



Technical Memorandum

Transportation Safety



Prepared for:
OHIO DEPARTMENT OF
TRANSPORTATION

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1. EXISTING SAFETY CONDITIONS AND TRENDS

1.1 Highway Safety

The Ohio Department of Transportation's (ODOT's) Systems Planning Section, in the Division of Planning, analyzes crash data trends to prioritize improvements that will enhance the safety of Ohio's roadway system.

1.1.1 Total Crashes 2006-2010

In 2010, there were 300,163 crashes in Ohio. 984 were fatal crashes resulting in 1,080 deaths. In other words, there was an average of approximately three motor vehicle related fatalities per day. Additionally, 108,755 people sustained injuries in 74,409 injury crashes.¹ These injuries include those reported as possible, non-incapacitating, or incapacitating injuries.

Table 1-1 provides a summary of crashes, along with resulting fatalities and injuries between 2006 and 2010. As shown in the table, there has been a general downward trend in total crashes, fatalities, fatal crashes, fatality rate, injuries, injury crashes, and injury rate. In fact, total crashes between 2006 and 2010 were reduced by 34,052 or 10.2 percent. It should be understood that in 2011, a law was passed in Ohio changing the threshold for "property damage only" crashes from \$400 to \$1,000. As a result, total crash records will be lower in the coming years reflecting this amendment.

Since 2006, total fatalities have decreased by 12.8 percent, and injuries have decreased by 11.6 percent, with historic low fatalities reported in 2009².

Table 1-1: Ohio Crash History, 2006-2010

Year	Total Crashes	Million Vehicle Miles Traveled (MVMT)	Total Registered Vehicles	Fatalities	Fatal Crashes	Fatality Rate per 100 MVMT	Injuries	Injury Crashes	Injury Rate per MVMT
2006	334,206	112,098	12,127,645	1,239	1,142	1.11	122,979	83,269	1.10
2007	328,742	111,064	12,021,879	1,257	1,163	1.13	116,382	79,674	1.05
2008	320,877	108,631	11,944,527	1,191	1,099	1.10	112,404	77,288	1.03
2009	298,658	110,776	11,792,455	1,022	945	0.92	107,564	73,228	0.97
2010	300,163	113,504	12,027,351	1,080	984	0.95	108,755	74,409	0.96

Source: *Historic Crash Rates, ODOT,*

http://www.dot.state.oh.us/Divisions/Planning/SPPM/SystemsPlanning/Crash_Rate_Information/Historical%20Crash%20Rates.pdf

¹ Historic Crash Rates, ODOT,

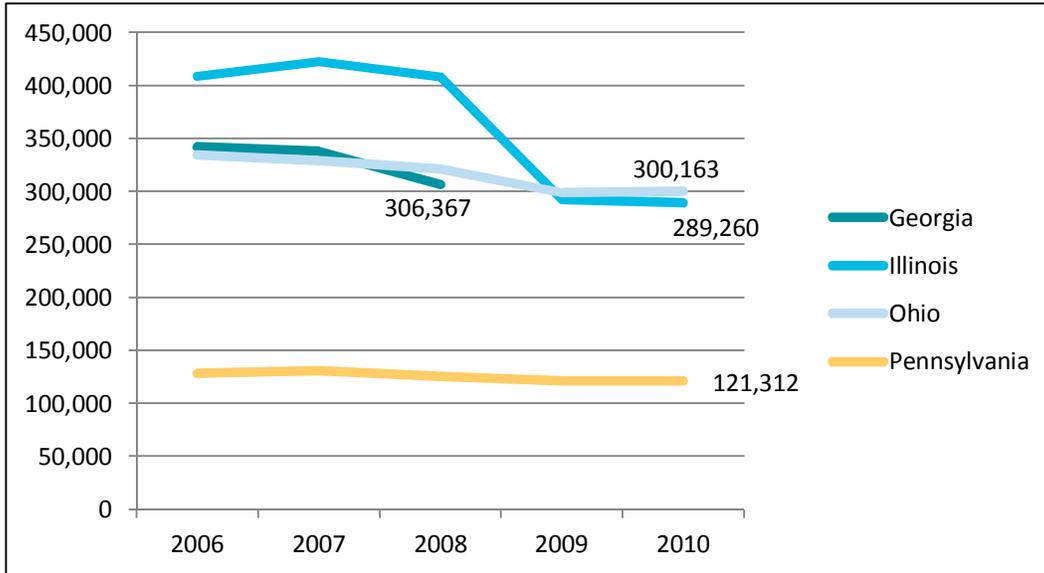
http://www.dot.state.oh.us/Divisions/Planning/SPPM/SystemsPlanning/Crash_Rate_Information/Historical%20Crash%20Rates.pdf

² <http://www.dot.state.oh.us/districts/D12/Deputy%20Director/News/Pages/OhioTrafficFatalitiesReachHistoricLowIn2009.aspx>

1.1.2 Crashes – State Comparison

It is difficult to compare crash totals between States since each State has varying crash report requirements, especially for property damage only crashes. **Figure 1-1** illustrates that crashes are trending downward in States such as Georgia, Illinois, Ohio, and Pennsylvania, all of which have similar populations.

Figure 1-1: Reported Crashes in Ohio and Comparison States, 2006-2010



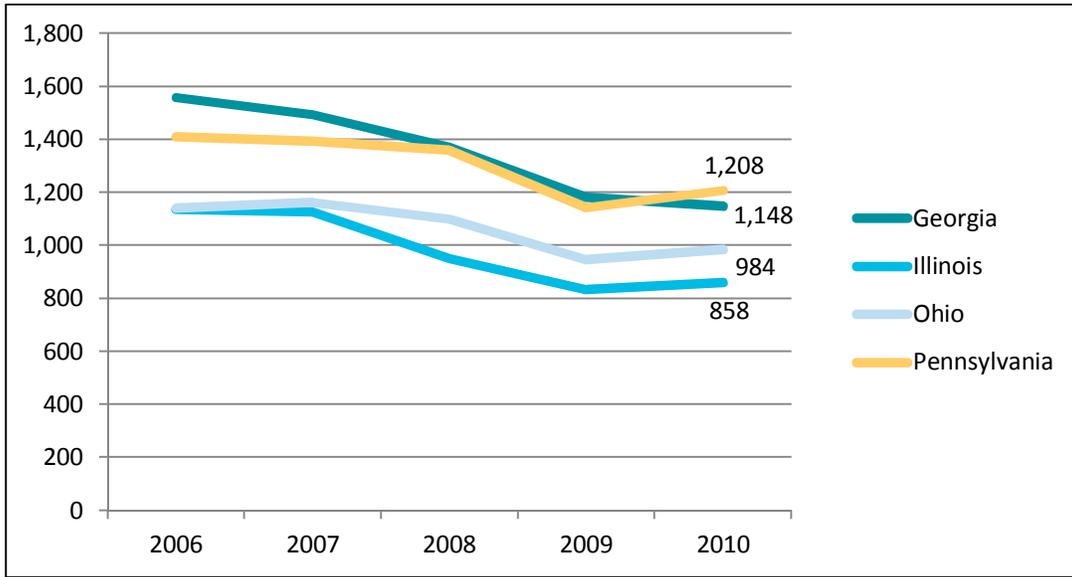
Sources: Ohio Department of Transportation, Illinois Department of Transportation, Pennsylvania Department of Transportation, Governor’s Office of Highway Safety in Georgia

Fatal crash counts are a much more comparable statewide crash statistic than total crashes. As illustrated in **Figure 1-2**, Ohio had 984 fatal crashes in 2010, which was lower than that of both Georgia and Pennsylvania. Ohio, along with Pennsylvania and Illinois, saw a slight increase in the number of fatal crashes in 2010. Overall, however, all four states have a downward trend in fatal crashes between 2006 and 2010.

Ohio has consistently been below the national rate of fatalities per 100 million vehicle miles traveled (MVMT).³ In 2010, the national fatality rate was 1.11 deaths per 100 MVMT, whereas the Ohio rate was below one death per 100 MVMT. The comparison states of Georgia and Pennsylvania also had fatality rates higher than Ohio’s. These rates can be seen in **Figure 1-3**.

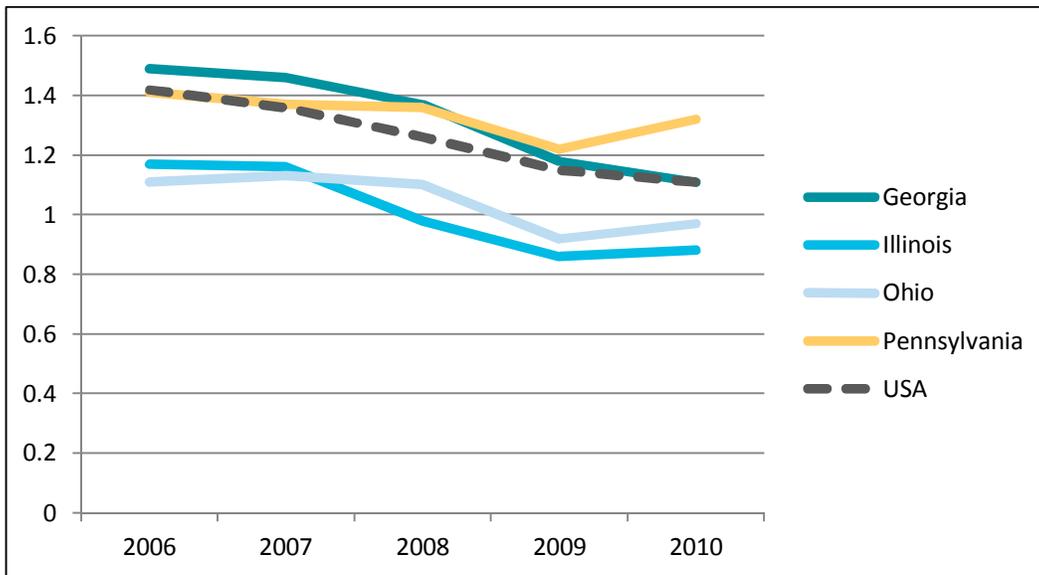
³ <http://www-nrd.nhtsa.dot.gov/Pubs/811630.pdf>

Figure 1-2: Fatal Crashes in Ohio and Comparison States, 2006-2010



Source: Fatality Analysis Reporting System (FARS), National Highway Traffic Safety Administration (NHTSA)

Figure 1-3: Fatality Rates in Ohio, USA, and Comparison States, 2006-2010



Source: FARS, NHTSA

1.1.3 Ohio Crash Characteristics

It is important to note that crash data per MVMT is only gathered on the federal aid highway system, which in Ohio represents 19,256 of the State’s 122,692 centerline miles of roadway. **Table 1-2** provides crash rates per MVMT by ODOT functional classification system on the federal aid highway system. As can be seen, overall crash rates on Urban Interstates and Other Freeways and Expressways are higher than crash rates on Rural Interstates. Conversely, crash rates on collectors are higher in rural areas than urban areas.

Table 1-2: Crash Rates by Functional Classification

Functional Classification	Crash Rate (Crashes per MVMT)
1 - Rural Interstate	0.63
2 - Rural Other Principal Arterial	0.98
6 - Rural Minor Arterial	1.54
7 - Rural Major Collector	1.94
8 - Rural Minor Collector	2.41
9 - Rural Local	0.12
11 - Urban Interstate	0.95
12 - Urban Other Freeways and Expressways	0.89
14 - Urban Other Principal Arterial	2.07
16 - Urban Minor Arterial	2.00
17 - Urban Collector	1.52

Source: 2010 One Year Base Rates by Functional Class, ODOT,

http://www.dot.state.oh.us/Divisions/Planning/SPPM/SystemsPlanning/Crash_Rate_Information/2010%20One%20Year%20Crash%20Rates.pdf

Notes: Only includes state roadways (IR, US, SR); does not include the Ohio Turnpike; intersection and related crash data are not included.

ODOT tracks many types of crashes, including those that involve pedestrians, bicycles and motorcycles. In 2010, Ohio experienced the following:

- 4,466 crashes involving motorcycles (1.49 percent of total 300,163 crashes);⁴
- 2,014 crashes involving bicycles or similar modes of transport (0.67 percent of total);
- 2,546 crashes involving pedestrians (0.85 percent of total);⁵
- 76 crashes involving trains (0.03 percent of total); and
- 25,138 crashes involving animals (8.4 percent of total).⁶

⁴ Motorcycle Crash Severity by Year (1996-2010), ODOT, http://www.dot.state.oh.us/Divisions/Planning/SPPM/SystemsPlanning/Motorcycle_Crash_Data_Sheets/Motorcycle%20Severity%20Chart%201996-2011.pdf

⁵ ODOT Crash Data

⁶ ODOT Annual Crash Type Summaries, ODOT, <http://www.dot.state.oh.us/Divisions/Planning/SPPM/SystemsPlanning/Documents/Crash%20Type%20Counts%202001-2010.pdf>

ODOT also tracks and analyzes 14 characteristics of crashes to identify strategies for reducing crashes. By analyzing different combinations of crash characteristics, ODOT is able to identify interrelated causes of crashes, leading to an improved ability to optimize crash reduction strategies in the State Highway Safety Plan (SHSP), which is described in section 1.2.2.

Table 1-3 shows the number of fatalities tabulated by the 14 crash characteristics. Roadway departure is the characteristic that had the most fatalities (3,023) between 2006 and 2010. Other crash characteristics highly associated with fatalities included alcohol use, failure to use safety restraints, young drivers, and excessive speed. The highest combination of characteristics leading to fatalities was roadway departures in which vehicle occupants were not properly using safety restraints. This combination accounted for 1,470 fatalities.

