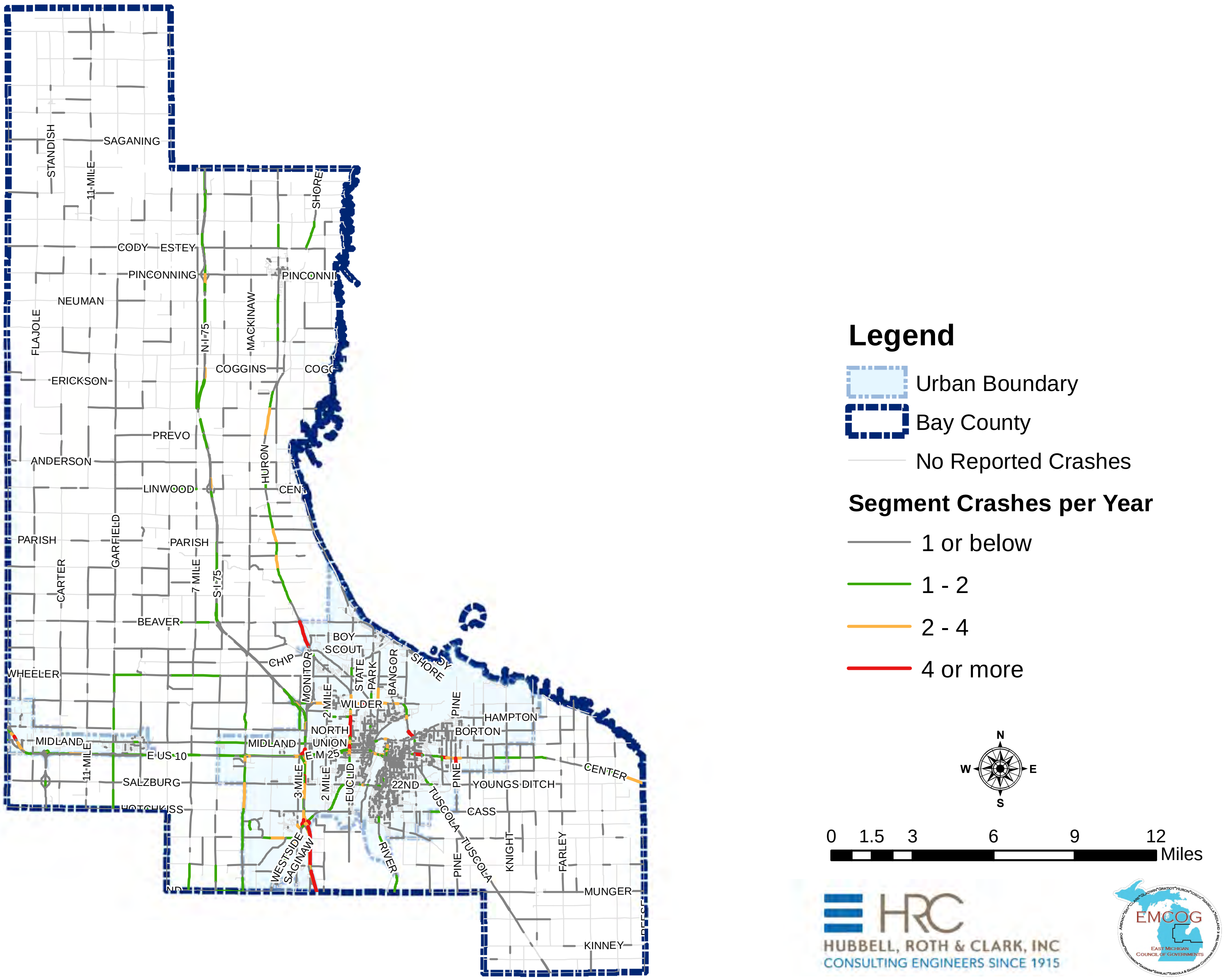
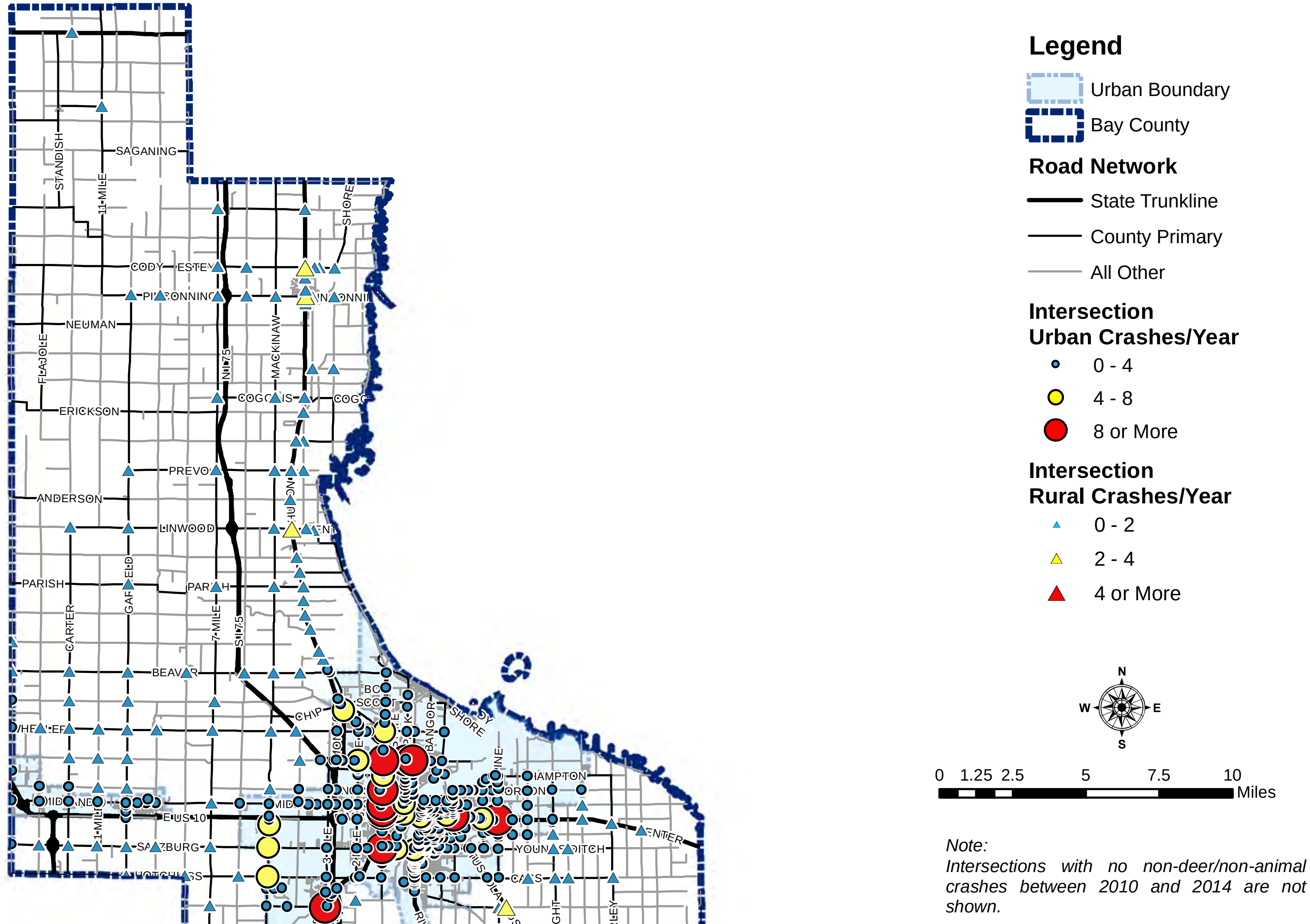
Bay County
Segment Crash Frequency (2010 - 2014)



Bay County
Intersection Crashes per Year (2010 - 2014)



Note:
Intersections with no non-deer/non-animal crashes between 2010 and 2014 are not shown.

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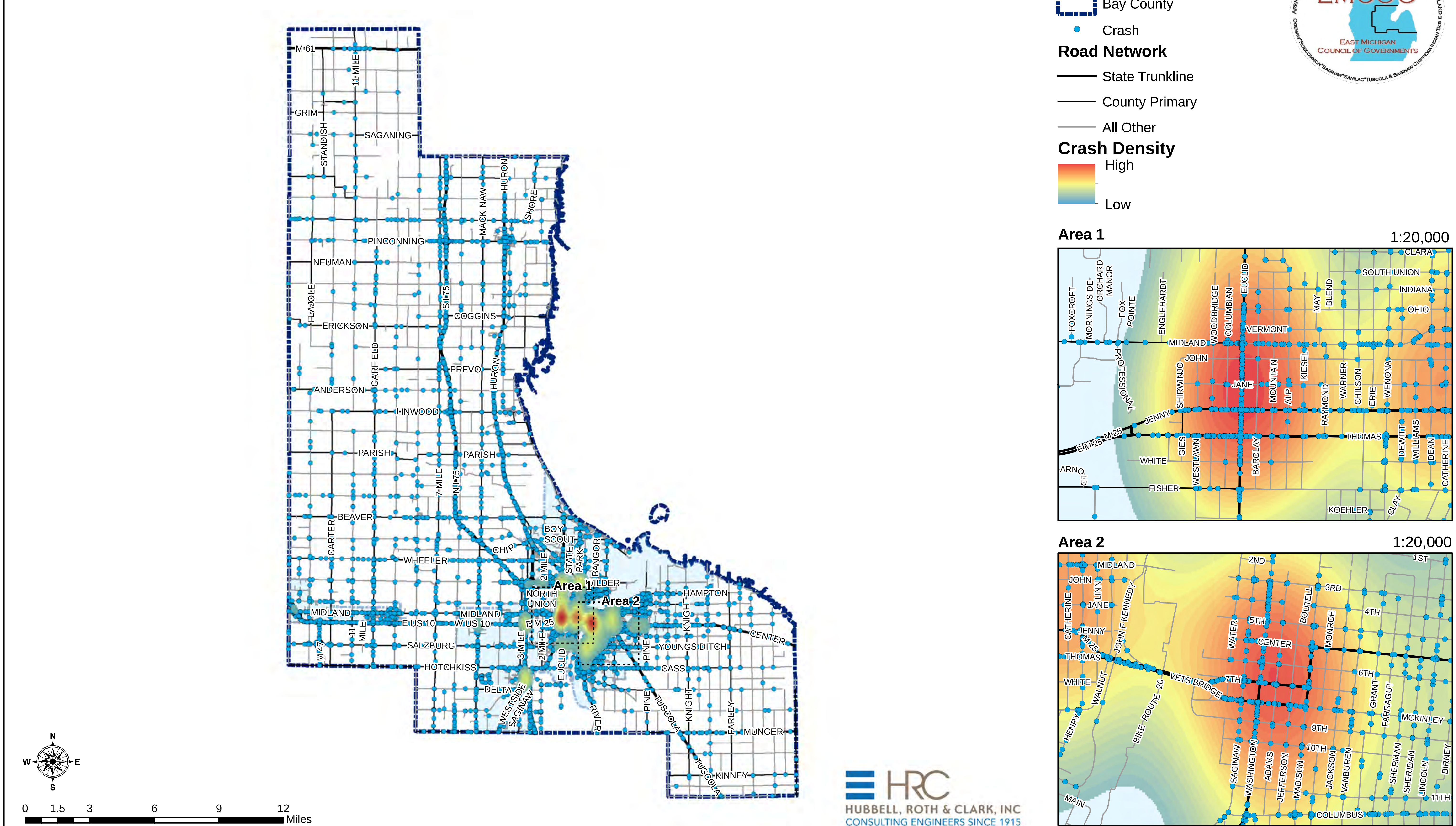
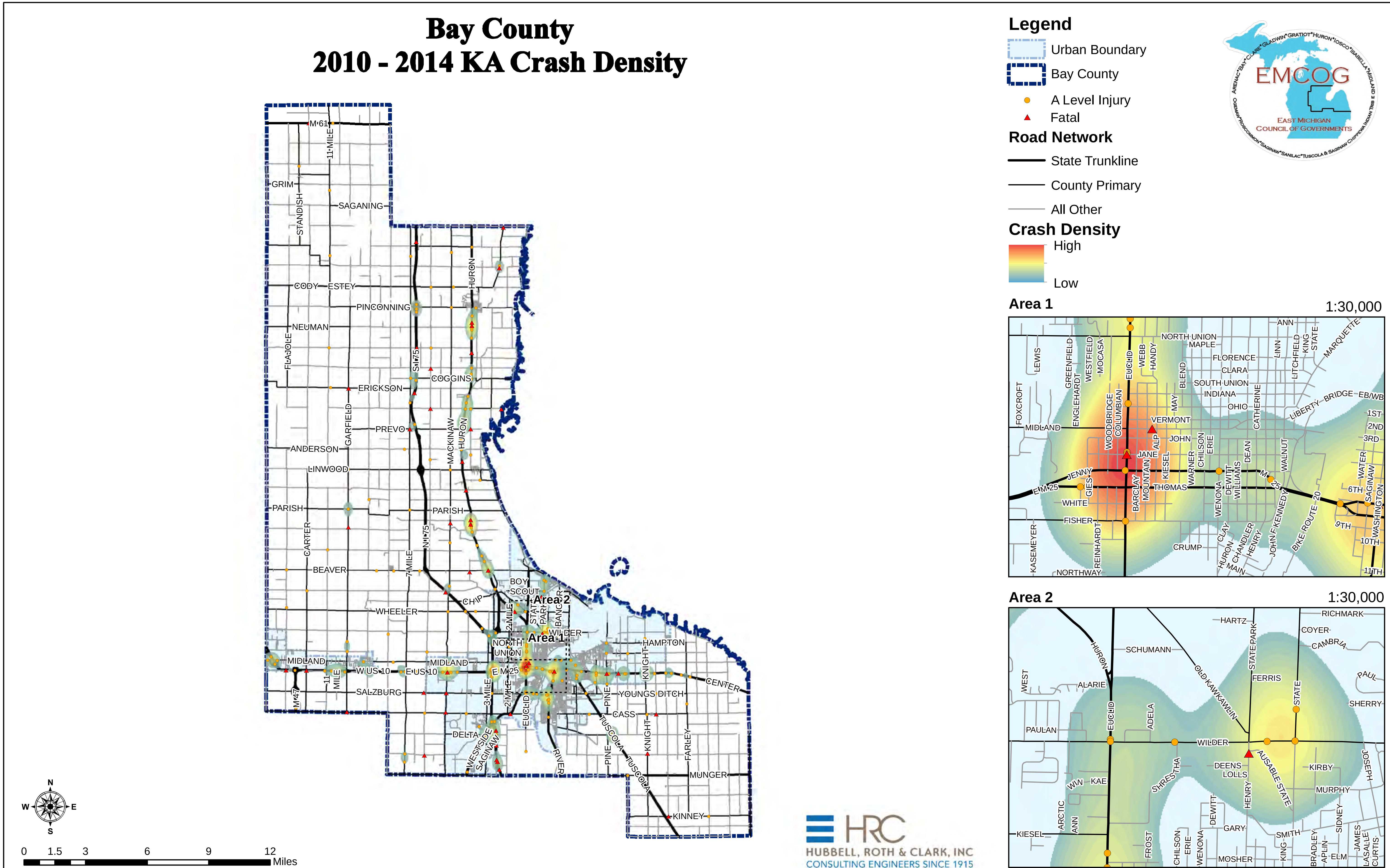
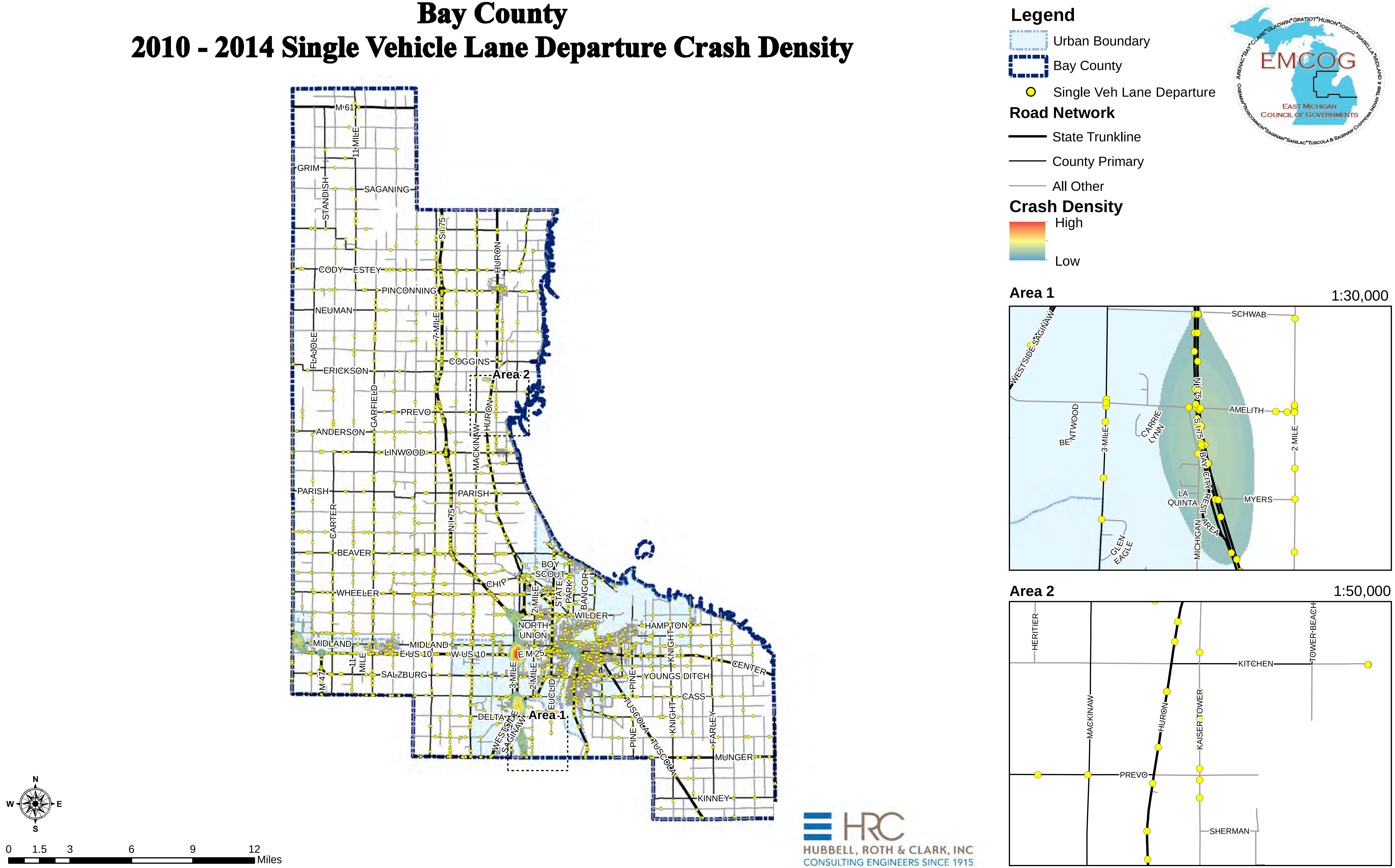
Bay County
2010 - 2014 Crash Density



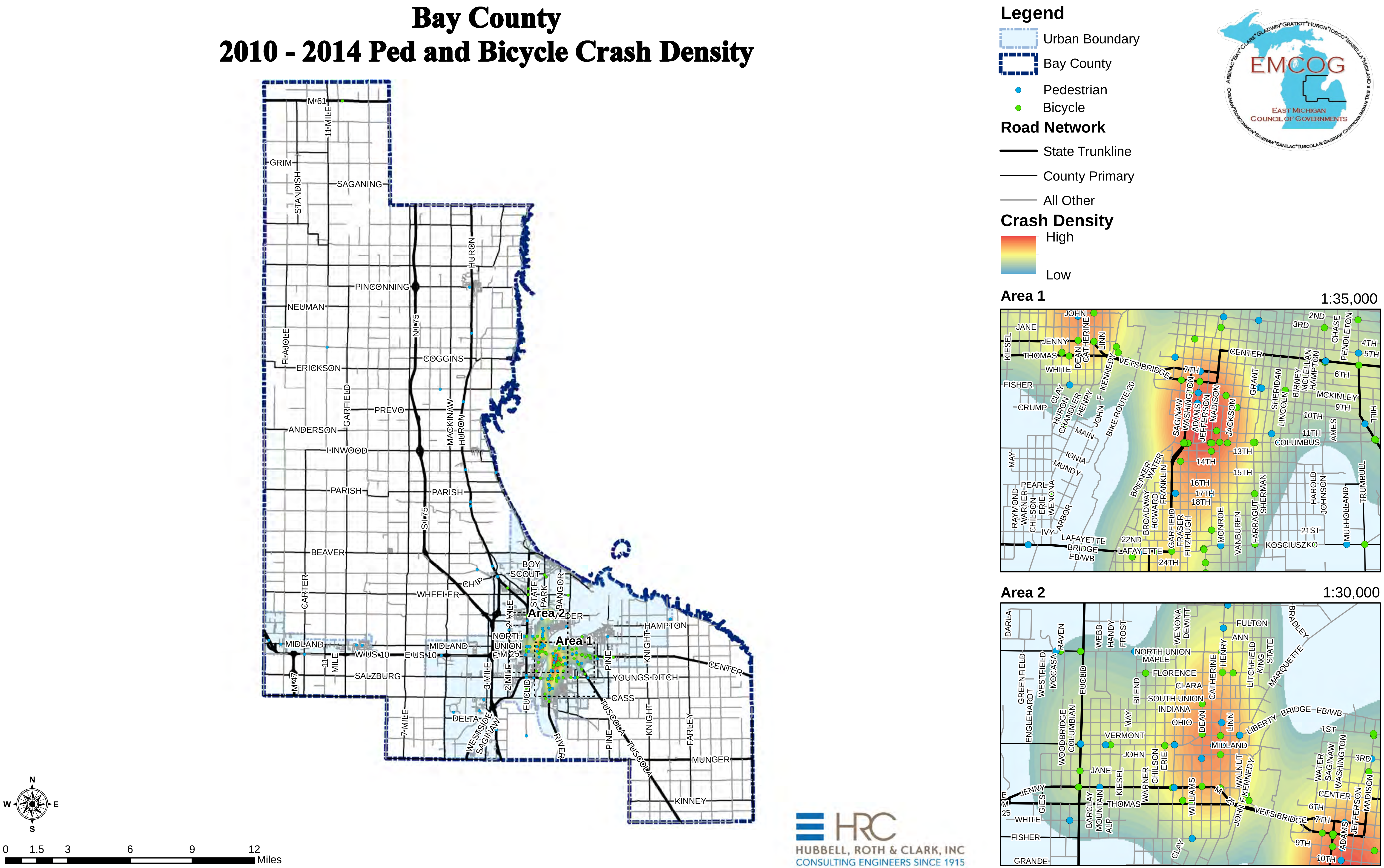
Bay County
2010 - 2014 KA Crash Density



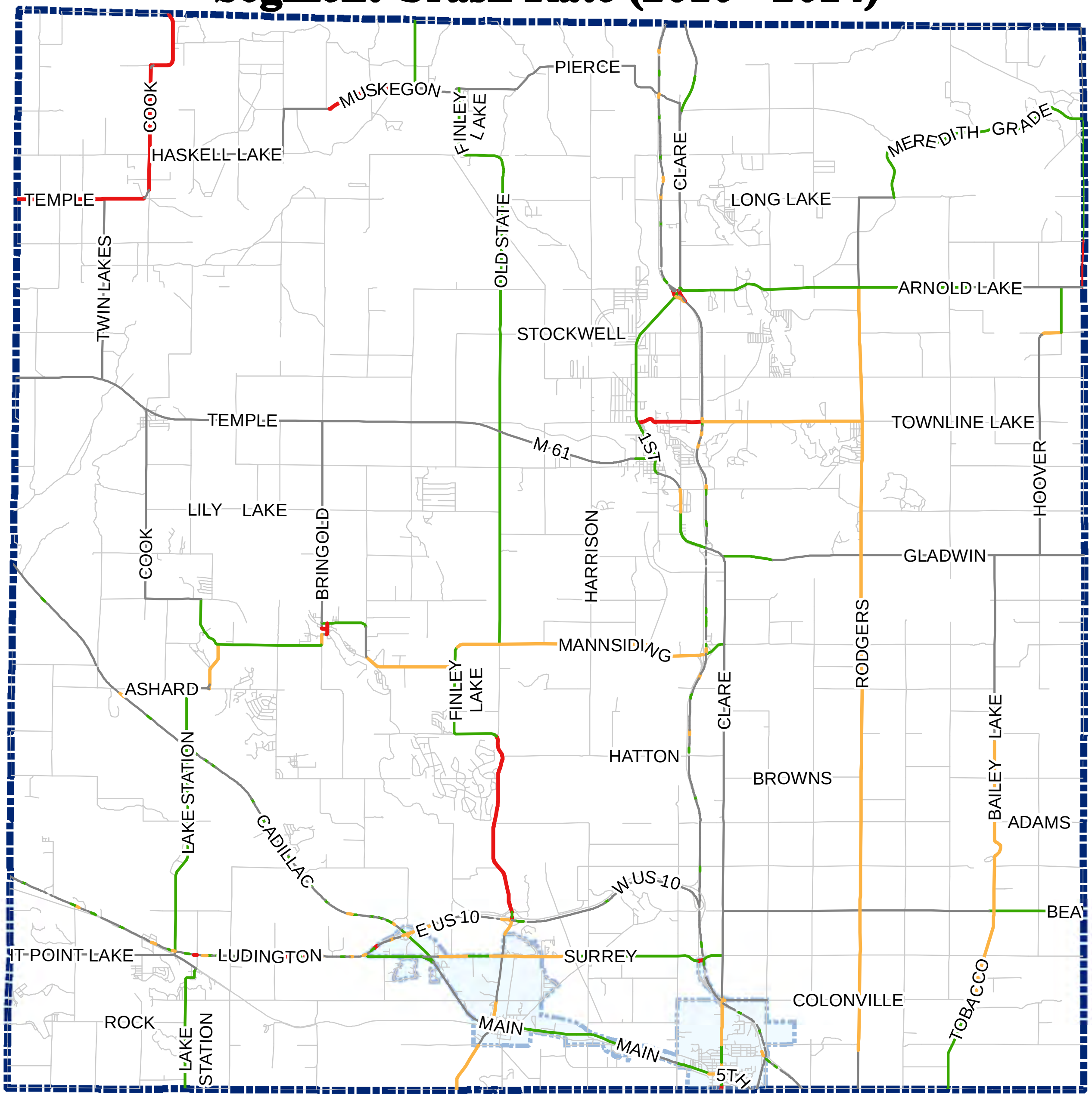
Bay County
2010 - 2014 Single Vehicle Lane Departure Crash Density



Bay County
2010 - 2014 Ped and Bicycle Crash Density



Clare County
Segment Crash Rate (2010 - 2014)



Legend

- Urban Boundary
- Clare County
- No Data

Segment Crash Rate (per 100 MVM)

- 100 or below
- 100 - 200
- 200 - 400
- 400 or higher

N W E S

0 1 2 4 6 8 Miles

Note:
Segments less than 300 ft are not illustrated.
Segment crash rates are expressed in 100 Million Vehicle Miles (MVM) traveled.
The first category (i.e. 100 or below) represents the regional dataset's average segment crash rates. Successive categories represent segment crash rate in multiples of two relative to the county average.

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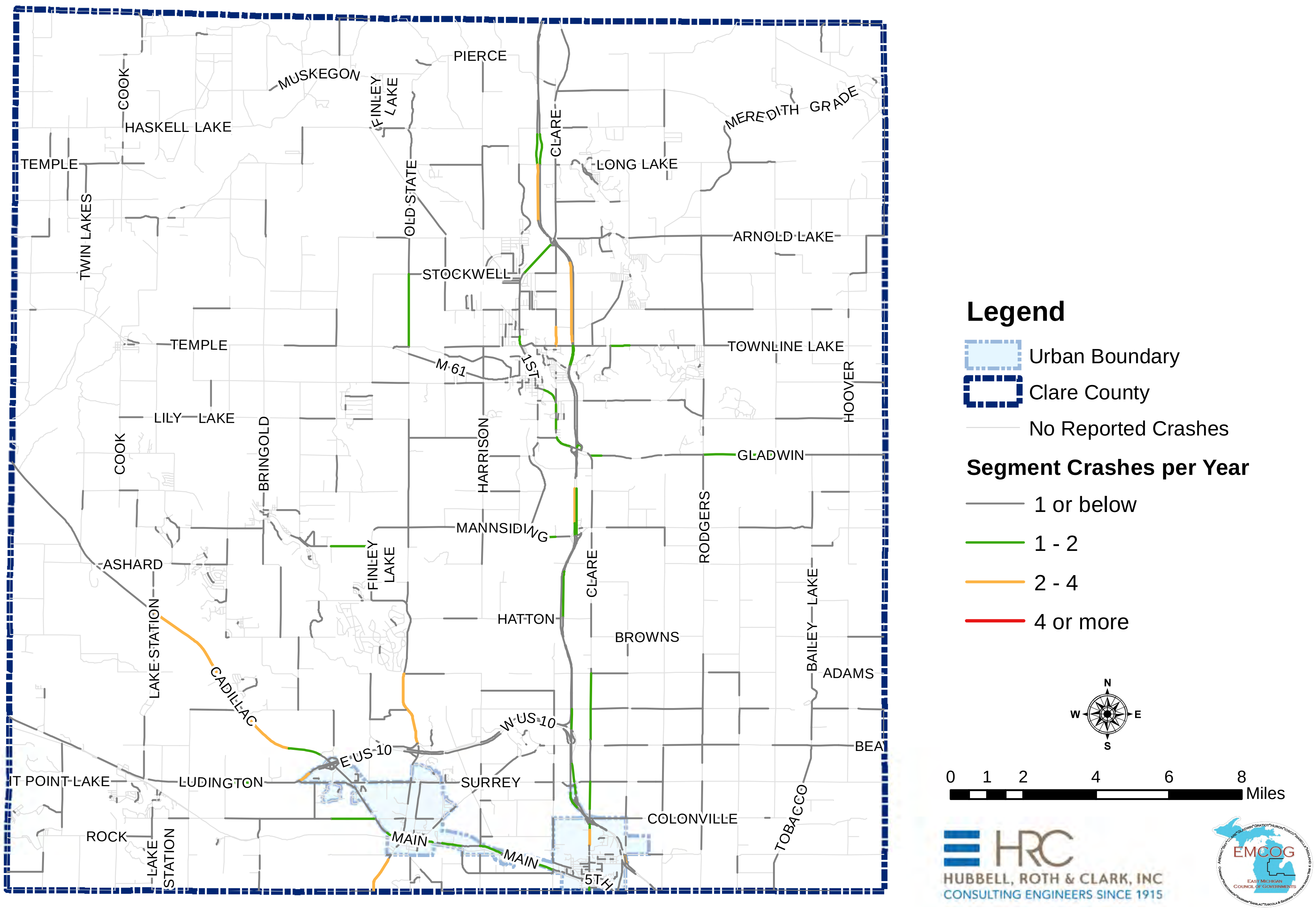
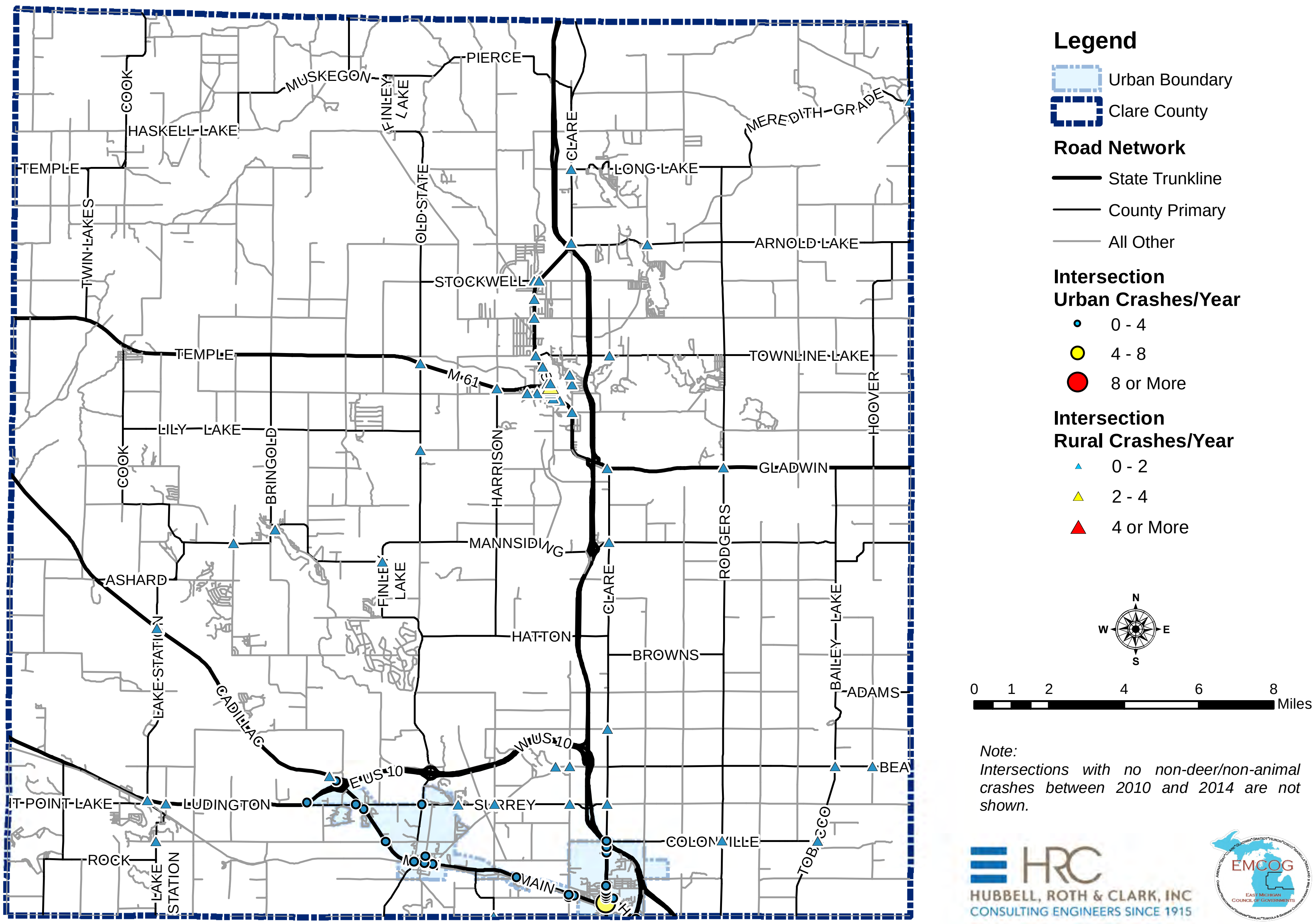
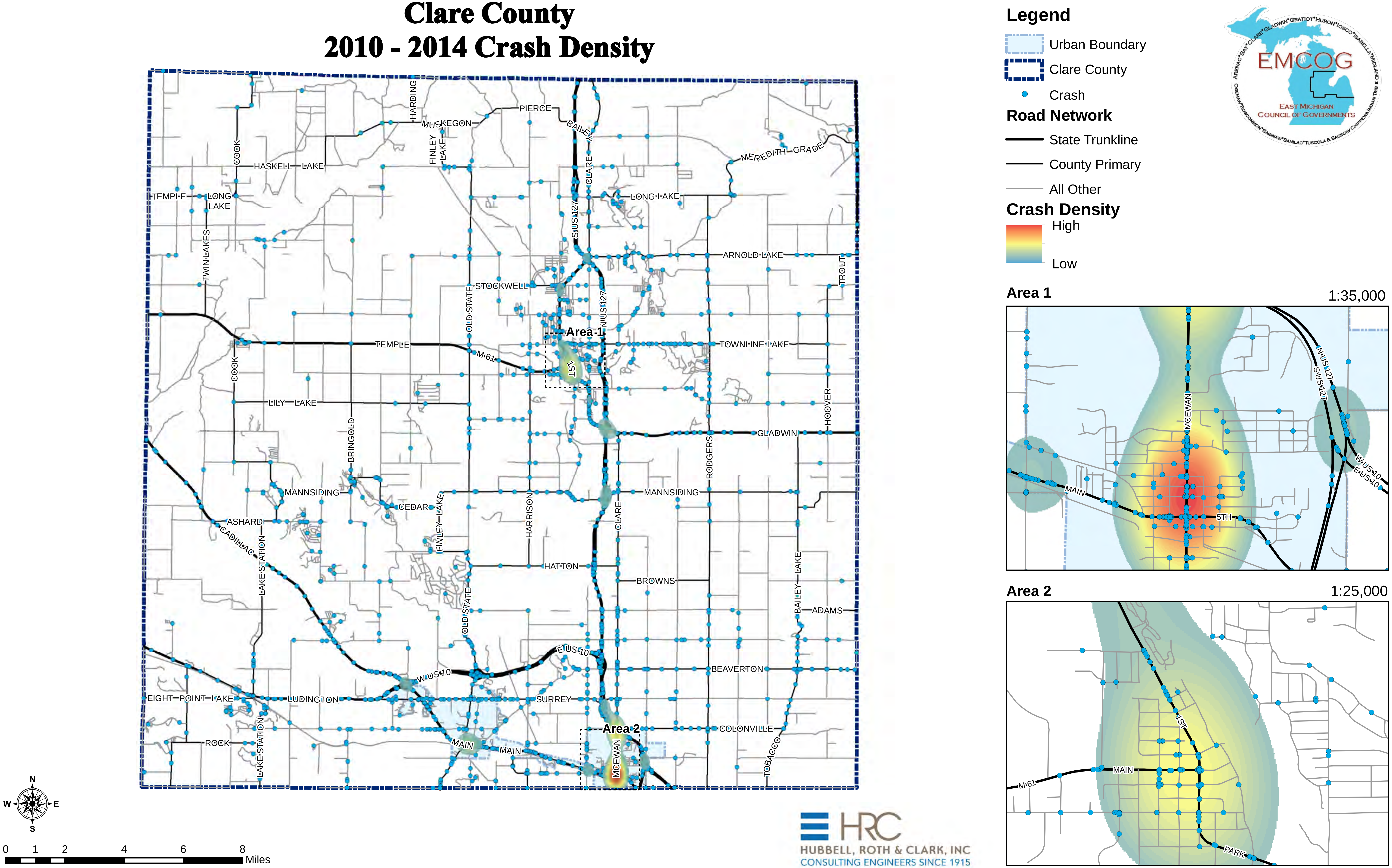
Clare County
Segment Crash Frequency (2010 - 2014)



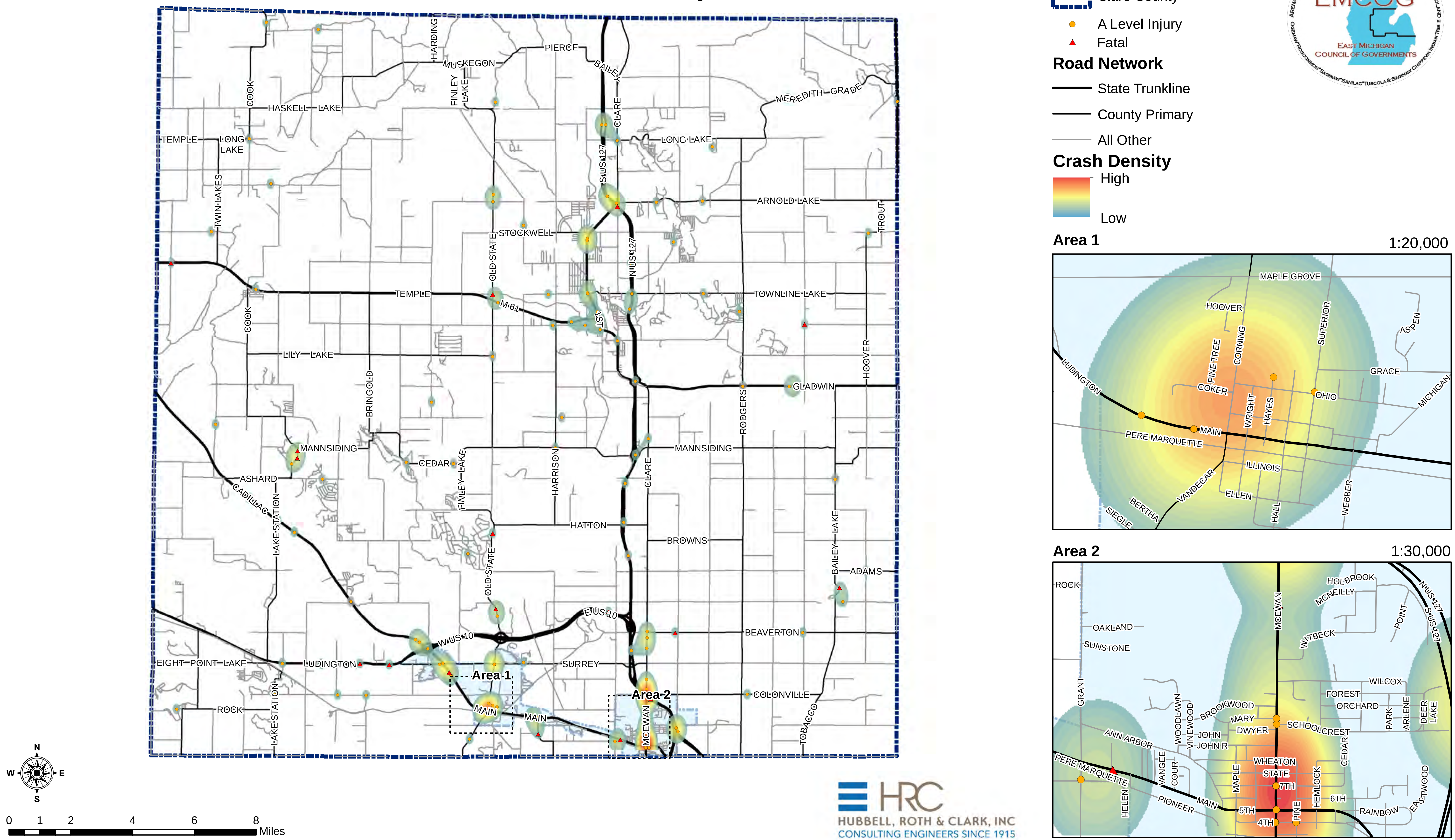
Clare County
Intersection Crashes per Year (2010 - 2014)