Table 1-4 shows the number of serious injuries tabulated by various crash characteristics. Young drivers were the characteristic most highly associated with serious injuries between 2006 and 2010. Other characteristics that were highly associated with serious injuries are intersections, roadway departure, and excessive speed. The highest combination of characteristics was young drivers involved in intersection related crashes. This combination produced 8,299 serious injuries.

In order to prioritize areas for crash reduction efforts, ODOT uses Safety Analyst⁷ software to identify roadway locations and potential improvements with the highest potential for crash reduction. These priority locations, as shown in **Figure 1-4**, are based on 2010 crash data. A clustering of priority areas exists in urbanized areas throughout the state.

⁷ Safety Analyst is a software package that is maintained and distributed by the American Association of State Highway and Transportation Officials (AASHTO). It was developed as a cooperative effort by the Federal Highway Administration (FHWA) and participating state and local agencies. See www.safetyanalyst.org.

Table 1-3: Fatalities by Associated Crash Characteristics

2006-2010 Fatalities		Total by Category	Roadway Departure	Intersection Related	Alcohol Related Involvement	Restraints Not Used Driver/Occupants	Young Driver Involvement (15-25)	Distracted or Fatigued Drivers	Speed Related Involvement	Older Driver Involvement (65 or Older)	Commercial Motor Vehicle Involvement	Motorcycle Driver/Occupants	Pedestrian Involvement	Bicycle Involvement	Rear-end crashes	Work Zone Crashes
Roadway Departure	Fatalities =	3,023		39	1376	1470	1067	86	1269	356	276	393				28
Intersection Related	Fatalities =	1,522	39		450	444	526	28	344	444	265	266	129	29	61	12
Alcohol Related Involvement	Fatalities =	2,238	1376	450		1035	727	42	934	138	158	389	183	25	67	22
Restraints Not Used Driver/Occupants	Fatalities =	2,153	1470	444	1035		831	45	870	285	262	614			68	24
Young Driver Involvement (15-25)	Fatalities =	1,965	1067	526	727	831		41	779	187	208	232	124	21	84	21
Distracted or Fatigued Drivers	Fatalities =	160	86	28	42	45	41		21	29	31	19	31	5	11	6
Speed Related Involvement	Fatalities =	1,854	1269	344	934	870	779	21		179	147	286	73	6	57	13
Older Driver Involvement (65 or Older)	Fatalities =	1,032	356	444	138	285	187	29	179		189	96	43	16	66	24
Commercial Motor Vehicle Involvement	Fatalities =	811	276	265	158	262	208	31	147	189		49	45	8	106	29
Motorcycle Driver/Occupants	Fatalities =	889	393	266	389	614	232	19	286	96	49		0	1	50	9
Pedestrian Involvement	Fatalities =	479		129	183		124	31	73	43	45	0				12
Bicycle Involvement	Fatalities =	82		29	25		21	5	6	16	8	1				1
Rear-end crashes	Fatalities =	244		61	67	68	84	11	57	66	106	50				17
Work Zone Crashes	Fatalities =	75	28	12	22	24	21	6	13	24	29	9	12	1	17	

Source: 2006-2010 Strategic Highway Safety Plan, ODOT, http://www.dot.state.oh.us/Divisions/Planning/SPPM/SystemsPlanning/SHSP_Matrix/2006-2010%20SHSP%20Matrix.pdf

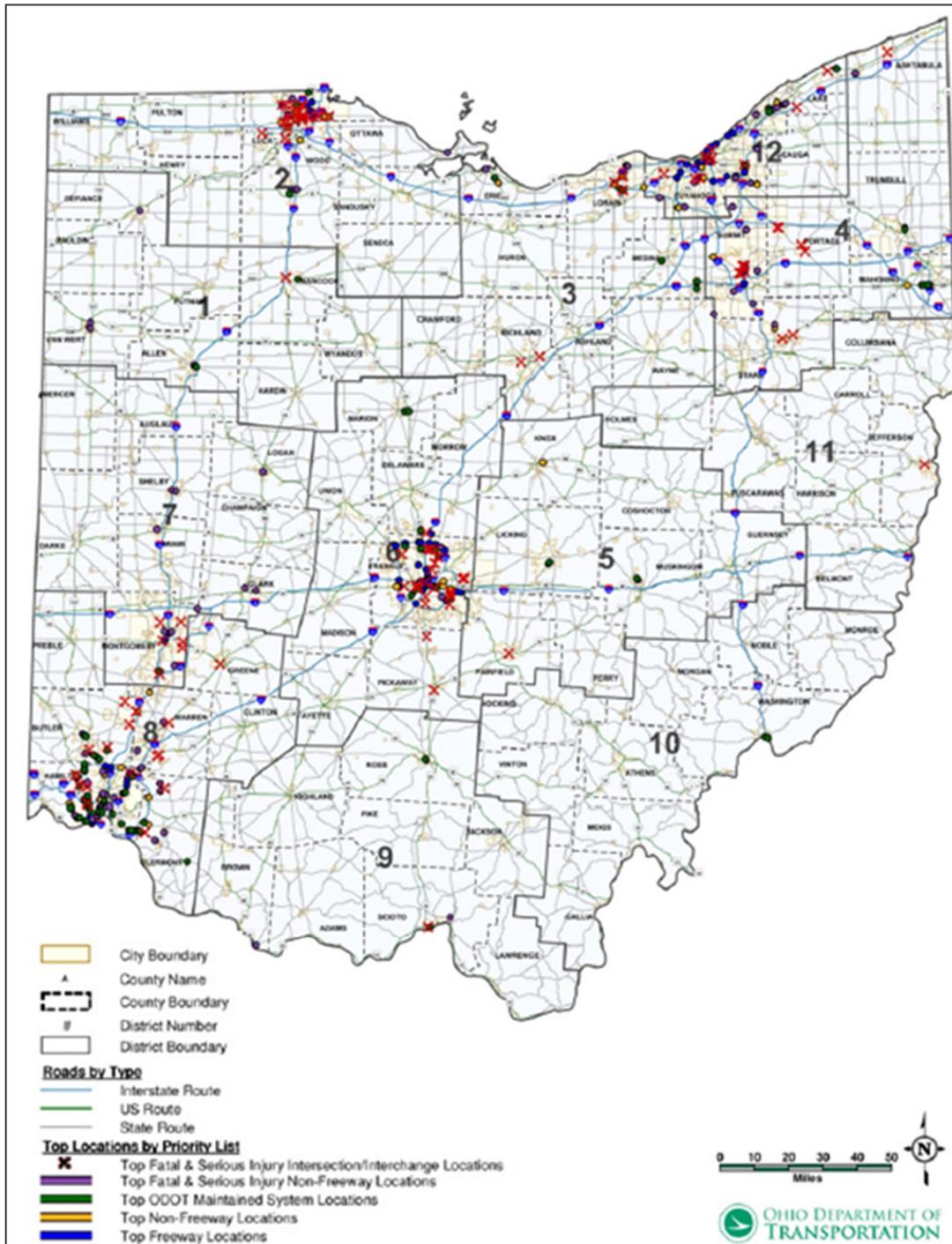
Table 1-4: Serious Injuries by Associated Crash Characteristics

2006-2010 Serious Injuries		Total by Category	Roadway Departure	Intersection Related	Alcohol Related Involvement	Restraints Not Used Driver/Occupants	Young Driver Involvement (15-25)	Distracted or Fatigued Drivers	Speed Related Involvement	Older Driver Involvement (65 or Older)	Commercial Motor Vehicle Involvement	Motorcycle Driver/Occupants	Pedestrian Involvement	Bicycle Involvement	Rear-end crashes	Work Zone Crashes
Roadway Departure	Serious Injuries =	18,705		316	5036	5522	7452	1367	7249	1365	879	1982				244
Intersection Related	Serious Injuries =	19,300	316		2006	2537	8299	352	2696	3965	1375	1887	968	625	2361	625
Alcohol Related Involvement	Serious Injuries =	8,626	5036	2006		3161	3232	211	3448	365	255	978	403	80	516	106
Restraints Not Used Driver/Occupants	Serious Injuries =	9,429	5522	2537	3161		4380	511	3491	814	690	3597			605	120
Young Driver Involvement (15-25)	Serious Injuries =	20,842	7452	8299	3232	4380		789	5518	1701	1158	1495	618	435	2774	266
Distracted or Fatigued Drivers	Serious Injuries =	2,203	1367	352	211	511	789		278	293	177	127	129	36	303	59
Speed Related Involvement	Serious Injuries =	12,058	7249	2696	3448	3491	5518	278		918	618	1460	225	52	729	191
Older Driver Involvement (65 or Older)	Serious Injuries =	7,435	1365	3965	365	814	1701	293	918		678	553	283	135	1280	143
Commercial Motor Vehicle Involvement	Serious Injuries =	3,708	879	1375	255	690	1158	177	618	678		90	118	27	788	173
Motorcycle Driver/Occupants	Serious Injuries =	6,018	1982	1887	978	3597	1495	127	1460	553	90		13	7	527	96
Pedestrian Involvement	Serious Injuries =	2,564		968	403		618	129	225	283	118	13				59
Bicycle Involvement	Serious Injuries =	1,143		625	80		435	36	52	135	27	7				5
Rear-end crashes	Serious Injuries =	6,222		2361	516	605	2774	303	729	1280	788	527				225
Work Zone Crashes	Serious Injuries =	803	244	185	106	120	266	59	191	143	173	96	59	5	225	

Source: 2006-2010 Strategic Highway Safety Plan, ODOT, http://www.dot.state.oh.us/Divisions/Planning/SPPM/SystemsPlanning/SHSP_Matrix/2006-2010%20SHSP%20Matrix.pdf



Figure 1-4: Safety Priority Locations



Source: Statewide 2010 Safety Analyst Peak Searching Locations, ODOT, http://www.dot.state.oh.us/Divisions/Planning/SPPM/SystemsPlanning/Safety%20Priority%20Documents/2010%20SafetyAnalyst%20Locations_Statewide%20Map.pdf

1.2 Aviation Safety

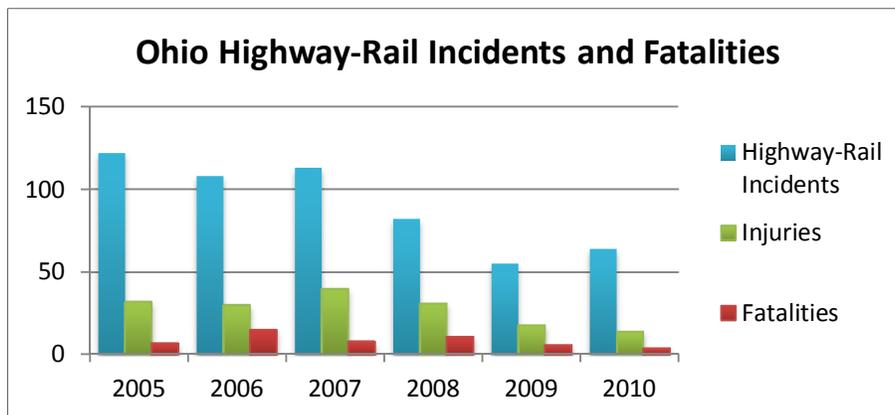
According to the National Transportation Safety Board (NTSB), Ohio had 72 fatal aircraft crashes resulting in 130 fatalities between January 1, 2002 and January 1, 2012. During the same time period there were 325 non-fatal crashes.⁸ An aircraft crash is defined as: “An occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage.”⁹

1.3 Rail Safety

The Public Utilities Commission of Ohio (PUCO) publishes an annual Highway-Rail Grade Crossing Statistics Report that highlights train crashes occurring between highway users and rail users at public grade rail crossings. Public grade rail crossings are those where the roadway is under the jurisdiction of and maintained by a public authority such as ODOT. Highway users include any pedestrian, motorized, or non-motorized mode of surface transportation that travels within the public highway right of way. The PUCO report does not include crashes that occur at private rail crossings or at any location along the rail tracks that is not within a designated crossing. For example, a trespassing pedestrian walking on the tracks will not be reported in PUCO’s annual Highway-Rail Grade Crossing Statistics Report.

Figure 1-5 illustrates a few train crash statistics at public grade rail crossings for the years 2005-2010. As can be seen, there has generally been a declining trend in total crashes, injury crashes, and fatalities at public grade rail crossings from 2005 to 2010. To continue improving the safety of public grade rail crossings the Ohio Rail Development Commission implements several safety programs. These programs are funded annually with approximately \$15 million from the FHWA Highway Safety Improvement and Surface Transportation Programs.

Figure 1-5: Train Crashes in Ohio, 2005-2010



Source: “Crash Statistics at Public Grade Crossings In Ohio”, Ohio Railroad Safety Improvement Plan - FY 2011, page 5.
 *Data does not include suicide or trespasser incidents

⁸ Aviation Accident Database, National Transportation Safety Board, <http://www.nts.gov/aviationquery/index.aspx>

⁹ Title 49 of the Code of Federal Regulations (CFR), part 830. Note that unmanned aircraft accidents as defined in 49 CFR part 830 are now included in aircraft accidents.

2. PLANNED IMPROVEMENTS AND PROGRAMS

2.1 Strategic Highway Safety Plan

Each state is required to develop a Strategic Highway Safety Plan (SHSP). The Ohio Departments of Transportation and Public Safety coordinate a steering committee comprised of various local, state and federal agencies in order to develop the SHSP for Ohio. The purpose of Ohio's SHSP is to identify key safety needs and guide investment decisions to achieve significant reductions in fatalities and serious injuries on all public roads and across all modes of transportation. The committee has identified the following emphasis areas in the SHSP:

- **Emphasis Area I—Data and Support Systems.** Includes strategies for increasing the timeliness, reliability, comprehensiveness, and integration of safety data and analysis systems.
- **Emphasis Area II— Serious Crash Types.** Includes strategies for reducing serious types of crashes such as fixed-object, head-on, and intersection crashes
- **Emphasis Area III—High-Risk Behaviors/Drivers.** Focuses on strategies that address high risk drivers, such as seniors or young drivers, and high risk behaviors like alcohol-impaired driving, misuse or nonuse of safety restraints, distracted or fatigued driving, and aggressive driving.
- **Emphasis Area IV— Special Vehicles/Roadway Users.** Focuses on strategies to reduce crashes involving motor carriers, motorcycles, bikes, and pedestrians, as these groups are more likely to be involved in fatal or incapacitating crashes.
- **Emphasis Area V—Incident and Congestion Related Crashes.** Targets the high number of rear-end collisions that occur in congestion or work zones.

2.2 ODOT Safety Programs

The safety-related projects and programs that are funded by ODOT reflect a focus on the five emphasis areas identified in the SHSP. The ODOT Safety Program and the Safe Routes to School Program are two ODOT managed programs that rely on the SHSP for project prioritization.

Tables 2-1 and **2-2** provide an overview of the type of projects that have included safety elements in the years 2010 - 2012. **Table 2-1** shows the number of projects and **Table 2-2** shows the total value of these projects. The dollar values cover full project costs, so some of the cost totals may not be related to the safety portion of the project. Road segment projects, as identified in these tables, are those which improve the network for capacity or some other modernization that improves safety characteristics. Realignment projects deal with roadway geometry issues.

In the last three fiscal years a total of 98 projects in Ohio included safety improvements that received funding under the Highway Safety Program. The total cost of these projects was over \$244 million. Among these projects, the road segment and intersection projects accounted for a large majority of the number of projects and associated cost.

Table 2-1: Projects that Address Safety

Project Type	2010	2011	2012	Grand Total
Intersection	14	14	13	41
Road Segments	9	10	13	32
Other	7	3	1	11
Realignment	4	2	1	7
Guardrail	1		4	5
Bridge			1	1
Interchange		1		1
Grand Total	35	30	33	98

Source: Summary of information provided by ODOT Highway Safety Program

Table 2-2: Cost of Projects that Address Safety

Project Type	2010	2011	2012	Grand Total
Road Segments	\$36,326,849	\$24,838,632	\$36,471,830	\$97,637,311
Intersection	\$18,204,228	\$21,962,011	\$33,882,743	\$74,048,982
Realignment	\$18,760,119	\$4,420,445	\$5,803,779	\$28,984,343
Interchange		\$21,528,684		\$21,528,684
Other	\$8,210,403	\$1,553,497	\$276,421	\$10,040,322

2.2.1 ODOT Safety Program

In an effort to reduce crashes, ODOT routinely works with various safety advocates to:

- Identify and improve high-crash and severe-crash locations through road improvements;
- Enforce traffic laws; and,
- Promote safe driving behavior through public education.

ODOT’s annual highway safety program project budget is roughly \$102 million. The majority of these funds are dedicated towards engineering improvements at severe-crash or high-crash locations on any public road in the state. In addition to these spot location improvements, ODOT annually budgets \$10 - \$20 million of its total safety program budget for systematic improvements designed for larger stretches of roadway. The addition of guard-rails or rumble stripes to a road that is geometrically prone to serious crashes is one example of a systematic improvement that has historically been funded by the safety program.

ODOT also pools funding with other Ohio agencies to support traffic enforcement and public education programs that help reduce crashes. This funding is meant specifically to help with the Emphasis Areas in the SHSP that are not addressed through engineering projects.

2.2.2 Safe Routes to School Program

The Safe Routes to School Program (SRTS) specifically targets students walking and bicycling to and from schools. Since the program’s inception in 2004, ODOT has committed \$48 million in SRTS funding to improve safety around schools and to educate and encourage, students, parents and communities on how to bike and walk safely. SRTS funding has provided funding assistance to over

150 infrastructure projects and 70 non-infrastructure projects in 2011 and 2012. Local and regional governments, schools, and community non-profit organizations are eligible to apply for SRTS funding and can be reimbursed 100% of total project costs. ODOT will continue Safe Routes to School as a stand-alone program for the foreseeable future.

3. 2010 HIGHWAY CRASH DETAILS BY COUNTY, MODE AND BEHAVIORAL FACTORS

3.1 Introduction

This section provides crash details for various highway modes and behavioral factors at the county level. These details identify counties where the number of crashes for a particular mode or behavior is high relative to the total number of crashes for those counties. This section also identifies the counties with the most crashes overall. **Table 3-1** lists the counties with the highest numbers of crashes and corresponding percent of total statewide crashes. The counties with the most crashes tend to be the most populated counties in the state, including the areas surrounding Columbus, Cleveland, Cincinnati, Akron, Toledo, Dayton, and Canton. **Figure 3-1** illustrates county crash totals across the state.

To determine locations that are prone to crashes involving specific modes or behaviors, 2010 crash data was calculated at the county level for crashes involving pedestrians, bicycles, motorcycles, commercial motor vehicles, alcohol use, drug use and excessive speed. Each statistic was measured as a proportion of total 2010 crashes for each county. **Figures 3-2** through **3-10** illustrate these crash statistics.

Table 3-1: Counties with Highest Numbers of Total Crashes, 2010

County	Total	Percent of State Total
Franklin	33,080	11.0%
Cuyahoga	31,106	10.4%
Hamilton	29,019	9.7%
Summit	14,526	4.8%
Lucas	14,074	4.7%
Montgomery	11,648	3.9%
Stark	10,206	3.4%
Butler	8,315	2.8%
Lorain	6,792	2.3%
Mahoning	5,923	2.0%
Statewide	300,163	100%

Source: CDM Smith analysis of ODOT crash data

3.2 Pedestrians and Bicycles

Statewide, motor vehicle crashes involving pedestrians totaled 2,546 in 2010. Crashes involving bicycles totaled 2,014 in that same year. **Figure 3-2** displays the percent of crashes in each county that involved either a pedestrian or a cyclist. The counties with the highest proportions of bike or pedestrian crashes tend to be clustered in the northern and western regions of the state. The most populated counties tend to have high rates of these types of crashes, especially those involving pedestrians. This is due to the fact that larger cities have better infrastructure to support walking, and in some cases biking, which introduces higher exposure potential between the modes. The counties that include Columbus, Cleveland, Cincinnati, Akron, Toledo, and Dayton all have pedestrian and bike crashes making up more than 1.5 percent of their total crashes. Those counties include Franklin, Cuyahoga, Hamilton, Summit, Lucas, and Montgomery.

In comparing **Figures 3-3** and **3-4**, it is evident that the correlation between crash percentages and population is higher for pedestrian-related crashes than bike-related crashes. The bike-related crashes, though less correlated with population, still seem to cluster in the northern and western counties. As shown in **Figure 3-4**, the highest rates of bike-related crashes occur in Cuyahoga, Fayette, Mercer, and Miami Counties.

3.3 Motorcycles

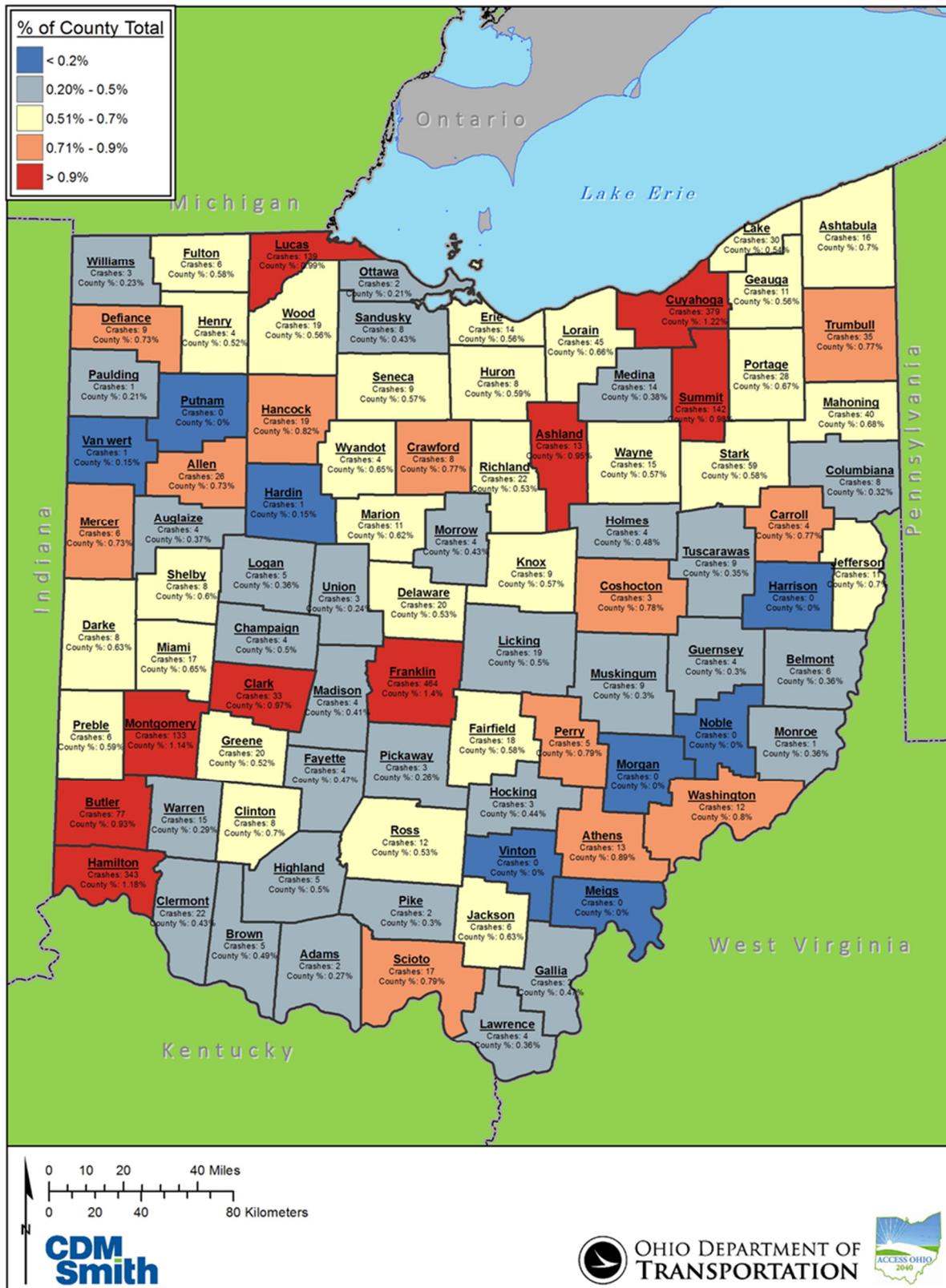
As shown in **Figure 3-5**, motorcycle crashes tend to be more likely in Ohio's southern and eastern counties. Coshocton, Harrison, Monroe, and Morgan Counties have particularly high rates of motorcycle crashes. These crashes account for more than five percent of all crashes in each of those counties. The hilly terrain in southeastern Ohio is one of the factors that makes motorcycle travel more dangerous.

3.4 Commercial Motor Vehicles

In 2010, there were 21,869 CMV crashes. ODOT's definition of a CMV includes all commercial trucks, buses, and all fifth-wheel coupled vehicles. **Figure 3-6** illustrates the geographic location of counties with high proportions of CMV crashes. Many of the counties in Ohio with the highest proportion of CMV crashes are rural counties with either an interstate running through them or a high manufacturing presence. Both of these conditions lead to a proportionally high percentage of commercial vehicle miles traveled when compared with counties that have high populations and an associated high volume of passenger vehicle travel.