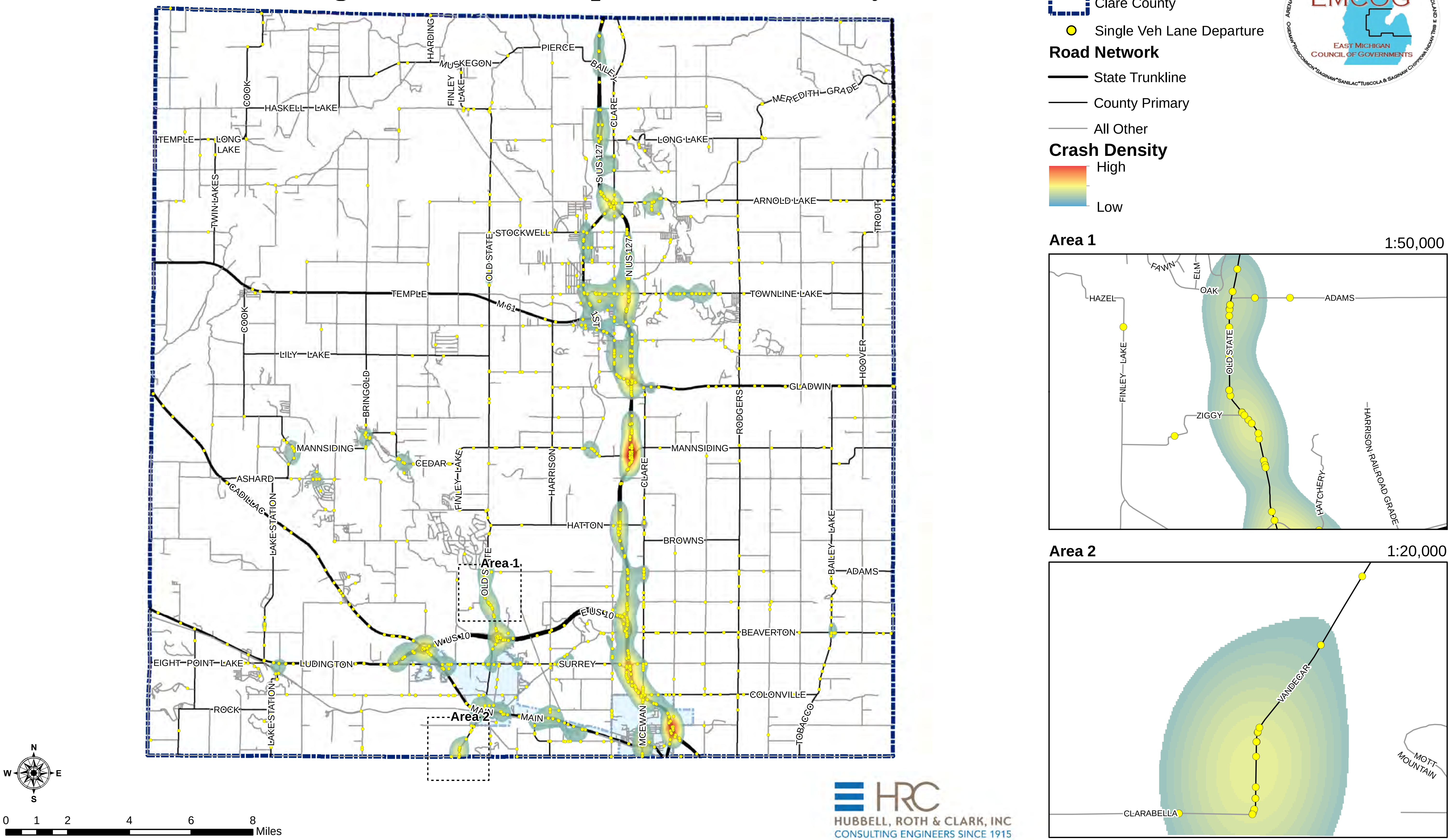
Clare County
2010 - 2014 Crash Density



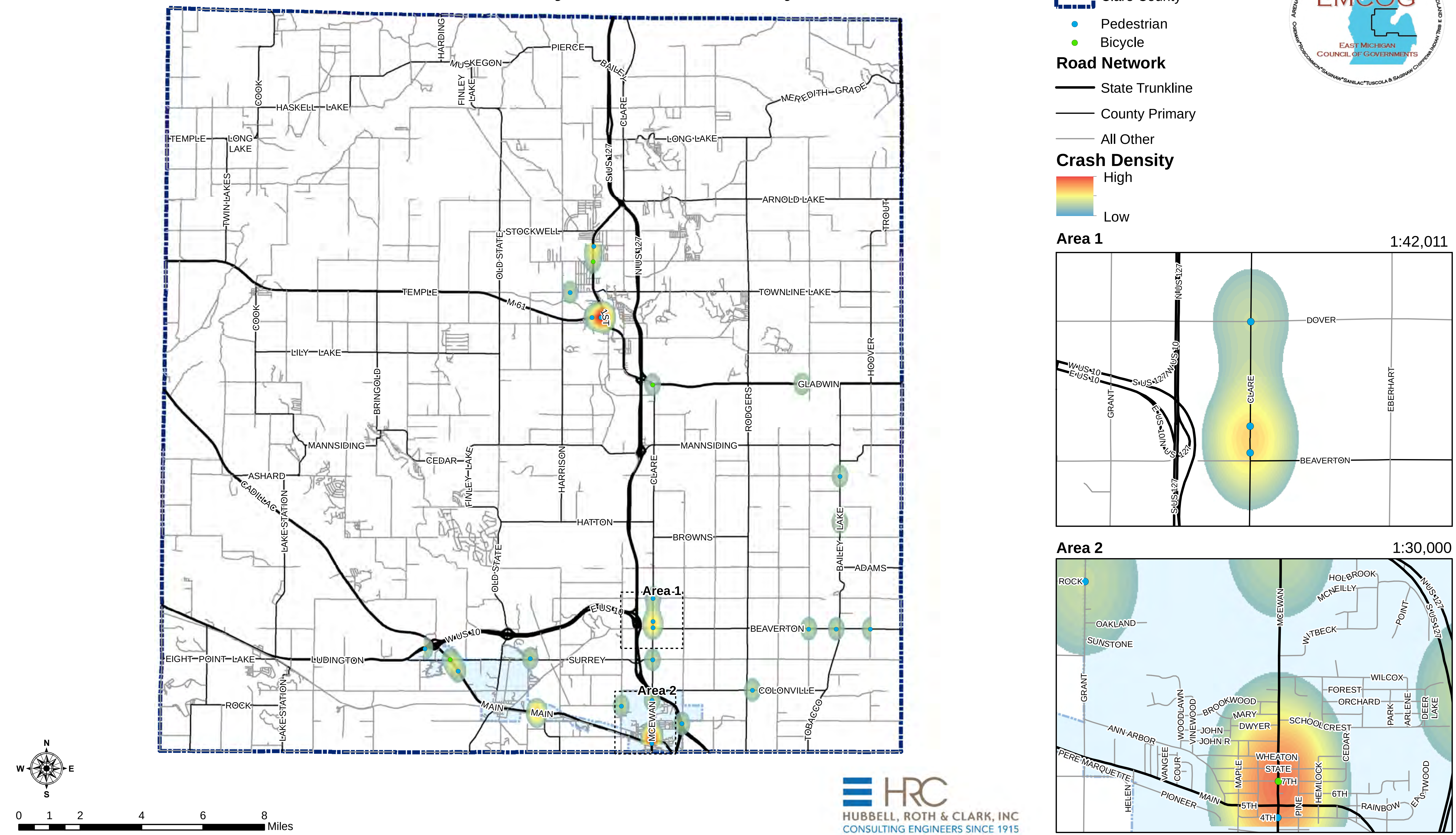
Clare County
2010 - 2014 KA Crash Density



Clare County
2010 - 2014 Single Vehicle Lane Departure Crash Density



Clare County
2010 - 2014 Ped and Bicycle Crash Density



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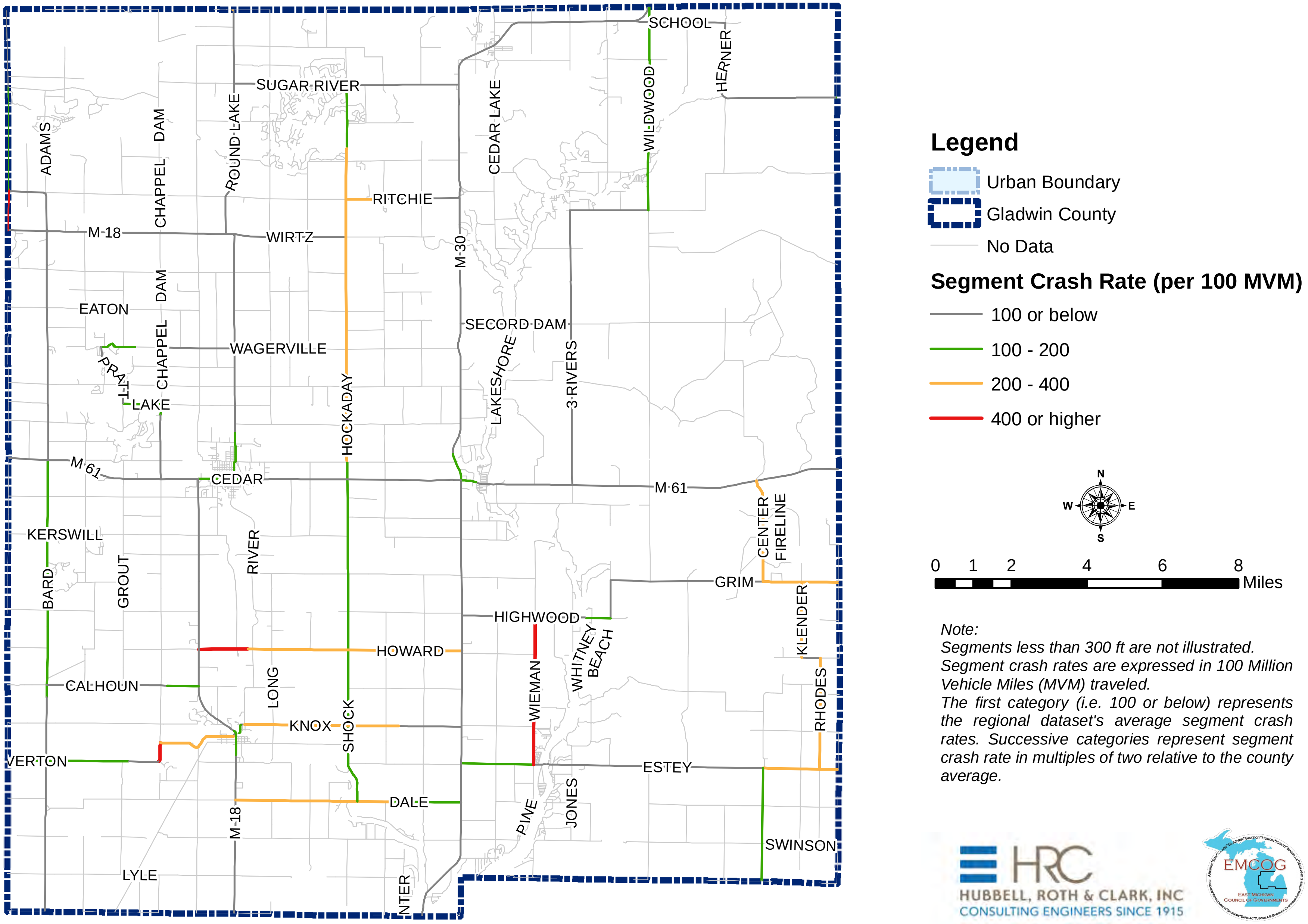
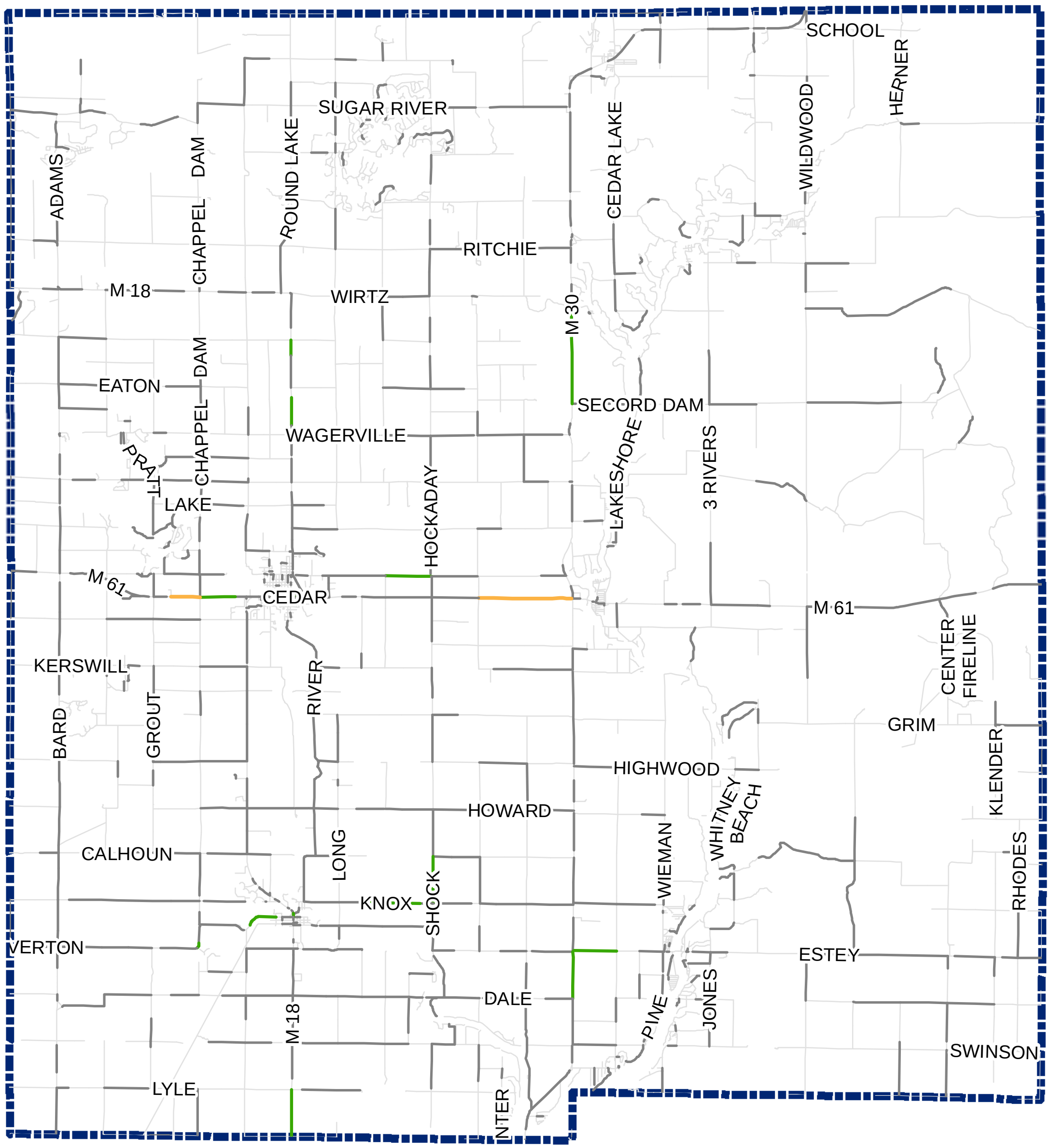
Gladwin County
Segment Crash Rate (2010 - 2014)



Gladwin County
Segment Crash Frequency (2010 - 2014)



Legend

Urban Boundary

Gladwin County

No Reported Crashes

Segment Crashes per Year

1 or below

1 - 2

2 - 4

4 or more

N W E S

0 1 2 4 6 8 Miles

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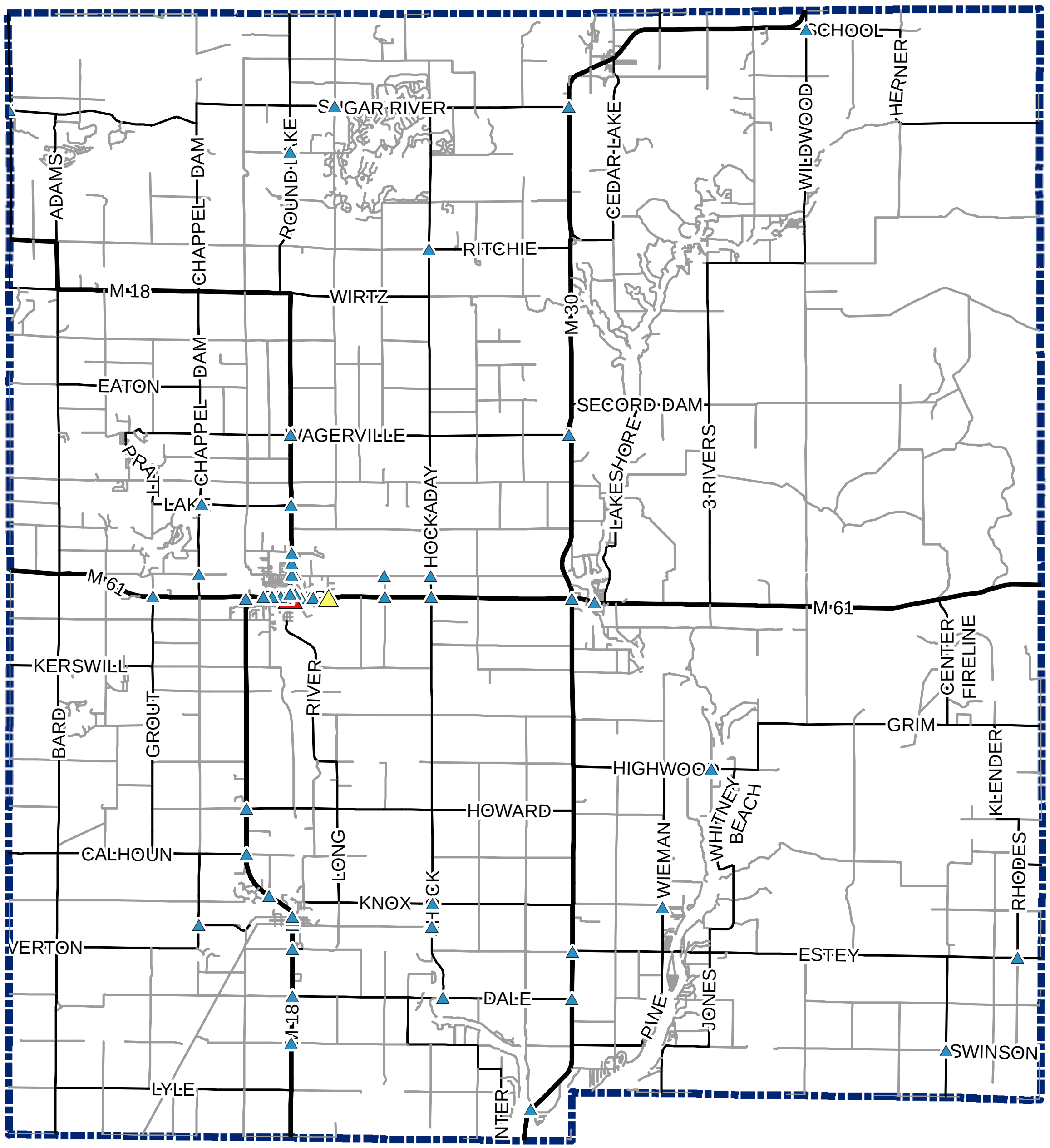
Gladwin County
Intersection Crashes per Year (2010 - 2014)



Legend

- Urban Boundary
- Gladwin County

Road Network

- State Trunkline
- County Primary
- All Other

Intersection Urban Crashes/Year

- 0 - 4
- 4 - 8
- 8 or More

Intersection Rural Crashes/Year

- 0 - 2
- 2 - 4
- 4 or More

N W E S

0 1 2 4 6 8 Miles

Note: Intersections with no non-deer/non-animal crashes between 2010 and 2014 are not shown.

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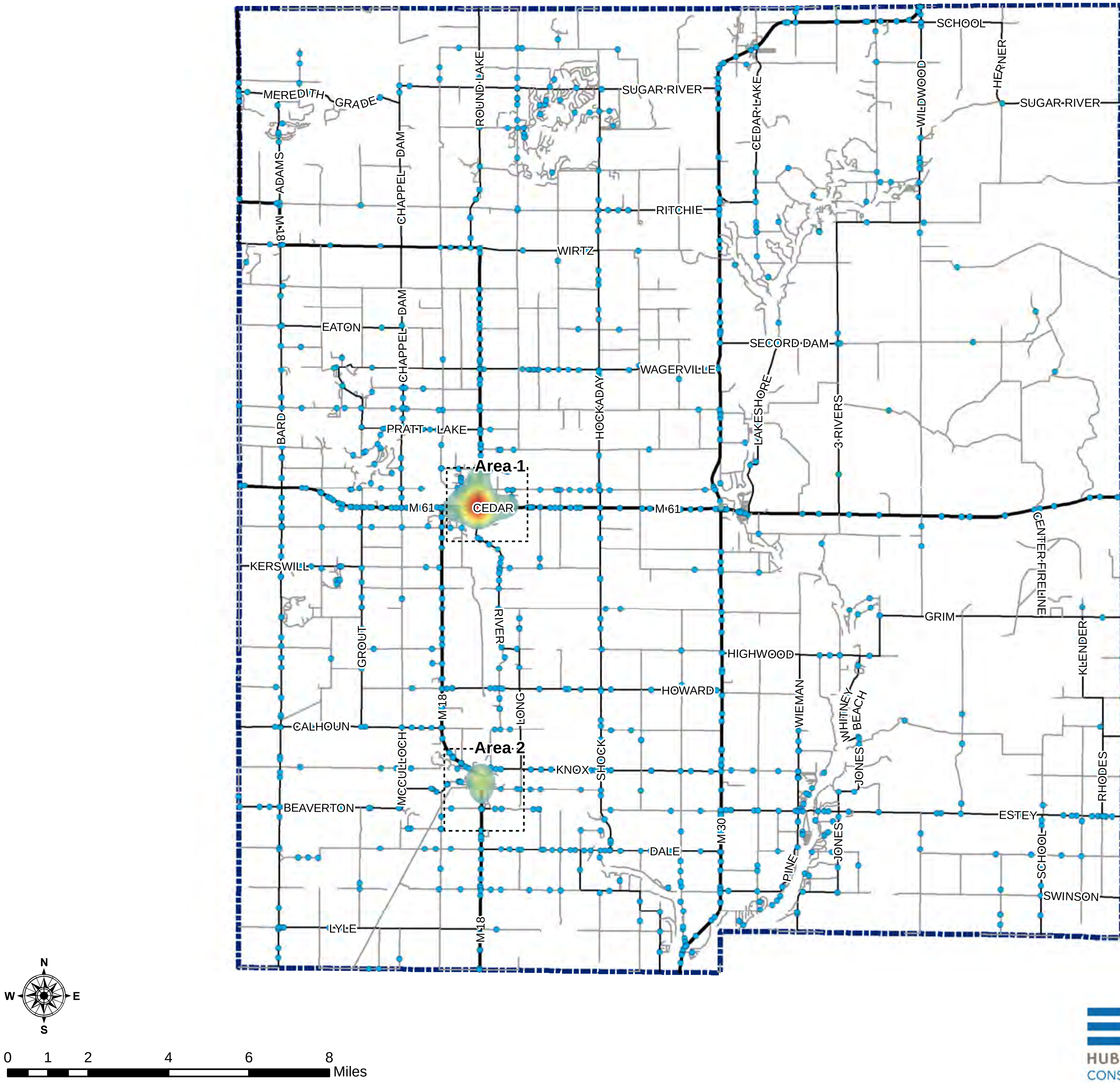
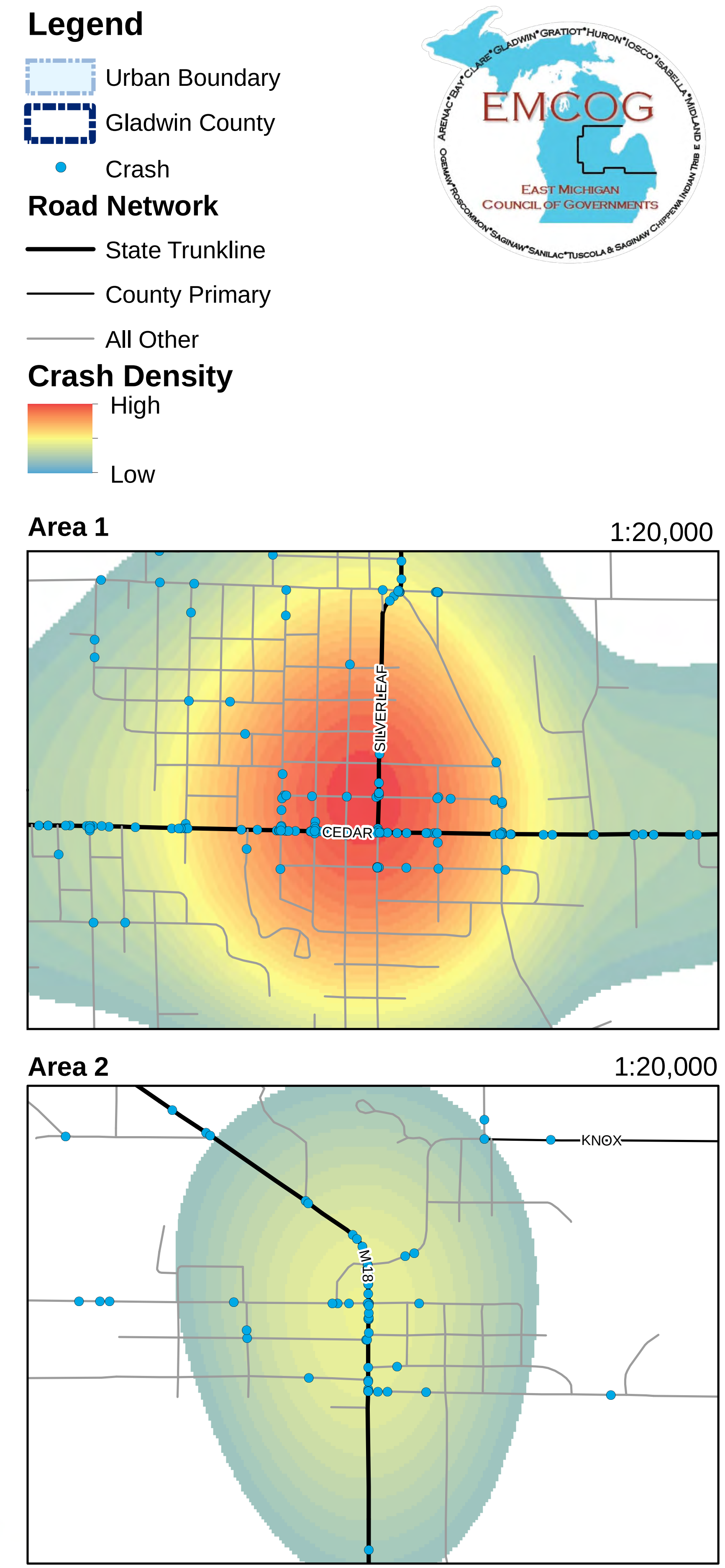
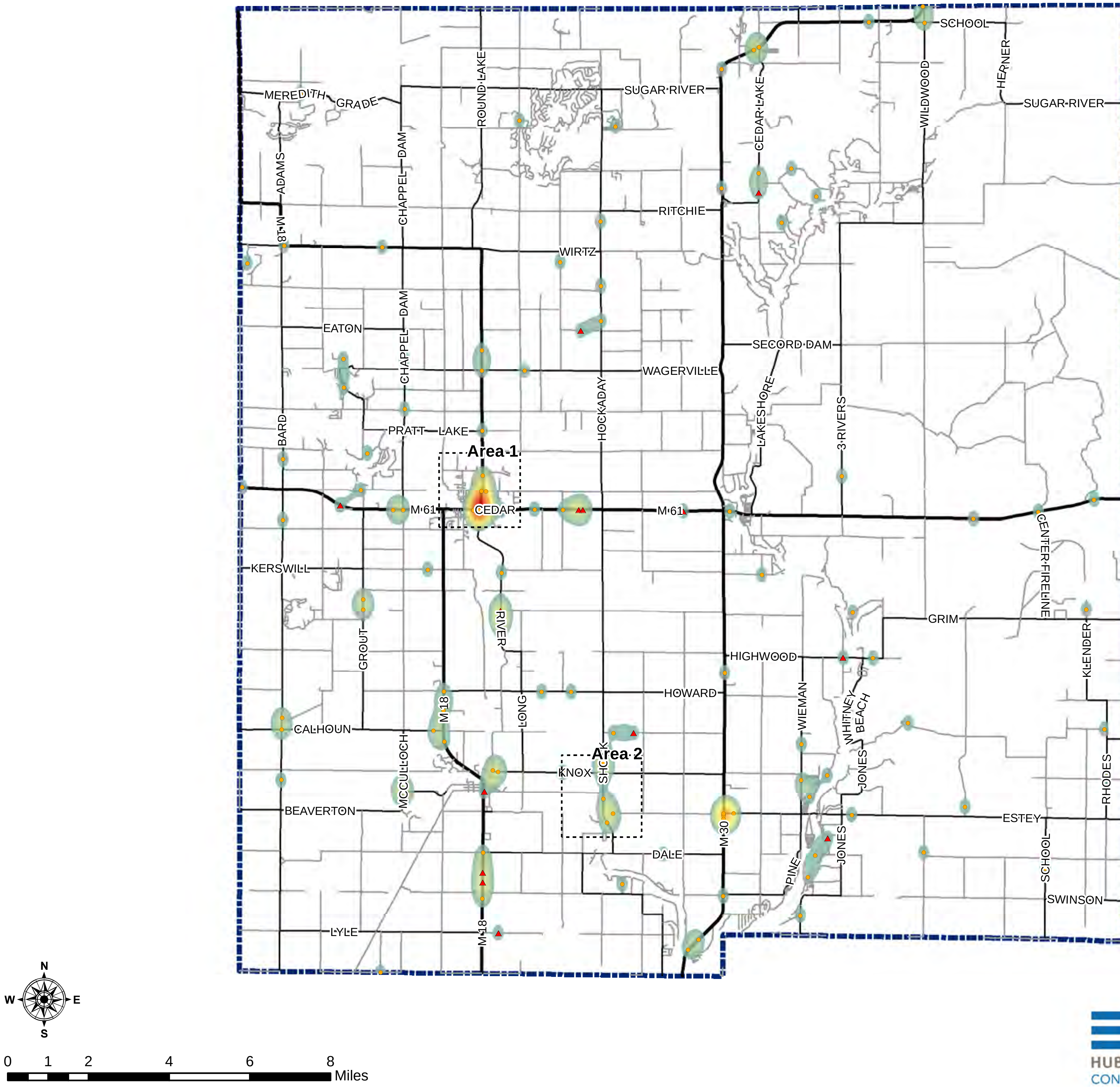
EMCOG East Michigan Council of Governments

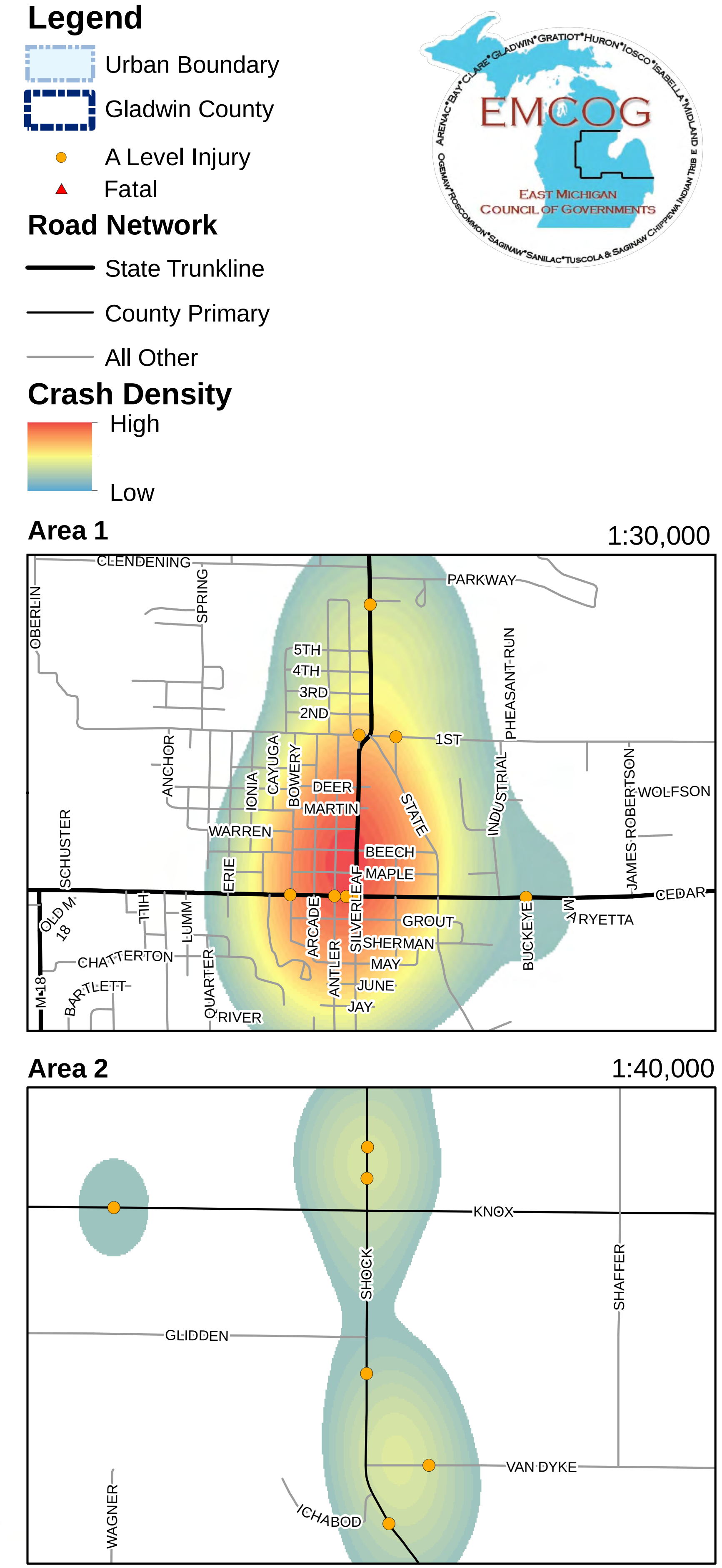
Gladwin County
2010 - 2014 Crash Density





Gladwin County
2010 - 2014 KA Crash Density





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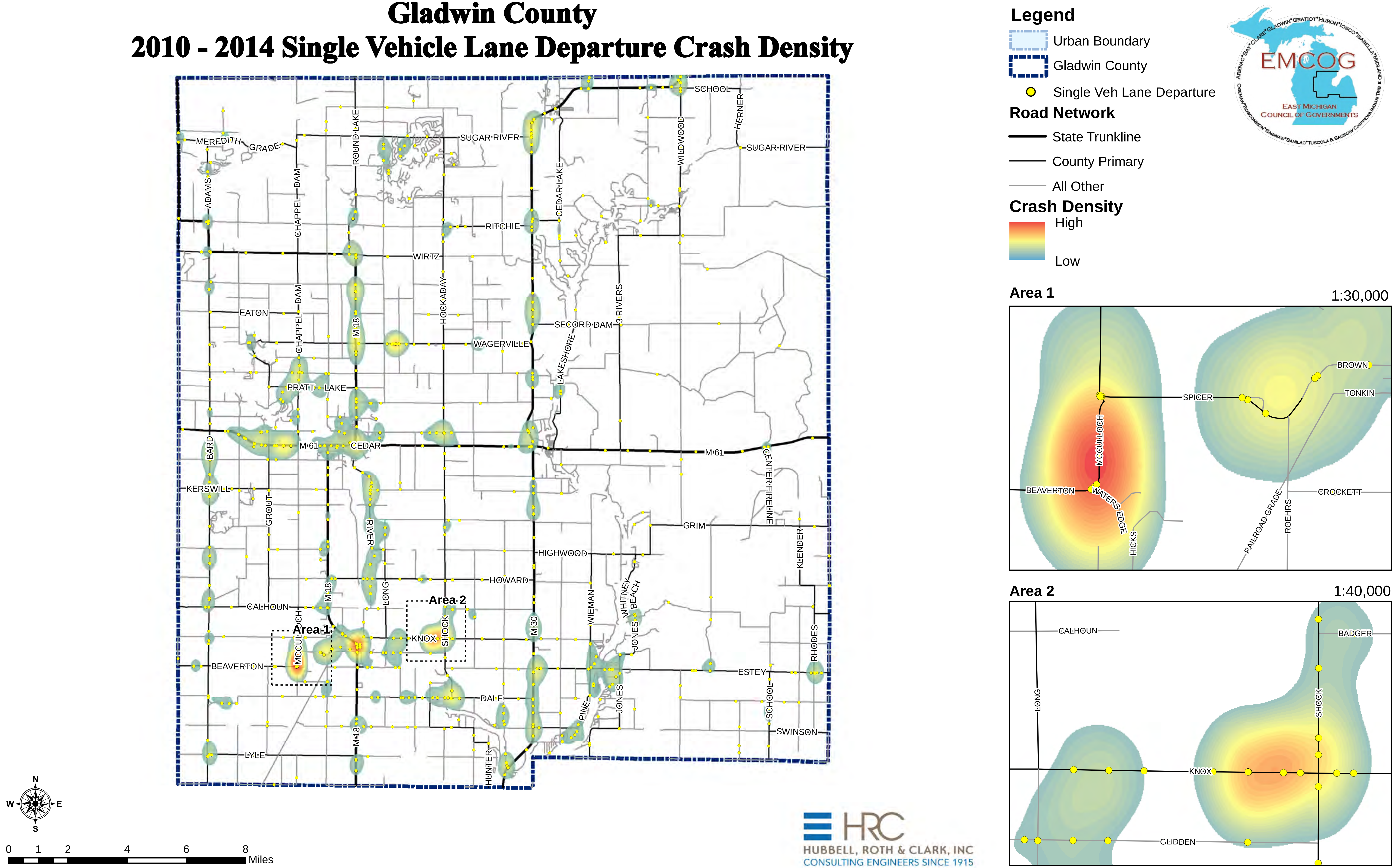
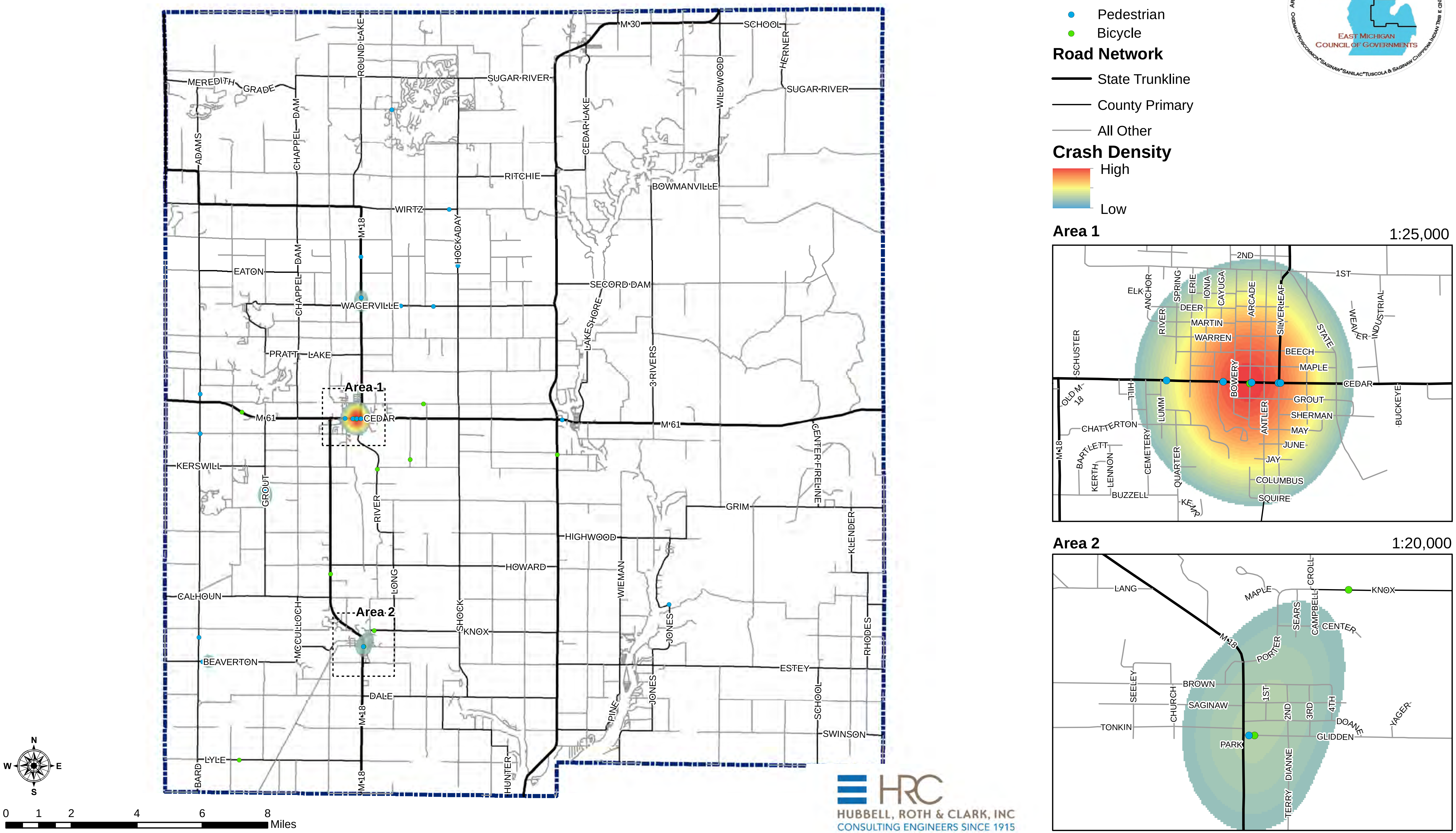
Gladwin County
2010 - 2014 Single Vehicle Lane Departure Crash Density



Gladwin County
2010 - 2014 Ped and Bicycle Crash Density



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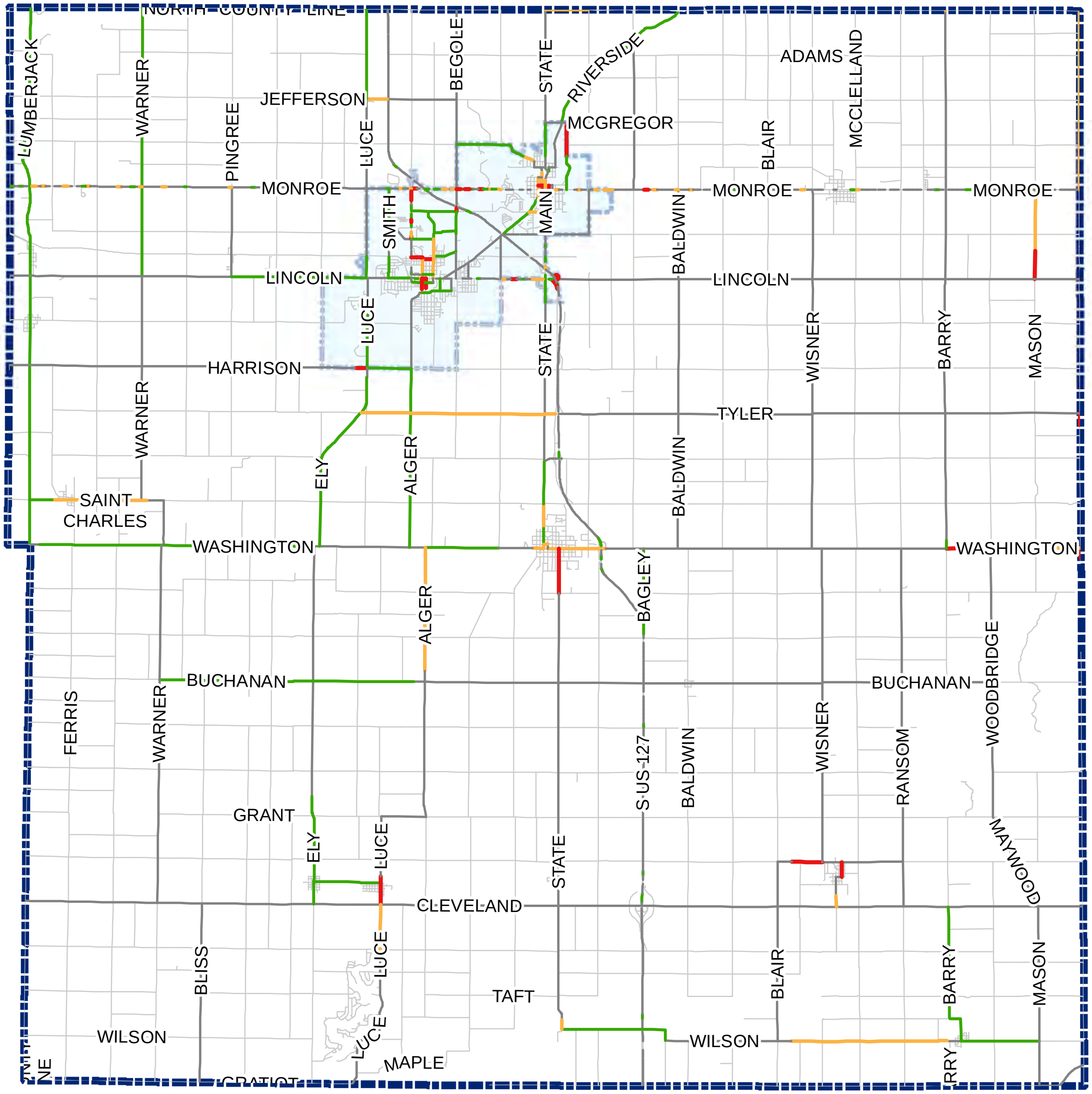
EMCOG
EAST MICHIGAN COUNCIL OF GOVERNMENTS

Gratiot County
Segment Crash Rate (2010 - 2014)

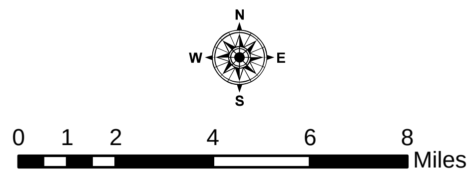


Legend

- Urban Boundary
- Gratiot County
- No Data

Segment Crash Rate (per 100 MVM)

- 100 or below
- 100 - 200
- 200 - 400
- 400 or higher



Note:
Segments less than 300 ft are not illustrated.
Segment crash rates are expressed in 100 Million Vehicle Miles (MVM) traveled.
The first category (i.e. 100 or below) represents the regional dataset's average segment crash rates. Successive categories represent segment crash rate in multiples of two relative to the county average.

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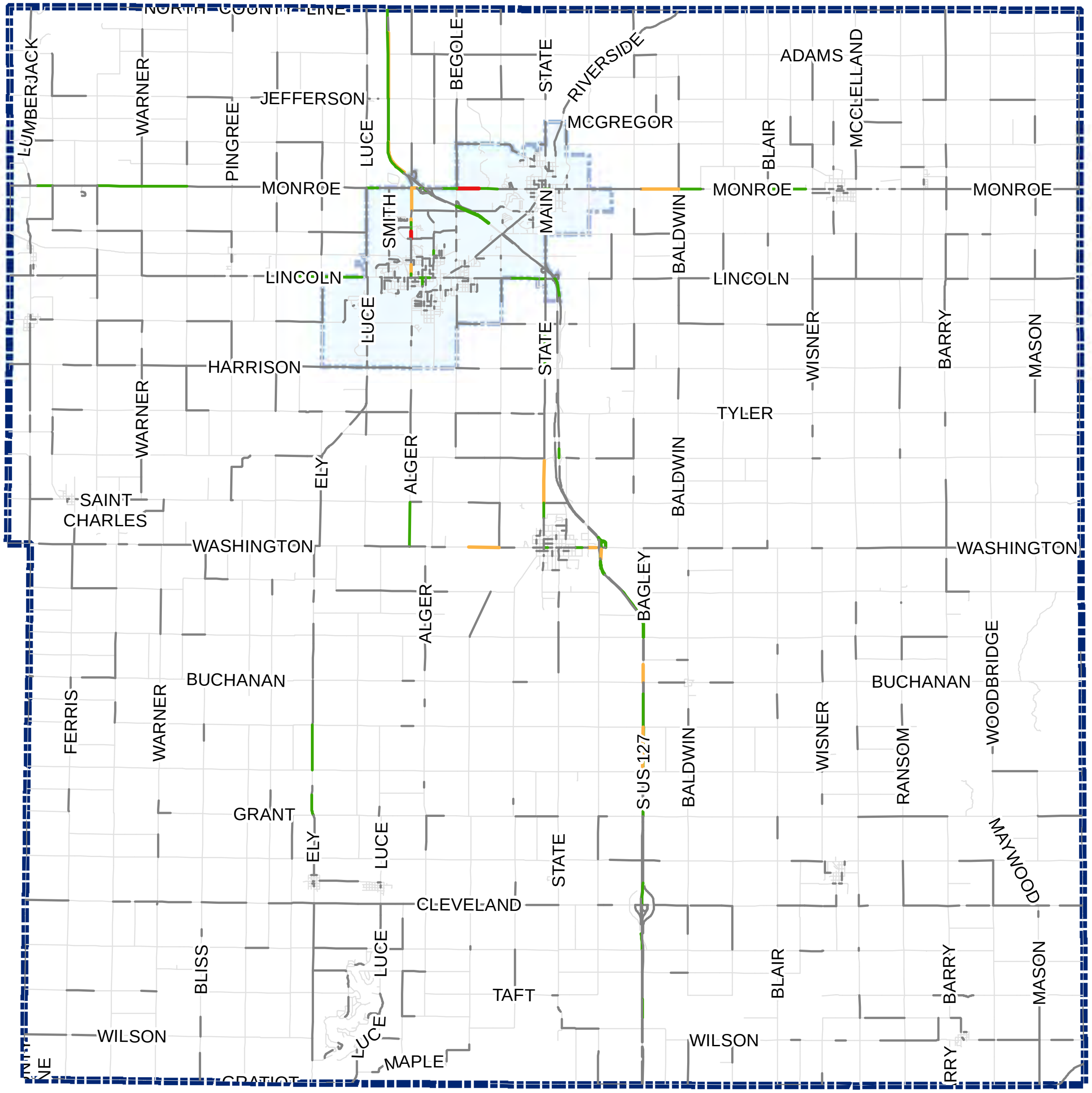
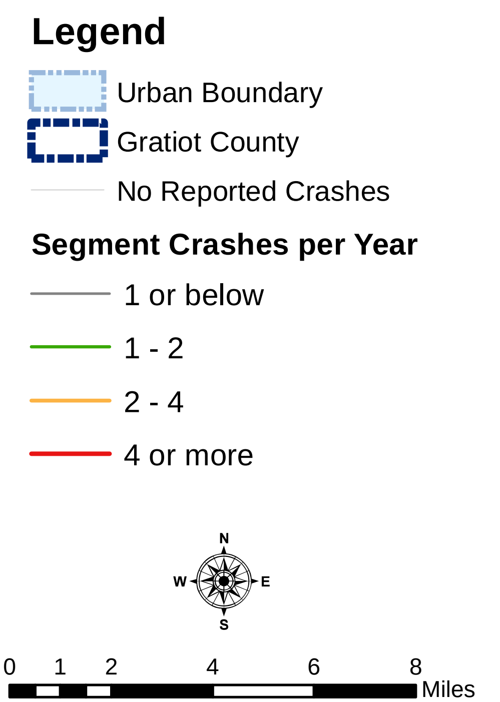
CONSULTING ENGINEERS SINCE 1915

EMCOG
EAST MICHIGAN COUNCIL OF GOVERNMENTS

Gratiot County
Segment Crash Frequency (2010 - 2014)



Legend



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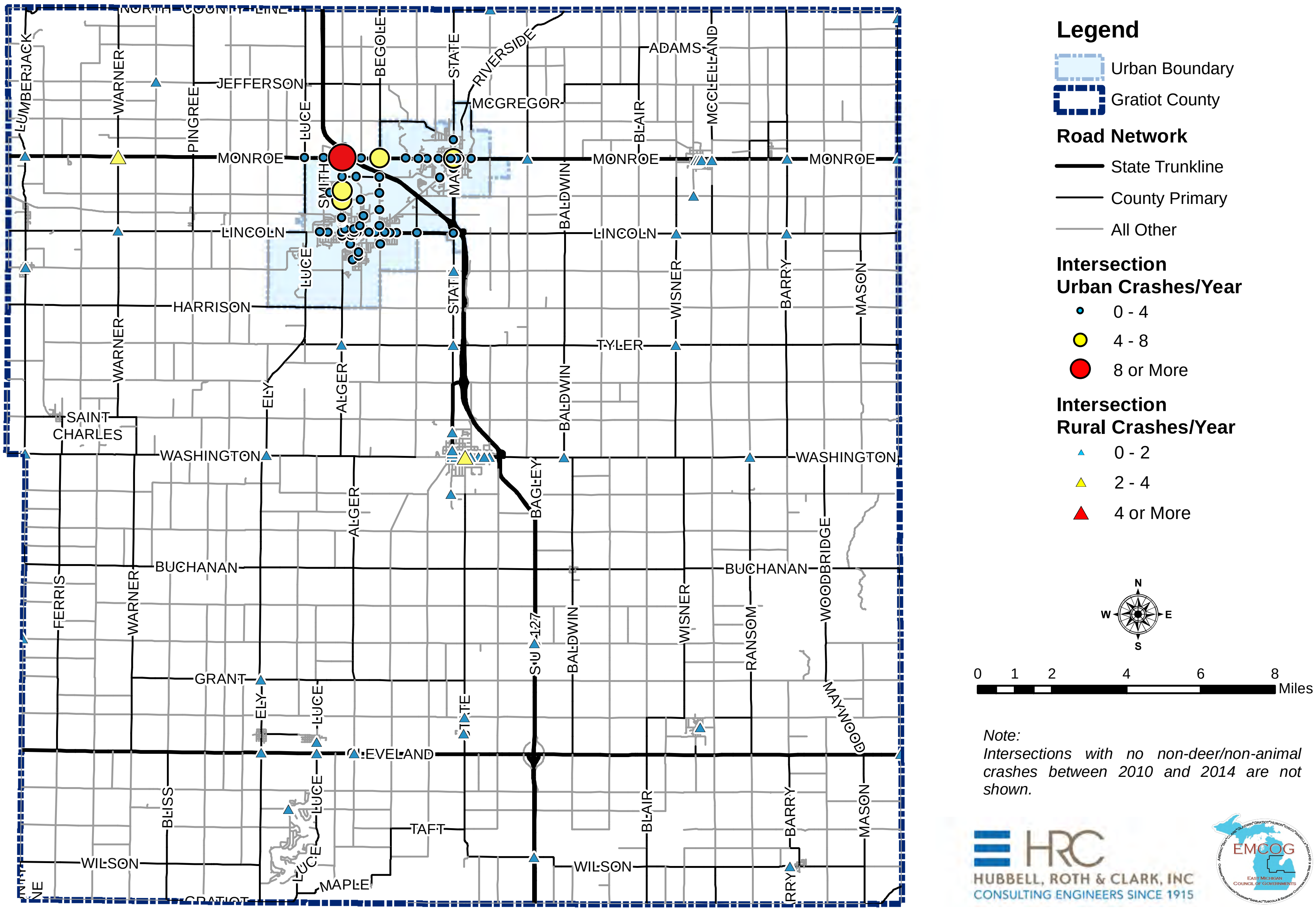
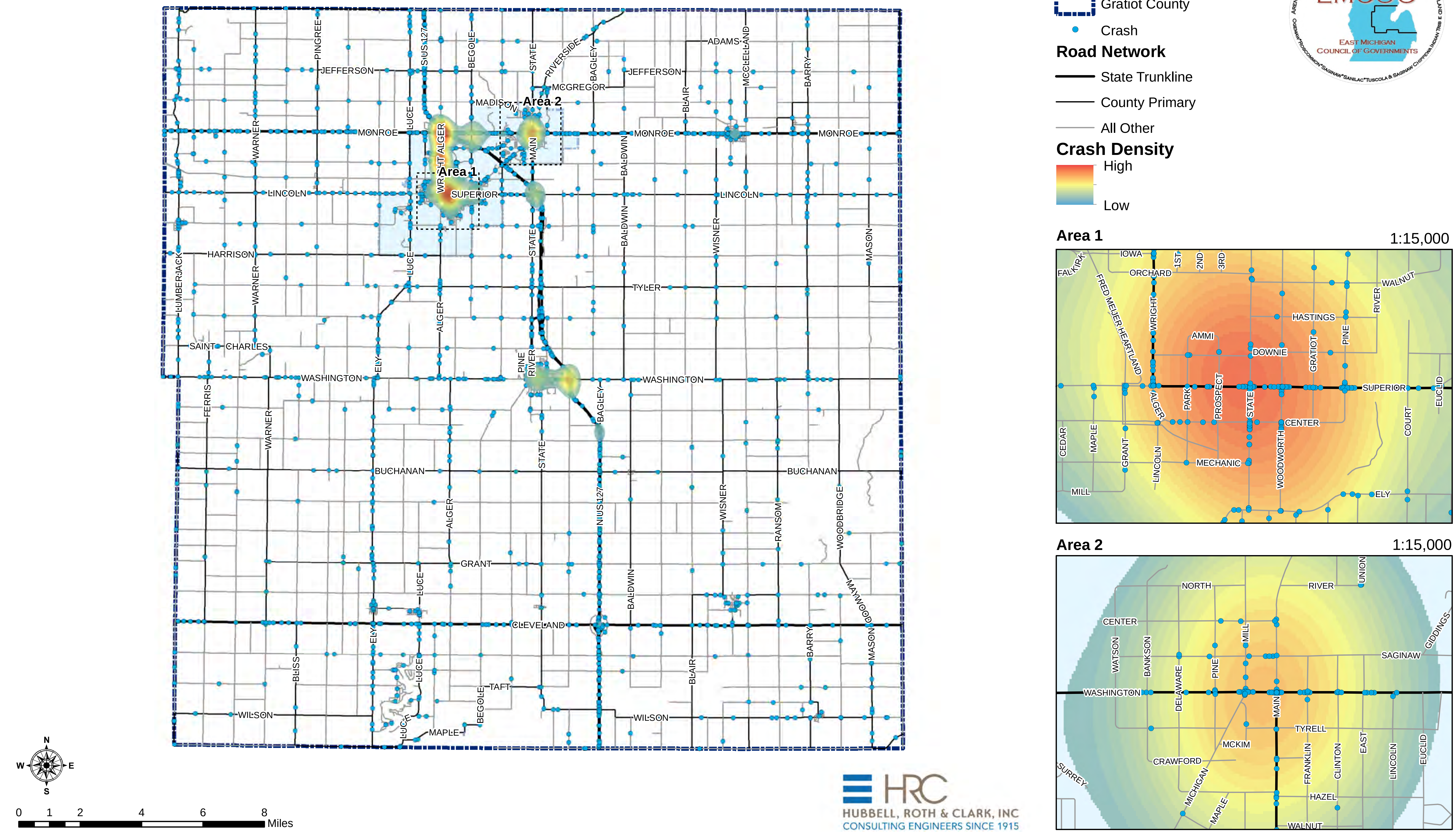
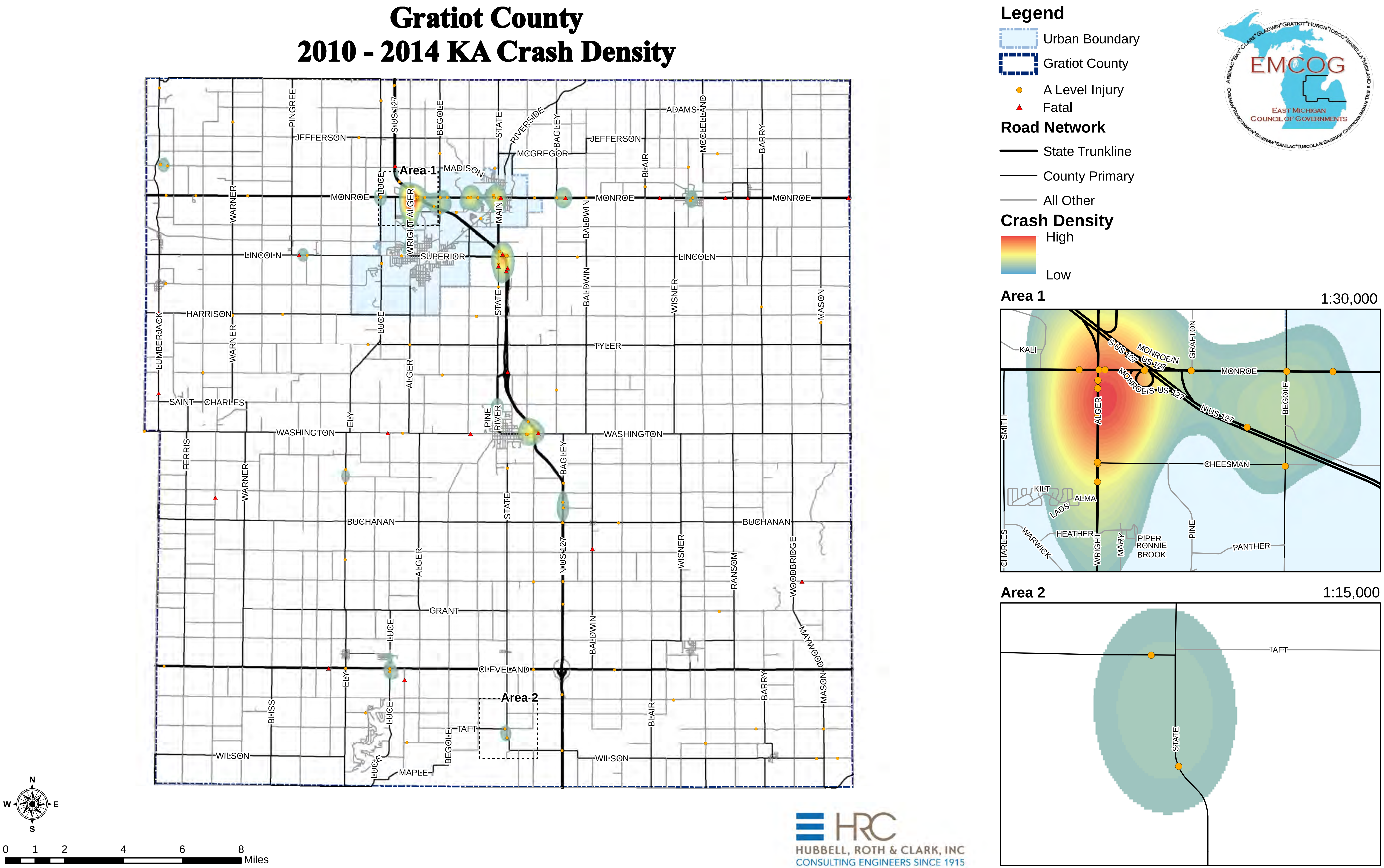
Gratiot County
Intersection Crashes per Year (2010 - 2014)



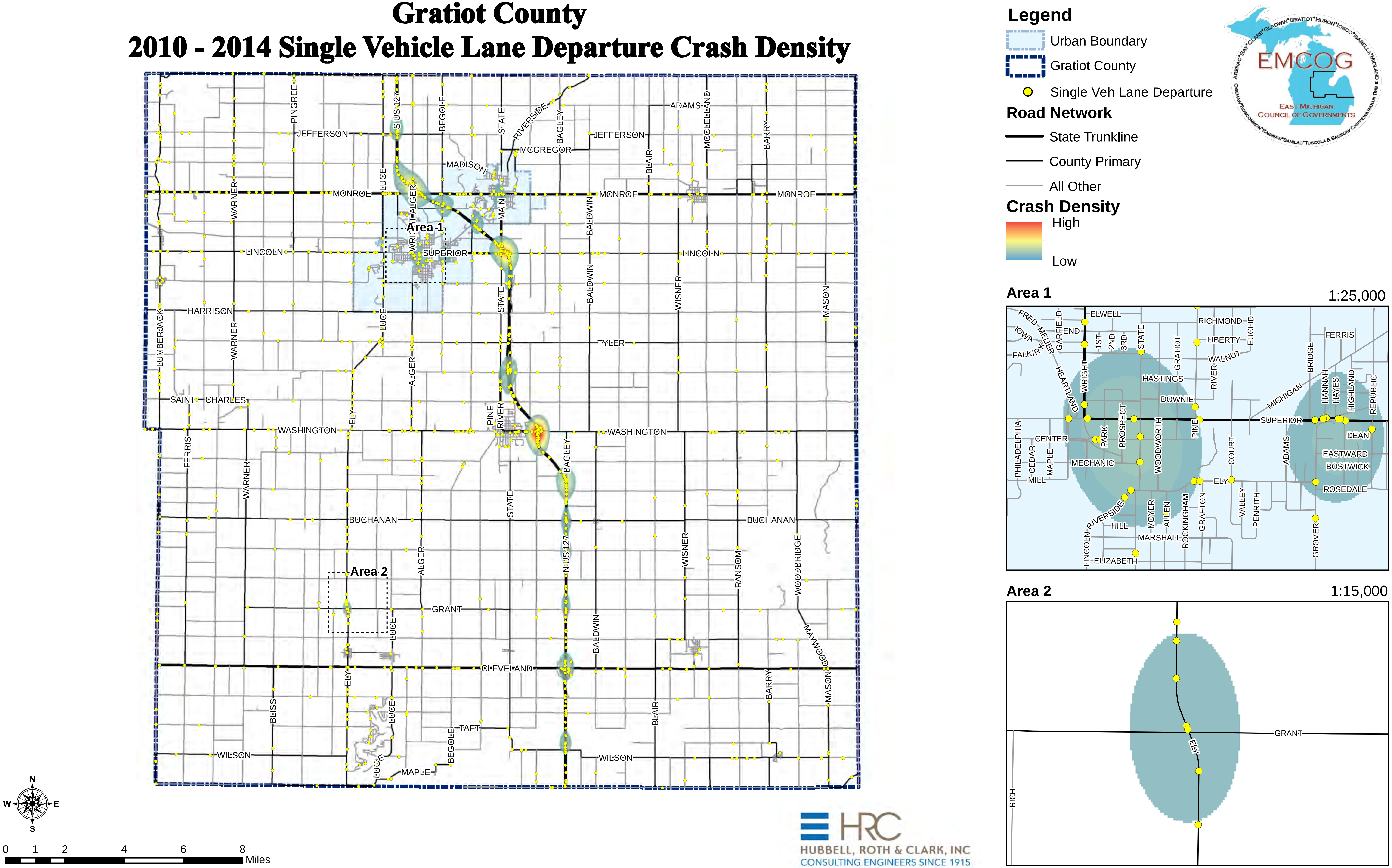
Gratiot County
2010 - 2014 Crash Density



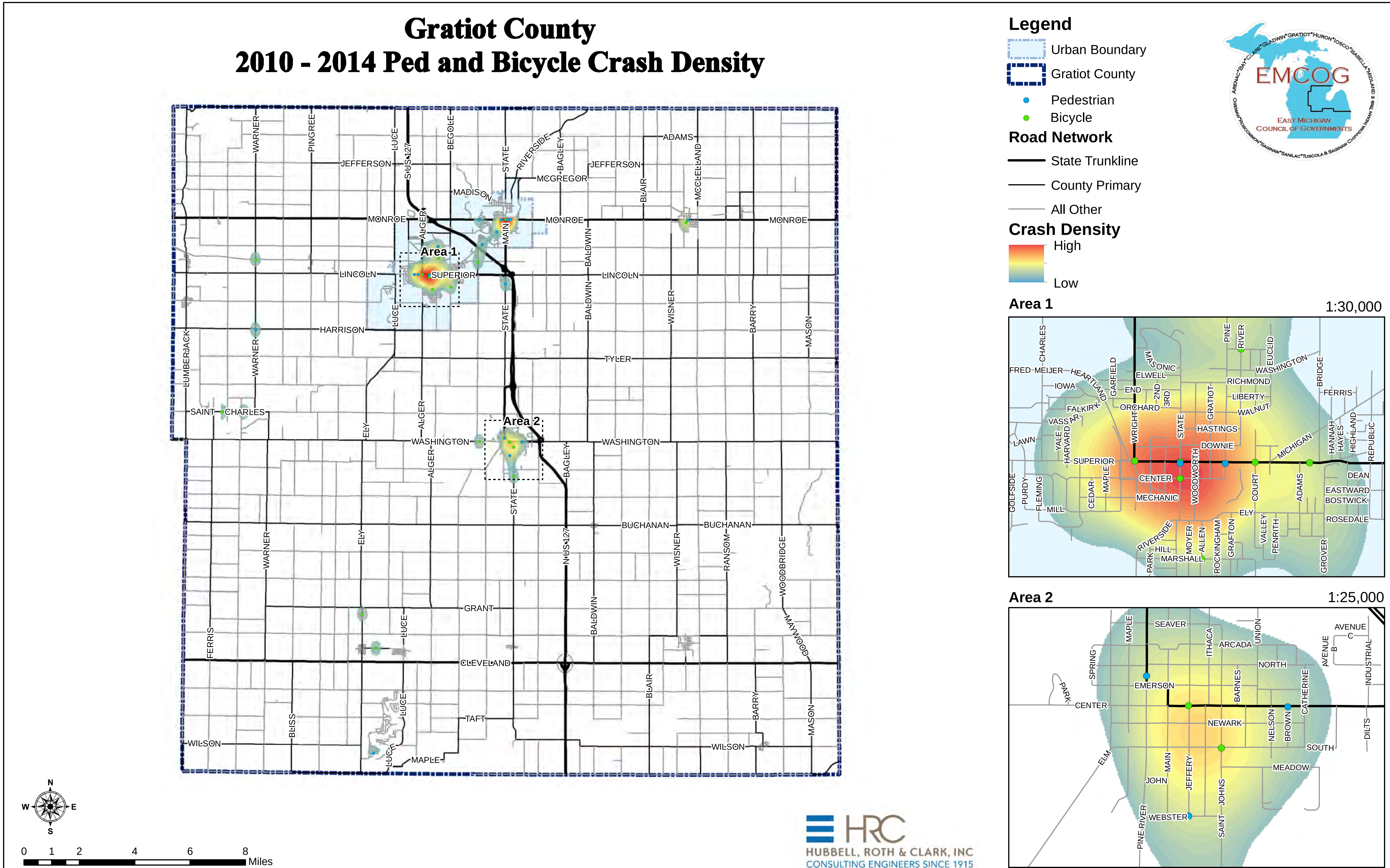
Gratiot County
2010 - 2014 KA Crash Density



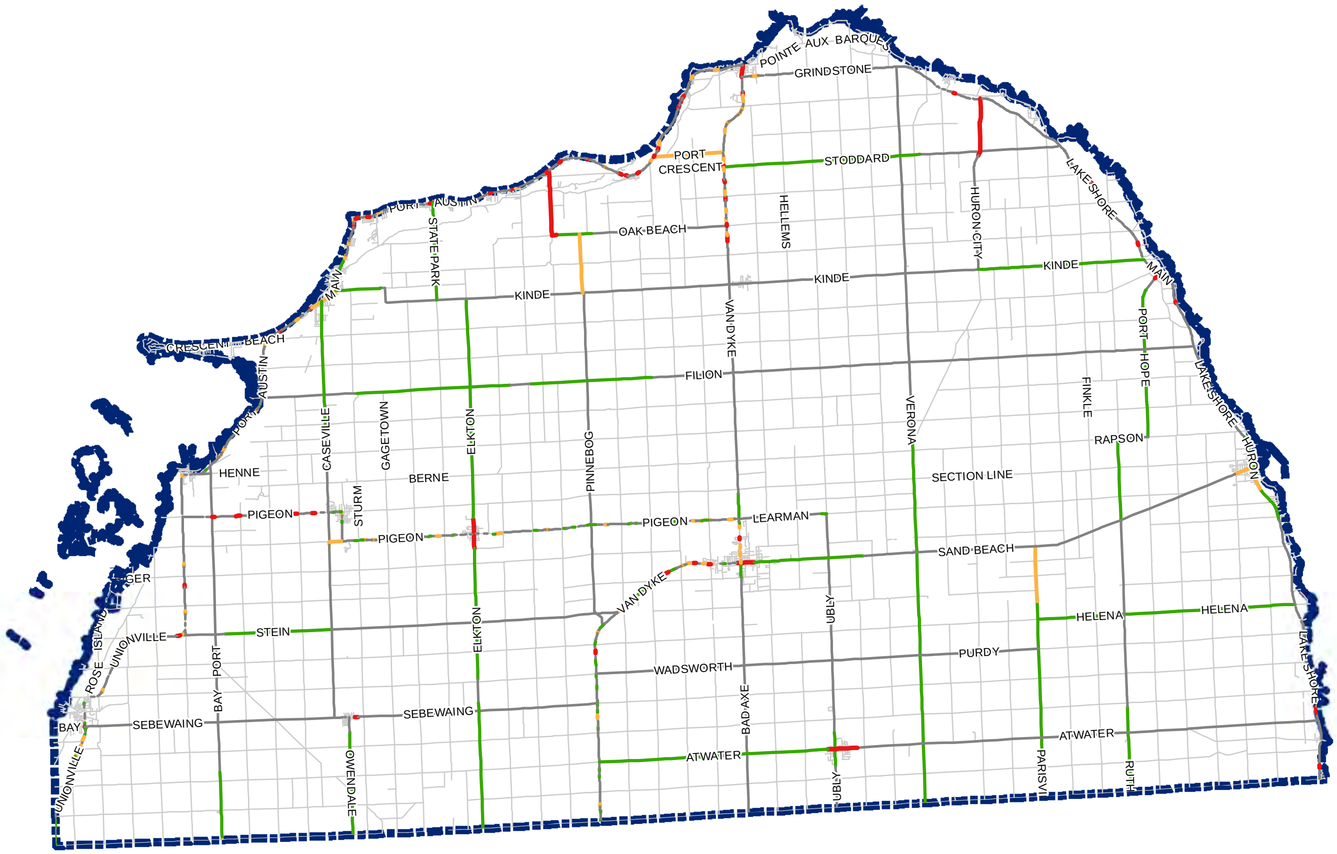
Gratiot County
2010 - 2014 Single Vehicle Lane Departure Crash Density



Gratiot County
2010 - 2014 Ped and Bicycle Crash Density



Huron County
Segment Crash Rate (2010 - 2014)



Legend

Urban Boundary

Huron County

No Data

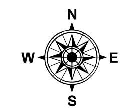
Segment Crash Rate (per 100 MVM)

100 or below

100 - 200

200 - 400

400 or higher



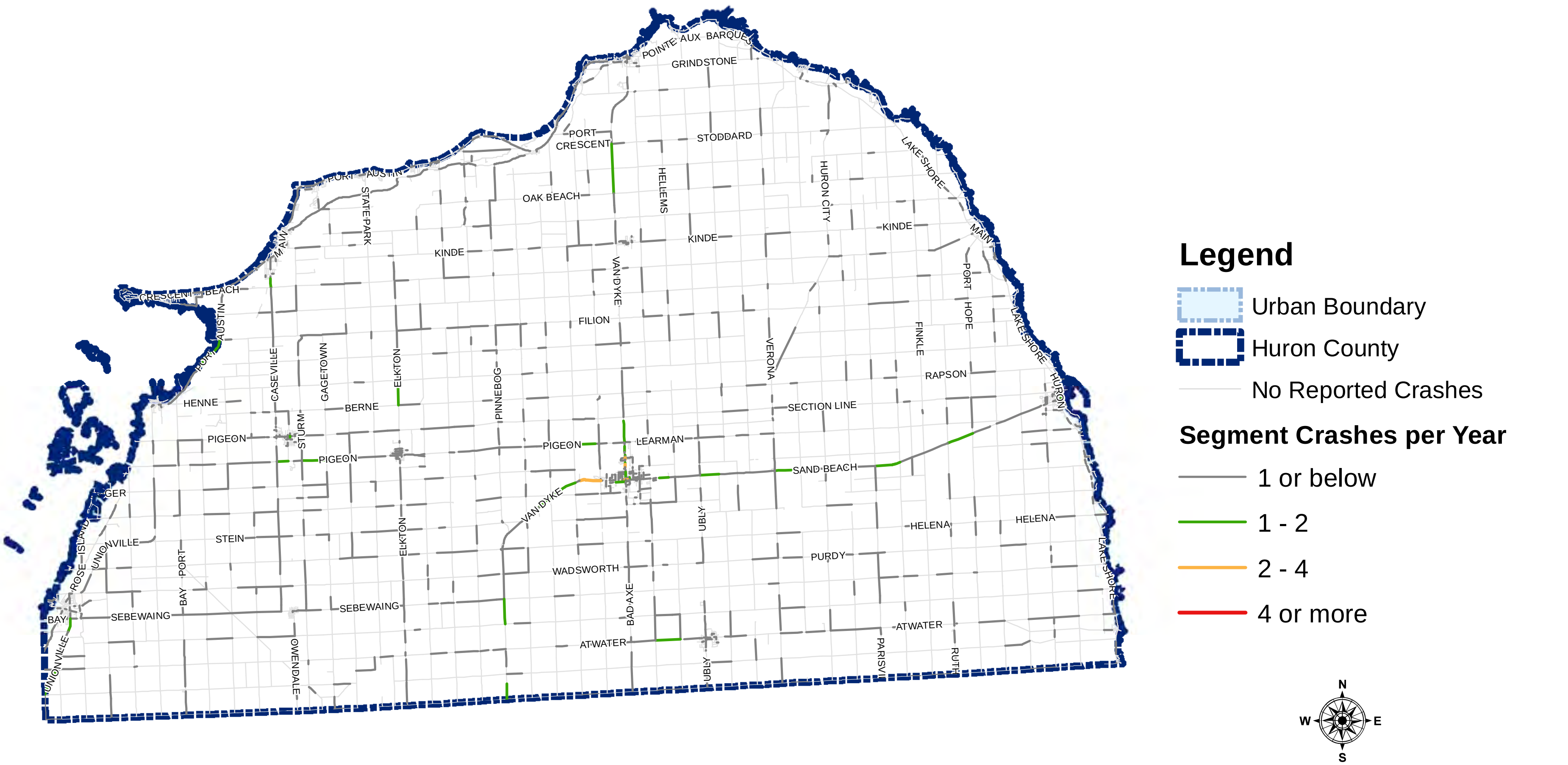
0 1.75 3.5 7 10.5 14
Miles

Note:
Segments less than 300 ft are not illustrated.
Segment crash rates are expressed in 100 Million Vehicle Miles (MVM) traveled.
The first category (i.e. 100 or below) represents the regional dataset's average segment crash rates. Successive categories represent segment crash rate in multiples of two relative to the county average.

HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915

EMCOG
EAST MICHIGAN COUNCIL OF GOVERNMENTS

Huron County
Segment Crash Frequency (2010 - 2014)



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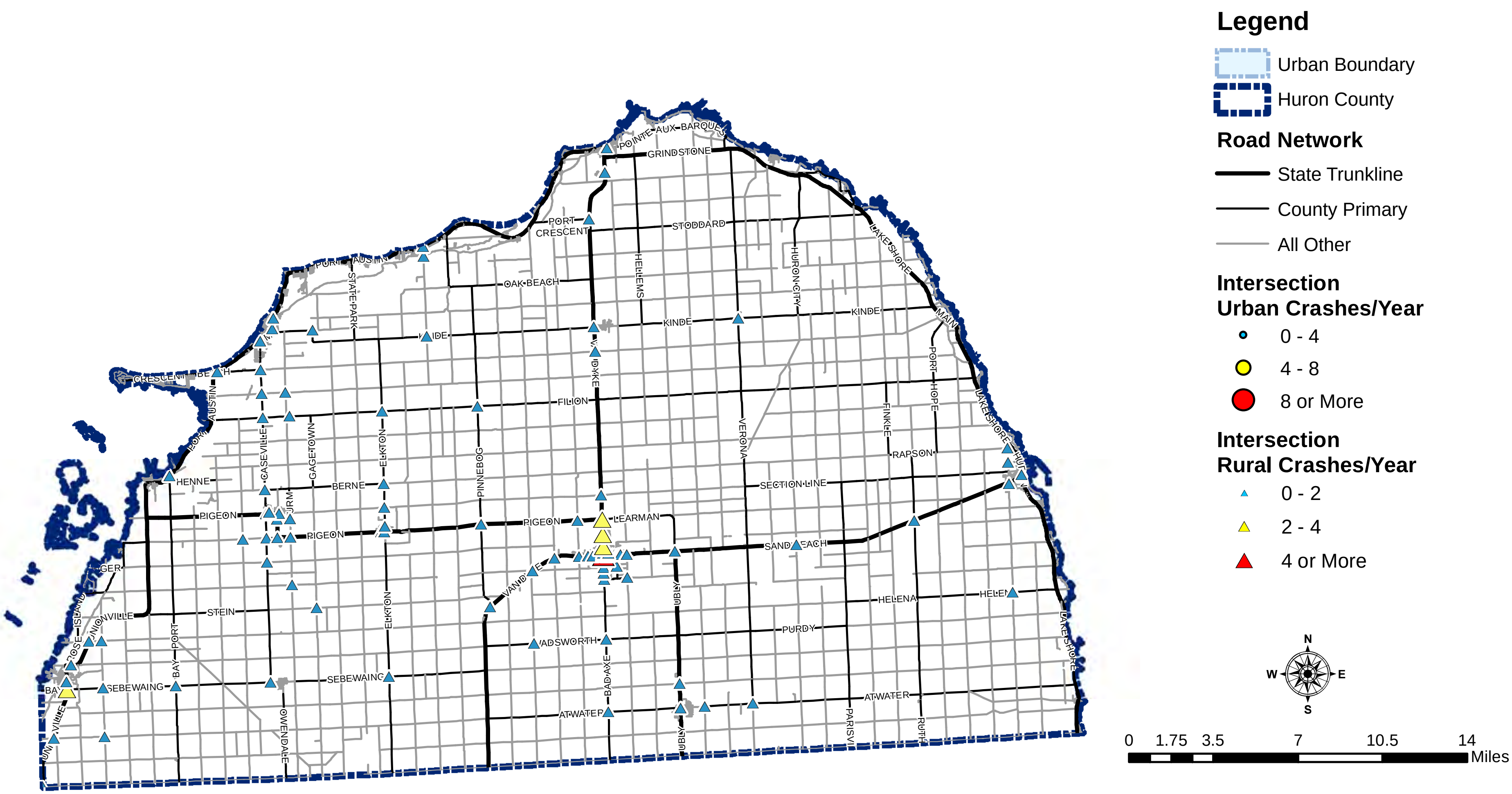
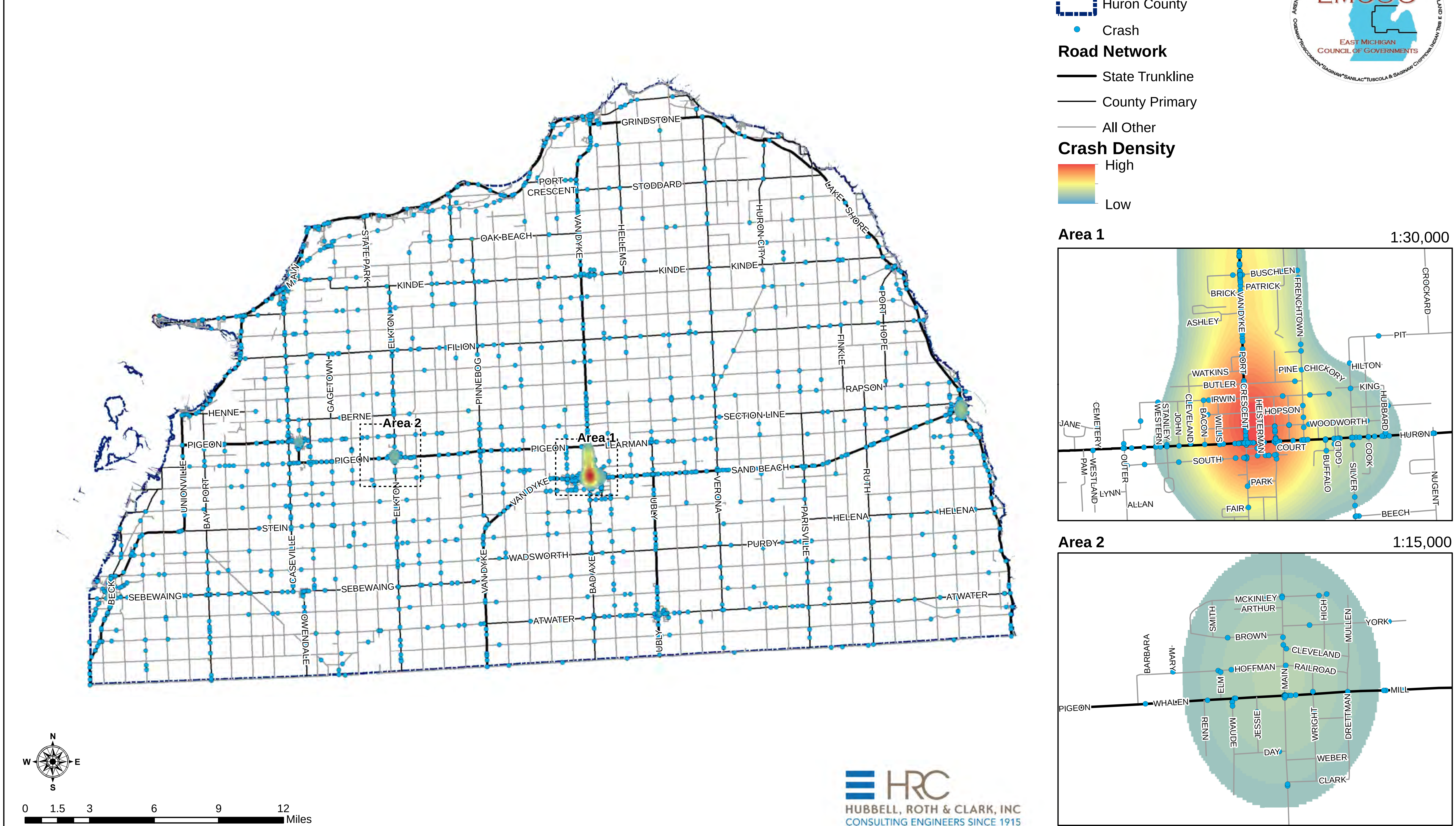
EMCOG
East Michigan Council of Governments

Huron County
Intersection Crashes per Year (2010 - 2014)

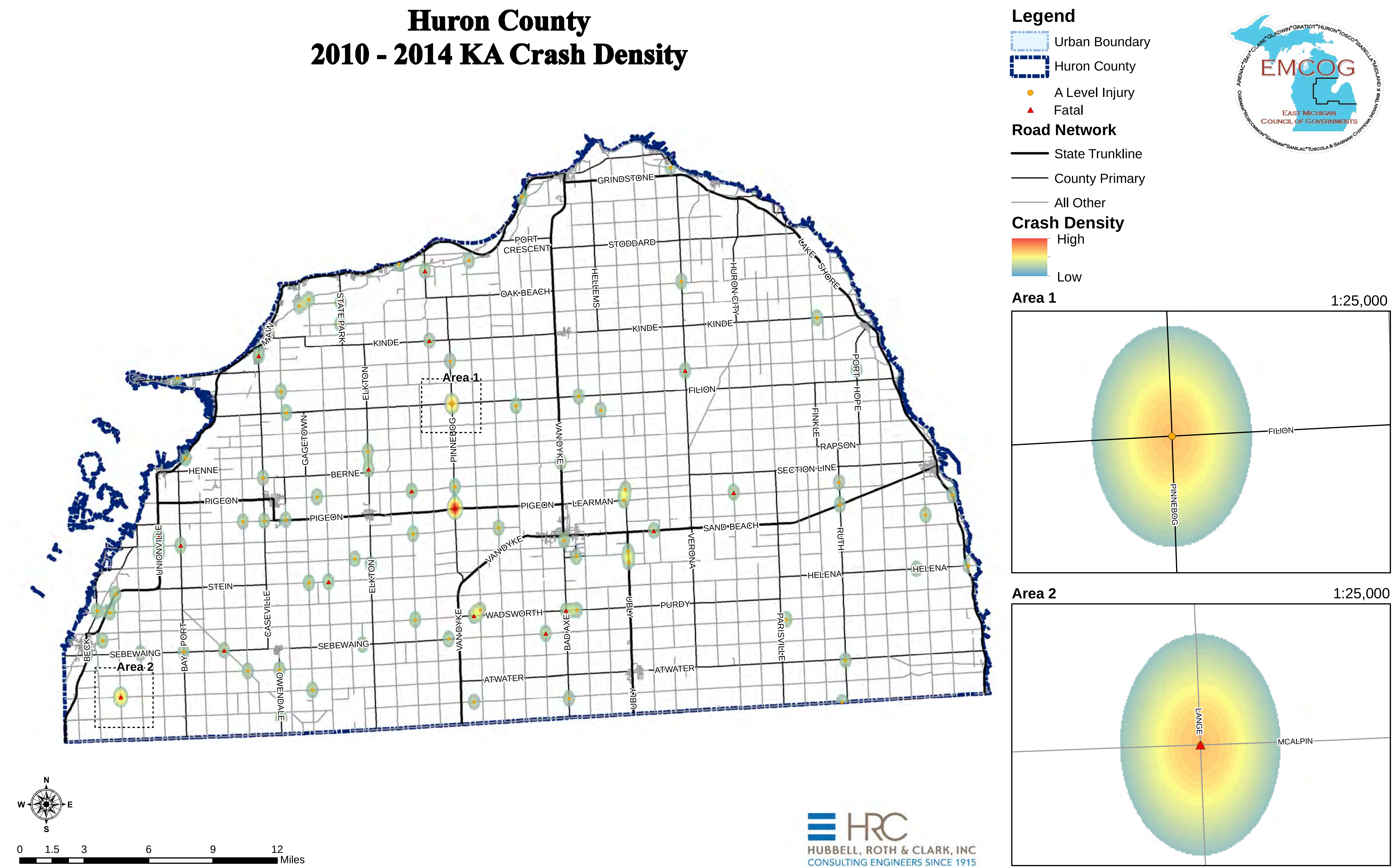


Note:
Intersections with no non-deer/non-animal crashes between 2010 and 2014 are not shown.