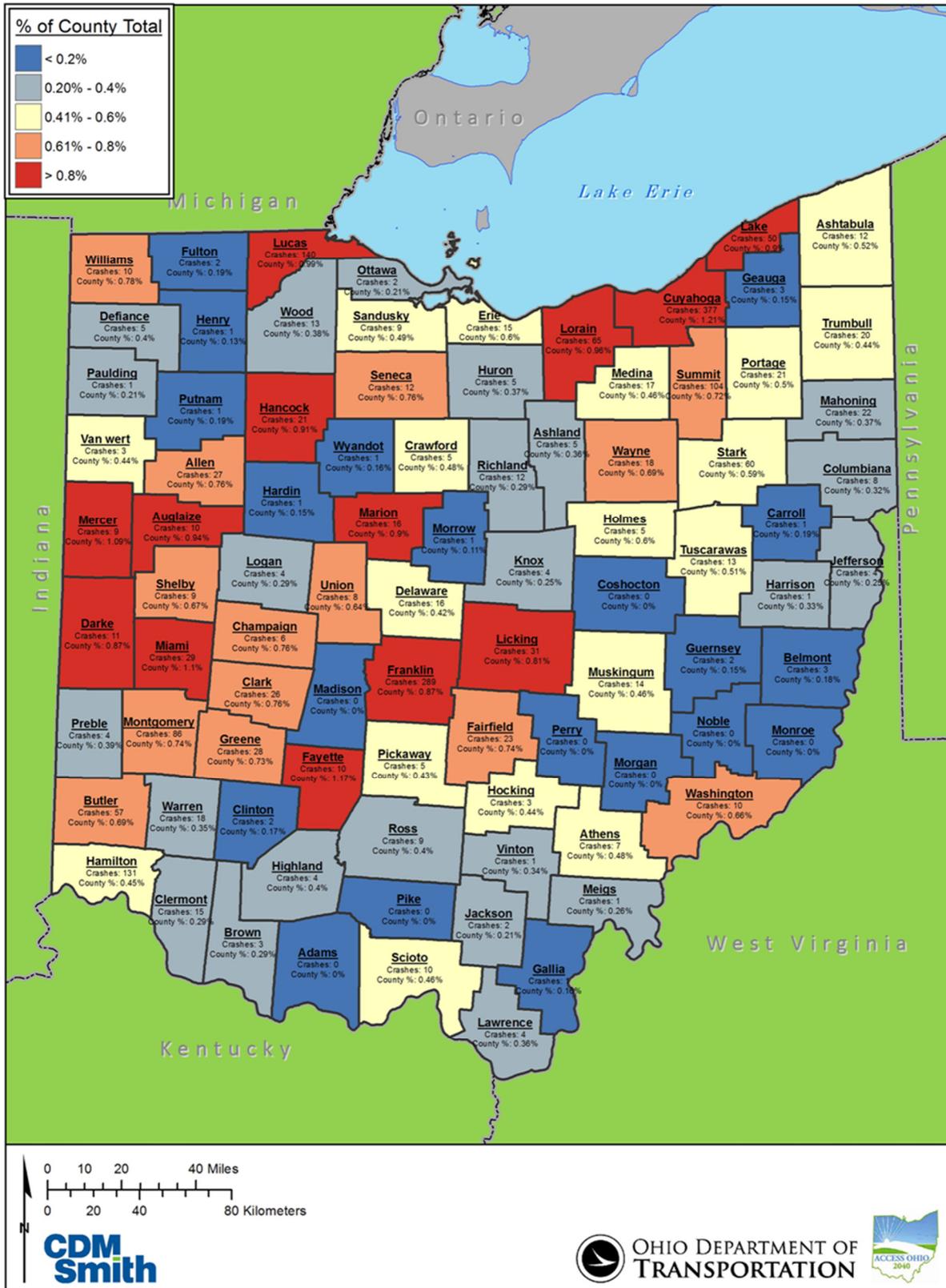
Fulton, Sandusky, and Harrison Counties all had more than 12 percent of their crashes involving CMVs in 2010. It is important to note that the total CMV crashes in each of these three counties was less than 250, which is much lower than the total CMV crashes in highly populated counties such as Cuyahoga and Franklin where there were over 2,000 CMV crashes. The percentages for these rural counties were inflated because of a high proportion of CMV travel and a low proportion of passenger vehicle travel.

Figure 3-3: 2010 Pedestrian Crashes



Source: Analysis of ODOT crash data

Figure 3-4: 2010 Bicycle Crashes



Source: Analysis of ODOT crash data

3.5 Behaviors

Dangerous driving behaviors such as speeding or driving under the influence of alcohol or drugs are a significant source of crashes and fatalities. Statewide, these three behaviors were associated with 49,000 crashes, or approximately 16 percent of total crashes in Ohio during 2010.

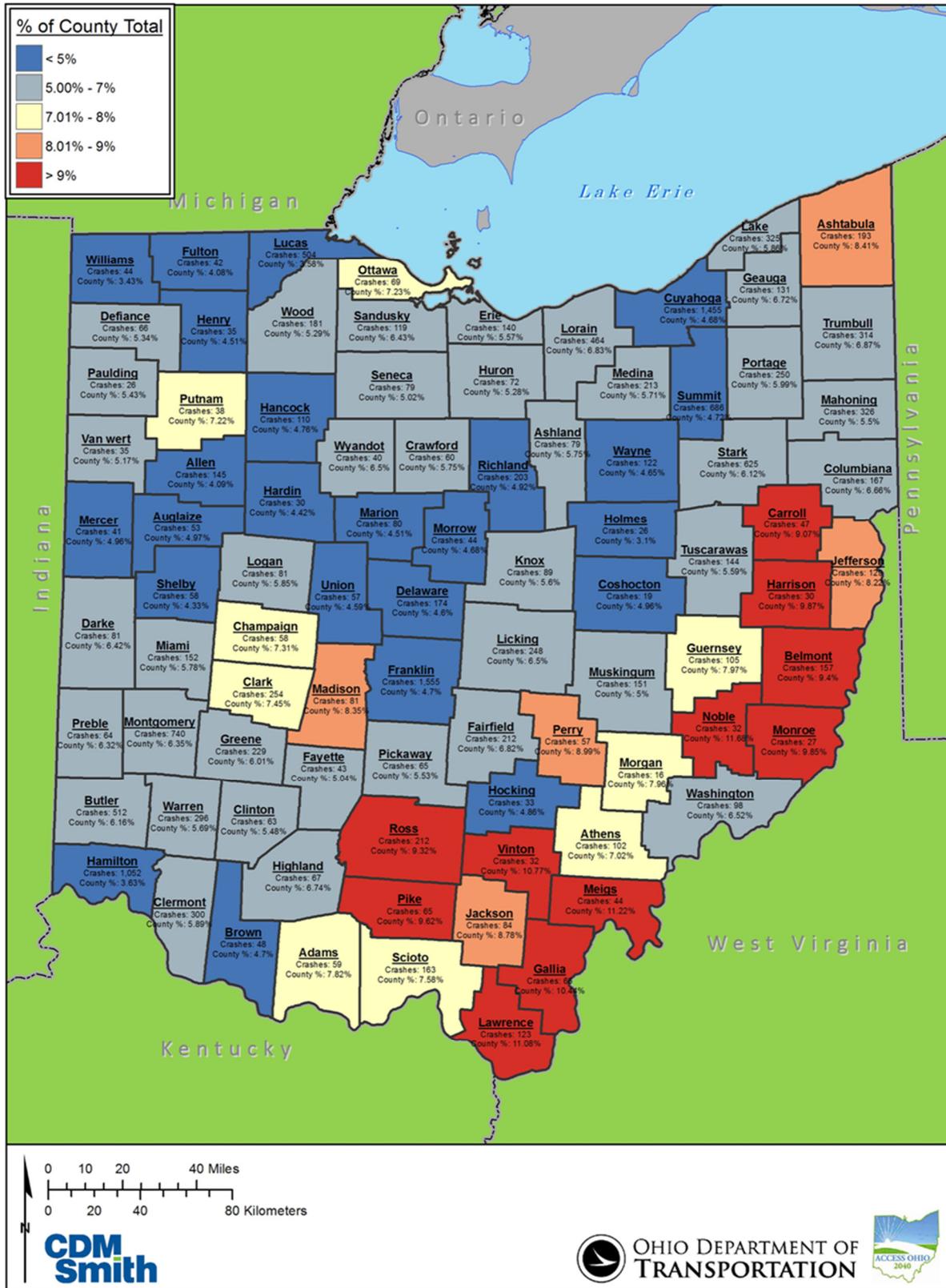
There is a strong geographic pattern associated with crashes involving drugs and alcohol, as seen in **Figure 3-7**. Counties in the southeastern part of Ohio have a much higher proportion of crashes where drugs or alcohol were a factor. Most counties have a drug or alcohol proportion of 7 percent or less, while many counties in the southeast have a proportion of over 9 percent. Noble, Lawrence, and Meigs Counties are particularly notable, having proportions over 11 percent. The southeastern counties tend to be more rural, and the residents tend to have less income than the state as a whole. Every county colored red in Figure 3-7 has a median household income that is less than the median household income for the state.¹⁰

As seen in **Figures 3-8** and **3-9**, alcohol-related crashes are more prevalent than drug-related crashes. Interestingly, counties with high proportions of alcohol-related crashes are more correlated with the eastern part of the state, while counties with high proportions of drug-related crashes are more correlated with the southern part of the state.

Finally, **Figure 3-10** reveals that speed-related crashes also tend to occur with more relative frequency in the southern and eastern counties. The crashes in this region are likely related to the steep terrain and sharp curves. Drivers tend to drive too fast for the conditions and run off the road.

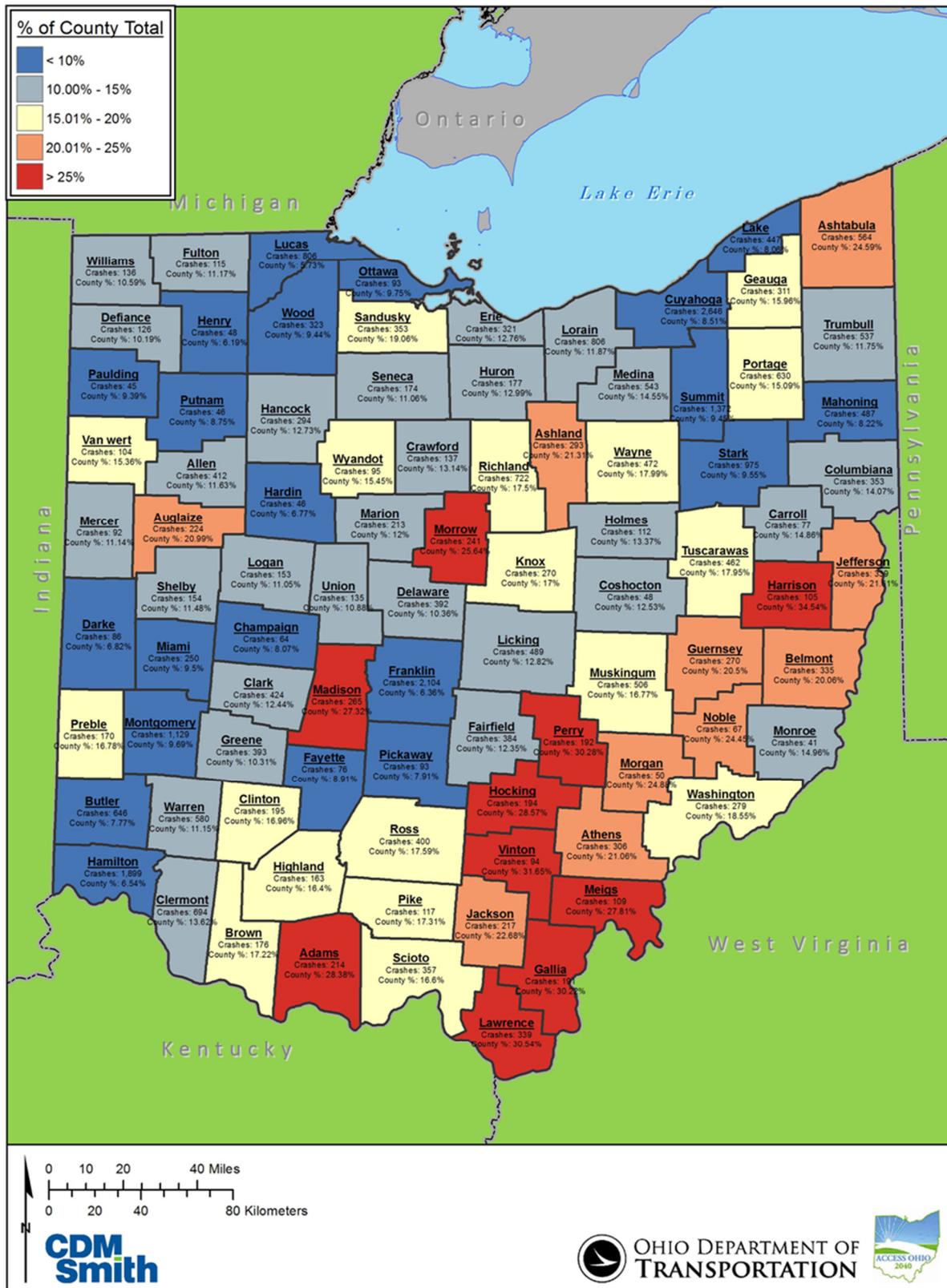
¹⁰ Census Bureau, 2010 American Community Survey, 5-year Estimates

Figure 3-7: 2010 Alcohol- or Drug-related Crashes



Source: Analysis of ODOT crash data

Figure 3-10: 2010 Speed-related Crashes



Source: Analysis of ODOT crash data



4. FUTURE CRASH PROJECTIONS AND SAFETY RELATED NEEDS

4.1 Introduction

For planning purposes, crashes were forecasted for the years 2025 and 2040 at the county level and at the corridor level. This information will be used to help determine priority safety locations for the coming decades. At the county level, crash projections were based on changes in vehicle miles traveled (VMT) from the statewide travel model. In general, counties adjacent to large cities are expected to see the highest increase in future crashes when compared to an average of annual crashes from 2007-2011. To project future crashes on specific highway corridors, the Safety Analyst model was used. In general, highways in counties north of Columbus, counties between Columbus and Cleveland along I-71, and counties directly north and east of Cincinnati are expected to have the highest percent increase in crashes by 2040.

4.2 Future Crashes by County

4.2.1 Methodology

Countywide crash projections for 2025 and 2040 are based on percent changes in VMT from a baseline year of 2010. The VMT changes were derived from the statewide travel demand model. VMT was chosen as the key indicator because it has a high positive correlation with total crashes. Also, removing other variables that affect crash totals, such as safety improvements, provides a baseline projection of what crashes are expected to be if safety measures are not taken.