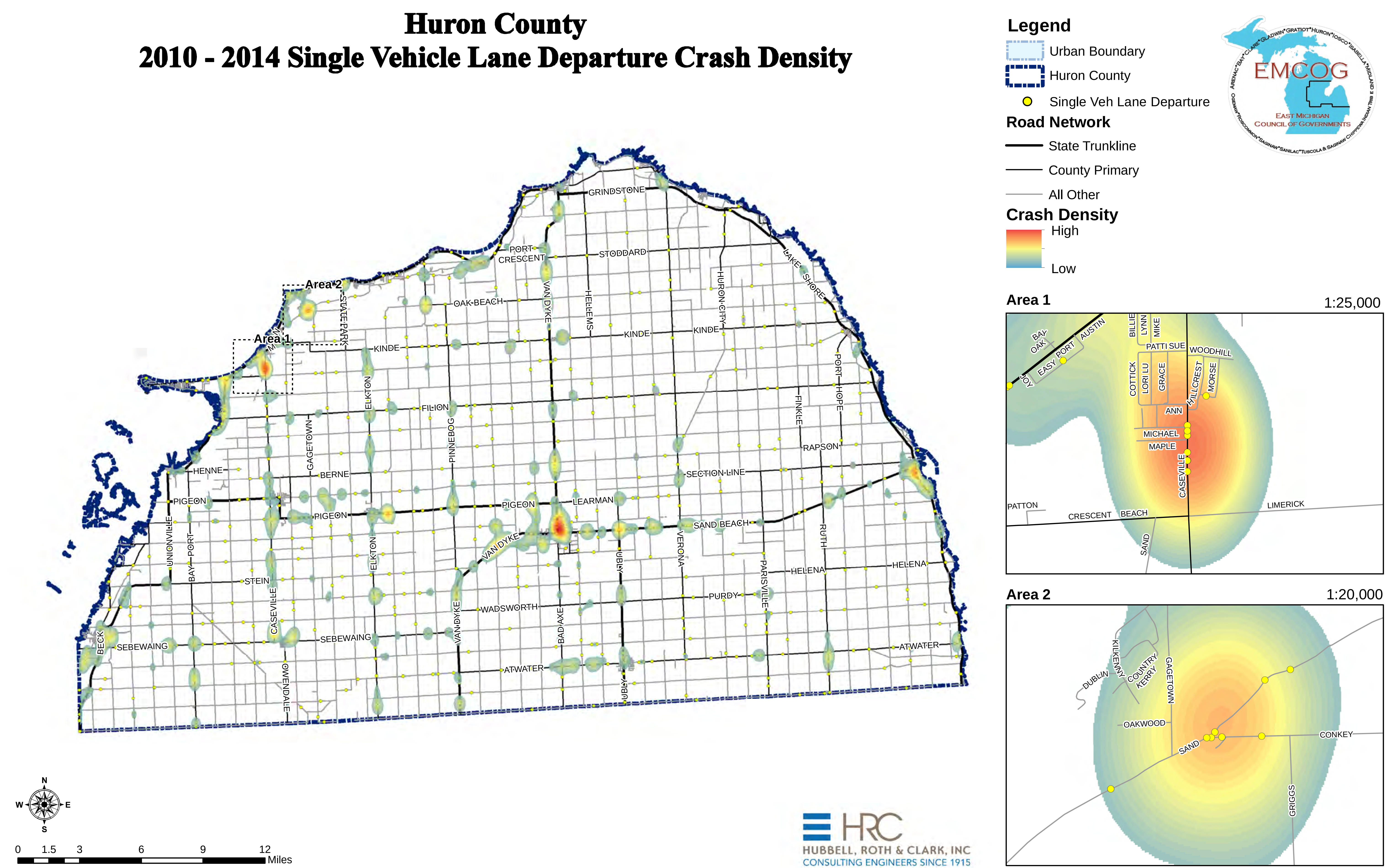
Huron County
2010 - 2014 Crash Density



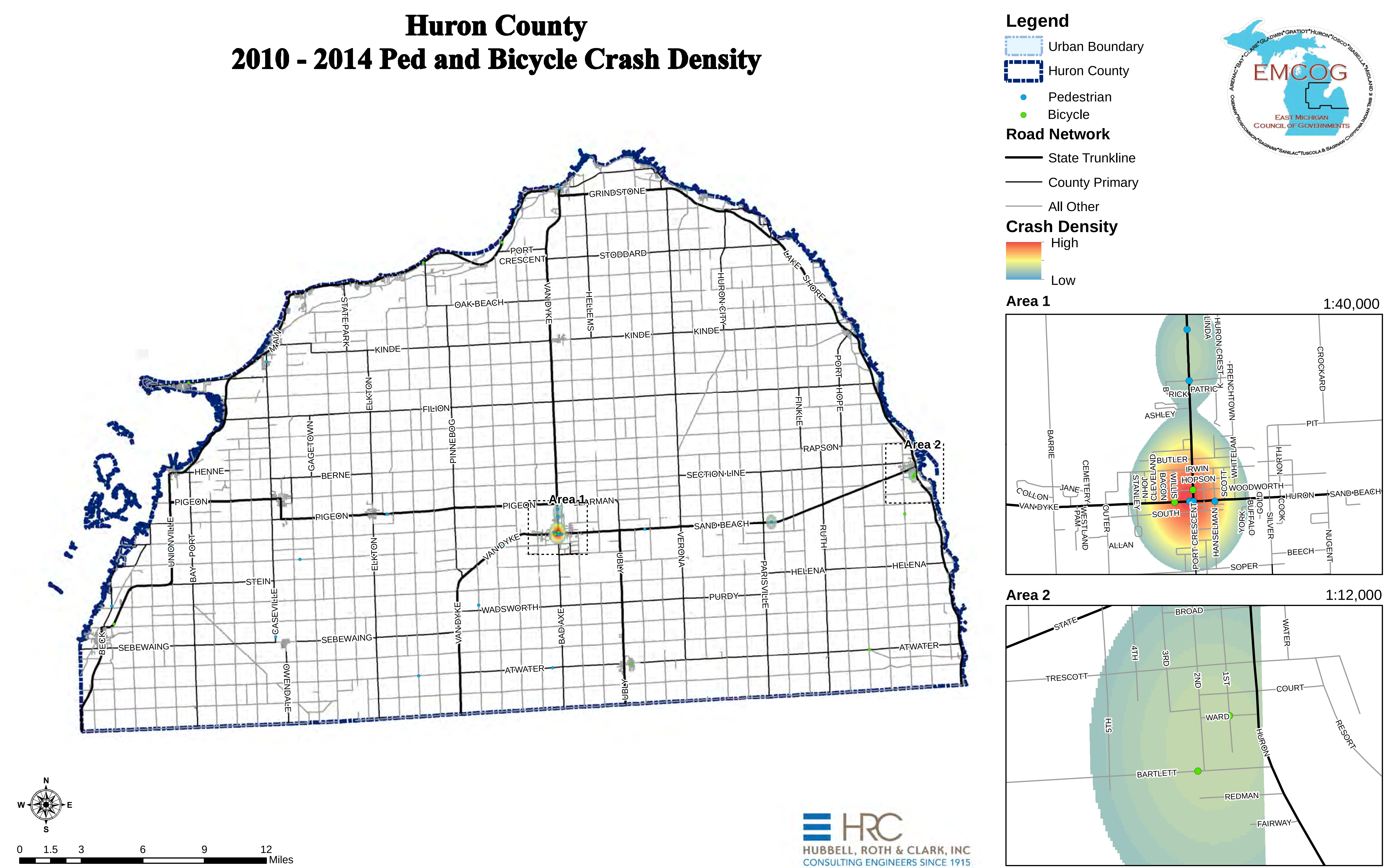
Huron County
2010 - 2014 KA Crash Density



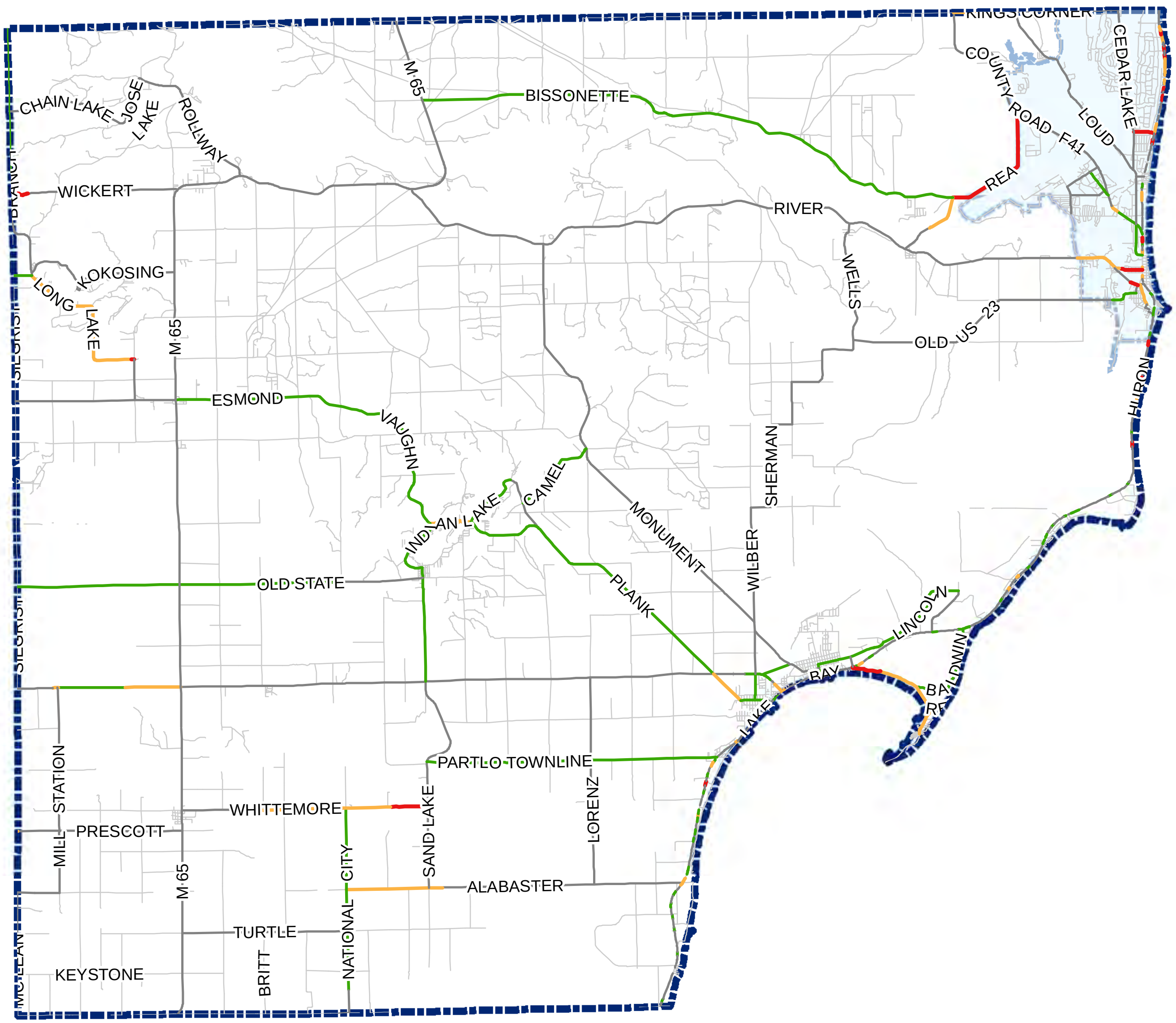
Huron County
2010 - 2014 Single Vehicle Lane Departure Crash Density



Huron County
2010 - 2014 Ped and Bicycle Crash Density



Iosco County
Segment Crash Rate (2010 - 2014)



Note:
Segments less than 300 ft are not illustrated.
Segment crash rates are expressed in 100 Million Vehicle Miles (MVM) traveled.
The first category (i.e. 100 or below) represents the regional dataset's average segment crash rates. Successive categories represent segment crash rate in multiples of two relative to the county average.

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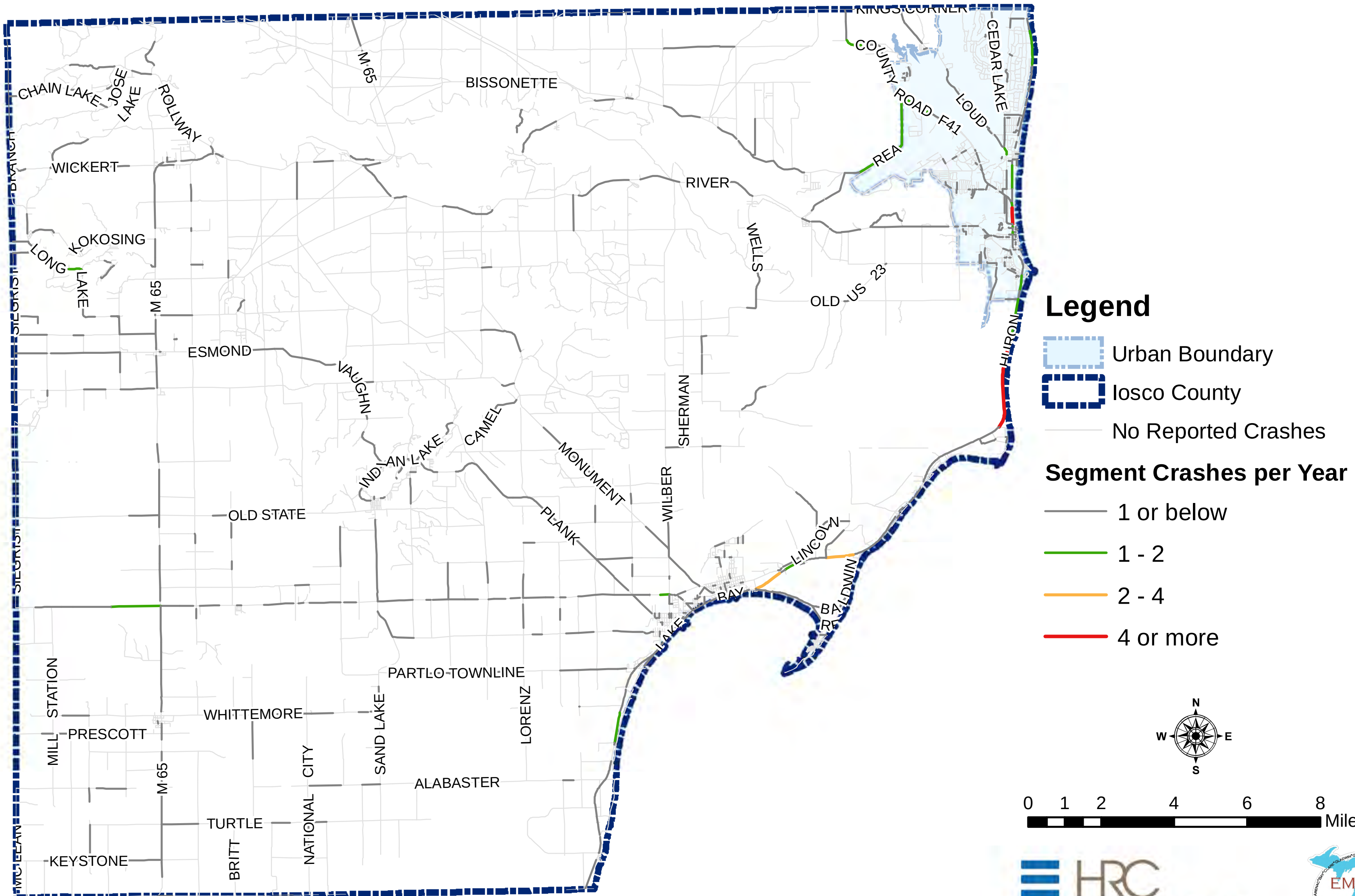
EMCOG
East Michigan Council of Governments

Iosco County
Segment Crash Frequency (2010 - 2014)



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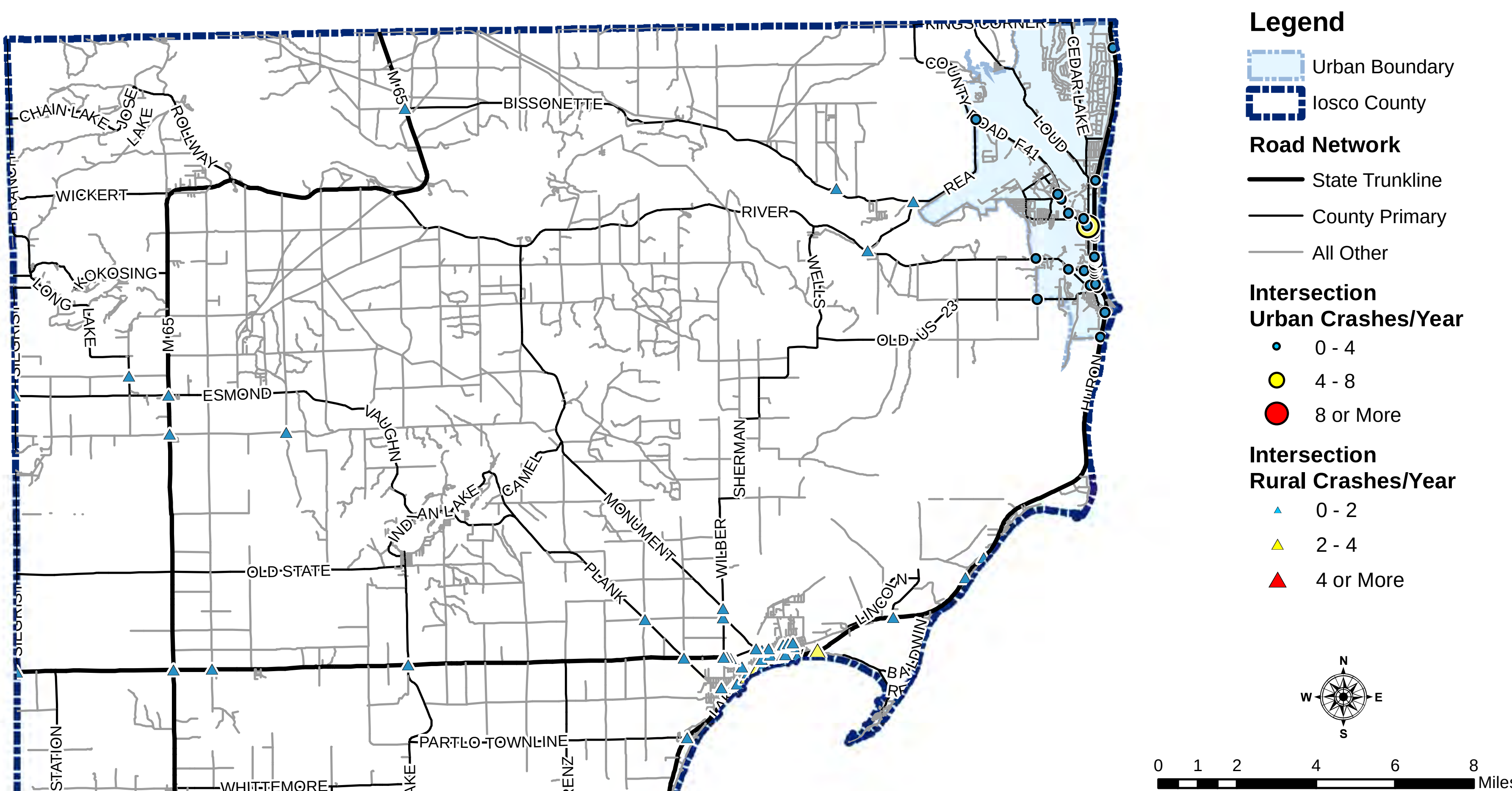
EMCOG
East Michigan Council of Governments

Iosco County
Intersection Crashes per Year (2010 - 2014)



Note:
Intersections with no non-deer/non-animal crashes between 2010 and 2014 are not shown.

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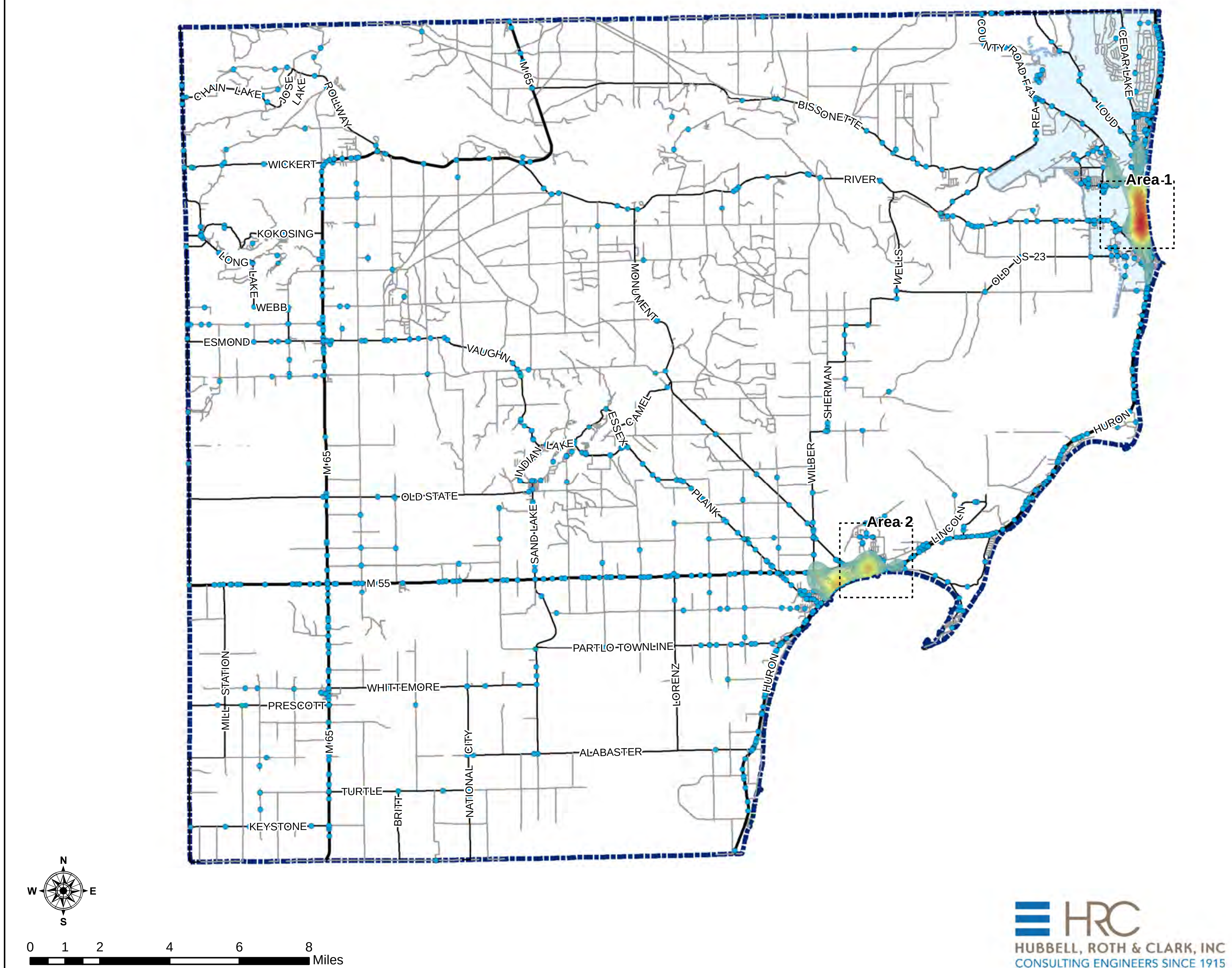
EMCOG East Michigan Council of Governments

Iosco County
2010 - 2014 Crash Density



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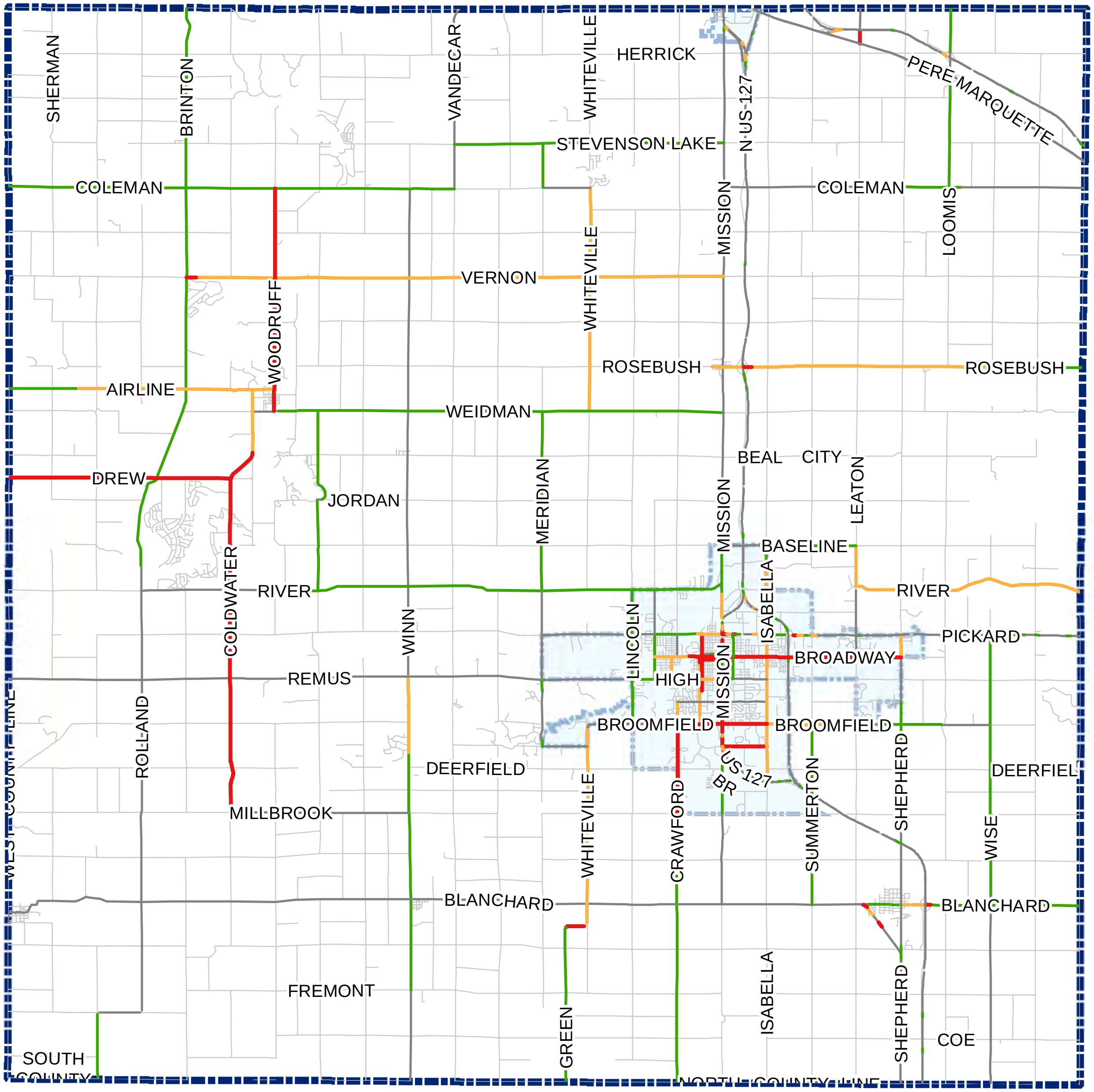
EMCOG
EAST MICHIGAN COUNCIL OF GOVERNMENTS

Isabella County
Segment Crash Rate (2010 - 2014)



Note:
Segments less than 300 ft are not illustrated.
Segment crash rates are expressed in 100 Million Vehicle Miles (MVM) traveled.
The first category (i.e. 100 or below) represents the regional dataset's average segment crash rates. Successive categories represent segment crash rate in multiples of two relative to the county average.

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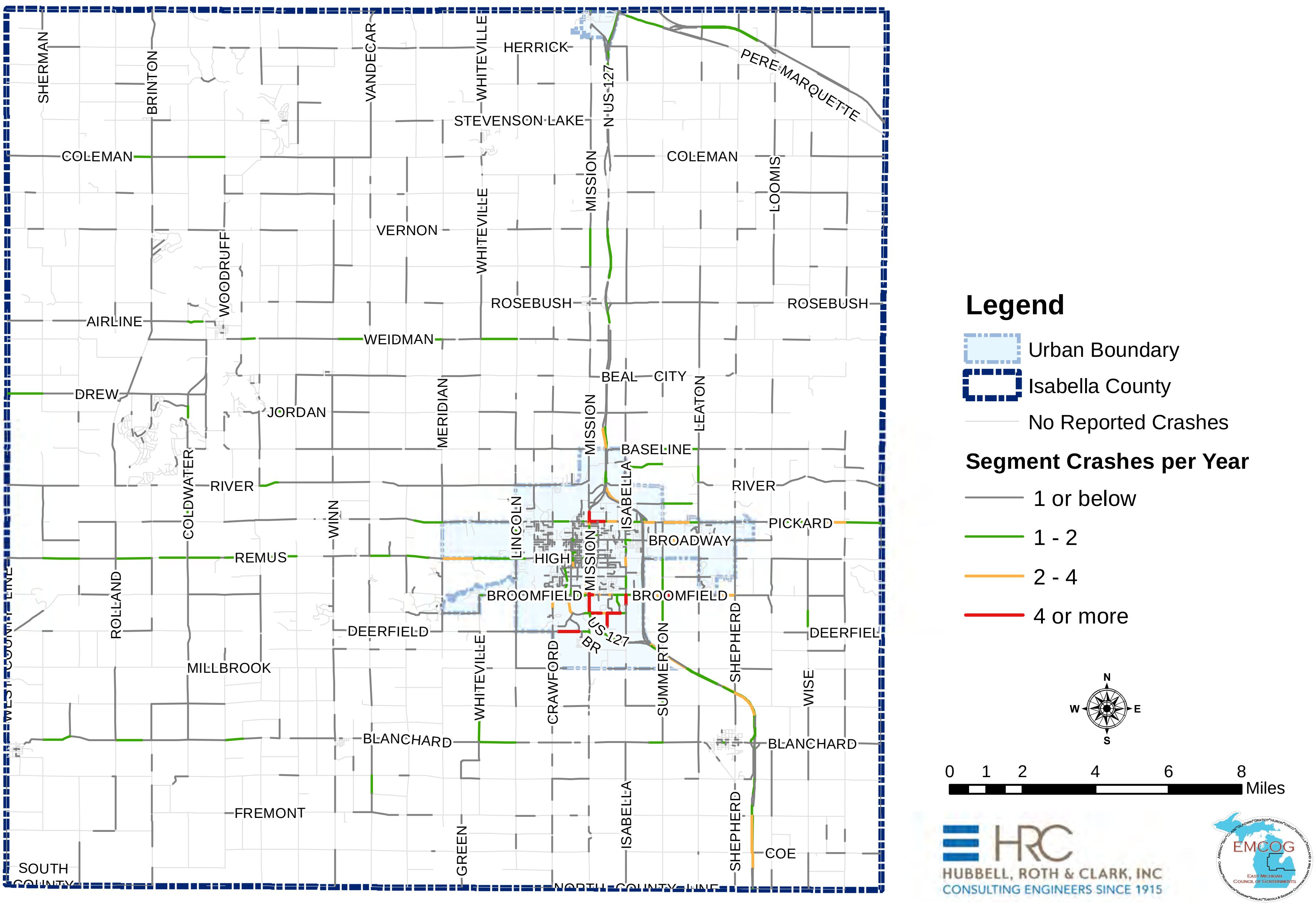
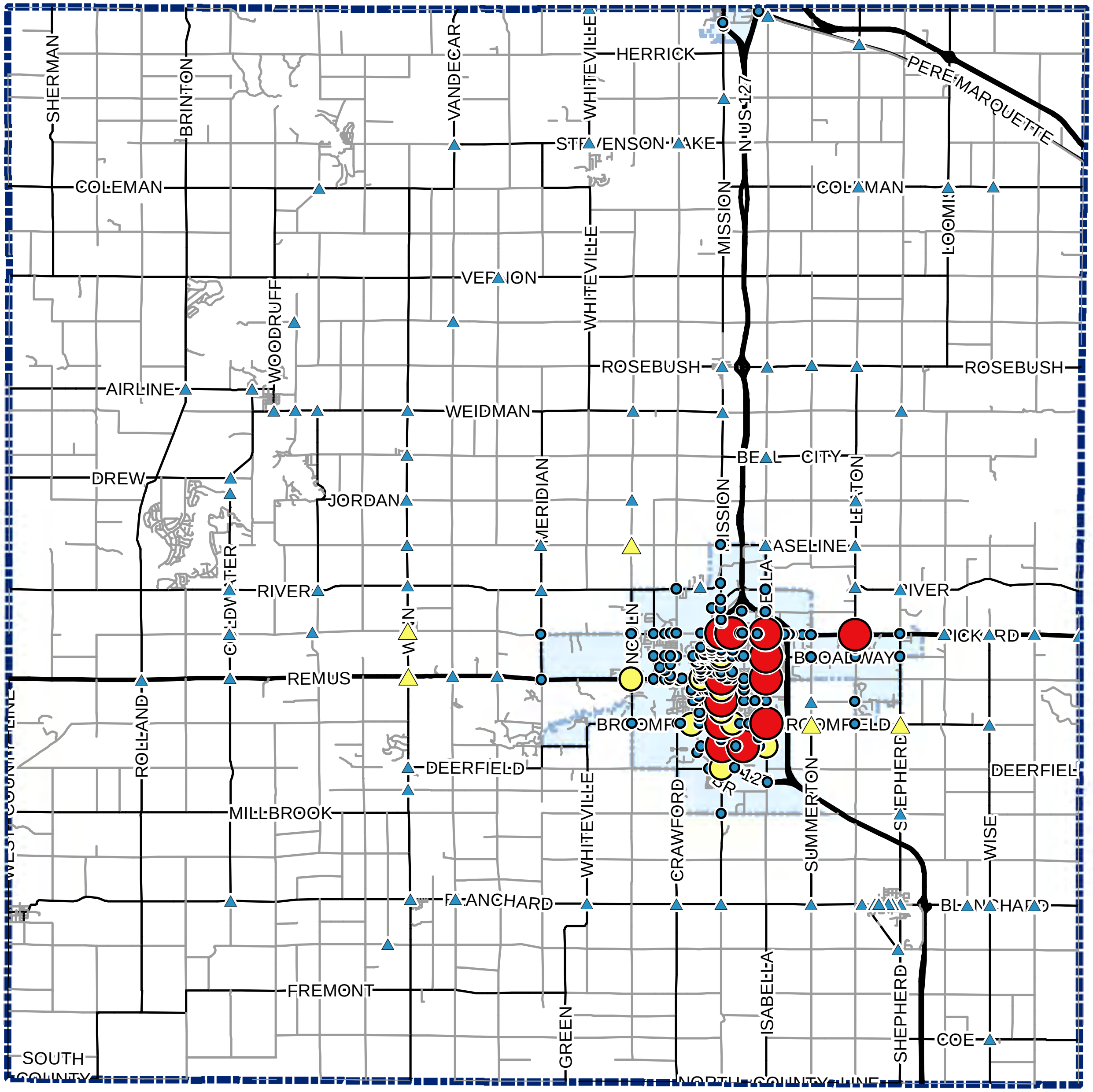
Isabella County
Segment Crash Frequency (2010 - 2014)



Isabella County
Intersection Crashes per Year (2010 - 2014)



Legend

Urban Boundary
Isabella County

Road Network

State Trunkline
County Primary
All Other

Intersection Urban Crashes/Year

0 - 4
4 - 8
8 or More

Intersection Rural Crashes/Year

0 - 2
2 - 4
4 or More

N W E S

0 1 2 4 6 8 Miles

Note: Intersections with no non-deer/non-animal crashes between 2010 and 2014 are not shown.