The percent change in VMT from 2010 to 2025 and 2010 to 2040 was applied to a baseline number of fatal, injury, and property damage only (PDO) crashes for all Ohio counties. Each county's baseline crash total is the average number of annual injury, fatal, and PDO crashes from 2007 – 2011. **Table 4-1** shows a statewide summary of crash projections for each crash type. Again, these projections are based solely on projected changes in VMT; therefore, future safety improvements will likely keep projected crash levels from reaching the totals displayed below.

Table 4-1: Statewide Crash Projections, by Severity

	2011	2025	2040
Fatal	941	1,114	1,199
Injury	72,305	80,798	85,963
PDO	218,917	248,273	264,176
Total	292,163	330,185	351,338

Source: CDM Smith analysis of ODOT crash data

4.2.2 Fatal Crashes

Figures 4-1 and **4-2** illustrate the projected percent change in fatal crashes from recent years to 2025 and 2040. In 2025, Delaware, Harrison, Morgan, and Noble Counties are predicted to have the greatest relative increase in fatal crashes at over 30 percent. By 2040, 17 counties are projected to see a 30 percent or greater increase in fatal crashes from the 2007-2011 average. Delaware, Harrison,

Knox, Morgan, and Noble Counties are all projected to see in excess of a 40 percent increase in fatal crashes. An important note on these numbers is that absolute increases in fatal crashes tend to be quite small. For example, Noble County is predicted to increase in fatal crashes by 50 percent. However, Noble County only had an average of 2 fatal crashes between the years 2007 and 2011, so an increase of 50 percent is an increase of one fatal crash.

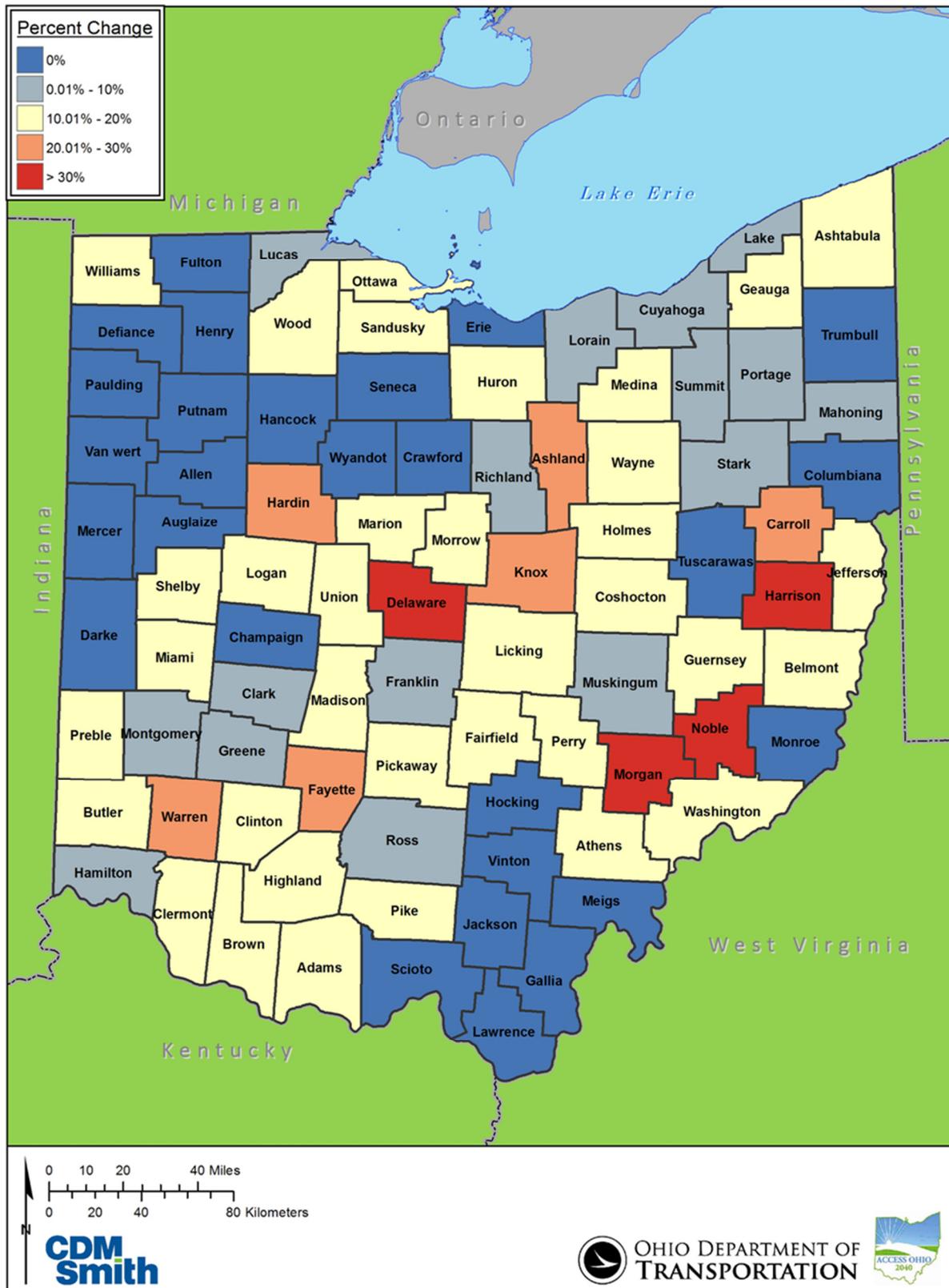
4.2.3 Injury Crashes

As shown in **Figure 4-3**, Delaware, Union, and Warren Counties are projected to have the highest percentage change in injury crashes from the base crash number to the projected 2025 crash number. These counties will each increase in injury crashes by over 20 percent. By 2040, 32 counties are predicted to experience an increase in injury crashes of more than 20 percent, which is shown in **Figure 4-4**.

4.2.4 All Crashes

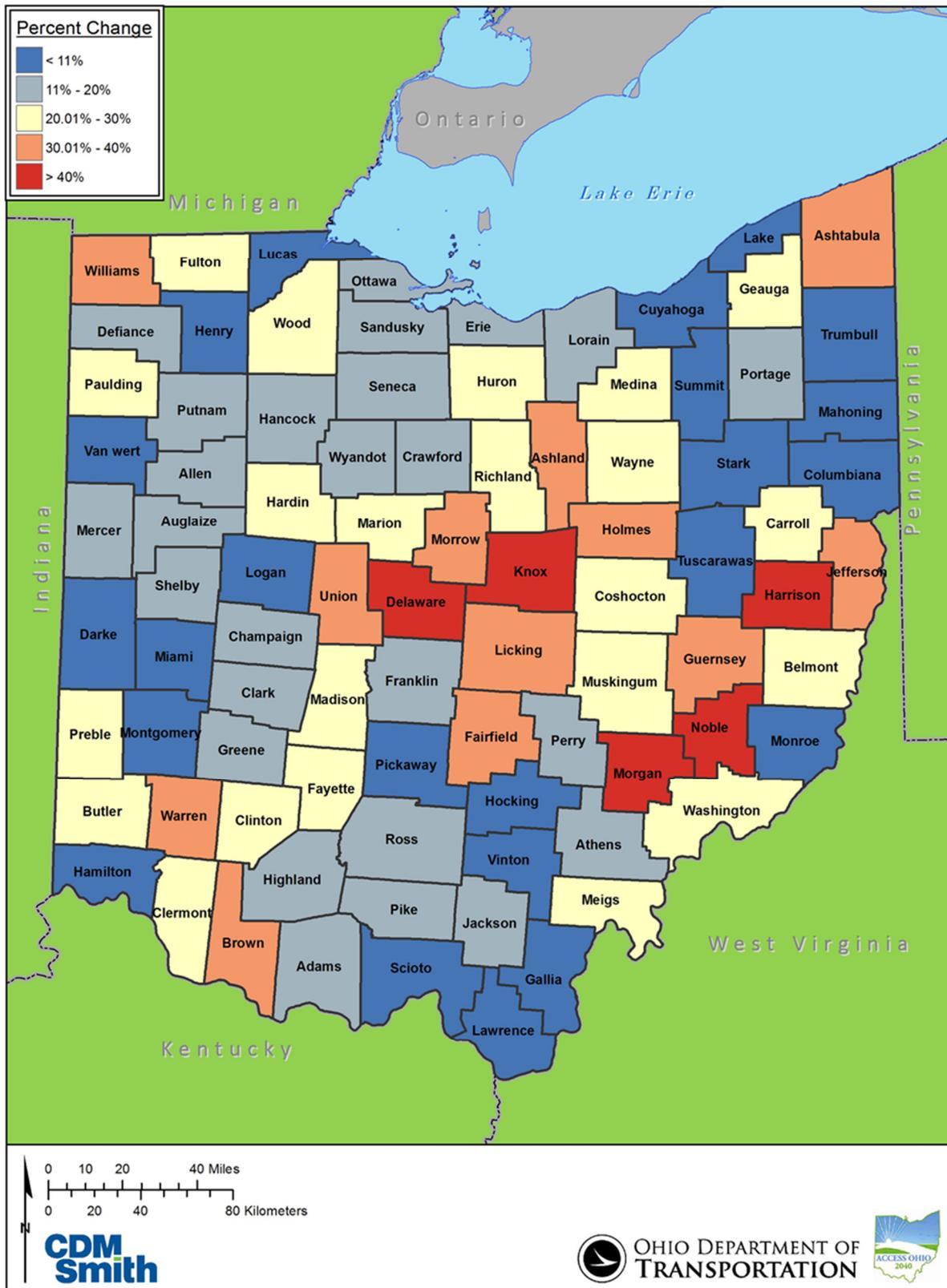
In general, the counties adjacent to large cities are expected to see the most growth over the next 27 years, and, as a result total crashes are expected to increase the most in these counties. Delaware and Union counties, which are adjacent to Columbus, and Warren County, which is adjacent to Cincinnati, are projected to have the highest percentage change in total crashes from the base crash number to the 2025 crash number, as shown in **Figure 4-5**. By 2040 (**Figure 4-6**), 32 counties are predicted to experience an increase in total crashes of more than 20 percent.

Figure 4-1: Percent Change in Fatal Crashes from 2007-2011 Average to 2025



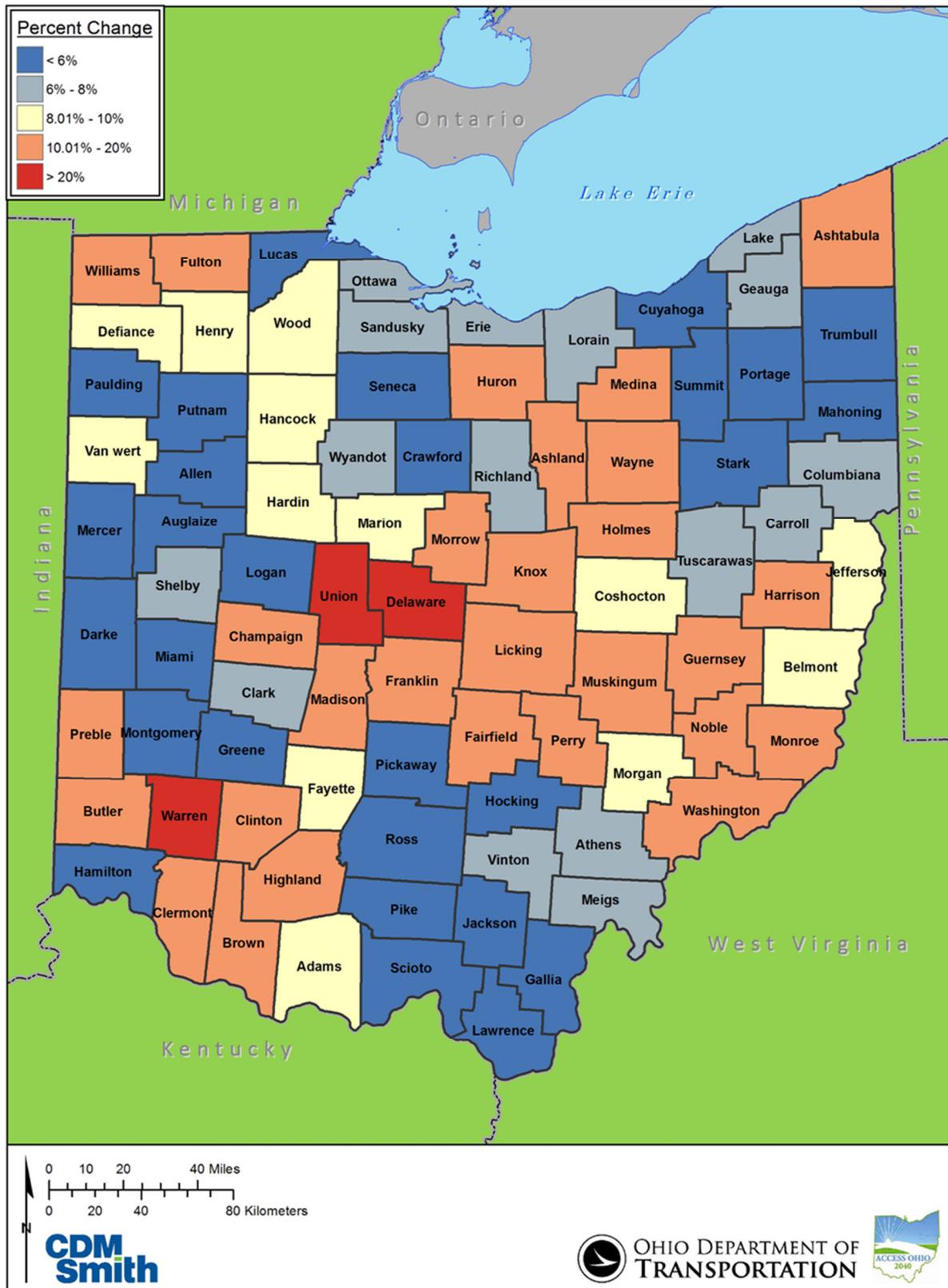
Source: Analysis of ODOT crash data and statewide travel model projections