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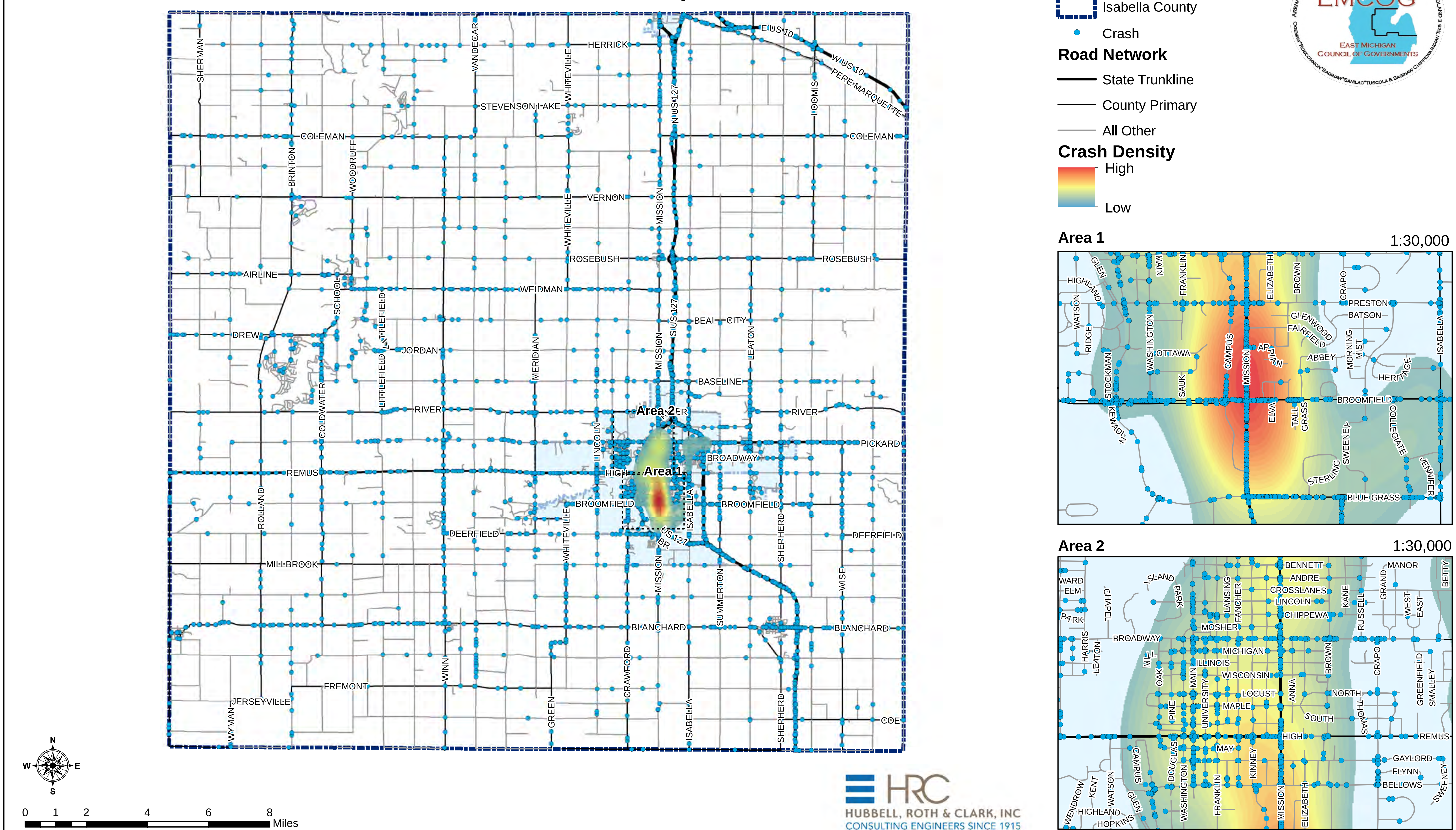
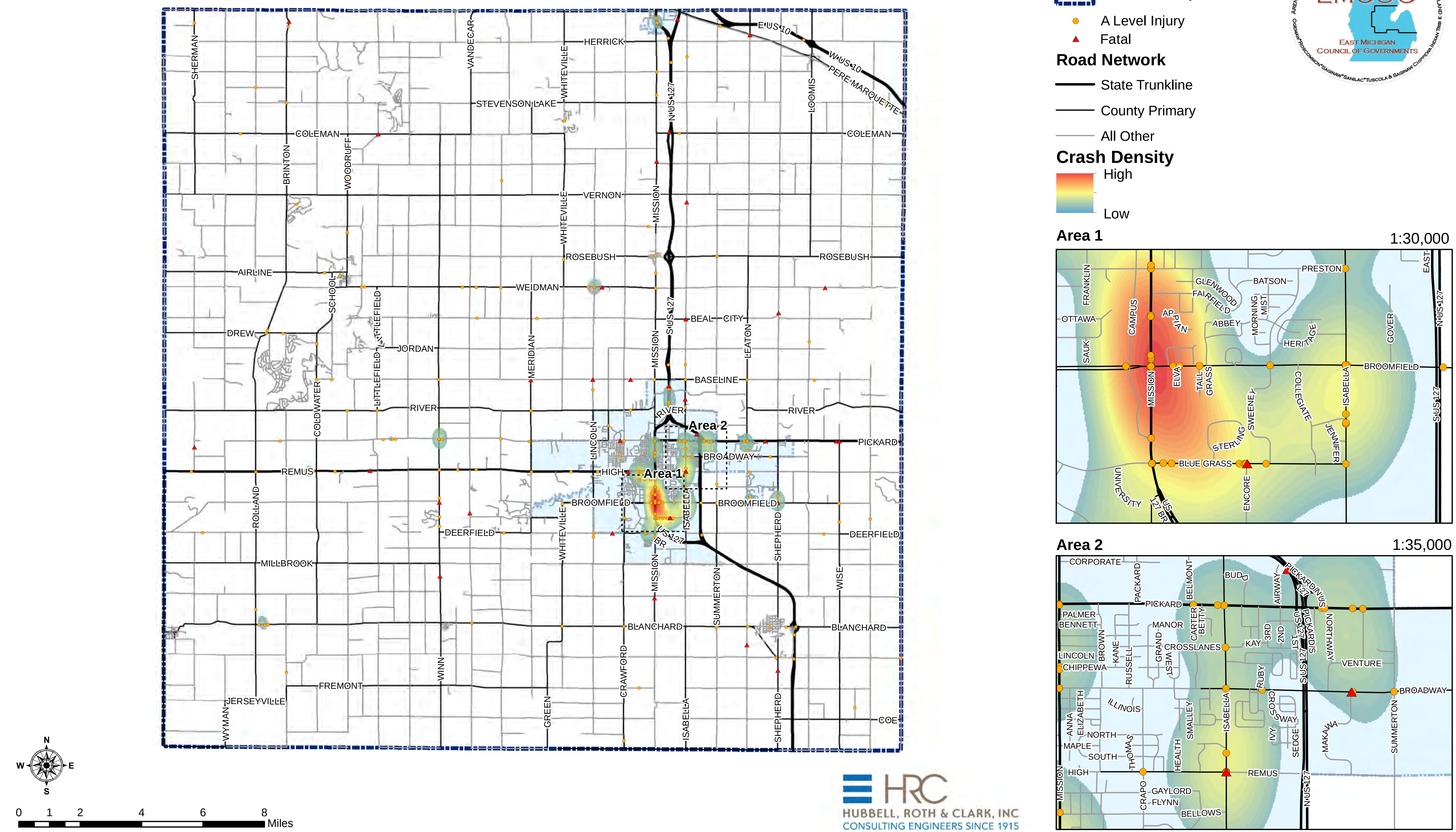
EMCOG

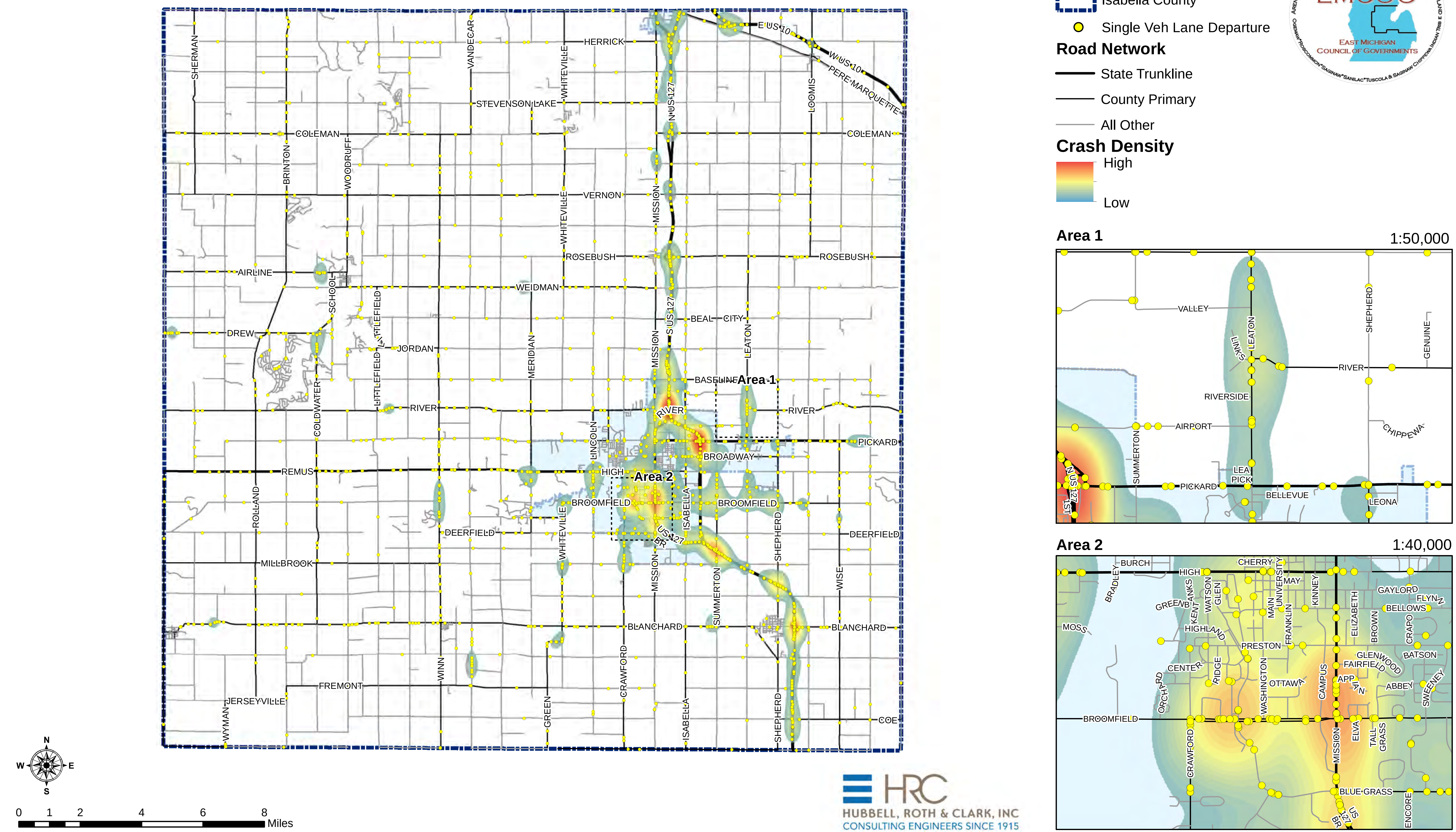
Isabella County
2010 - 2014 Crash Density



Isabella County
2010 - 2014 KA Crash Density

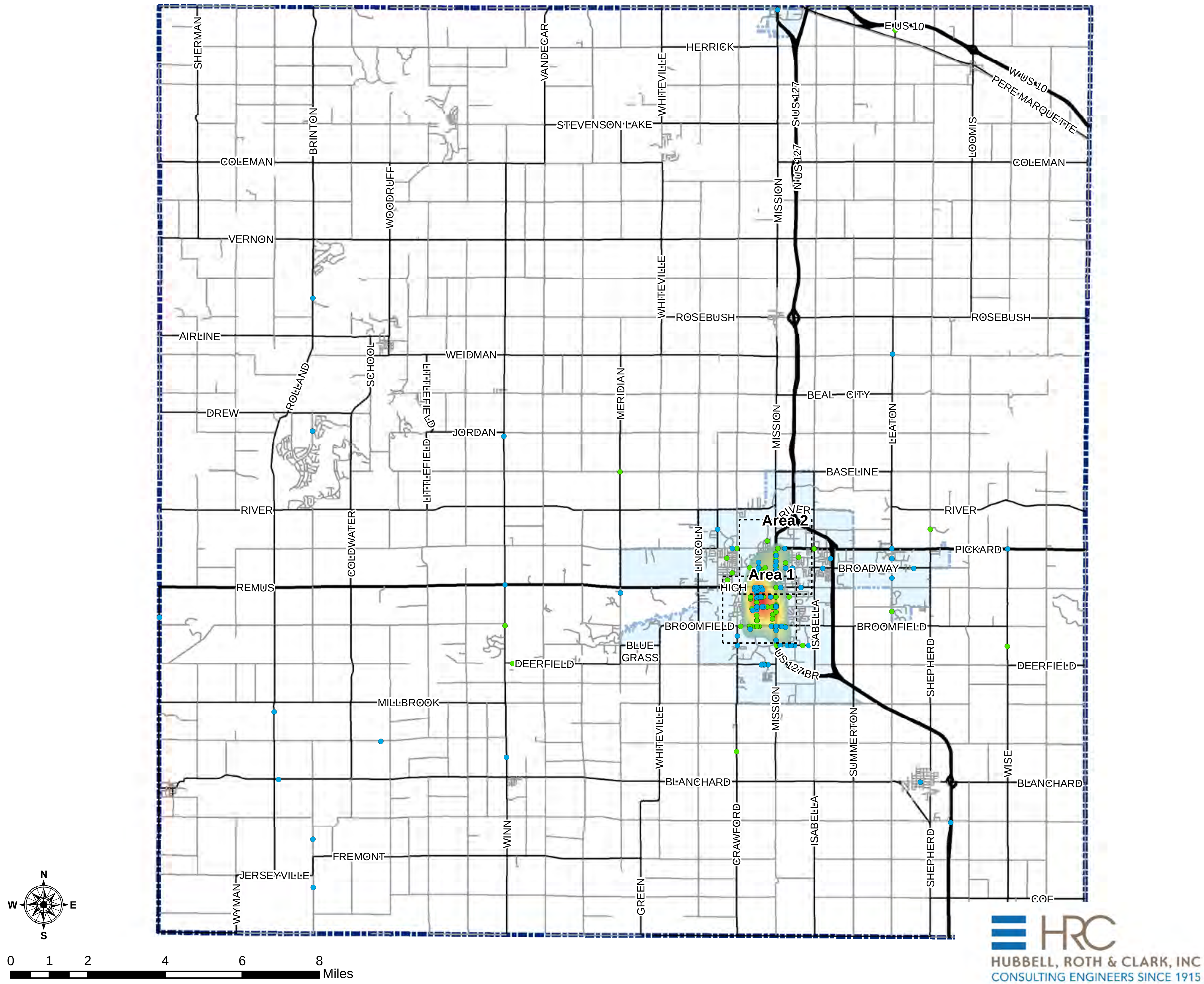


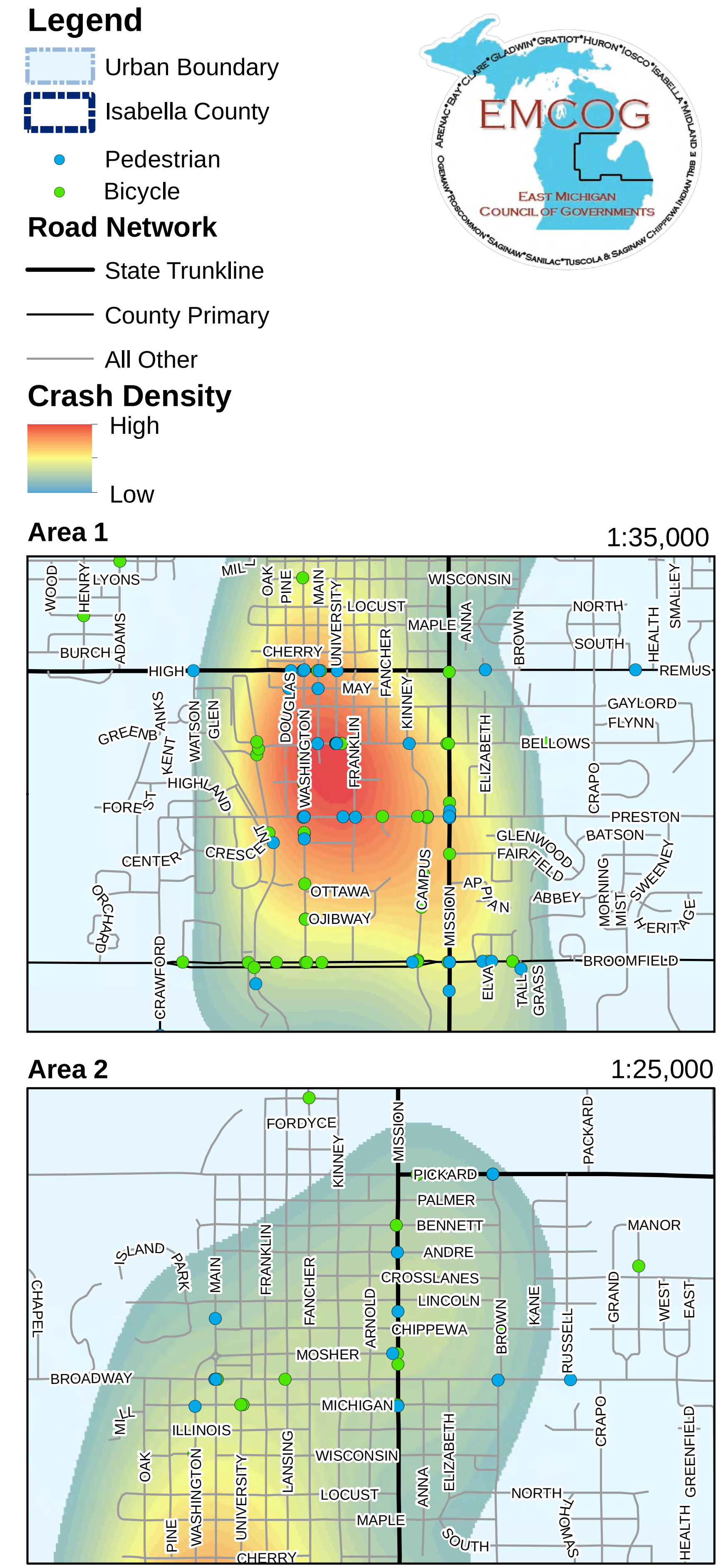
Isabella County
2010 - 2014 Single Vehicle Lane Departure Crash Density



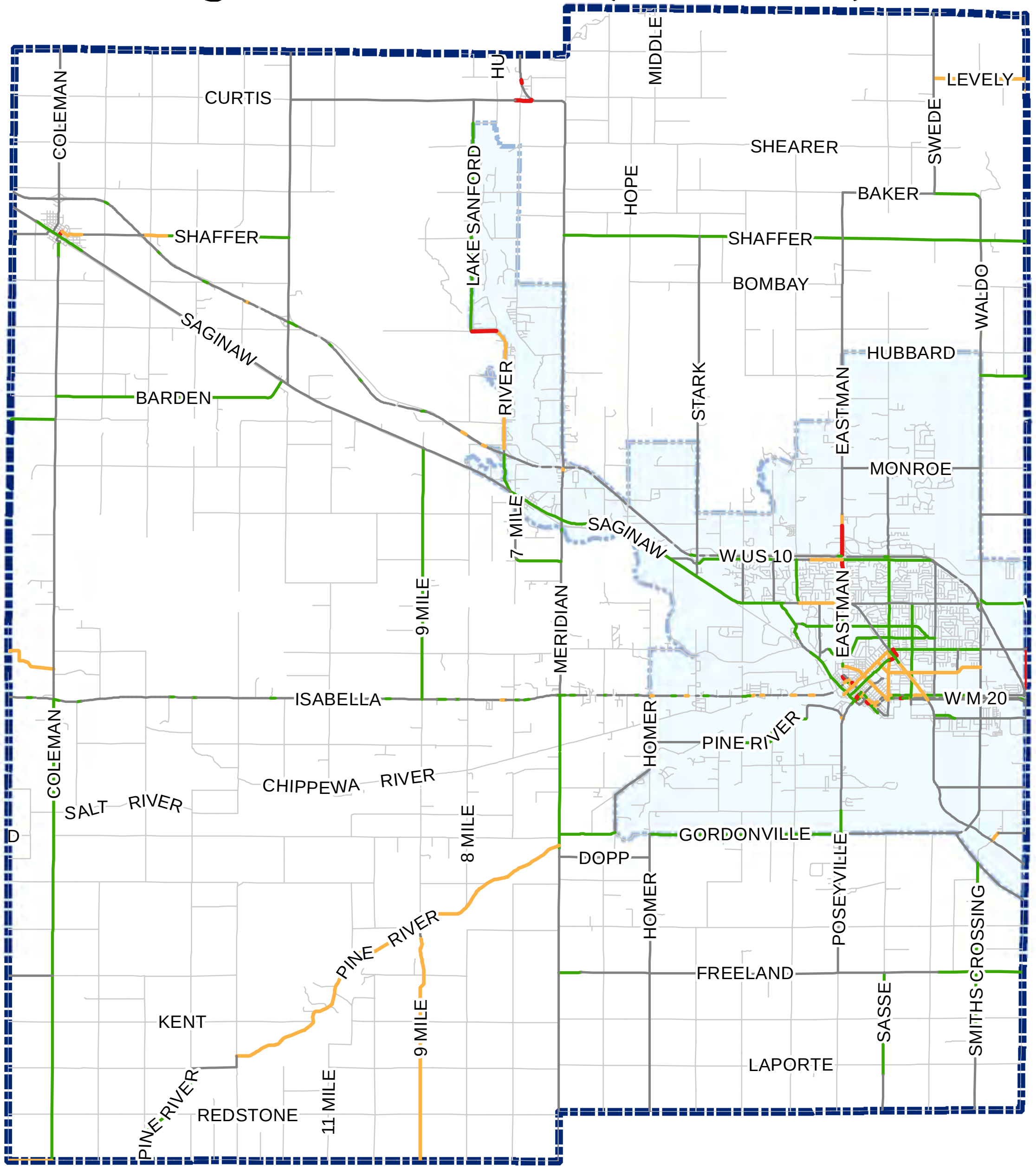
Isabella County

2010 - 2014 Ped and Bicycle Crash Density





Midland County
Segment Crash Rate (2010 - 2014)



Legend

Urban Boundary

Midland County

No Data

Segment Crash Rate (per 100 MVM)

100 or below

100 - 200

200 - 400

400 or higher

Note:
Segments less than 300 ft are not illustrated.
Segment crash rates are expressed in 100 Million Vehicle Miles (MVM) traveled.
The first category (i.e. 100 or below) represents the regional dataset's average segment crash rates. Successive categories represent segment crash rate in multiples of two relative to the county average.

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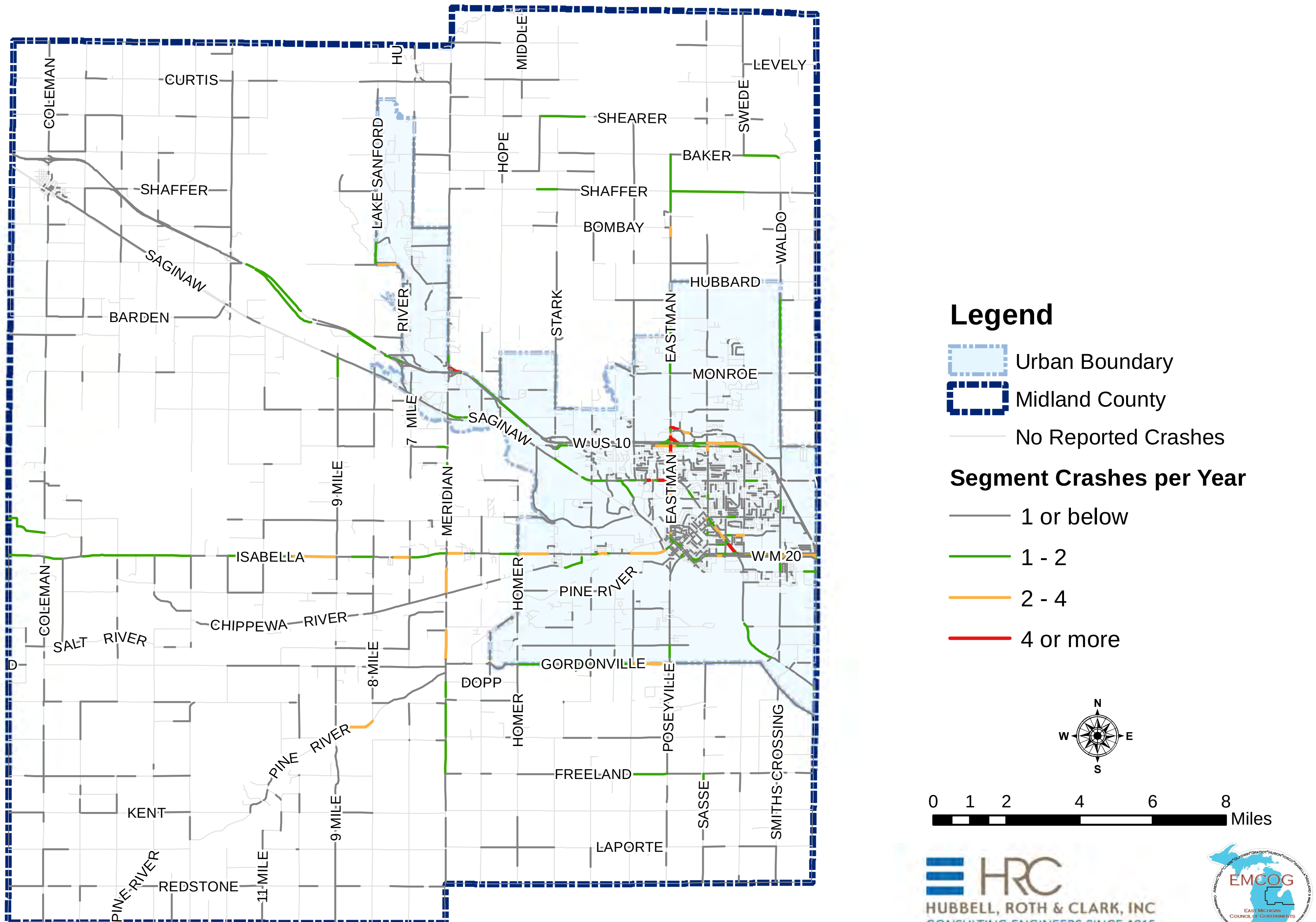
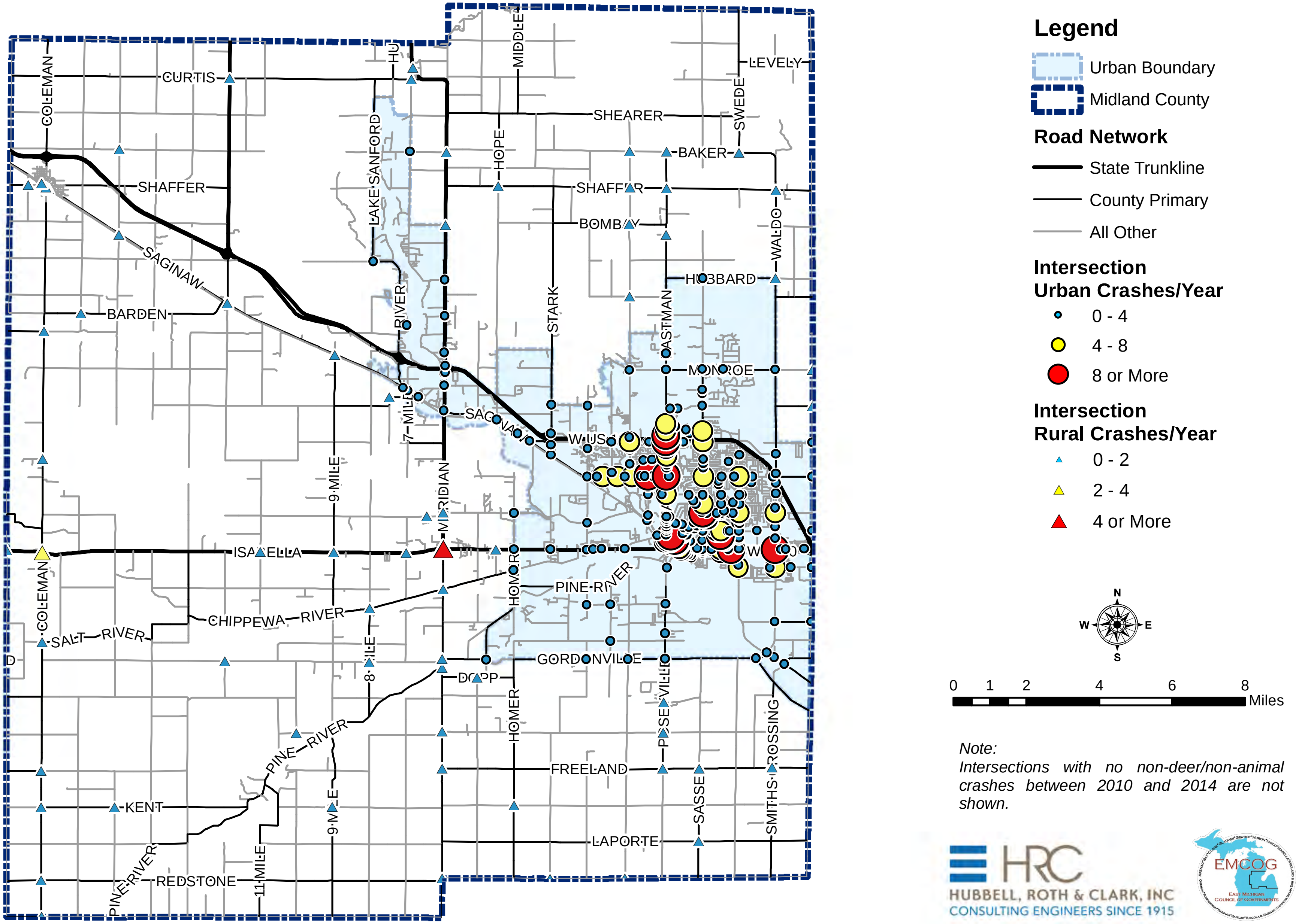
East Michigan Council of Governments

Midland County
Segment Crash Frequency (2010 - 2014)



Midland County
Intersection Crashes per Year (2010 - 2014)



Note:
Intersections with no non-deer/non-animal crashes between 2010 and 2014 are not shown.

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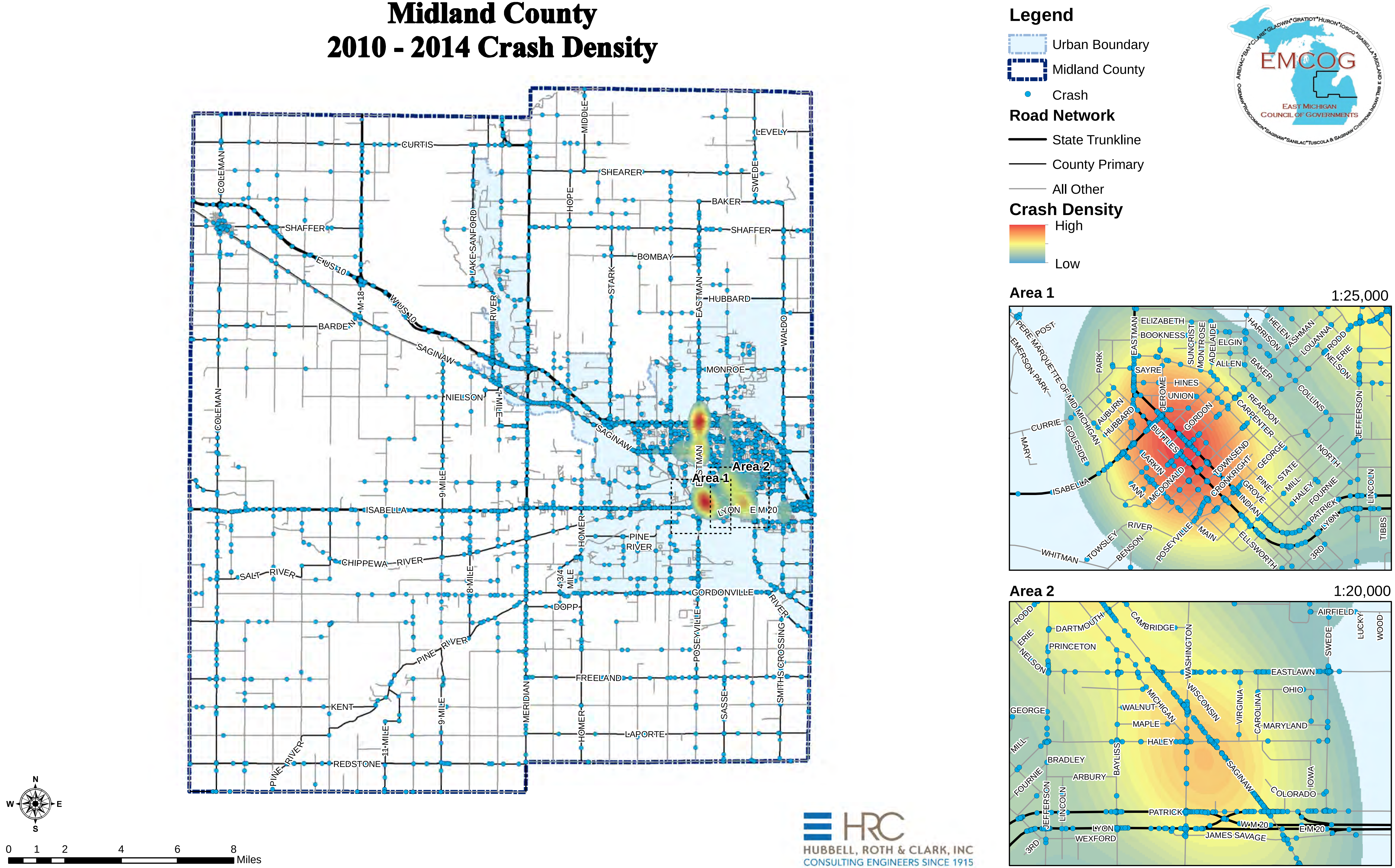
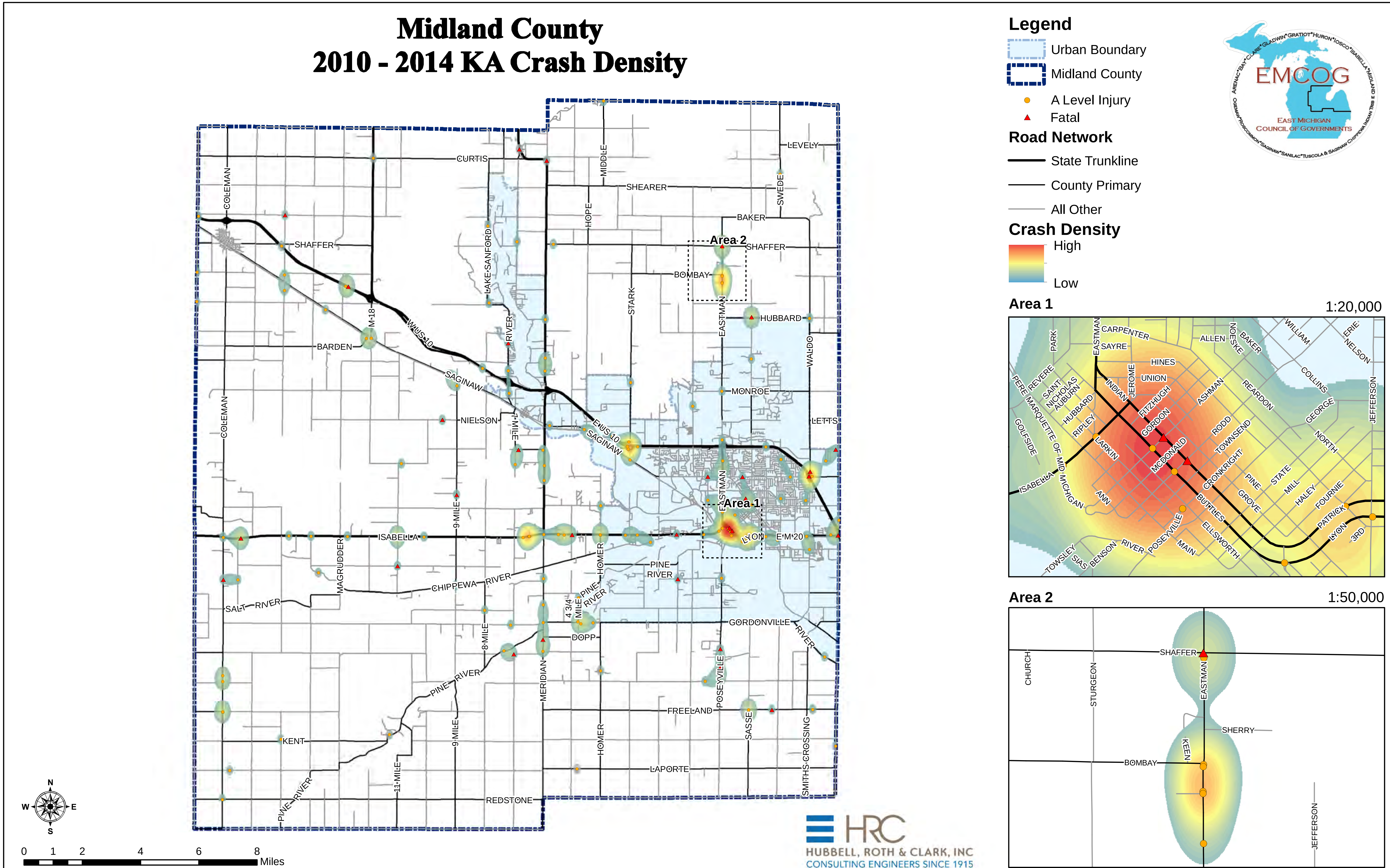
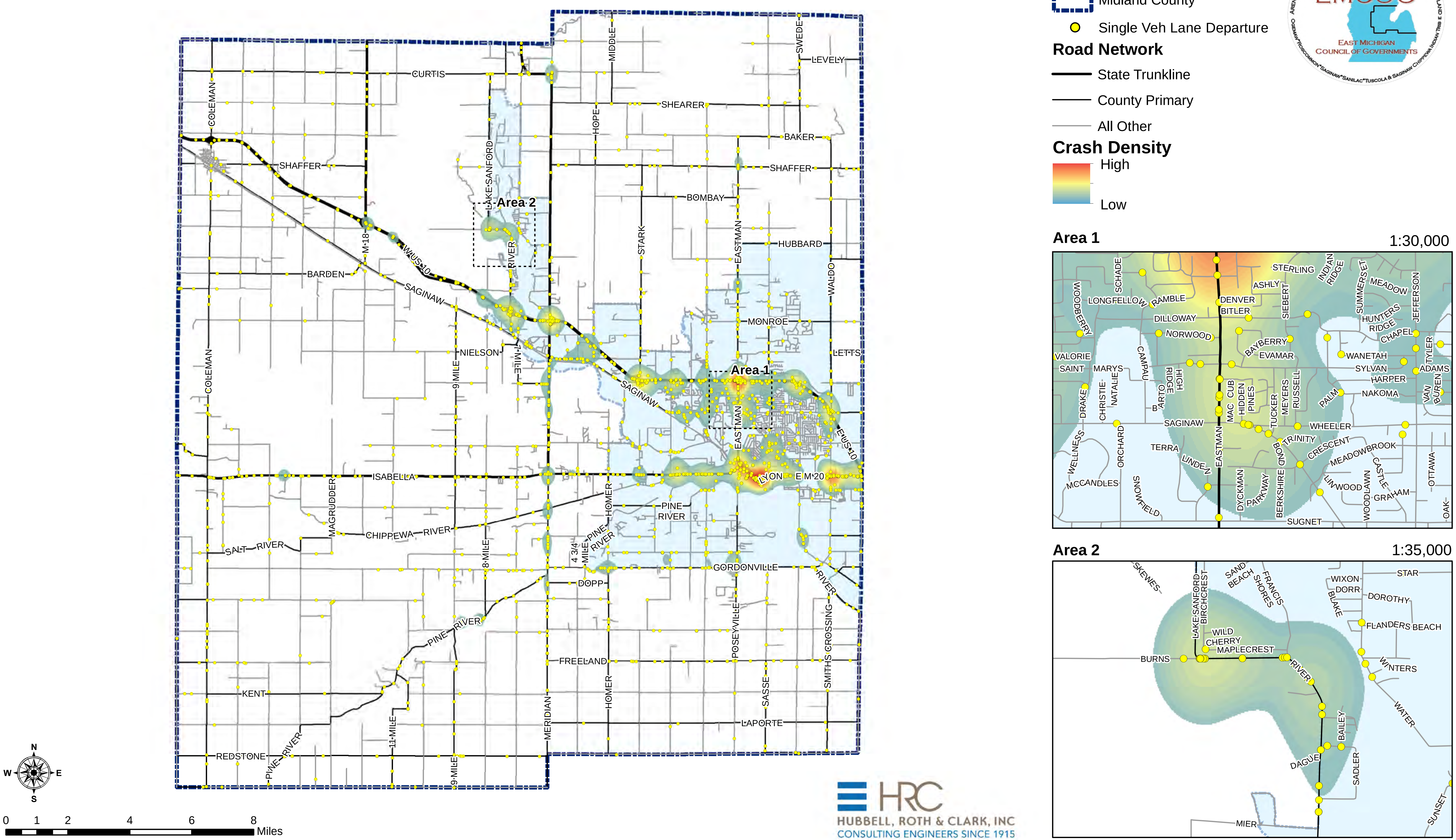
Midland County
2010 - 2014 Crash Density



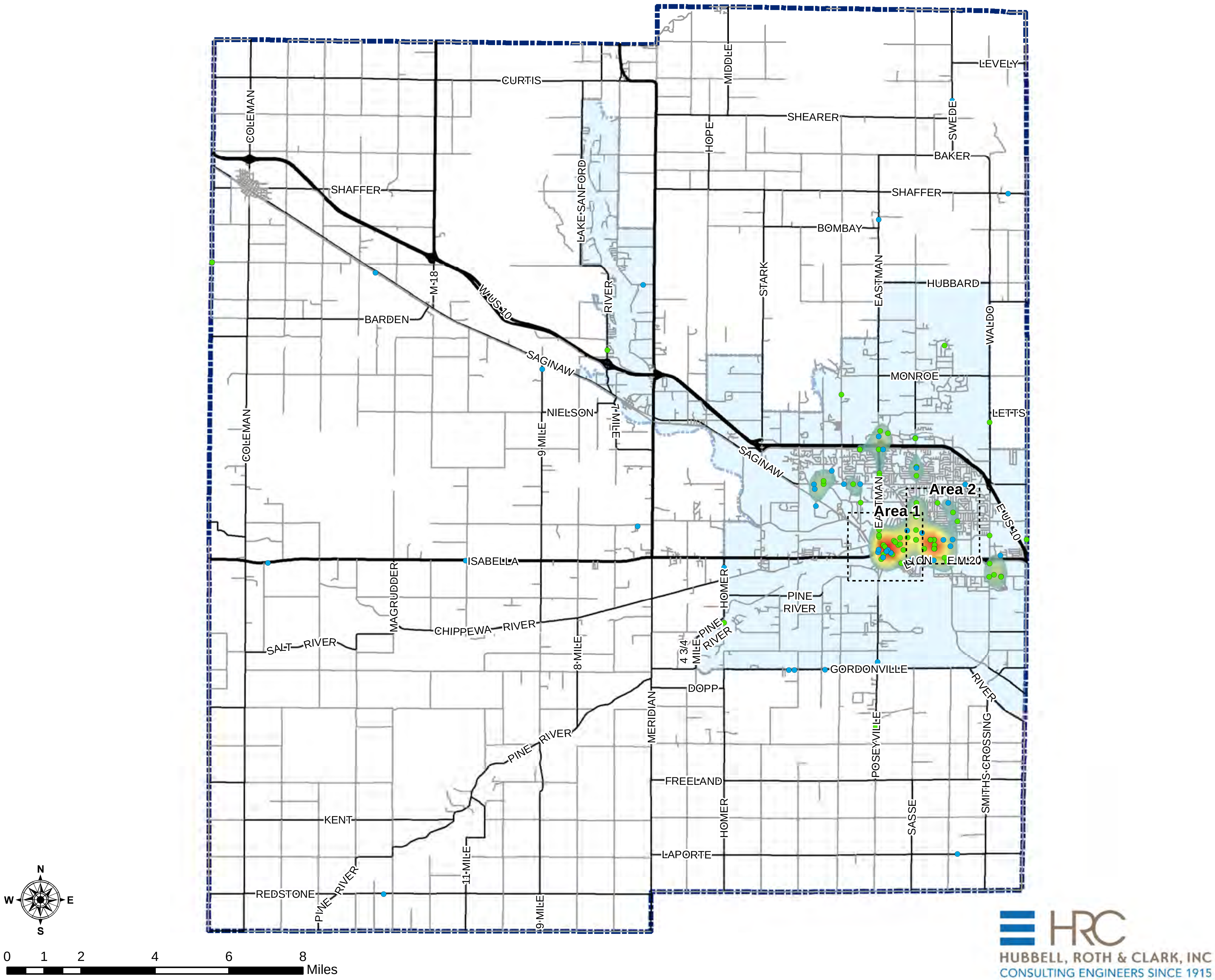
Midland County
2010 - 2014 KA Crash Density