Figure 4-2: Percent Change in Fatal Crashes from 2007-2011 Average to 2040



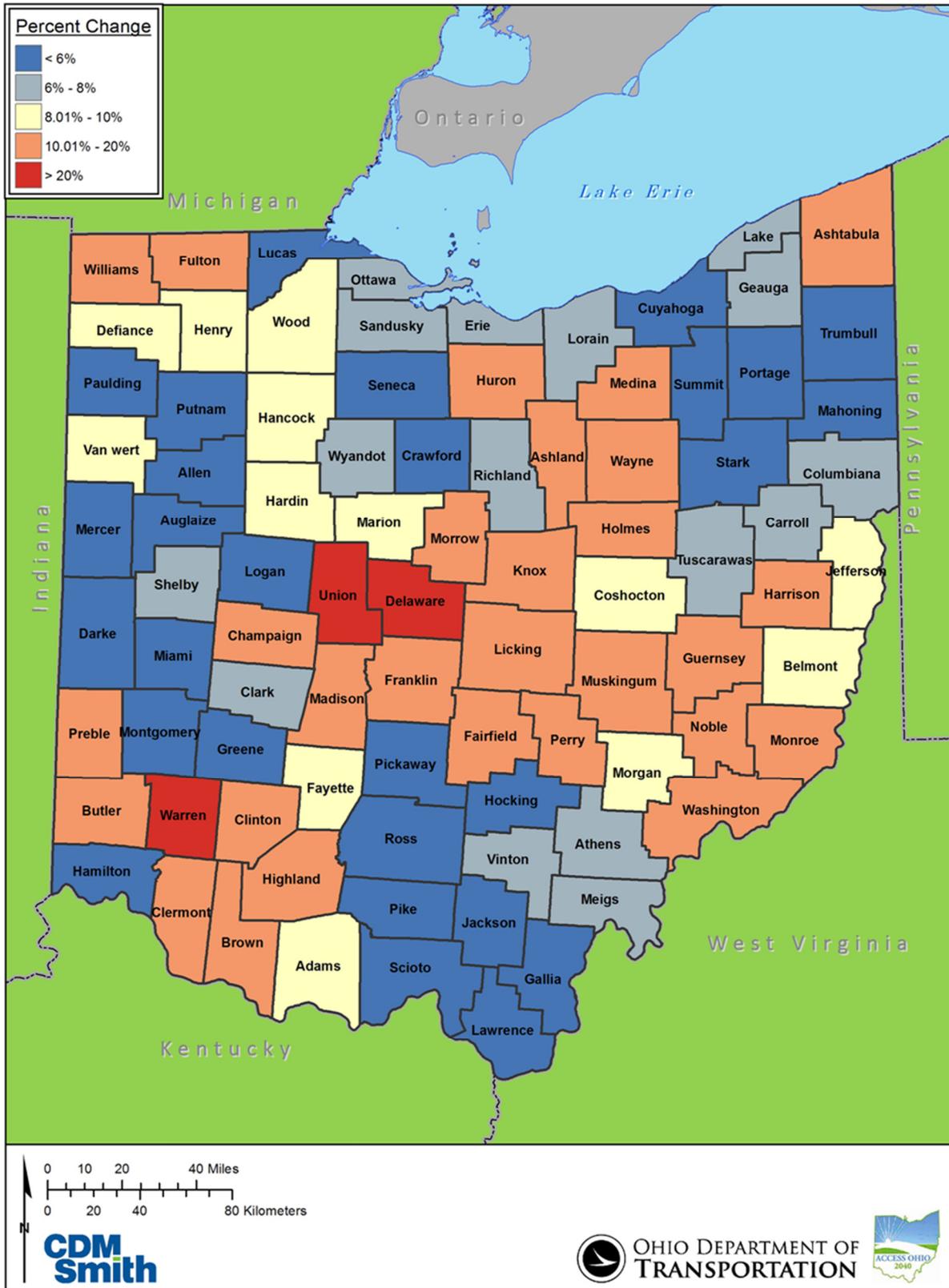
Source: Analysis of ODOT crash data and statewide travel model projections

Figure 4-3: Percent Change in Injury Crashes from 2007-2011 Average to 2025



Source: Analysis of ODOT crash data and statewide travel model projections

Figure 4-5: Percent Change in Total Crashes from 2007-2011 Average to 2025



Source: Analysis of ODOT crash data and statewide travel model projections

4.3 Cost to Society

Combining the crash projections with cost-to-society figures (**Table 4-2**) provides a sense of how much crashes will cost Ohio residents in future years if ODOT takes no action to reduce crashes (**Table 4-3**). Based on this analysis methodology, crash costs in 2011 total \$7.2 billion. The growth in cost to the projected future year cost of crashes is 14% by 2025 and 21% by 2040. Further, normalizing cost-to-society for each county by the projected population in the county gives a sense of which counties’ residents benefit the most from reducing crashes (**Table 4-4** and **Figures 4-7** and **4-8**). Note that the cost-to-society figures presented here only cover human capital costs. Comprehensive societal costs would be higher.

Table 4-2: Cost to Society per Crash by Severity

Crash Severity	Cost per Crash (2011 \$)
Fatal	\$1,581,912
Injury	\$54,608
PDO	\$8,128

Source: ODOT.

Note: Costs based only on human capital costs.

Table 4-3: Cost of Ohio Crashes in 2011 Dollars, 2025 and 2040

Year	2011	2025	2040
Total Cost	\$7.2 Billion	\$8.2 Billion	\$8.7 Billion
Cost per Capita	\$626	\$741	\$806

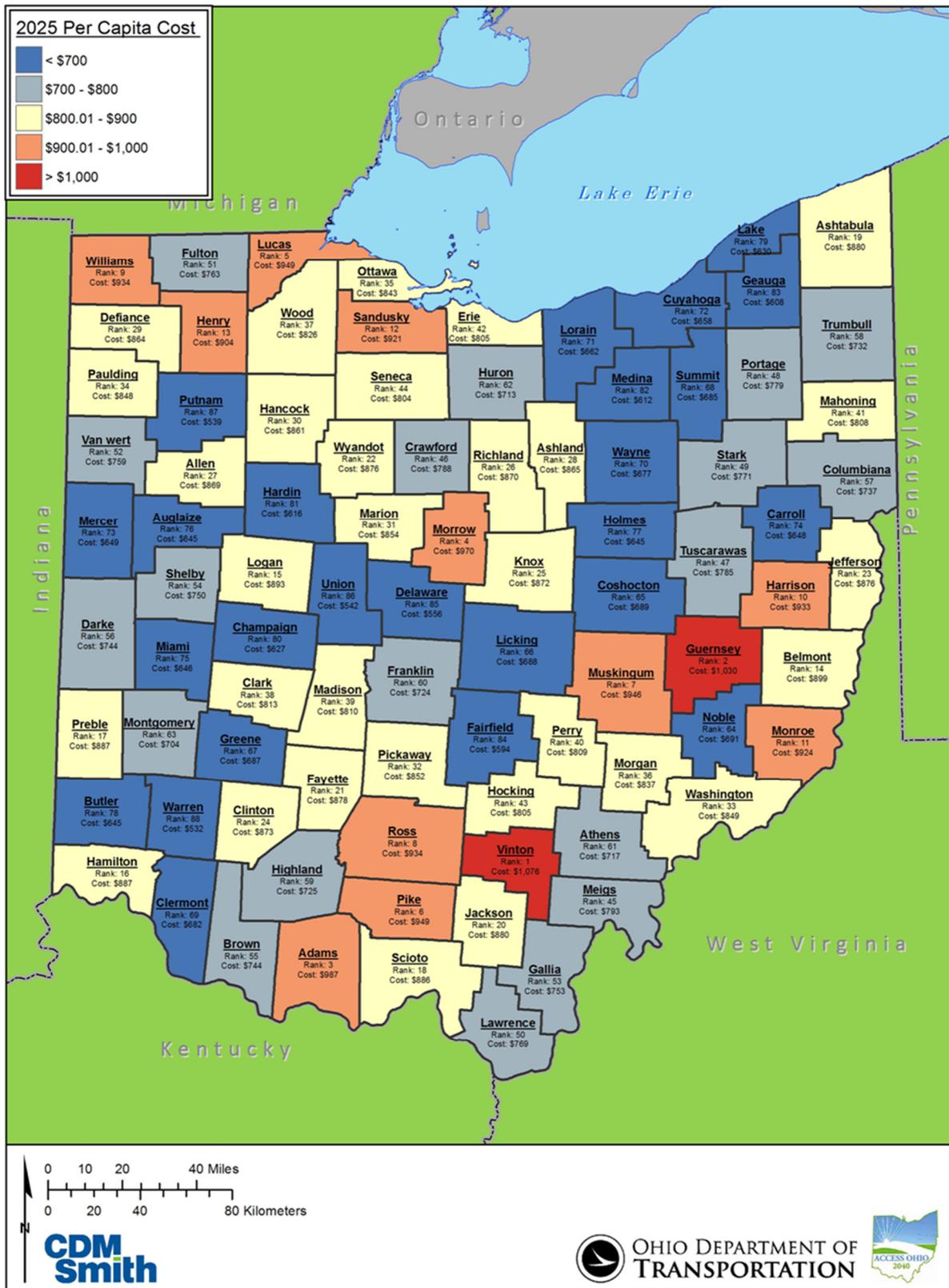
Source: CDM Smith analysis of ODOT crash data and Highway Safety Manual crash cost data.

Table 4-4: Counties with Highest per Capita Costs of Crashes

County Name	2011 per Capita Cost of Crashes (2011 \$)	County Name	2025 per Capita Cost of Crashes (2011 \$)	County Name	2040 per Capita Cost of Crashes (2011 \$)
Vinton	\$953	Vinton	\$1,076	Guernsey	\$1,221
Adams	\$857	Guernsey	\$1,030	Jefferson	\$1,178
Henry	\$836	Adams	\$987	Williams	\$1,171
Morrow	\$816	Morrow	\$970	Harrison	\$1,165
Richland	\$811	Lucas	\$949	Vinton	\$1,163
Muskingum	\$799	Pike	\$949	Lucas	\$1,123
Guernsey	\$798	Muskingum	\$946	Muskingum	\$1,117
Hancock	\$793	Ross	\$934	Wyandot	\$1,110
Ashland	\$789	Williams	\$934	Morrow	\$1,097
Logan	\$787	Harrison	\$933	Belmont	\$1,096

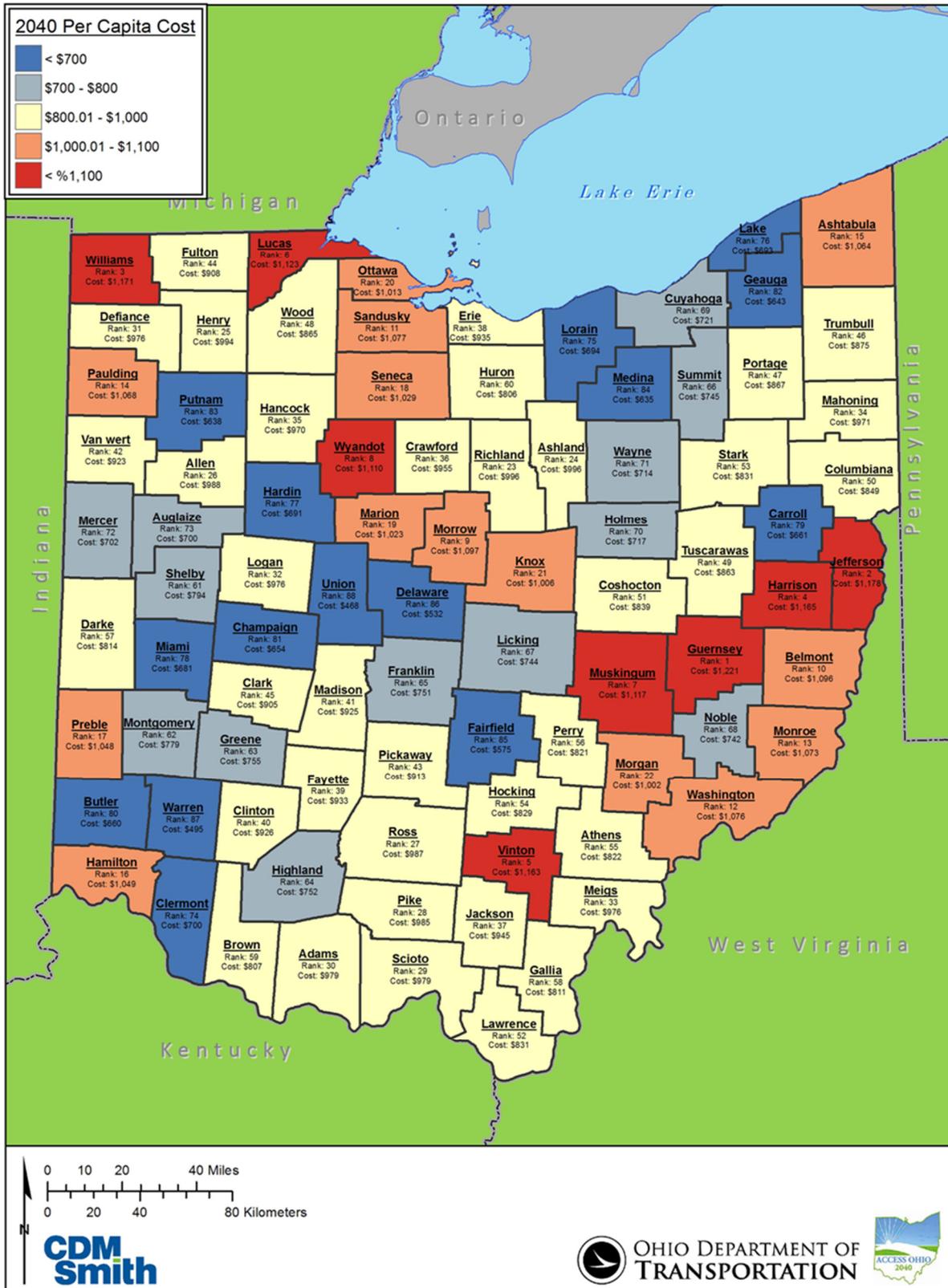
Source: CDM Smith analysis of ODOT crash data, statewide travel model data, U.S. Census Projections, and Highway Safety Manual crash cost data.

Figure 4-7: 2025 Per Capita Cost of Crashes



Source: Analysis of ODOT crash data, statewide travel model data, and Highway Safety Manual crash cost data.

Figure 4-8: 2040 Per Capita Cost of Crashes



4.4 Future High Crash Corridors

ODOT uses a SafetyAnalyst model to identify future crash projections on individual roadways. The statistical equations used by SafetyAnalyst have been applied to corridors identified in the statewide travel demand model. The statistical equations use daily travel volumes and roadway characteristics to predict the number of crashes per mile. The roadway characteristics include the number of lanes, the type of road (some examples are freeway or two-lane road or multilane arterial), and whether the segment is in an urban or rural area. Both the coefficients and calibration factors were applied to road segments in the travel model. This analysis yields the predicted number of crashes per mile for each road segment in the years 2025 and 2040. The year 2010 is also provided as a baseline for comparison. **Figures 4-9** and **4-10** display the expected change in crashes per mile between 2010 and the years 2025 and 2040, respectively. **Figures 4-11** and **4-12** display the expected change in fatal and injury crashes per mile between 2010 and the years 2025 and 2040, respectively. By 2025, highways to the north and northwest of the Columbus area are predicted to have high increases in total crashes per mile. This also applies to the highways northeast of the Cincinnati area. By 2040, highways in counties to the east and southeast of Columbus are projected to see crashes increase by more than 20 percent, as well as the highways in counties north and east of Cincinnati and in counties between Columbus and Cleveland. Fatal and injury crash projections follow a similar pattern.

Figure 4-9: Percent Change in Total Predicted Crashes per Mile between 2010 and 2025



Source: Analysis of Ohio statewide travel model data.

Figure 4-10: Percent Change in Total Predicted Crashes per Mile between 2010 and 2040



Source: Analysis of Ohio statewide travel model data.

Figure 4-11: Percent Change in Predicted Fatal and Injury Crashes per Mile between 2010 and 2025



Source: Analysis of Ohio statewide travel model data.

Figure 4-12: Percent Change in Predicted Fatal and Injury Crashes per Mile between 2010 and 2040



Source: Analysis of Ohio statewide travel model data.

4.5 Recommendations

As noted in Section 3, behavioral factors associated with crashes had distinct geographic patterns. Counties in the southern and eastern parts of Ohio had noticeably higher proportions of crashes involving behavioral factors. It is recommended that ODOT continue to give special emphasis to high-risk behaviors as set forth in the SHSP. ODOT may want to further research causes for the geographical differences in behavioral factors. Public education campaigns and enforcement efforts should be continued and perhaps expanded in key areas.

The SHSP also focuses on special roadway users, such as pedestrians. The analysis in Section 3 identifies large urban areas as having much higher proportions of pedestrian-involved crashes; which often lead to serious injuries and fatalities. To lessen fatalities and serious injuries in the future, reducing pedestrian-involved crashes must be a priority, particularly in large urban areas.

According to both the county-based and corridor-based analyses in Section 4, roadways in Delaware, Union, and Warren Counties are projected to have the greatest relative increases in crashes moving into the future. This is most likely due to population growth at the edge of the Cincinnati and Columbus areas. As these areas continue to grow, ODOT should employ the latest safety technologies in designing future roadway expansions.

Finally, the Highway Safety Manual (HSM) was released in 2010 by ASSHTO. The HSM provides the best information to facilitate roadway planning, design, operations, and maintenance decisions based on their safety consequences. The HSM methodology accounts for the regression to the mean, which results in more effectively identifying locations with potential for safety improvements. ODOT should continue to implement the HSM methodology throughout the Department.



APPENDIX A: CRASH COUNT DETAILS AND COMPLETE CRASH PROJECTION RESULTS

Table A- 1: Proportions of Statewide Crashes by County in 2010

County	Total Crashes Countywide	Percent of Statewide:							
		Total Crashes	Involving Bikes	Involving Pedestrians	Involving Motorcycles	Involving CMV	Involving Alcohol	Involving Drug	Involving Speeding
Adams	754	0.25%	0.00%	0.08%	0.36%	0.20%	0.28%	0.69%	0.66%
Allen	3,543	1.18%	1.34%	1.02%	0.96%	1.28%	1.00%	0.47%	1.26%
Ashland	1,375	0.46%	0.25%	0.51%	0.47%	0.58%	0.49%	0.47%	0.90%
Ashtabula	2,294	0.76%	0.60%	0.63%	1.19%	0.79%	1.23%	1.04%	1.73%
Athens	1,453	0.48%	0.35%	0.51%	0.65%	0.38%	0.67%	0.47%	0.94%
Auglaize	1,067	0.36%	0.50%	0.16%	0.45%	0.50%	0.35%	0.22%	0.69%
Belmont	1,670	0.56%	0.15%	0.24%	0.78%	0.82%	1.00%	0.85%	1.03%
Brown	1,022	0.34%	0.15%	0.20%	0.52%	0.28%	0.25%	0.50%	0.54%
Butler	8,315	2.77%	2.83%	3.02%	2.91%	2.45%	3.04%	3.66%	1.98%
Carroll	518	0.17%	0.05%	0.16%	0.40%	0.16%	0.35%	0.06%	0.24%
Champaign	793	0.26%	0.30%	0.16%	0.40%	0.26%	0.37%	0.32%	0.20%
Clark	3,409	1.14%	1.29%	1.30%	1.10%	1.25%	1.60%	1.45%	1.30%
Clermont	5,095	1.70%	0.74%	0.86%	1.81%	1.14%	1.76%	2.24%	2.13%
Clinton	1,150	0.38%	0.10%	0.31%	0.43%	0.44%	0.35%	0.57%	0.60%
Columbiana	2,508	0.84%	0.40%	0.31%	1.19%	0.73%	1.07%	0.88%	1.08%
Coshocton	383	0.13%	0.00%	0.12%	0.43%	0.11%	0.15%	0.00%	0.15%
Crawford	1,043	0.35%	0.25%	0.31%	0.36%	0.31%	0.39%	0.28%	0.42%
Cuyahoga	31,106	10.36%	18.72%	14.89%	7.61%	9.37%	9.05%	8.68%	8.12%
Darke	1,261	0.42%	0.55%	0.31%	0.60%	0.40%	0.54%	0.35%	0.26%
Defiance	1,236	0.41%	0.25%	0.35%	0.34%	0.31%	0.43%	0.32%	0.39%
Delaware	3,783	1.26%	0.79%	0.79%	1.23%	1.31%	1.11%	0.92%	1.20%
Erie	2,515	0.84%	0.74%	0.55%	1.07%	0.94%	0.92%	0.63%	0.99%
Fairfield	3,109	1.04%	1.14%	0.71%	1.19%	0.77%	1.17%	1.89%	1.18%
Fayette	853	0.28%	0.50%	0.16%	0.20%	0.36%	0.25%	0.32%	0.23%
Franklin	33,080	11.02%	14.35%	18.22%	8.58%	11.46%	9.72%	9.09%	6.46%
Fulton	1,030	0.34%	0.10%	0.24%	0.36%	0.61%	0.28%	0.16%	0.35%
Gallia	632	0.21%	0.05%	0.12%	0.43%	0.18%	0.33%	0.73%	0.59%
Geauga	1,949	0.65%	0.15%	0.43%	0.81%	0.64%	0.84%	0.69%	0.95%
Greene	3,810	1.27%	1.39%	0.79%	1.37%	0.89%	1.38%	1.55%	1.21%
Guernsey	1,317	0.44%	0.10%	0.16%	0.63%	0.68%	0.62%	0.76%	0.83%
Hamilton	29,019	9.67%	6.50%	13.47%	5.80%	9.33%	6.27%	7.38%	5.83%
Hancock	2,309	0.77%	1.04%	0.75%	0.74%	0.95%	0.69%	0.63%	0.90%
Hardin	679	0.23%	0.05%	0.04%	0.18%	0.25%	0.18%	0.22%	0.14%
Harrison	304	0.10%	0.05%	0.00%	0.38%	0.21%	0.20%	0.13%	0.32%
Henry	776	0.26%	0.05%	0.16%	0.20%	0.37%	0.25%	0.06%	0.15%
Highland	994	0.33%	0.20%	0.20%	0.27%	0.21%	0.39%	0.50%	0.50%
Hocking	679	0.23%	0.15%	0.12%	0.56%	0.18%	0.21%	0.16%	0.60%
Holmes	838	0.28%	0.25%	0.16%	0.45%	0.39%	0.18%	0.09%	0.34%
Huron	1,363	0.45%	0.25%	0.31%	0.60%	0.59%	0.48%	0.28%	0.54%
Jackson	957	0.32%	0.10%	0.24%	0.34%	0.27%	0.35%	1.20%	0.67%
Jefferson	1,569	0.52%	0.20%	0.43%	0.63%	0.34%	0.86%	0.54%	1.04%
Knox	1,588	0.53%	0.20%	0.35%	0.43%	0.39%	0.56%	0.50%	0.83%
Lake	5,548	1.85%	2.48%	1.18%	2.49%	1.53%	1.93%	2.34%	1.37%
Lawrence	1,110	0.37%	0.20%	0.16%	0.63%	0.22%	0.65%	1.20%	1.04%
Licking	3,814	1.27%	1.54%	0.75%	1.77%	1.39%	1.58%	1.33%	1.50%
Logan	1,384	0.46%	0.20%	0.20%	0.56%	0.49%	0.54%	0.35%	0.47%

County	Total Crashes Countywide	Percent of Statewide:							
		Total Crashes	Involving Bikes	Involving Pedestrians	Involving Motorcycles	Involving CMV	Involving Alcohol	Involving Drug	Involving Speeding
Lorain	6,792	2.26%	3.23%	1.77%	2.46%	2.10%	3.04%	2.15%	2.47%
Lucas	14,074	4.69%	6.95%	5.46%	4.32%	4.46%	3.27%	2.46%	2.47%
Madison	970	0.32%	0.00%	0.16%	0.43%	0.52%	0.49%	0.54%	0.81%
Mahoning	5,923	1.97%	1.09%	1.57%	1.68%	1.93%	2.00%	2.05%	1.49%
Marion	1,775	0.59%	0.79%	0.43%	0.72%	0.63%	0.46%	0.63%	0.65%
Medina	3,732	1.24%	0.84%	0.55%	1.57%	1.47%	1.40%	0.95%	1.67%
Meigs	392	0.13%	0.05%	0.00%	0.29%	0.10%	0.25%	0.38%	0.33%
Mercer	826	0.28%	0.45%	0.24%	0.20%	0.39%	0.26%	0.22%	0.28%
Miami	2,632	0.88%	1.44%	0.67%	0.99%	0.89%	0.96%	0.85%	0.77%
Monroe	274	0.09%	0.00%	0.04%	0.34%	0.07%	0.15%	0.22%	0.13%
Montgomery	11,648	3.88%	4.27%	5.22%	4.10%	3.69%	4.28%	5.74%	3.46%
Morgan	201	0.07%	0.00%	0.00%	0.29%	0.05%	0.12%	0.00%	0.15%
Morrow	940	0.31%	0.05%	0.16%	0.38%	0.40%	0.31%	0.13%	0.74%
Muskingum	3,018	1.01%	0.70%	0.35%	1.30%	1.07%	1.00%	0.66%	1.55%
Noble	274	0.09%	0.00%	0.00%	0.09%	0.12%	0.18%	0.25%	0.21%
Ottawa	954	0.32%	0.10%	0.08%	0.58%	0.40%	0.44%	0.38%	0.29%
Paulding	479	0.16%	0.05%	0.04%	0.16%	0.19%	0.15%	0.19%	0.14%
Perry	634	0.21%	0.00%	0.20%	0.22%	0.17%	0.35%	0.35%	0.59%
Pickaway	1,176	0.39%	0.25%	0.12%	0.40%	0.43%	0.38%	0.50%	0.29%
Pike	676	0.23%	0.00%	0.08%	0.31%	0.29%	0.28%	0.88%	0.36%
Portage	4,174	1.39%	1.04%	1.10%	1.43%	1.80%	1.64%	1.14%	1.93%
Preble	1,013	0.34%	0.20%	0.24%	0.40%	0.53%	0.39%	0.41%	0.52%
Putnam	526	0.18%	0.05%	0.00%	0.07%	0.19%	0.27%	0.09%	0.14%
Richland	4,126	1.37%	0.60%	0.86%	1.57%	1.31%	1.28%	1.14%	2.22%
Ross	2,274	0.76%	0.45%	0.47%	0.58%	0.63%	1.06%	2.34%	1.23%
Sandusky	1,852	0.62%	0.45%	0.31%	0.76%	1.09%	0.80%	0.47%	1.08%
Scioto	2,151	0.72%	0.50%	0.67%	0.67%	0.48%	0.77%	1.96%	1.10%
Seneca	1,573	0.52%	0.60%	0.35%	0.47%	0.63%	0.51%	0.38%	0.53%
Shelby	1,341	0.45%	0.45%	0.31%	0.58%	0.62%	0.35%	0.41%	0.47%
Stark	10,206	3.40%	2.98%	2.32%	4.16%	2.78%	4.07%	2.97%	2.99%
Summit	14,526	4.84%	5.16%	5.58%	4.43%	4.21%	4.35%	3.76%	4.21%
Trumbull	4,569	1.52%	0.99%	1.37%	1.97%	1.52%	1.93%	1.99%	1.65%
Tuscarawas	2,574	0.86%	0.65%	0.35%	1.01%	0.78%	0.96%	0.60%	1.42%
Union	1,241	0.41%	0.40%	0.12%	0.31%	0.43%	0.38%	0.22%	0.41%
Van Wert	677	0.23%	0.15%	0.04%	0.27%	0.35%	0.19%	0.32%	0.32%
Vinton	297	0.10%	0.05%	0.00%	0.04%	0.09%	0.15%	0.41%	0.29%
Warren	5,202	1.73%	0.89%	0.59%	1.81%	2.17%	1.73%	2.24%	1.78%
Washington	1,504	0.50%	0.50%	0.47%	0.69%	0.50%	0.56%	0.79%	0.86%
Wayne	2,623	0.87%	0.89%	0.59%	1.25%	1.18%	0.83%	0.44%	1.45%
Williams	1,284	0.43%	0.50%	0.12%	0.36%	0.61%	0.28%	0.22%	0.42%
Wood	3,421	1.14%	0.65%	0.75%	1.28%	1.68%	1.17%	0.88%	0.99%
Wyandot	615	0.20%	0.05%	0.16%	0.22%	0.29%	0.28%	0.13%	0.29%
Total	300,163	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%