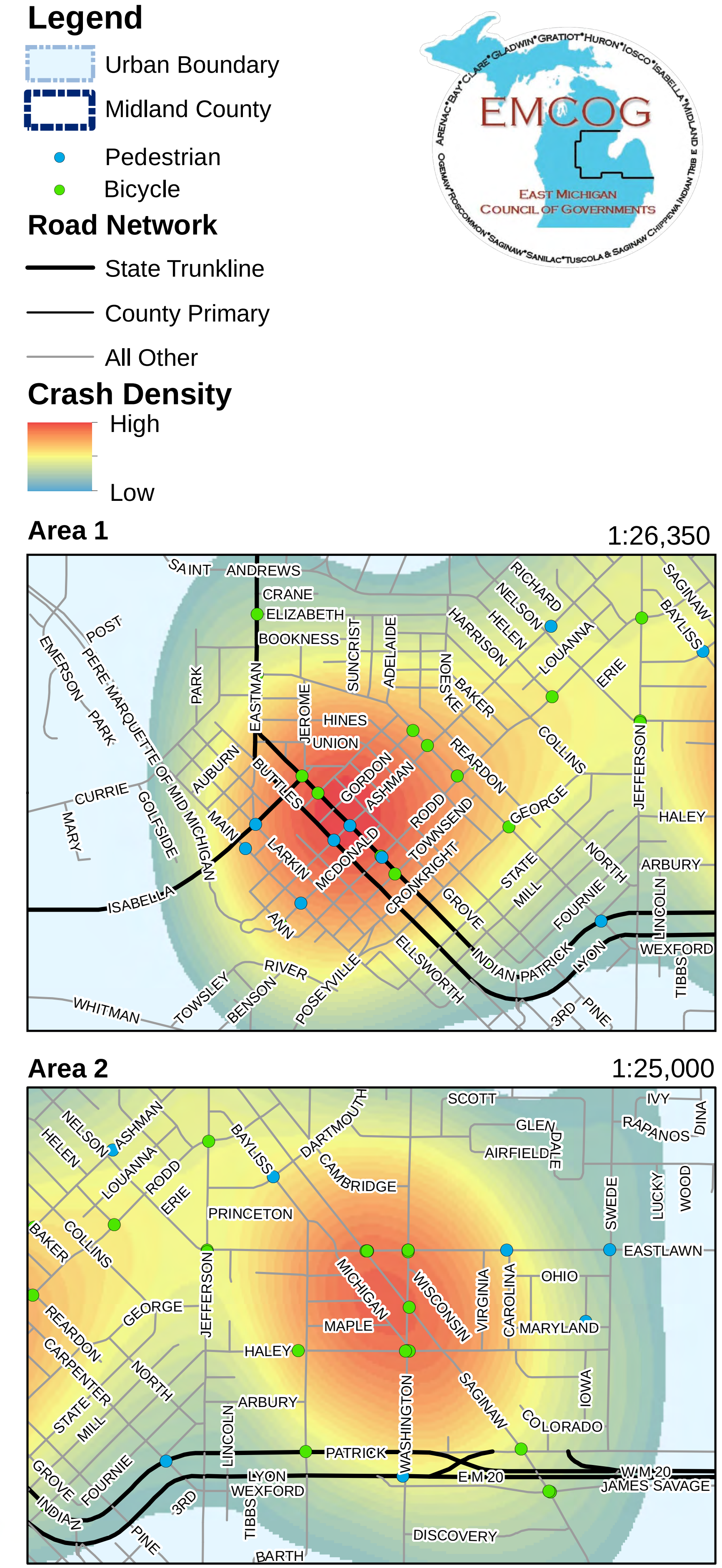


Midland County
2010 - 2014 Single Vehicle Lane Departure Crash Density

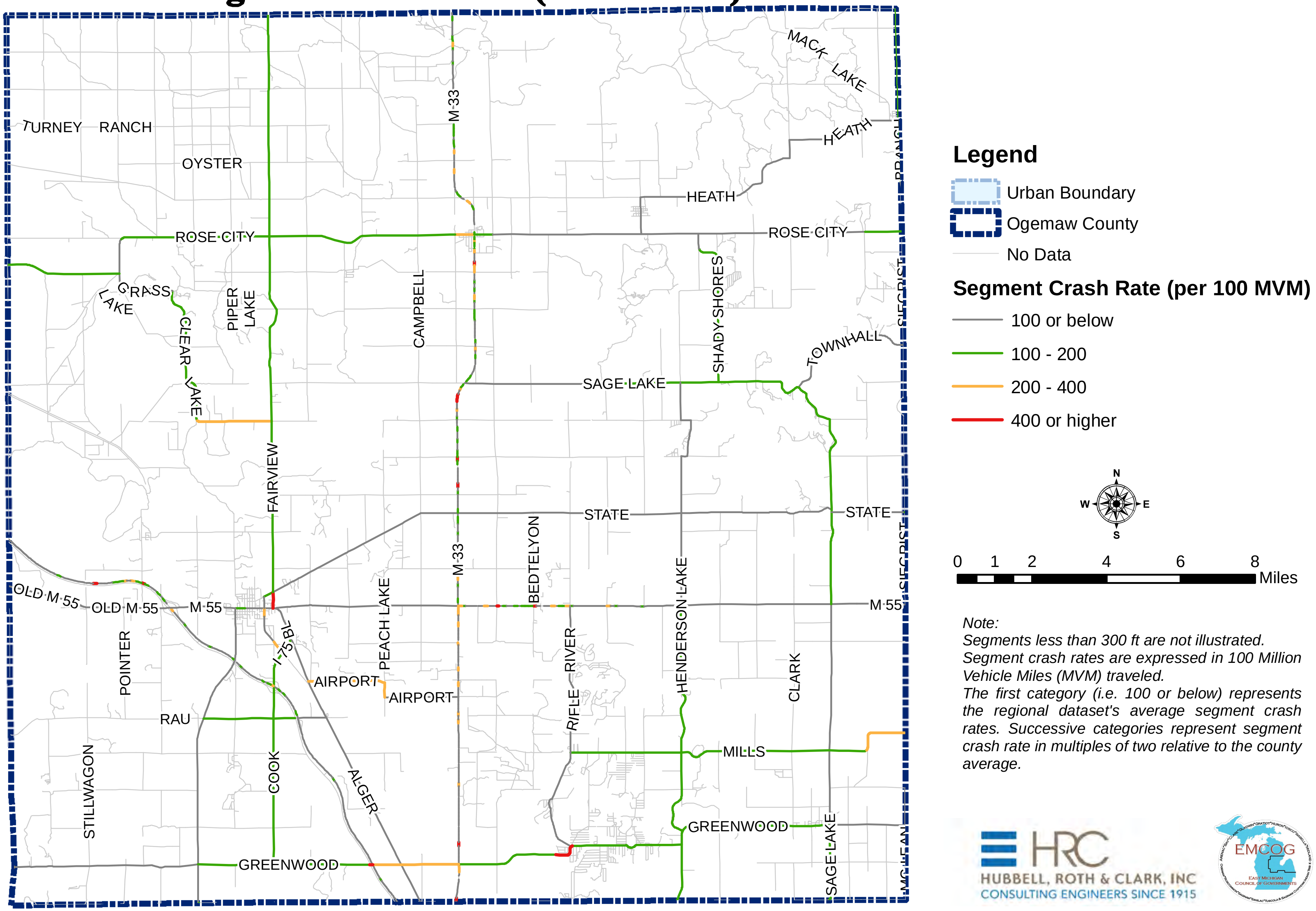


Midland County
2010 - 2014 Ped and Bicycle Crash Density

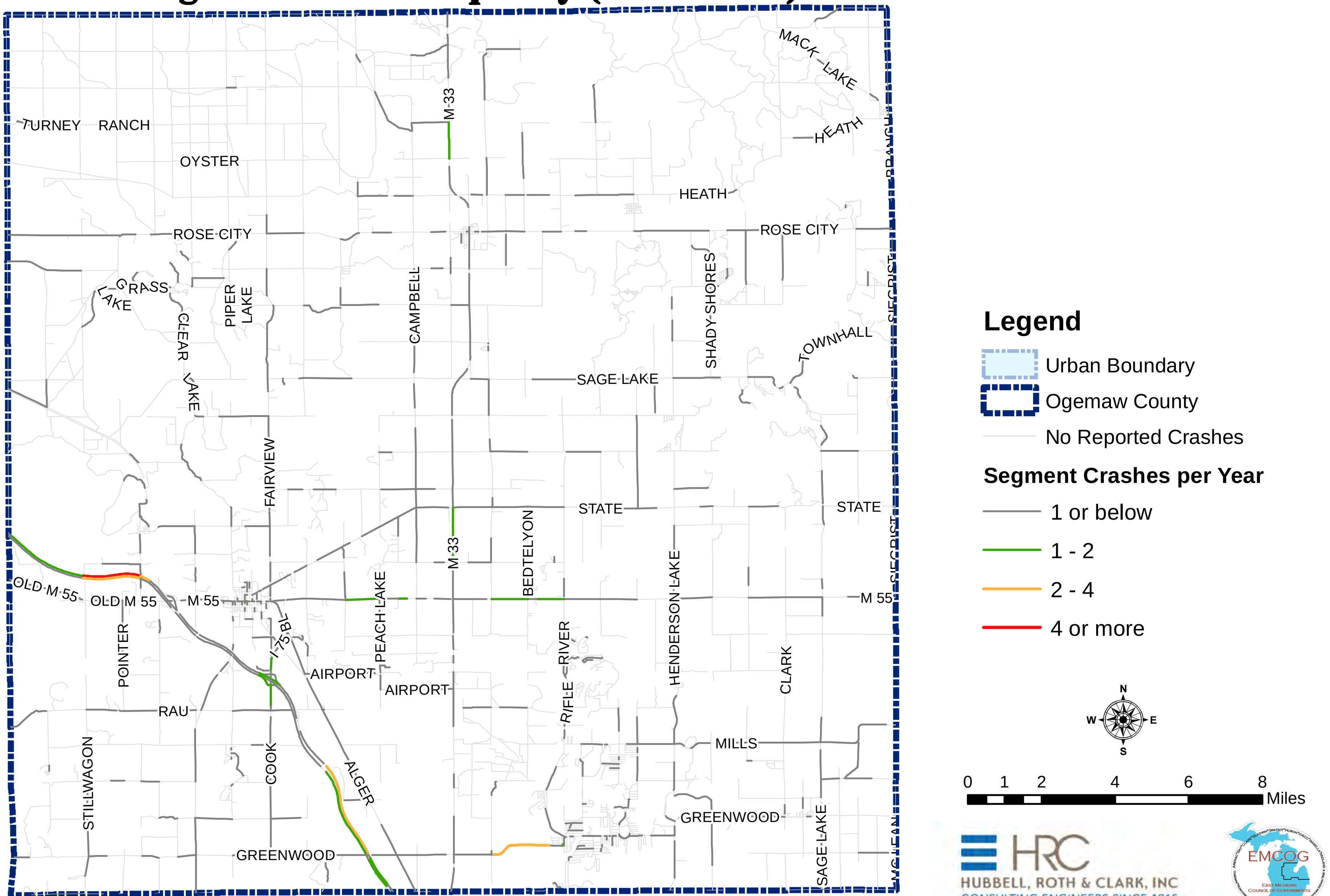




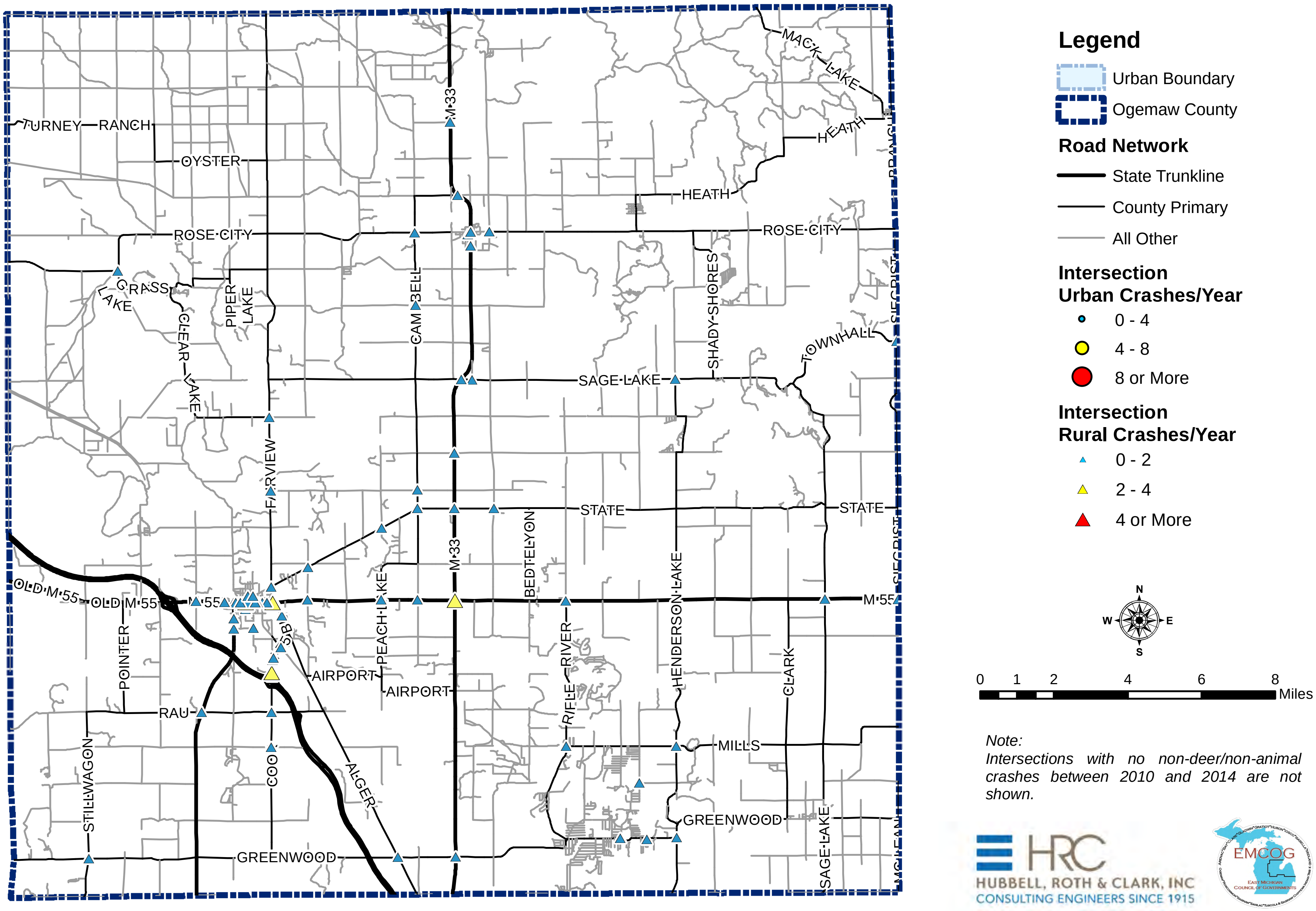
Ogemaw County
Segment Crash Rate (2010 - 2014)



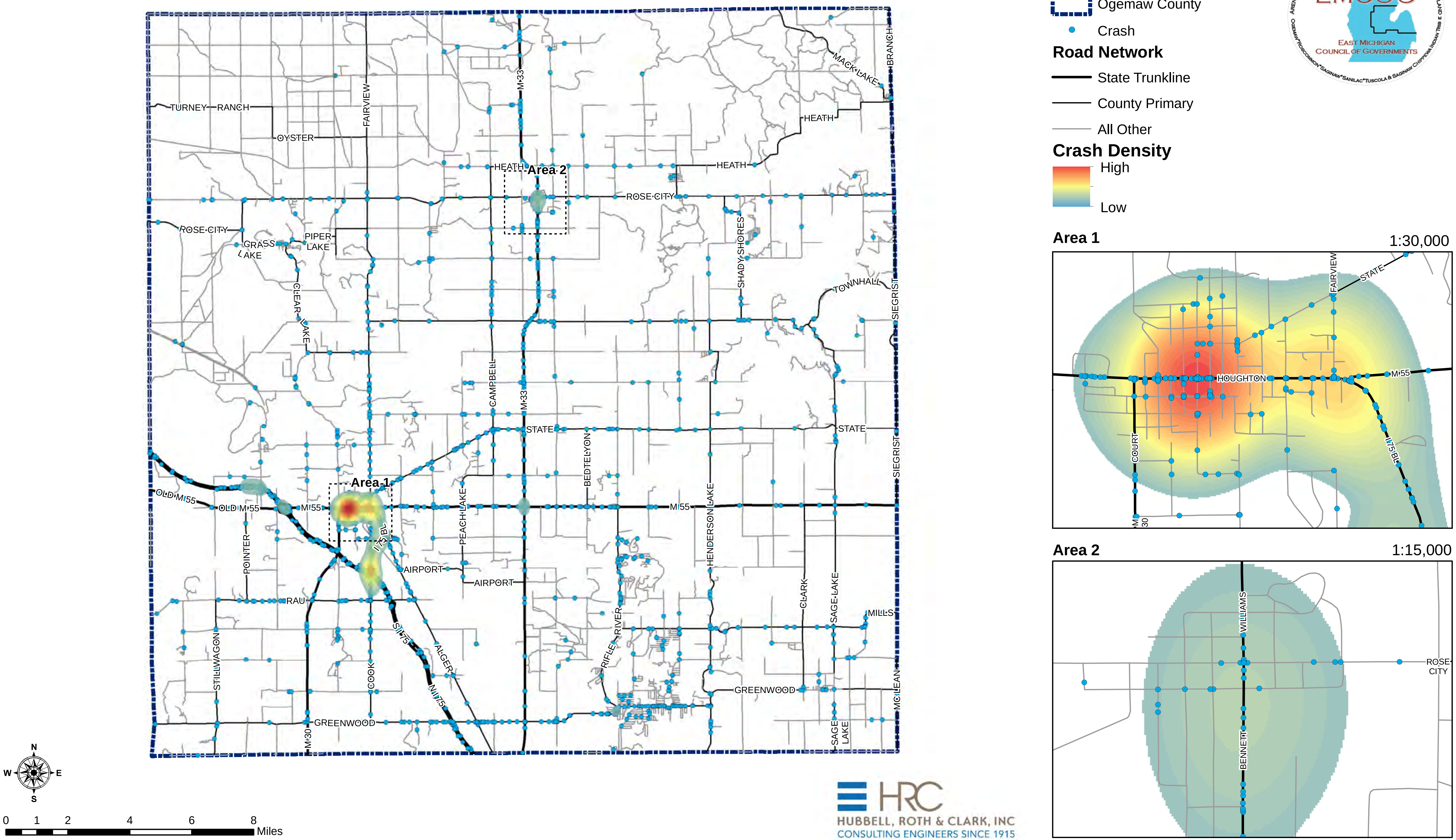
Ogemaw County
Segment Crash Frequency (2010 - 2014)



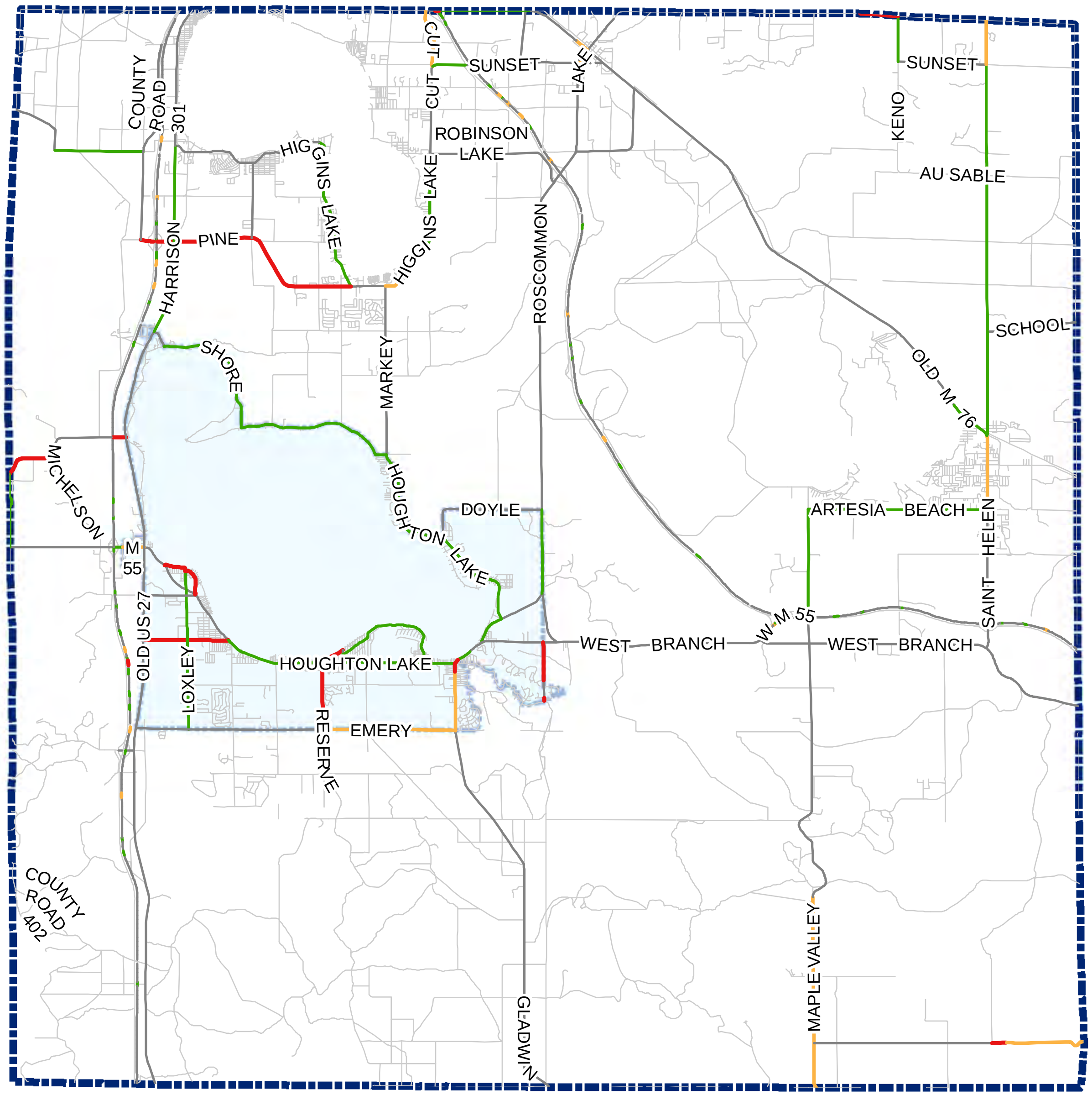
Ogemaw County
Intersection Crashes per Year (2010 - 2014)



Ogemaw County
2010 - 2014 Crash Density



Roscommon County
Segment Crash Rate (2010 - 2014)



Legend

- Urban Boundary
- Roscommon County
- No Data

Segment Crash Rate (per 100 MVM)

- 100 or below
- 100 - 200
- 200 - 400
- 400 or higher

N W E S

0 1 2 4 6 8 Miles

Note:
Segments less than 300 ft are not illustrated.
Segment crash rates are expressed in 100 Million Vehicle Miles (MVM) traveled.
The first category (i.e. 100 or below) represents the regional dataset's average segment crash rates. Successive categories represent segment crash rate in multiples of two relative to the county average.

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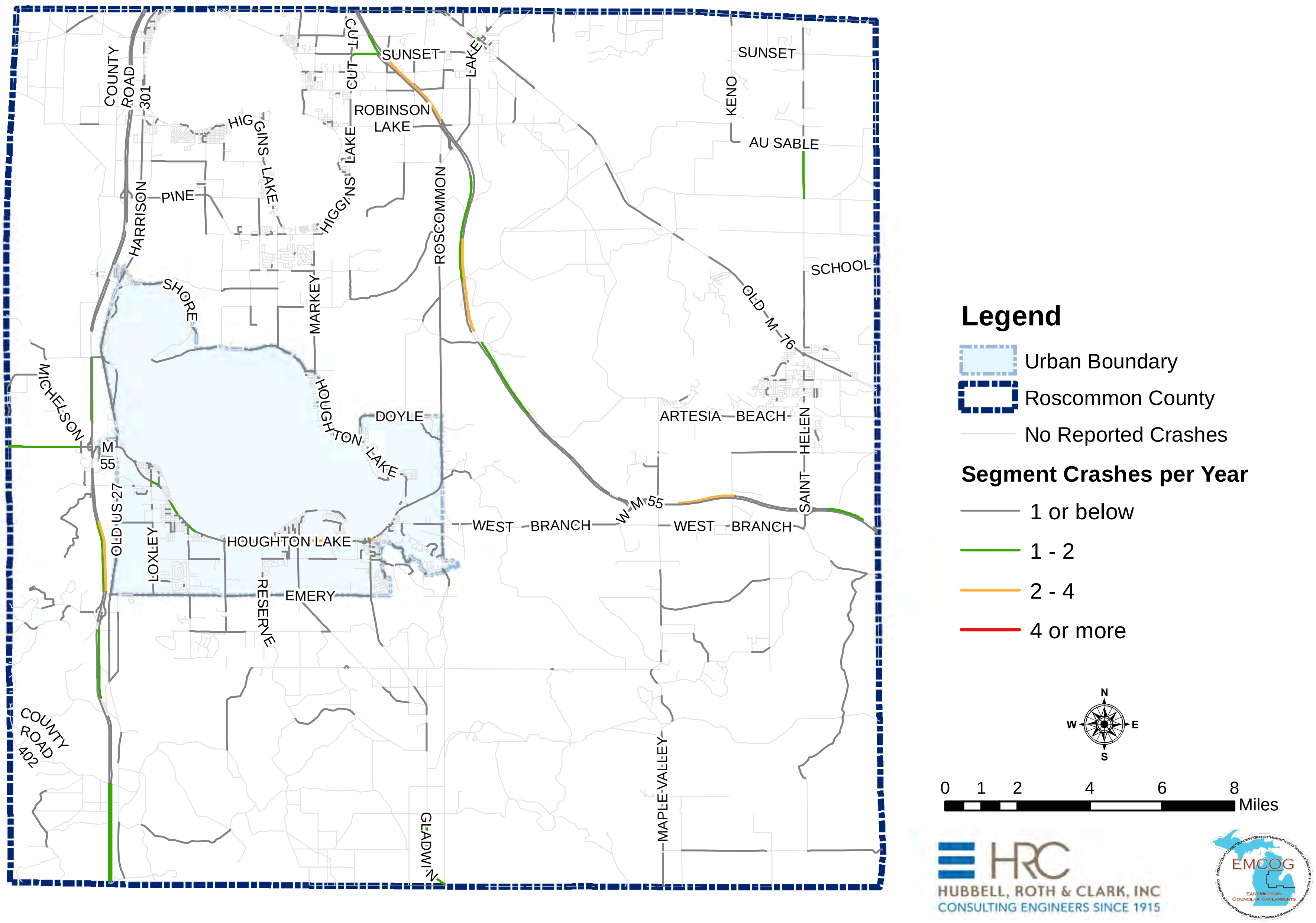
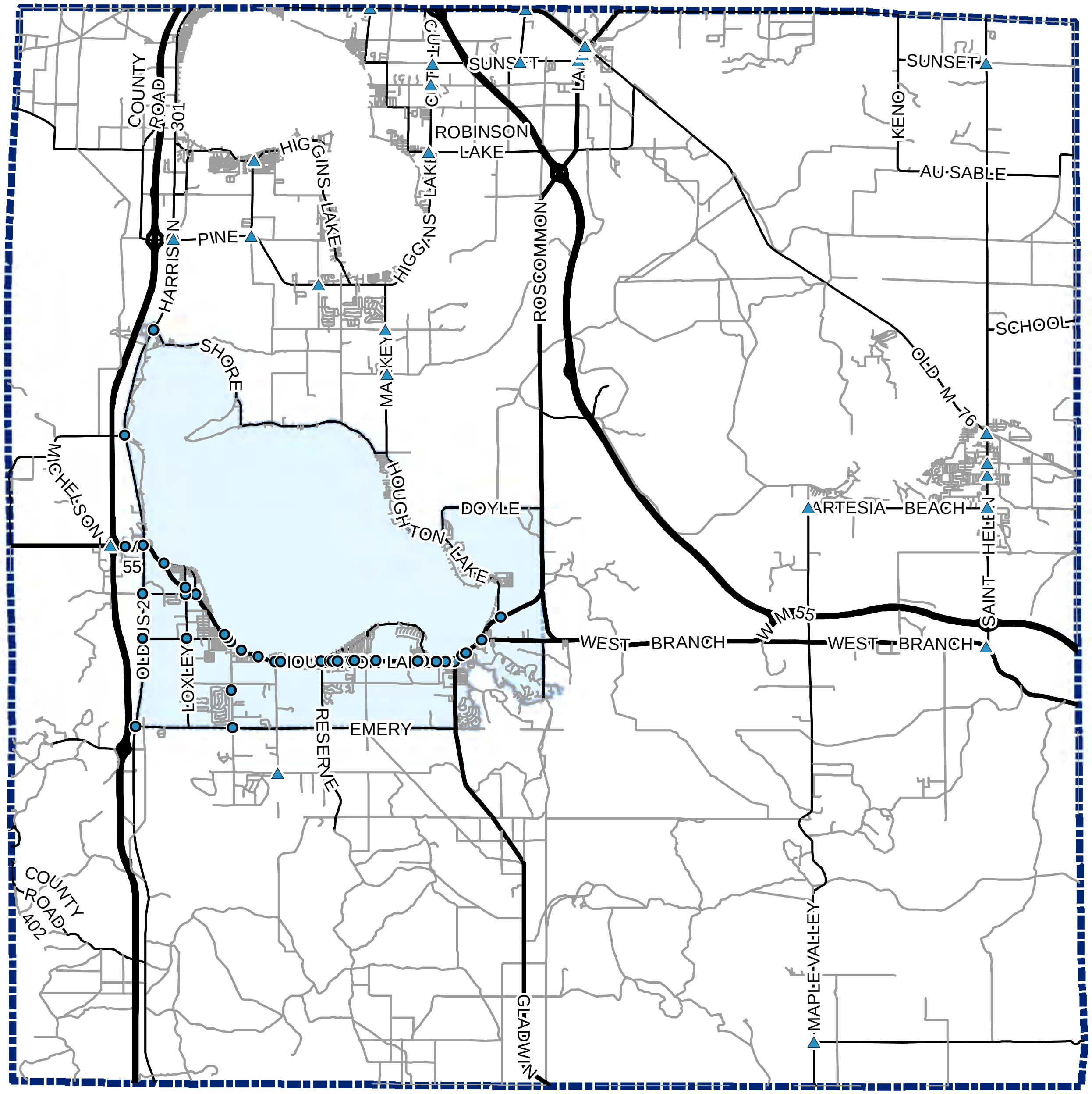
East Michigan Council of Governments

Roscommon County
Segment Crash Frequency (2010 - 2014)



Roscommon County
Intersection Crashes per Year (2010 - 2014)



Legend

- Urban Boundary
- Roscommon County

Road Network

- State Trunkline
- County Primary
- All Other

Intersection Urban Crashes/Year

- 0 - 4
- 4 - 8
- 8 or More

Intersection Rural Crashes/Year

- 0 - 2
- 2 - 4
- 4 or More

N W E S

0 1 2 4 6 8 Miles

Note:
Intersections with no or one non-deer/non-animal crashes between 2010 and 2014 are not shown.

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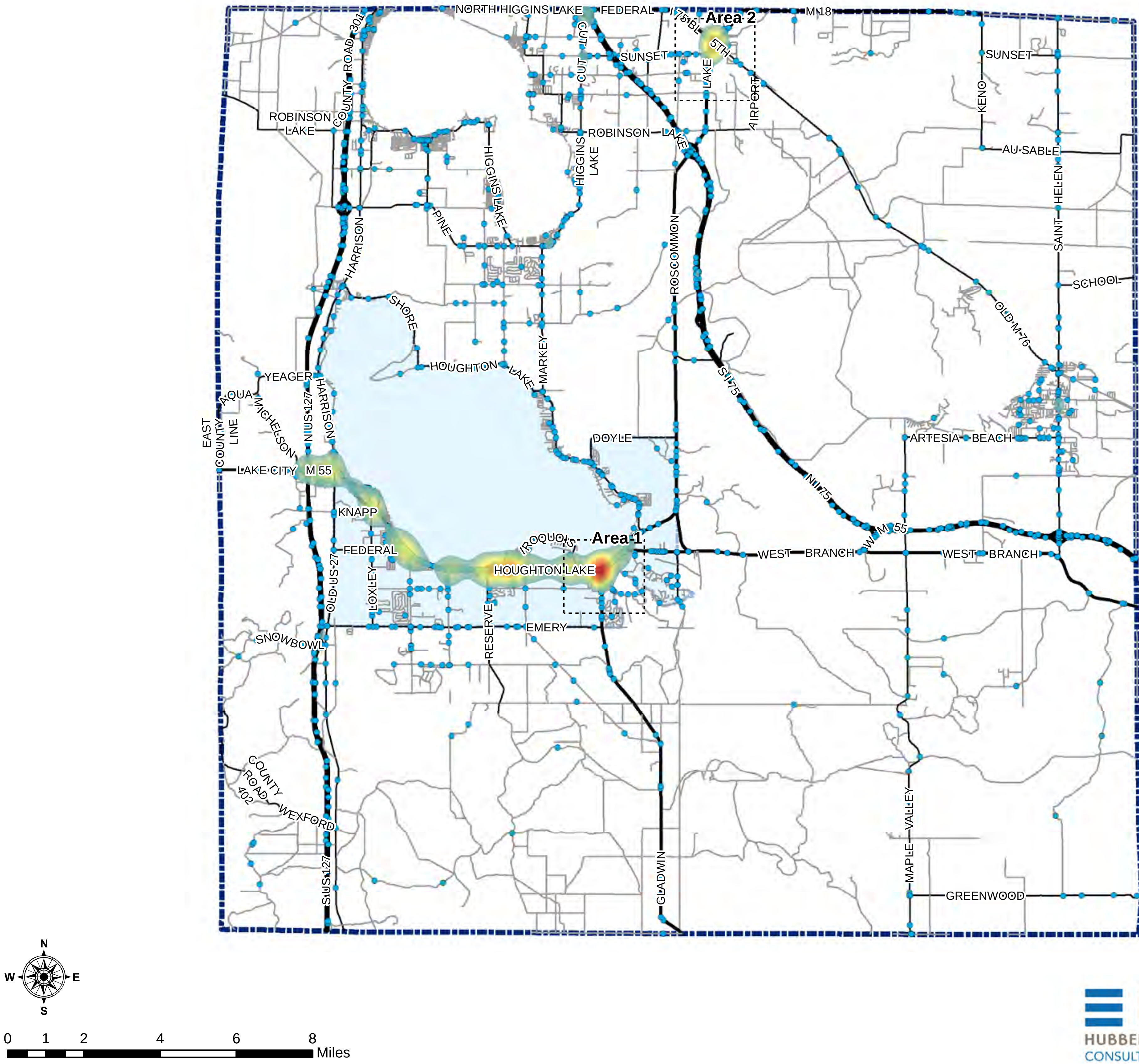
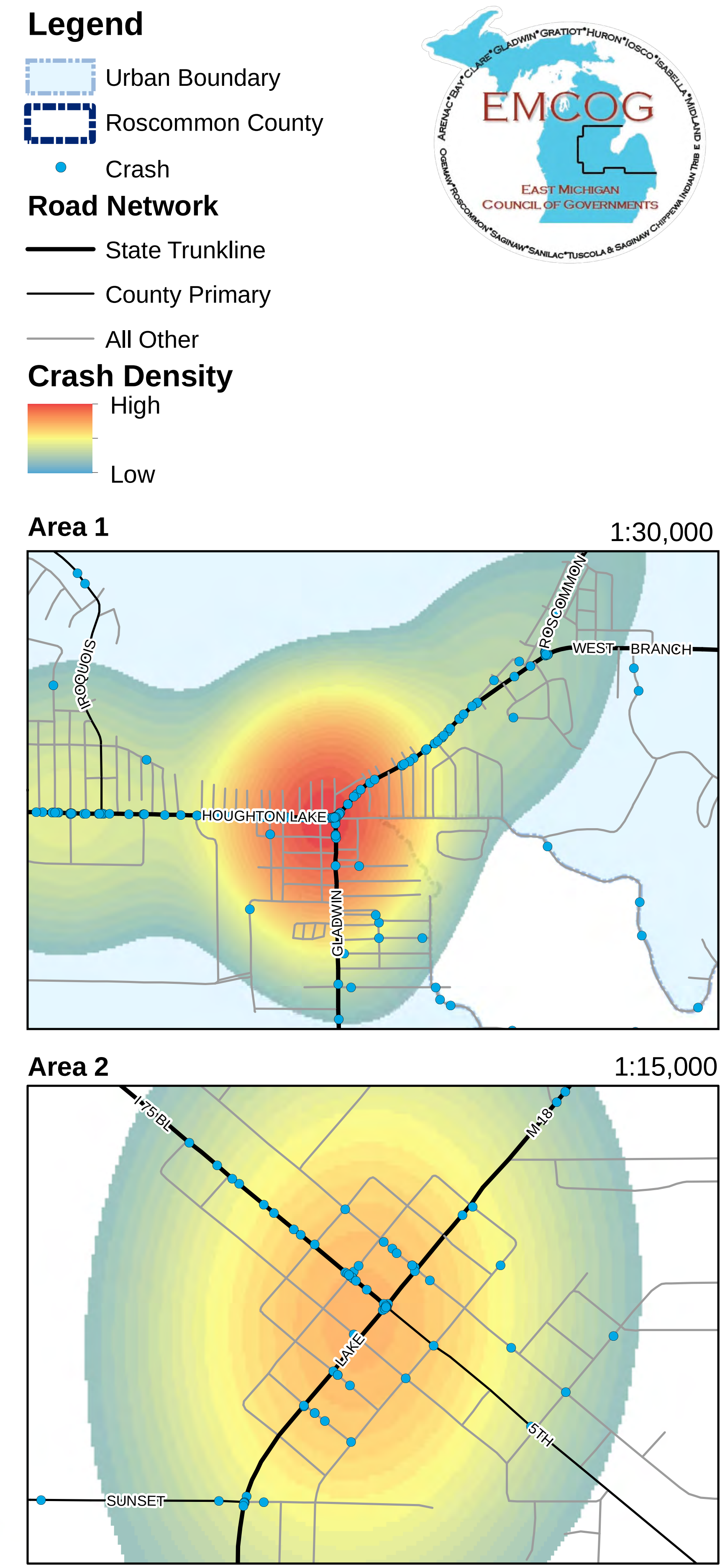
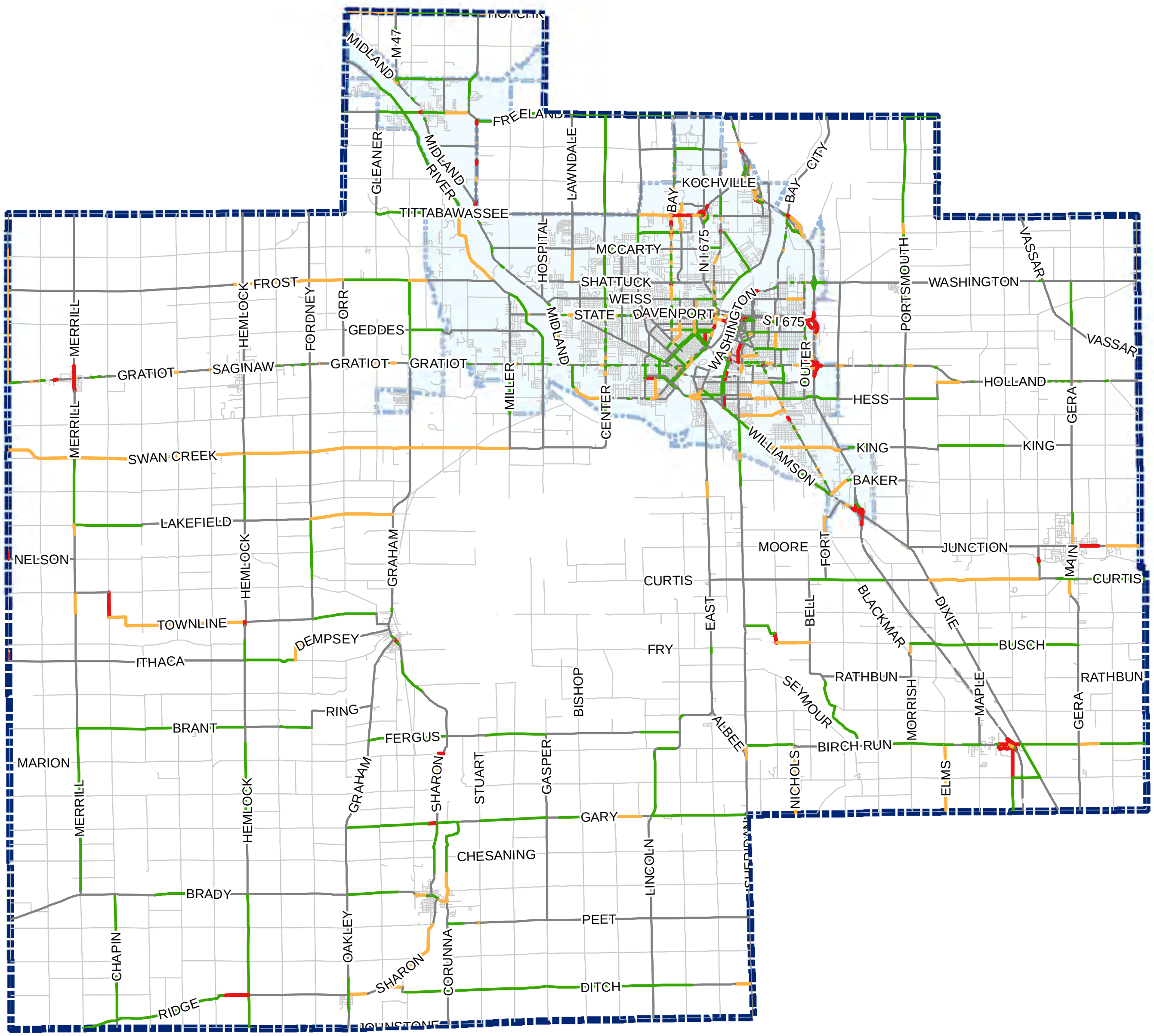
Roscommon County
2010 - 2014 Crash Density





Saginaw County
Segment Crash Rate (2010 - 2014)



Legend

Urban Boundary

Saginaw County

No Data

Segment Crash Rate (per 100 MVM)

100 or below

100 - 200

200 - 400

400 or higher

N W E S

0 1.25 2.5 5 7.5 10 Miles

Note:
Segments less than 300 ft are not illustrated.
Segment crash rates are expressed in 100 Million Vehicle Miles (MVM) traveled.
The first category (i.e. 100 or below) represents the regional dataset's average segment crash rates. Successive categories represent segment crash rate in multiples of two relative to the county average.

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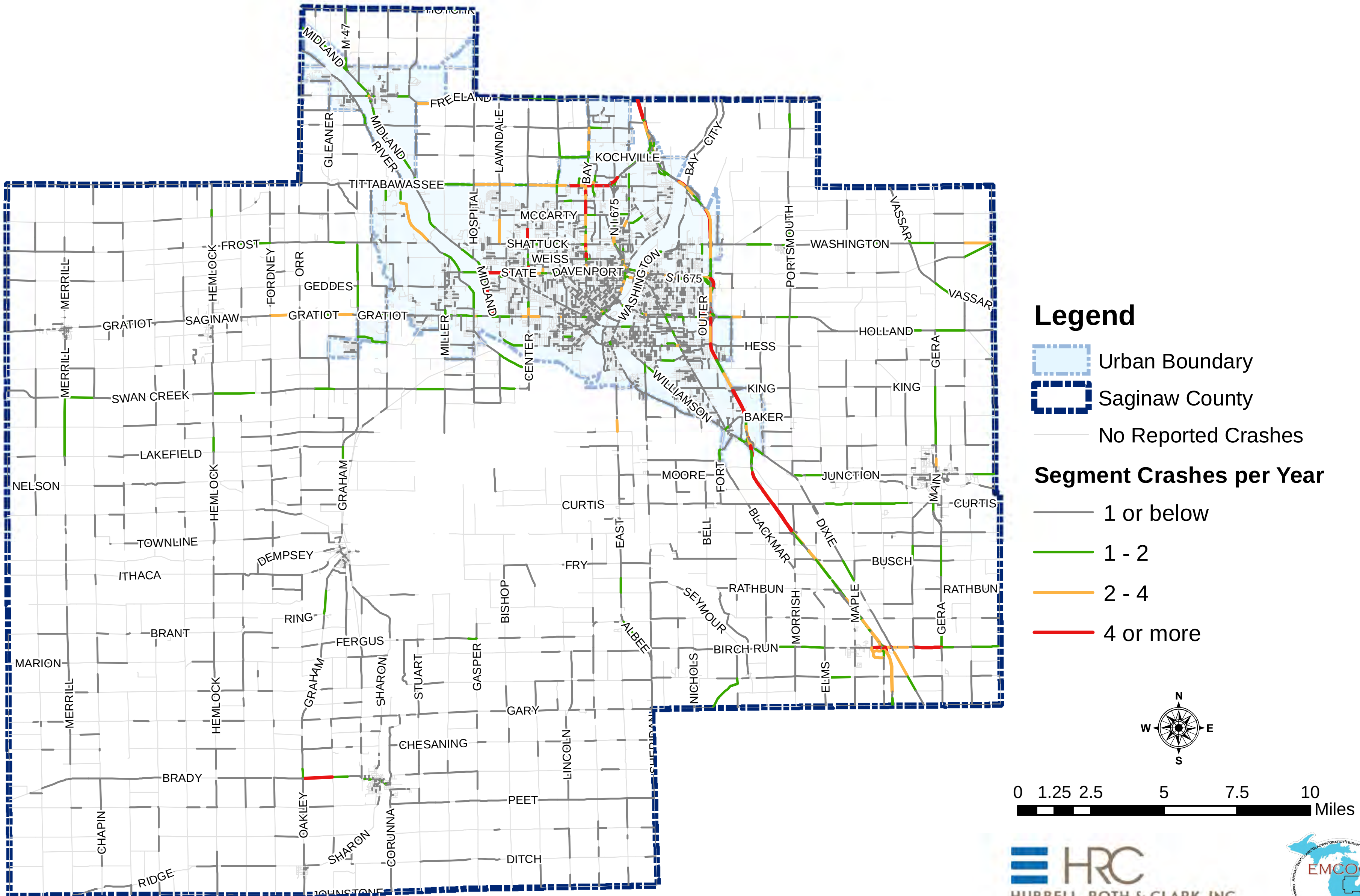
East Michigan Council of Governments

Saginaw County
Segment Crash Frequency (2010 - 2014)



HRC
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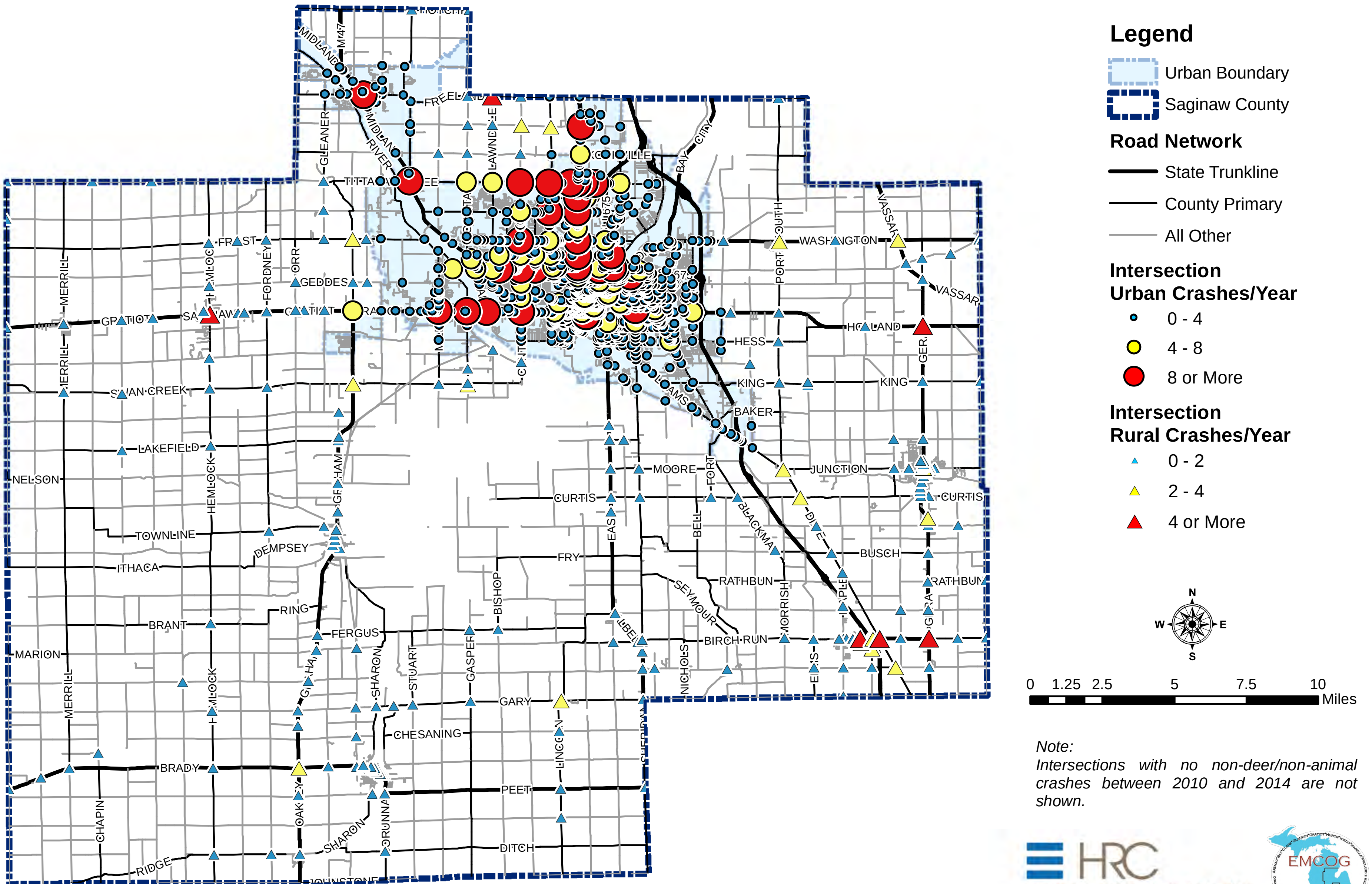
EMCOG

Saginaw County
Intersection Crashes per Year (2010 - 2014)



Note:
Intersections with no non-deer/non-animal crashes between 2010 and 2014 are not shown.

HUBBELL, ROTH & CLARK, INC
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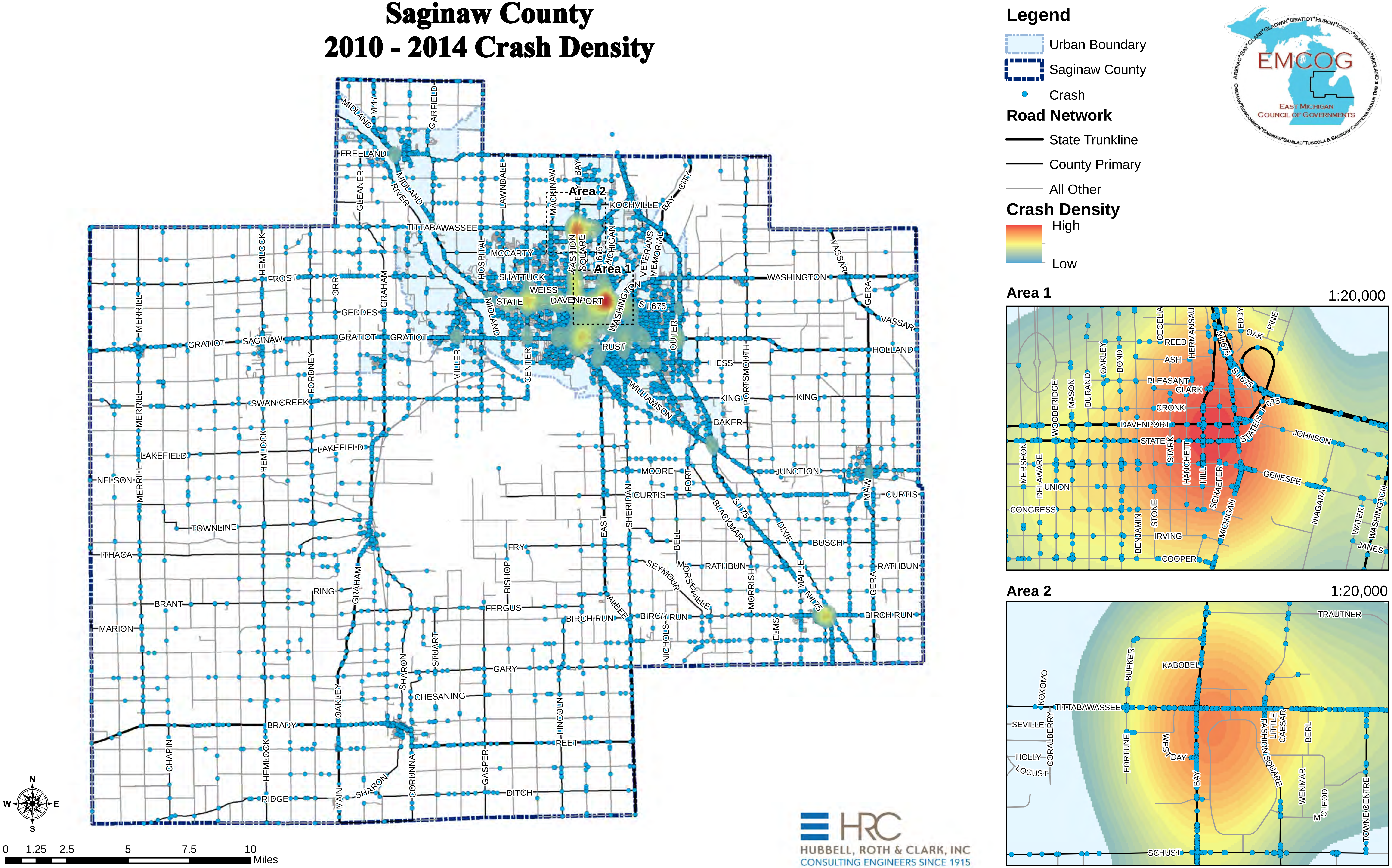
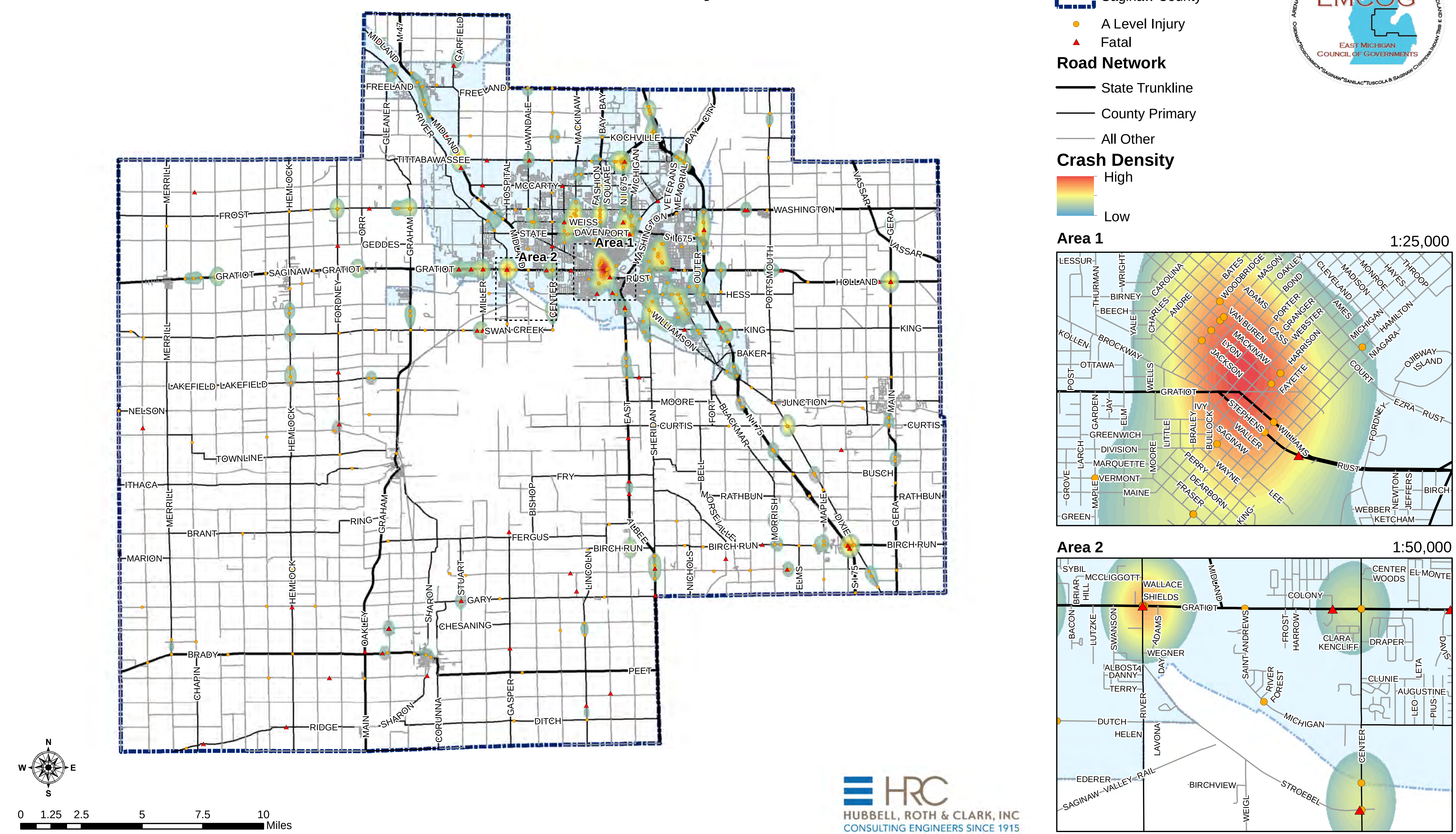
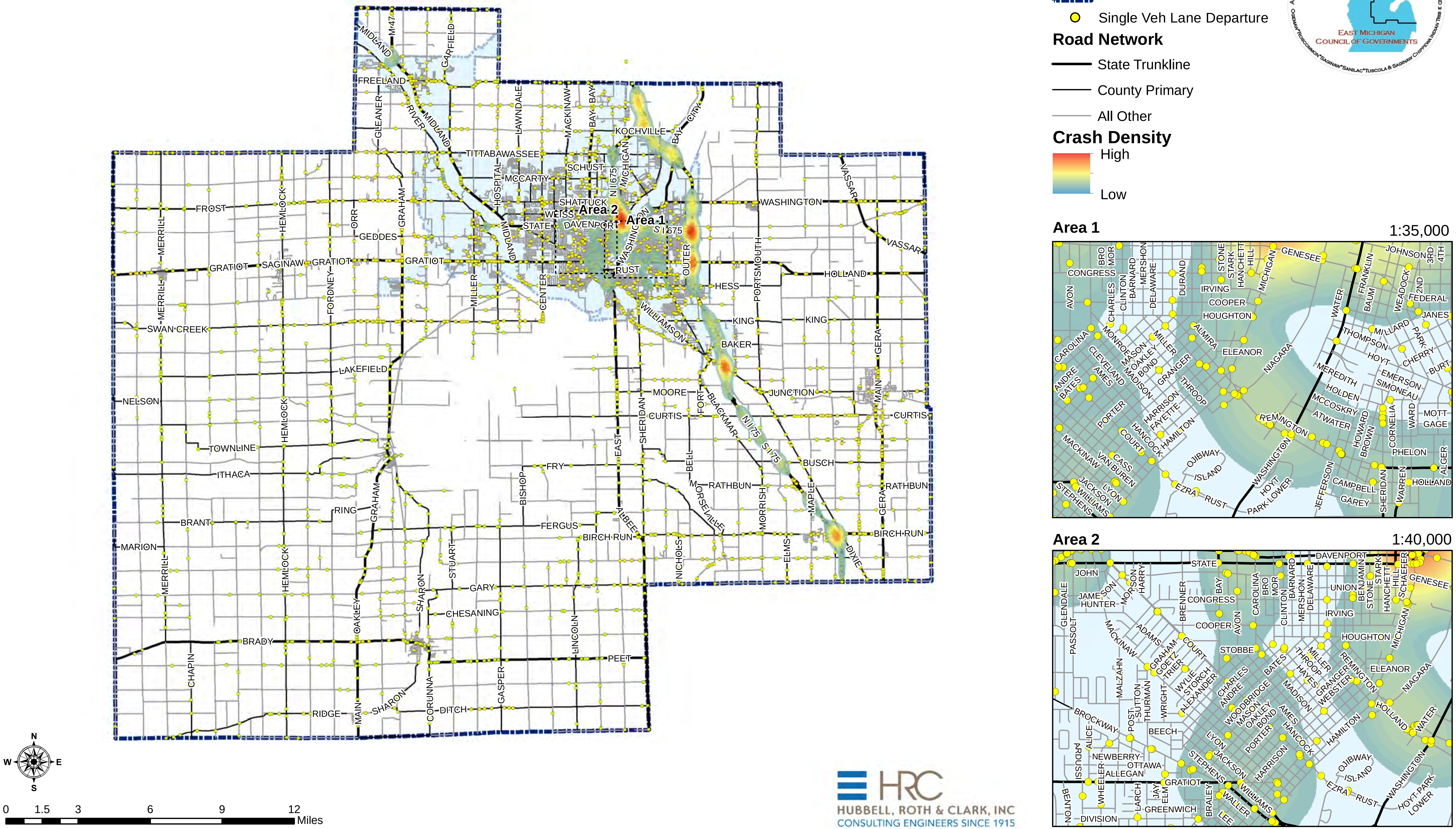
Saginaw County
2010 - 2014 Crash Density



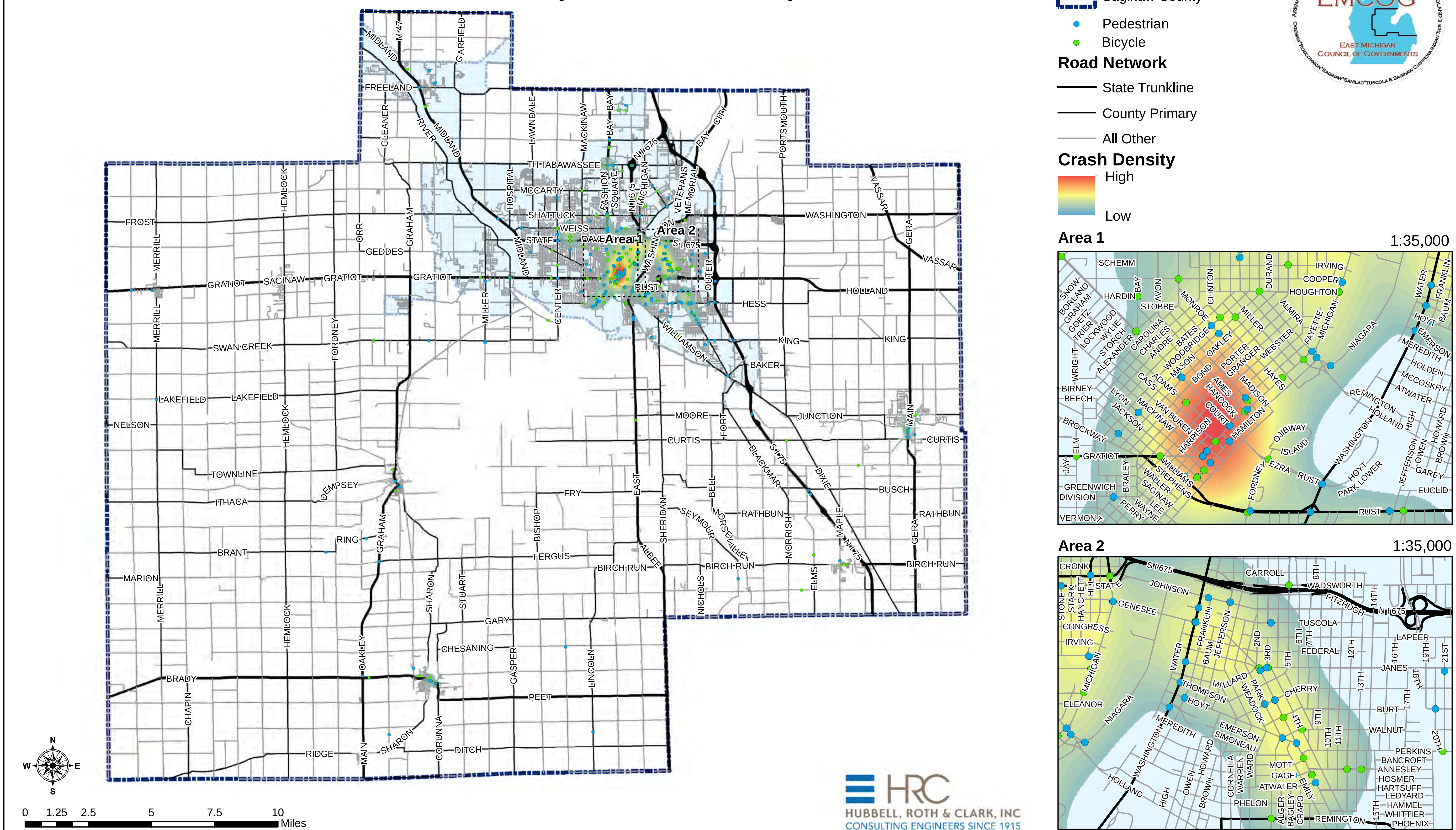
Saginaw County
2010 - 2014 KA Crash Density



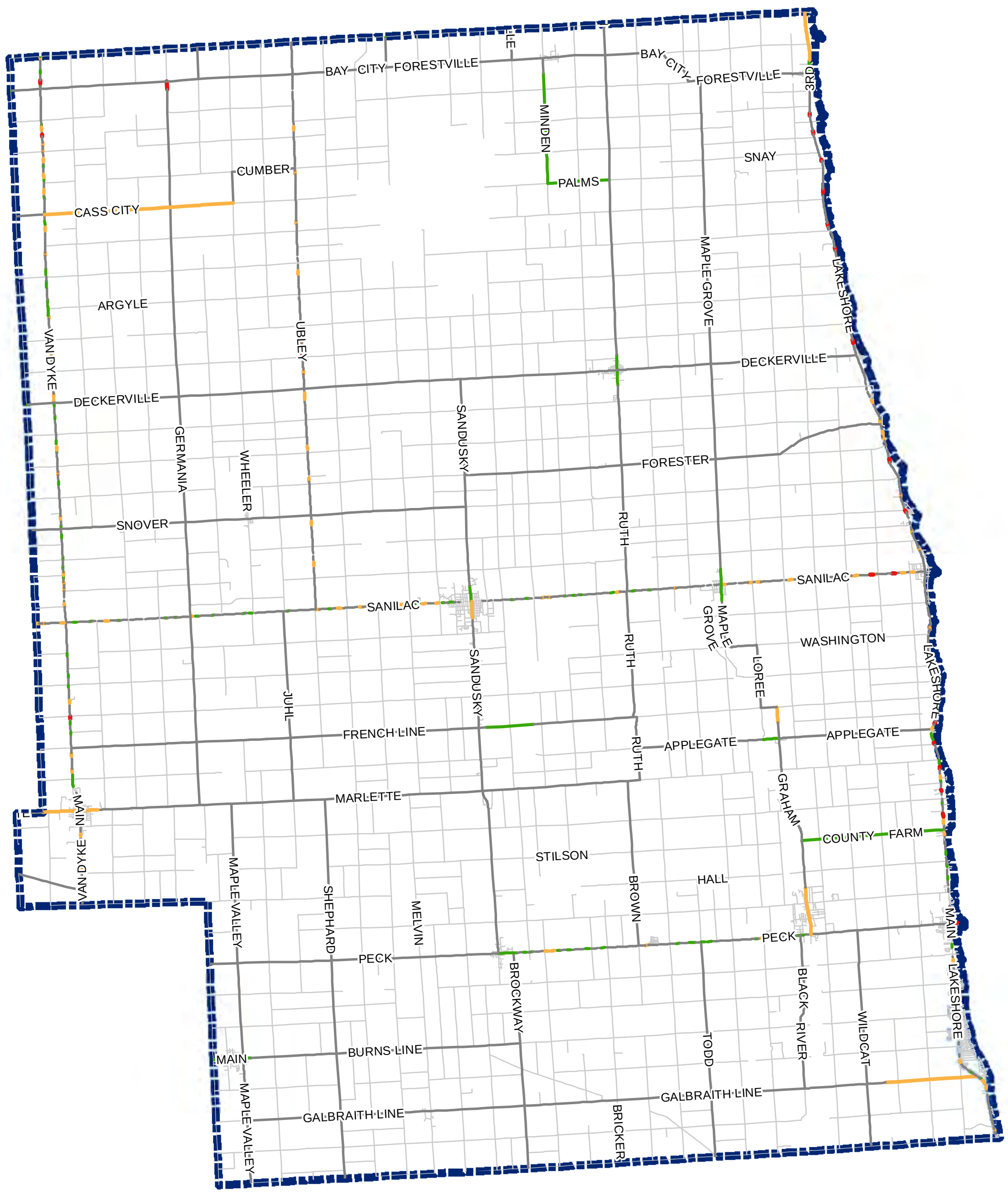
Saginaw County
2010 - 2014 Single Vehicle Lane Departure Crash Density



Saginaw County
2010 - 2014 Ped and Bicycle Crash Density



Sanilac County
Segment Crash Rate (2010 - 2014)



Legend

Urban Boundary

Sanilac County

No Data

Segment Crash Rate (per 100 MVM)

- 100 or below
- 100 - 200
- 200 - 400
- 400 or higher

N S E W

0 1.5 3 6 9 12 Miles

Note:
Segments less than 300 ft are not illustrated.
Segment crash rates are expressed in 100 Million Vehicle Miles (MVM) traveled.
The first category (i.e. 100 or below) represents the regional dataset's average segment crash rates. Successive categories represent segment crash rate in multiples of two relative to the county average.

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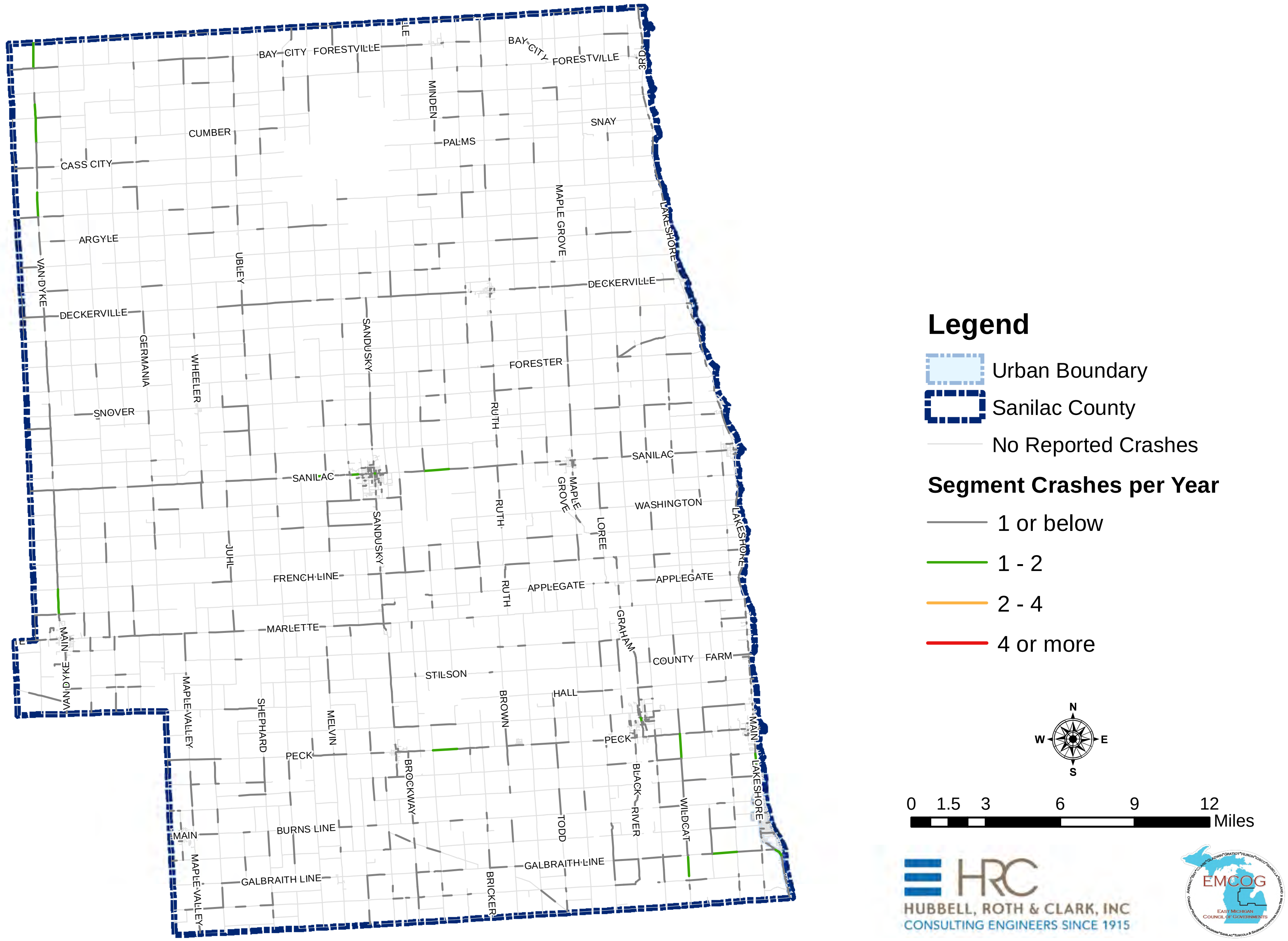
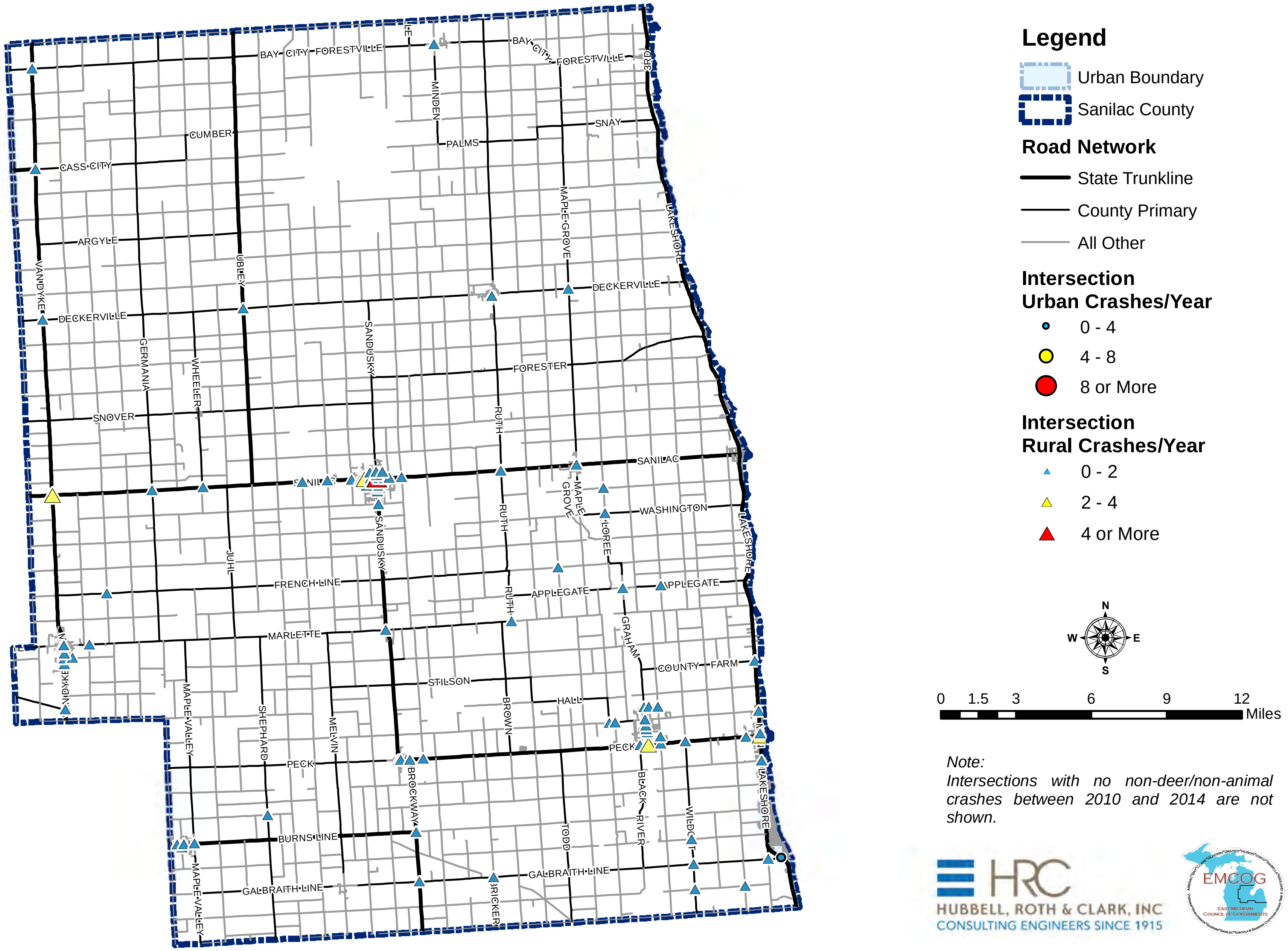
Sanilac County
Segment Crash Frequency (2010 - 2014)



Sanilac County
Intersection Crashes per Year (2010 - 2014)



Note:
Intersections with no non-deer/non-animal crashes between 2010 and 2014 are not shown.

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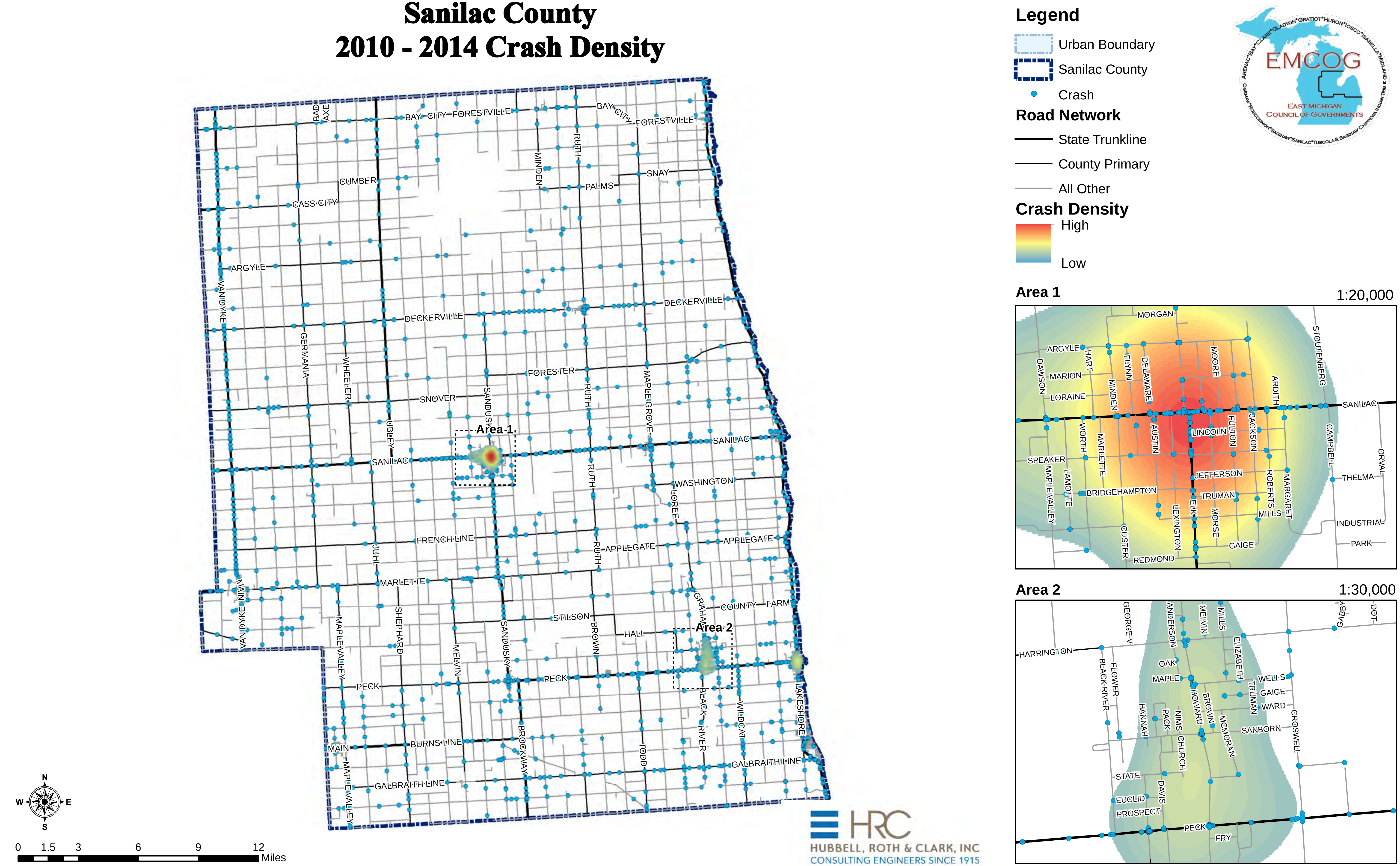
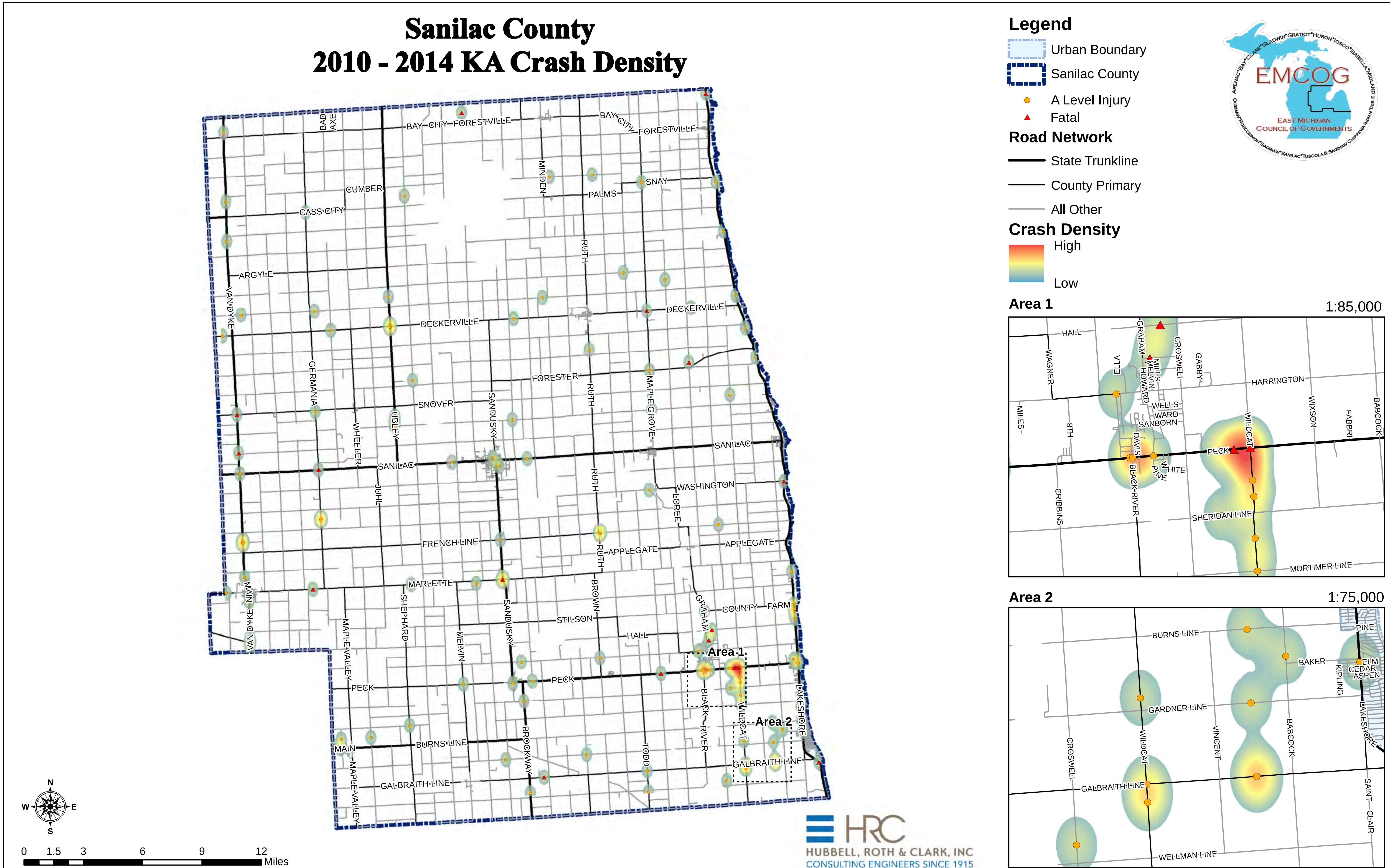
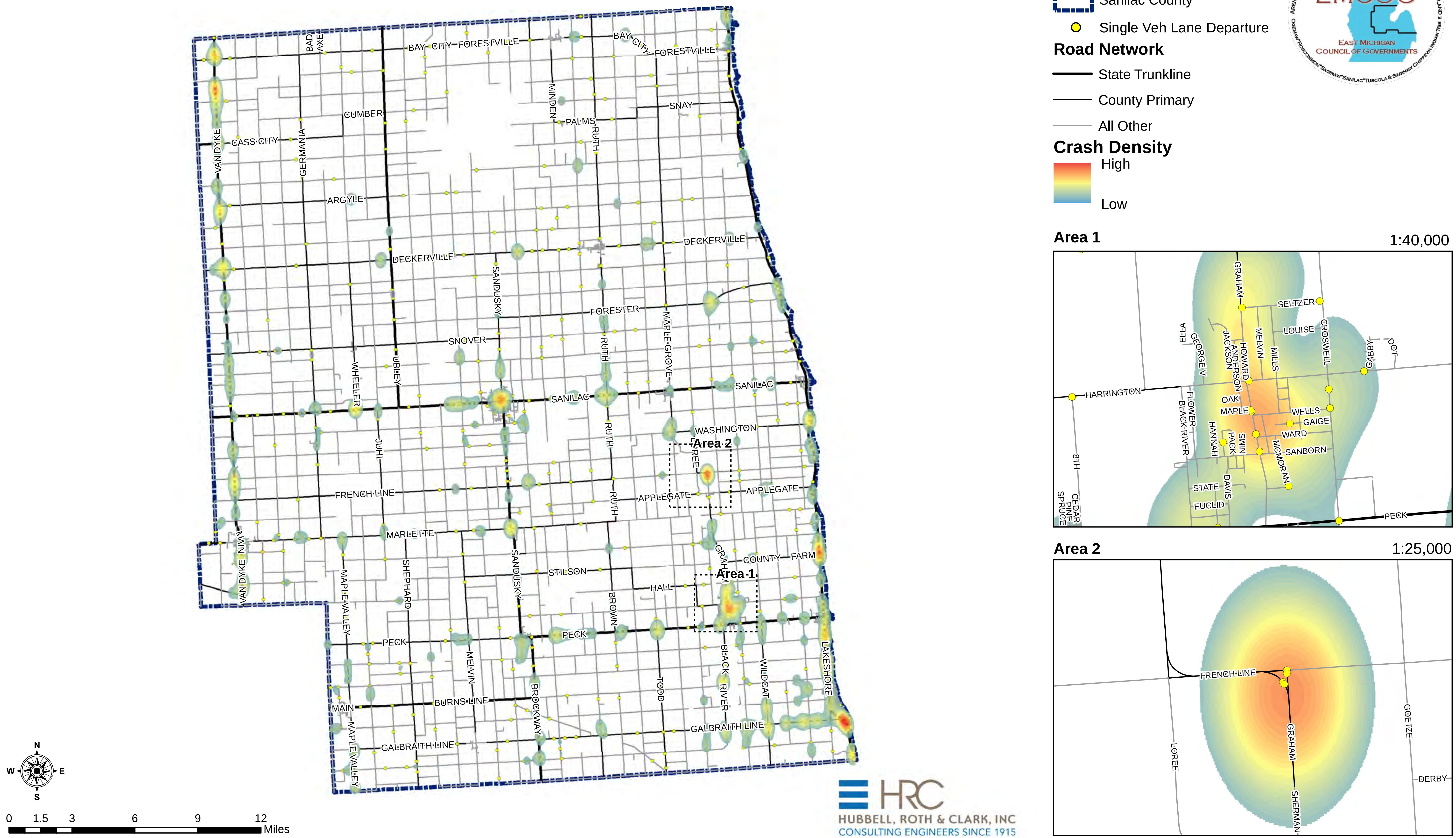
Sanilac County
2010 - 2014 Crash Density

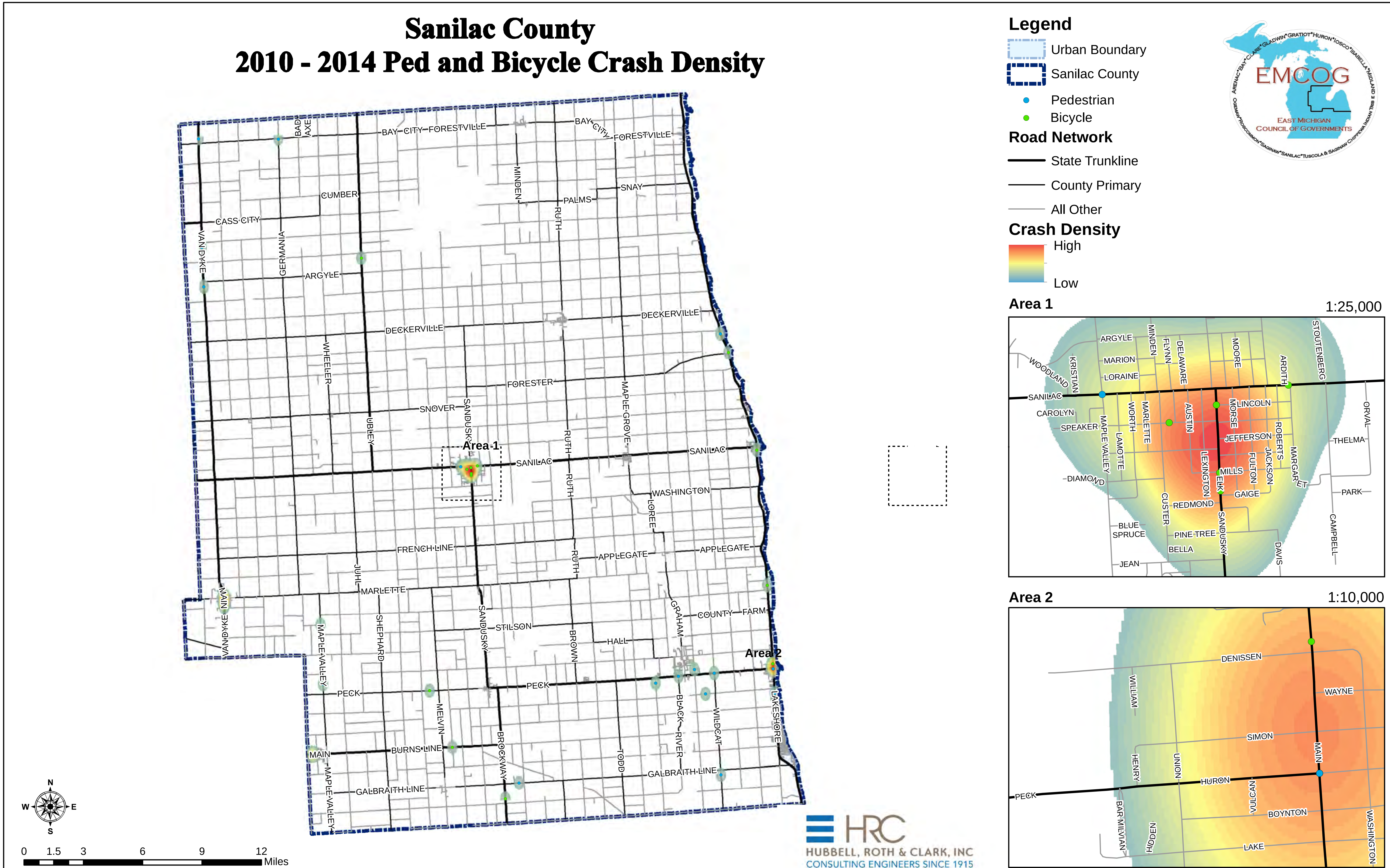



Sanilac County
2010 - 2014 KA Crash Density
Legend
Urban Boundary
Sanilac County
A Level Injury
Fatal
Road Network
State Trunkline
County Primary
All Other
Crash Density
High
Low
Area 1
1:85,000
Area 2
1:75,000
EMCOG
EAST MICHIGAN COUNCIL OF GOVERNMENTS
HRC
HUBBELL, ROTH & CLARK, INC
CONSULTING ENGINEERS SINCE 1915
0 1.5 3 6 9 12 Miles
N
S
E
W
BAY CITY FORESTVILLE
CASS CITY
CUMBER
SNAY
PALMS
ARGYLE
DECKERVILLE
FORESTER
SNOVER
SANILAC
WASHINGTON
FRENCH LINE
APPLEGATE
MARLETTE
STILSON
COUNTY FARM
HALL
PECK
BURNS LINE
GALBRAITH LINE
MAIN
VAN DYKE
GERMANIA
WHEELER
UBLEY
JUHL
SANDUSKY
RUTH
MINDEN
MAPLE GROVE
LOREE
BROWN
GRAHAM
BLACK RIVER
WILDCAT
LAKESHORE
SHEPHARD
MELVIN
MAPLE VALLEY
BROCKWAY
TODD
BAD AXE
HARRINGTON
WELLS
WARD
SANBORN
WHITE
PINE
DAVIS
SHERIDAN LINE
MORTIMER LINE
CRIBBINS
WAGNER
MILES
8TH
ELLA
HOWARD
CROSWELL
GABBY
WIXSON
FABBRI
BABCOCK
BURNS LINE
BAKER
GARDNER LINE
VINCENT
KIPLING
CEDAR
ELM
ASPEN
SAINT CLAIR
WELLMAN LINE

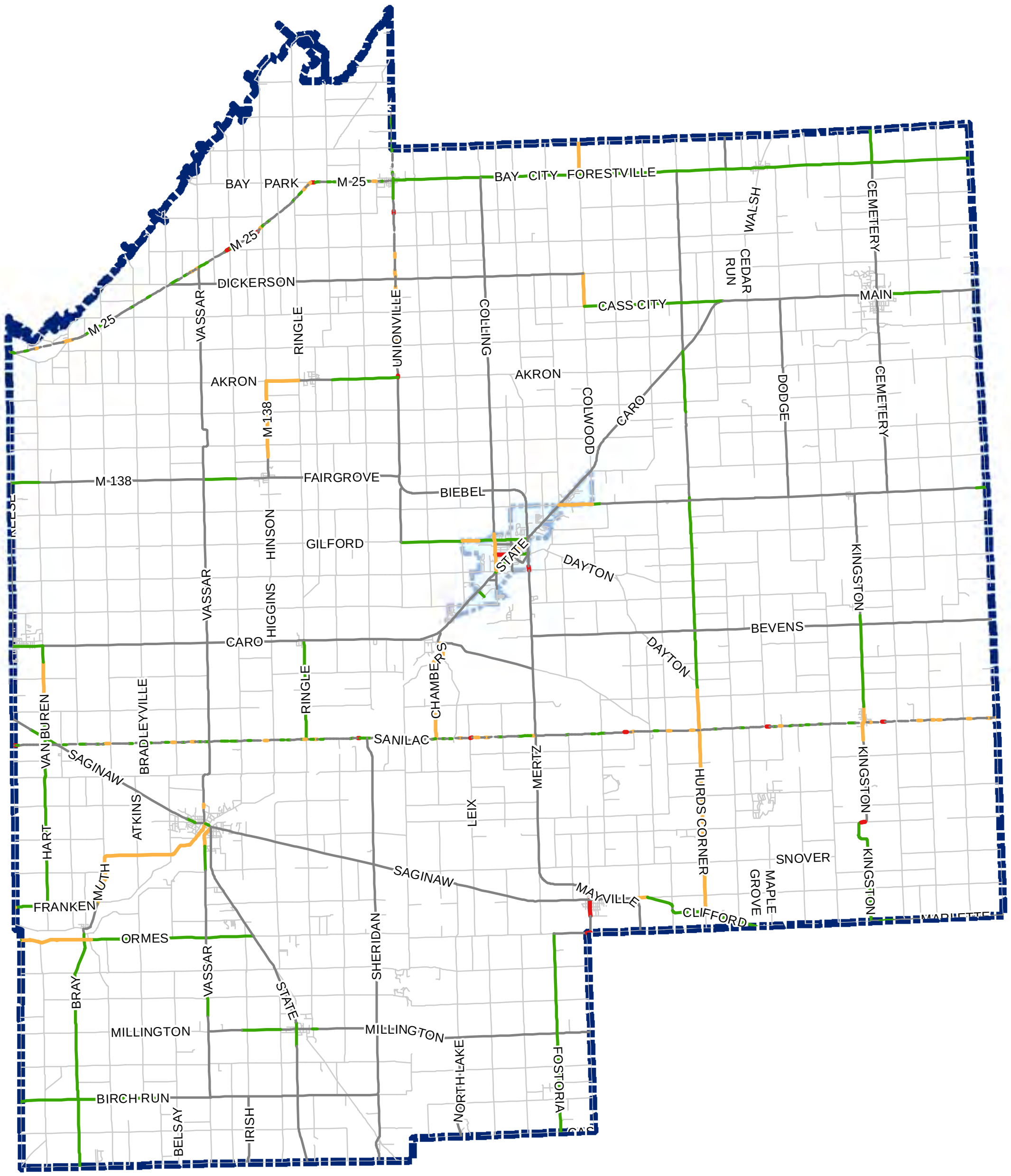
Sanilac County
2010 - 2014 Single Vehicle Lane Departure Crash Density



Sanilac County
2010 - 2014 Ped and Bicycle Crash Density



Tuscola County
Segment Crash Rate (2010 - 2014)



Legend

- Urban Boundary
- Tuscola County
- No Data

Segment Crash Rate (per 100 MVM)

- 100 or below
- 100 - 200
- 200 - 400
- 400 or higher

N S W E

0 1.5 3 6 9 12 Miles

Note:
Segments less than 300 ft are not illustrated.
Segment crash rates are expressed in 100 Million Vehicle Miles (MVM) traveled.
The first category (i.e. 100 or below) represents the regional dataset's average segment crash rates. Successive categories represent segment crash rate in multiples of two relative to the county average.

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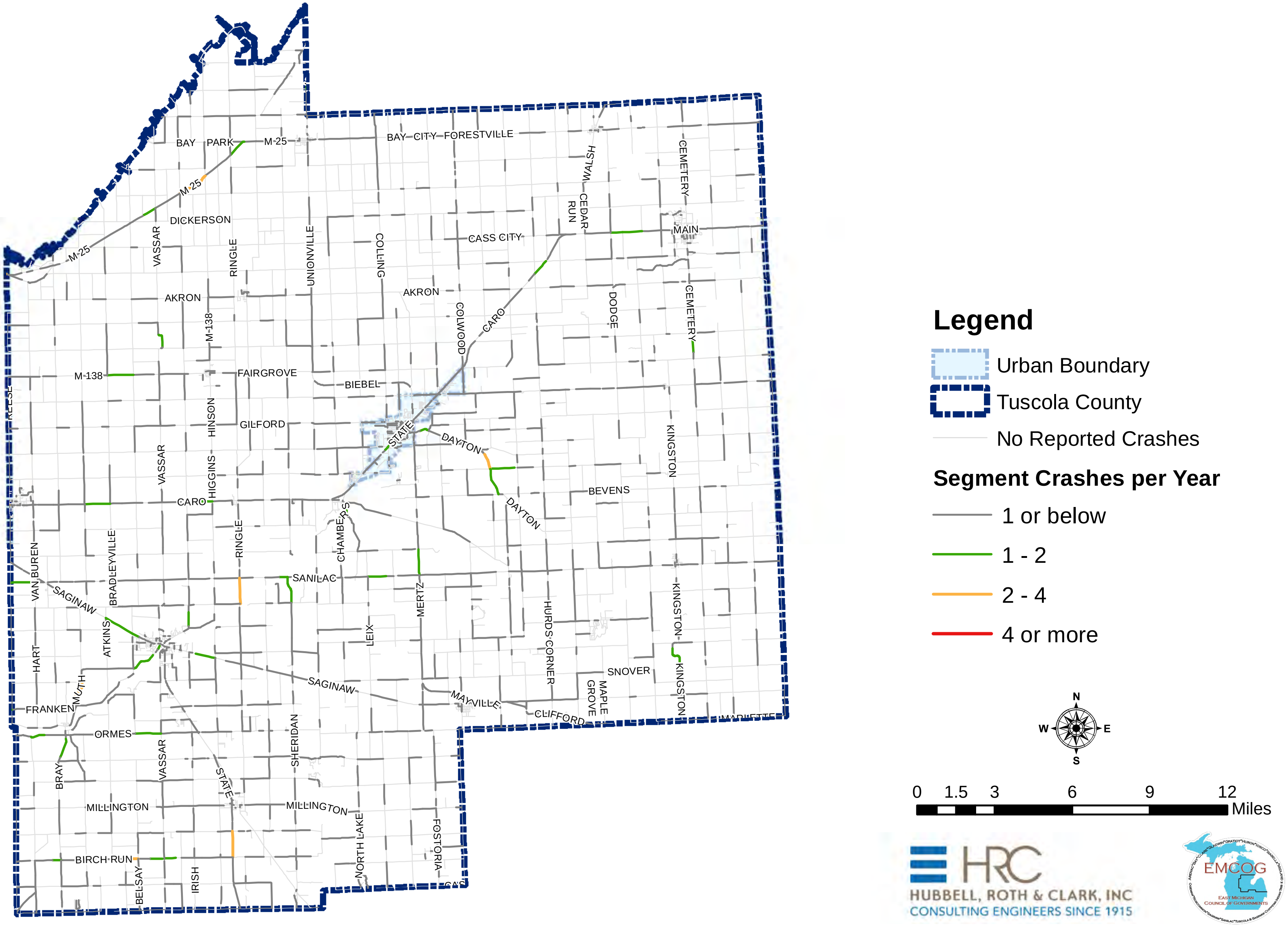
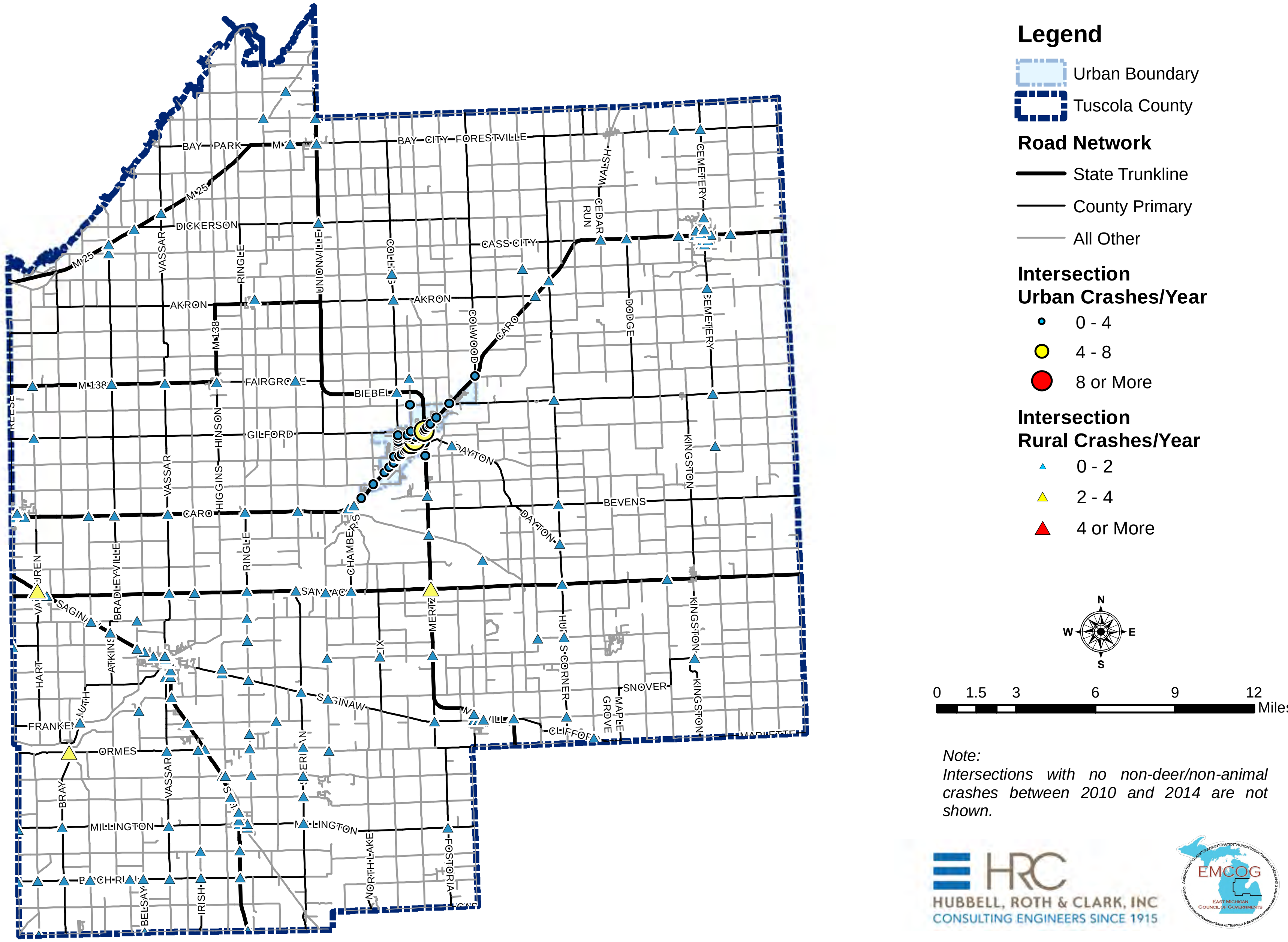
EMCOG East Michigan Council of Governments

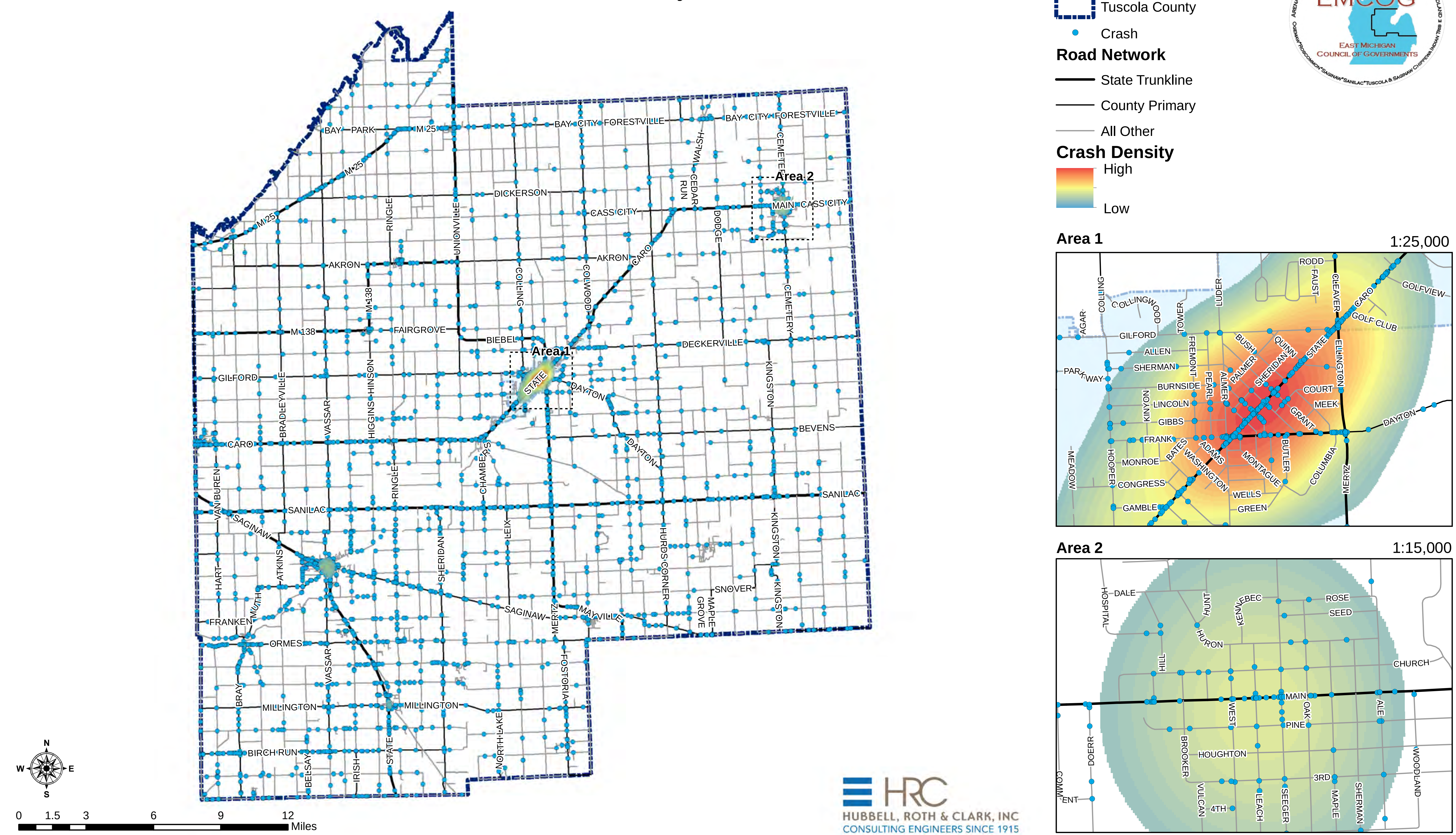
Tuscola County
Segment Crash Frequency (2010 - 2014)



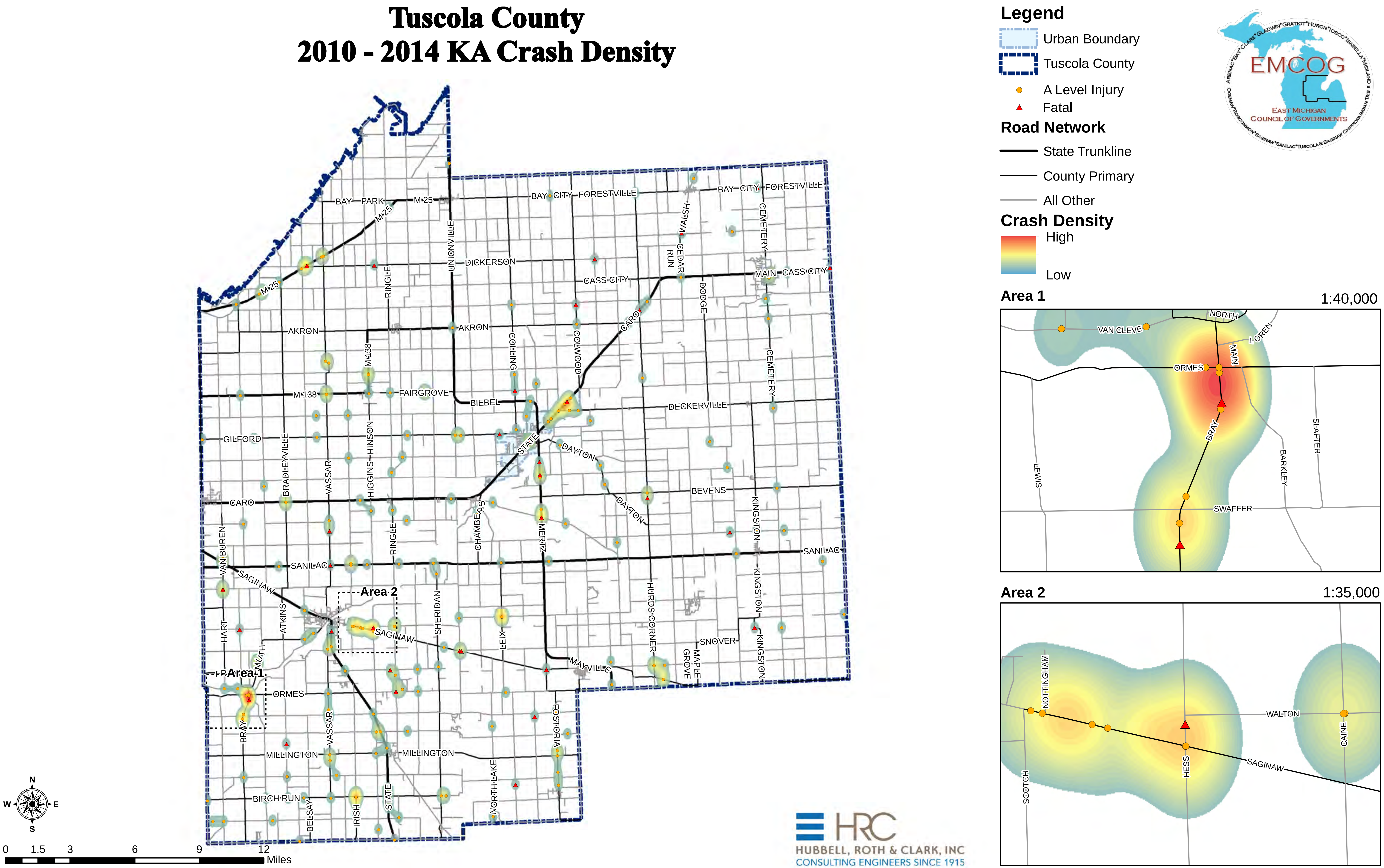
Tuscola County
Intersection Crashes per Year (2010 - 2014)



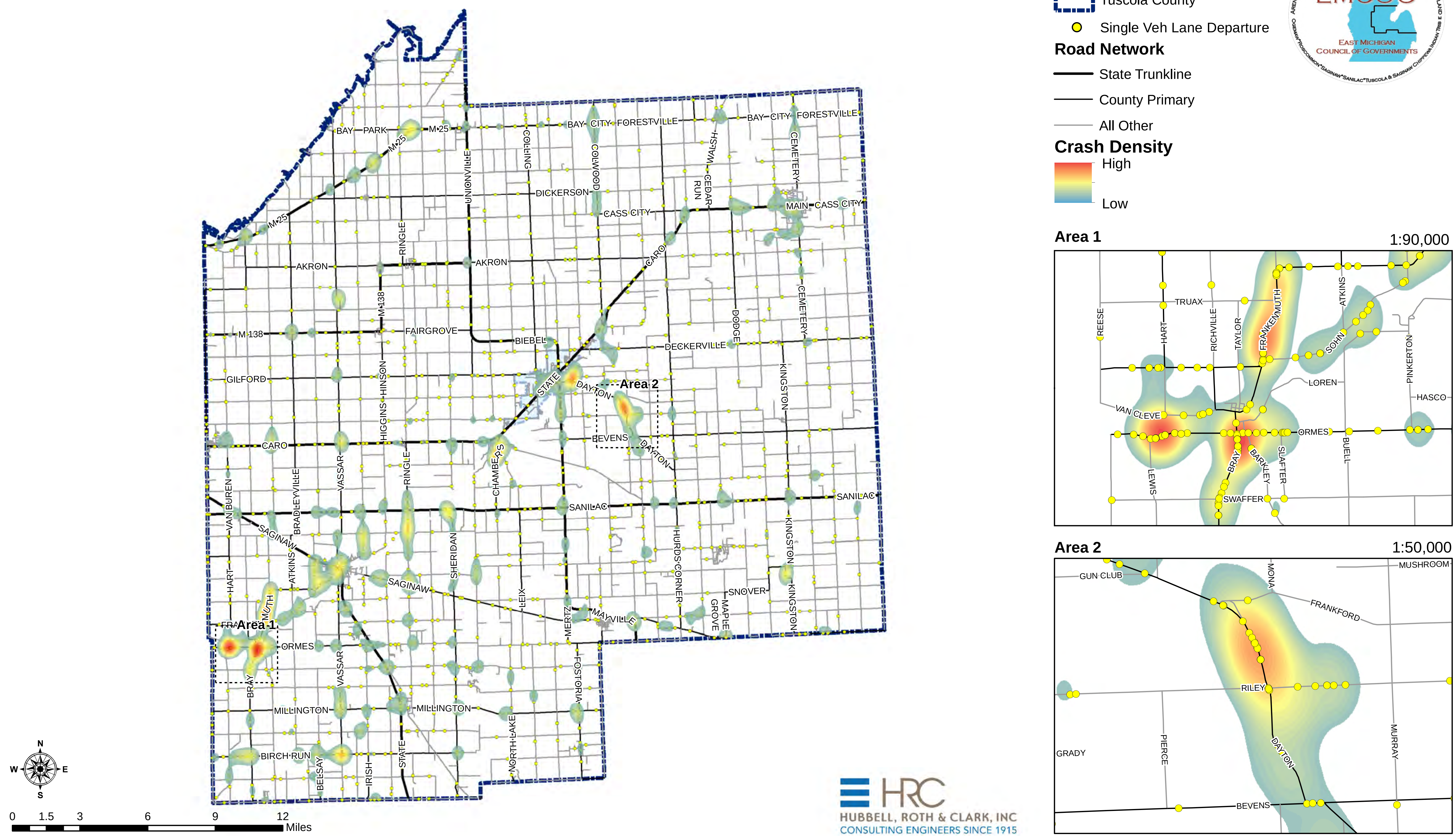
Tuscola County
2010 - 2014 Crash Density



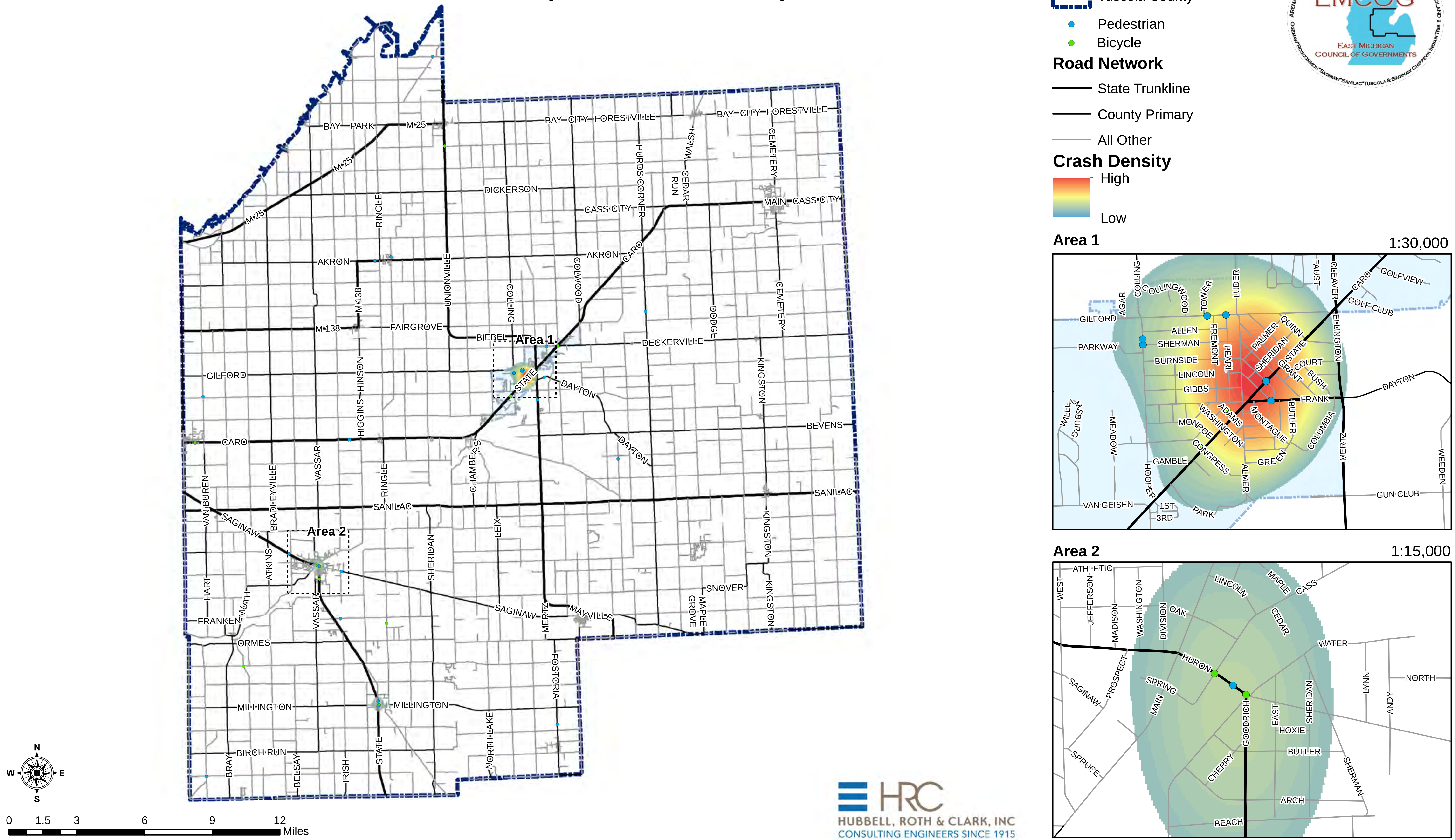
Tuscola County
2010 - 2014 KA Crash Density

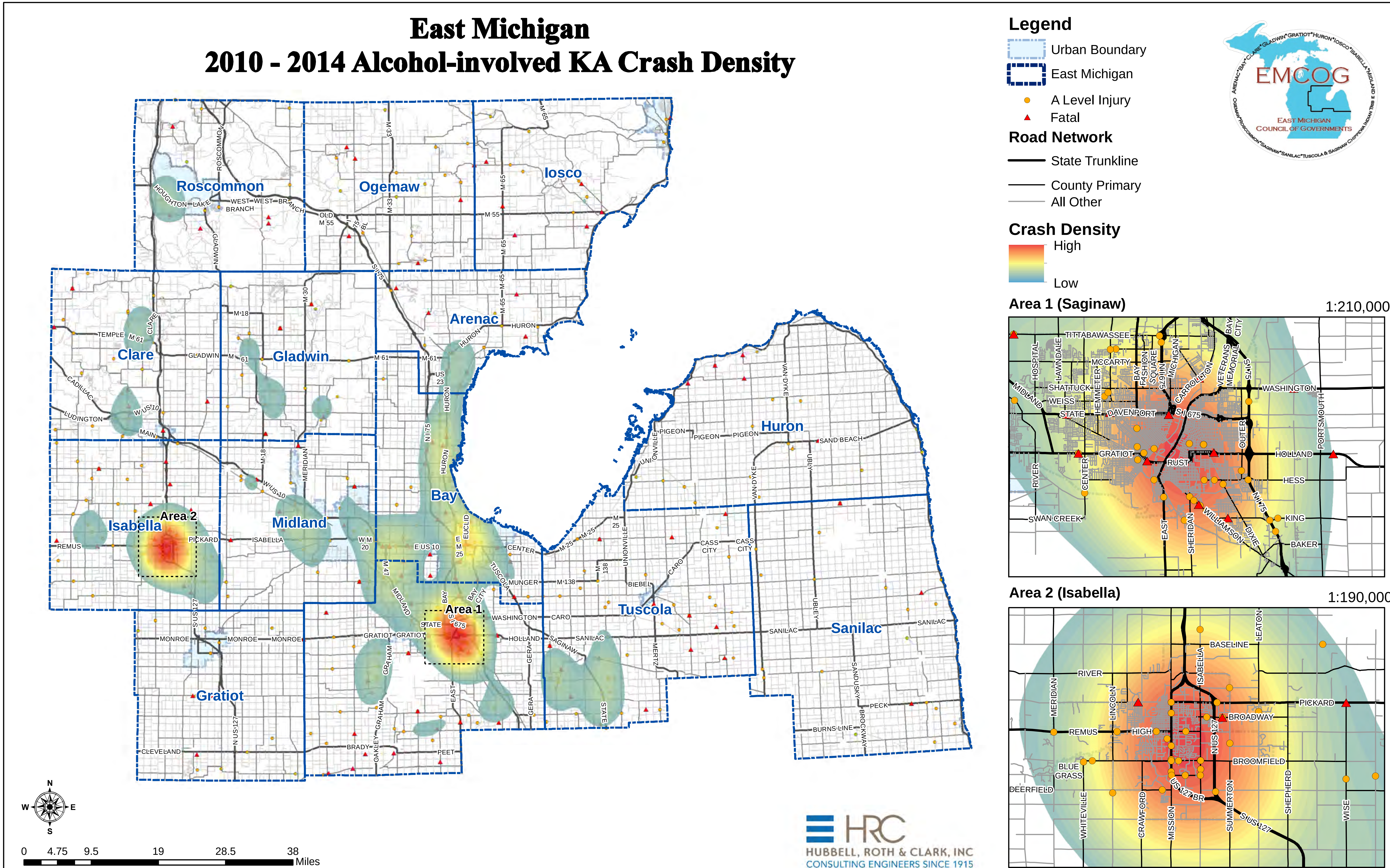


Tuscola County
2010 - 2014 Single Vehicle Lane Departure Crash Density



Tuscola County
2010 - 2014 Ped and Bicycle Crash Density




East Michigan
2010 - 2014 Alcohol-involved KA Crash Density
Legend
Urban Boundary
East Michigan
A Level Injury
Fatal
Road Network
State Trunkline
County Primary
All Other
Crash Density
High
Low
Area 1 (Saginaw)
1:210,000
Area 2 (Isabella)
1:190,000
EMCOG
East Michigan Council of Governments
Roscommon
Ogemaw
Iosco
Clare
Gladwin
Arenac
Isabella
Midland
Bay
Huron
Tuscola
Sanilac
Gratiot
Area 1
Area 2
0 4.75 9.5 19 28.5 38
Miles
N
S
E
W
HRC
HUBBELL, ROTH & CLARK, INC
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