Table A- 2: Proportions of Total County Crashes by Type in 2010

County	Total Crashes Countywide	Percent of Total County Crashes:						
		Involving Bikes	Involving Pedestrians	Involving Motorcycles	Involving CMVs	Involving Alcohol	Involving Drugs	Involving Speeding
Adams	754	0.00%	0.27%	2.12%	5.7%	4.9%	2.92%	28.4%
Allen	3,543	0.76%	0.73%	1.21%	7.9%	3.7%	0.42%	11.6%
Ashland	1,375	0.36%	0.95%	1.53%	9.2%	4.7%	1.09%	21.3%
Ashtabula	2,294	0.52%	0.70%	2.31%	7.5%	7.0%	1.44%	24.6%
Athens	1,453	0.48%	0.89%	2.00%	5.7%	6.0%	1.03%	21.1%
Auglaize	1,067	0.94%	0.37%	1.87%	10.2%	4.3%	0.66%	21.0%
Belmont	1,670	0.18%	0.36%	2.10%	10.7%	7.8%	1.62%	20.1%
Brown	1,022	0.29%	0.49%	2.25%	6.0%	3.1%	1.57%	17.2%
Butler	8,315	0.69%	0.93%	1.56%	6.4%	4.8%	1.40%	7.8%
Carroll	518	0.19%	0.77%	3.47%	6.9%	8.7%	0.39%	14.9%
Champaign	793	0.76%	0.50%	2.27%	7.2%	6.1%	1.26%	8.1%
Clark	3,409	0.76%	0.97%	1.44%	8.0%	6.1%	1.35%	12.4%
Clermont	5,095	0.29%	0.43%	1.59%	4.9%	4.5%	1.39%	13.6%
Clinton	1,150	0.17%	0.70%	1.65%	8.3%	3.9%	1.57%	17.0%
Columbiana	2,508	0.32%	0.32%	2.11%	6.3%	5.5%	1.12%	14.1%
Coshocton	383	0.00%	0.78%	4.96%	6.3%	5.0%	0.00%	12.5%
Crawford	1,043	0.48%	0.77%	1.53%	6.5%	4.9%	0.86%	13.1%
Cuyahoga	31,106	1.21%	1.22%	1.09%	6.6%	3.8%	0.88%	8.5%
Darke	1,261	0.87%	0.63%	2.14%	7.0%	5.6%	0.87%	6.8%
Defiance	1,236	0.40%	0.73%	1.21%	5.4%	4.5%	0.81%	10.2%
Delaware	3,783	0.42%	0.53%	1.45%	7.6%	3.8%	0.77%	10.4%
Erie	2,515	0.60%	0.56%	1.91%	8.2%	4.8%	0.80%	12.8%
Fairfield	3,109	0.74%	0.58%	1.70%	5.4%	4.9%	1.93%	12.4%
Fayette	853	1.17%	0.47%	1.06%	9.3%	3.9%	1.17%	8.9%
Franklin	33,080	0.87%	1.40%	1.16%	7.6%	3.8%	0.87%	6.4%
Fulton	1,030	0.19%	0.58%	1.55%	12.9%	3.6%	0.49%	11.2%
Gallia	632	0.16%	0.47%	3.01%	6.2%	6.8%	3.64%	30.2%
Geauga	1,949	0.15%	0.56%	1.85%	7.1%	5.6%	1.13%	16.0%
Greene	3,810	0.73%	0.52%	1.60%	5.1%	4.7%	1.29%	10.3%
Guernsey	1,317	0.15%	0.30%	2.13%	11.3%	6.2%	1.82%	20.5%
Hamilton	29,019	0.45%	1.18%	0.89%	7.0%	2.8%	0.81%	6.5%
Hancock	2,309	0.91%	0.82%	1.43%	9.0%	3.9%	0.87%	12.7%
Hardin	679	0.15%	0.15%	1.18%	8.0%	3.4%	1.03%	6.8%
Harrison	304	0.33%	0.00%	5.59%	15.5%	8.6%	1.32%	34.5%
Henry	776	0.13%	0.52%	1.16%	10.3%	4.3%	0.26%	6.2%
Highland	994	0.40%	0.50%	1.21%	4.7%	5.1%	1.61%	16.4%
Hocking	679	0.44%	0.44%	3.68%	5.7%	4.1%	0.74%	28.6%
Holmes	838	0.60%	0.48%	2.39%	10.3%	2.7%	0.36%	13.4%
Huron	1,363	0.37%	0.59%	1.98%	9.5%	4.6%	0.66%	13.0%
Jackson	957	0.21%	0.63%	1.57%	6.1%	4.8%	3.97%	22.7%
Jefferson	1,569	0.25%	0.70%	1.78%	4.7%	7.1%	1.08%	21.6%
Knox	1,588	0.25%	0.57%	1.20%	5.4%	4.6%	1.01%	17.0%
Lake	5,548	0.90%	0.54%	2.00%	6.0%	4.5%	1.33%	8.1%
Lawrence	1,110	0.36%	0.36%	2.52%	4.4%	7.7%	3.42%	30.5%
Licking	3,814	0.81%	0.50%	2.07%	8.0%	5.4%	1.10%	12.8%
Logan	1,384	0.29%	0.36%	1.81%	7.7%	5.1%	0.79%	11.1%

County	Total Crashes Countywide	Percent of Total County Crashes:						
		Involving Bikes	Involving Pedestrians	Involving Motorcycles	Involving CMVs	Involving Alcohol	Involving Drugs	Involving Speeding
Lorain	6,792	0.96%	0.66%	1.62%	6.8%	5.8%	1.00%	11.9%
Lucas	14,074	0.99%	0.99%	1.37%	6.9%	3.0%	0.55%	5.7%
Madison	970	0.00%	0.41%	1.96%	11.8%	6.6%	1.75%	27.3%
Mahoning	5,923	0.37%	0.68%	1.27%	7.1%	4.4%	1.10%	8.2%
Marion	1,775	0.90%	0.62%	1.80%	7.8%	3.4%	1.13%	12.0%
Medina	3,732	0.46%	0.38%	1.88%	8.6%	4.9%	0.80%	14.5%
Meigs	392	0.26%	0.00%	3.32%	5.4%	8.2%	3.06%	27.8%
Mercer	826	1.09%	0.73%	1.09%	10.4%	4.1%	0.85%	11.1%
Miami	2,632	1.10%	0.65%	1.67%	7.4%	4.7%	1.03%	9.5%
Monroe	274	0.00%	0.36%	5.47%	5.8%	7.3%	2.55%	15.0%
Montgomery	11,648	0.74%	1.14%	1.57%	6.9%	4.8%	1.56%	9.7%
Morgan	201	0.00%	0.00%	6.47%	5.0%	8.0%	0.00%	24.9%
Morrow	940	0.11%	0.43%	1.81%	9.4%	4.3%	0.43%	25.6%
Muskingum	3,018	0.46%	0.30%	1.92%	7.8%	4.3%	0.70%	16.8%
Noble	274	0.00%	0.00%	1.46%	9.9%	8.8%	2.92%	24.5%
Ottawa	954	0.21%	0.21%	2.73%	9.1%	6.0%	1.26%	9.7%
Paulding	479	0.21%	0.21%	1.46%	8.6%	4.2%	1.25%	9.4%
Perry	634	0.00%	0.79%	1.58%	6.0%	7.3%	1.74%	30.3%
Pickaway	1,176	0.43%	0.26%	1.53%	8.1%	4.2%	1.36%	7.9%
Pike	676	0.00%	0.30%	2.07%	9.3%	5.5%	4.14%	17.3%
Portage	4,174	0.50%	0.67%	1.53%	9.4%	5.1%	0.86%	15.1%
Preble	1,013	0.39%	0.59%	1.78%	11.5%	5.0%	1.28%	16.8%
Putnam	526	0.19%	0.00%	0.57%	7.8%	6.7%	0.57%	8.7%
Richland	4,126	0.29%	0.53%	1.70%	7.0%	4.0%	0.87%	17.5%
Ross	2,274	0.40%	0.53%	1.14%	6.1%	6.1%	3.25%	17.6%
Sandusky	1,852	0.49%	0.43%	1.84%	12.9%	5.6%	0.81%	19.1%
Scioto	2,151	0.46%	0.79%	1.39%	4.8%	4.7%	2.88%	16.6%
Seneca	1,573	0.76%	0.57%	1.34%	8.8%	4.3%	0.76%	11.1%
Shelby	1,341	0.67%	0.60%	1.94%	10.1%	3.4%	0.97%	11.5%
Stark	10,206	0.59%	0.58%	1.82%	6.0%	5.2%	0.92%	9.6%
Summit	14,526	0.72%	0.98%	1.36%	6.3%	3.9%	0.82%	9.4%
Trumbull	4,569	0.44%	0.77%	1.93%	7.3%	5.5%	1.38%	11.8%
Tuscarawas	2,574	0.51%	0.35%	1.75%	6.6%	4.9%	0.74%	17.9%
Union	1,241	0.64%	0.24%	1.13%	7.7%	4.0%	0.56%	10.9%
Van Wert	677	0.44%	0.15%	1.77%	11.4%	3.7%	1.48%	15.4%
Vinton	297	0.34%	0.00%	0.67%	6.7%	6.4%	4.38%	31.6%
Warren	5,202	0.35%	0.29%	1.56%	9.1%	4.3%	1.36%	11.1%
Washington	1,504	0.66%	0.80%	2.06%	7.3%	4.9%	1.66%	18.6%
Wayne	2,623	0.69%	0.57%	2.13%	9.9%	4.1%	0.53%	18.0%
Williams	1,284	0.78%	0.23%	1.25%	10.4%	2.9%	0.55%	10.6%
Wood	3,421	0.38%	0.56%	1.67%	10.8%	4.5%	0.82%	9.4%
Wyandot	615	0.16%	0.65%	1.63%	10.4%	5.9%	0.65%	15.4%
Total	300,163	0.67%	0.85%	1.49%	7.3%	4.3%	1.06%	10.9%

Table A-3: Crash Projections by County

PROJECTED CRASHES								
	2025				2040			
	Fatal	Injury	PDO	Total	Fatal	Injury	PDO	Total
Adams	7	244	577	828	7	259	614	880
Allen	9	863	2,688	3,560	10	884	2,752	3,646
Ashland	10	390	1,278	1,678	11	453	1,483	1,947
Ashtabula	18	738	2,000	2,756	21	842	2,281	3,144
Athens	8	395	1,133	1,536	8	429	1,233	1,670
Auglaize	6	246	880	1,132	7	264	943	1,214
Belmont	10	480	1,441	1,931	11	517	1,554	2,082
Brown	7	347	860	1,214	8	388	961	1,357
Butler	28	2,627	7,348	10,003	31	2,860	8,002	10,893
Carroll	5	169	406	580	5	180	434	619
Champaign	6	208	620	834	7	218	648	873
Clark	18	1,020	2,600	3,638	19	1,090	2,778	3,887
Clermont	17	1,569	4,281	5,867	19	1,725	4,705	6,449
Clinton	9	328	1,099	1,436	10	367	1,230	1,607
Columbiana	12	732	1,995	2,739	13	789	2,149	2,951
Coshocton	8	133	470	611	9	150	532	691
Crawford	7	227	935	1,169	8	247	1,017	1,272
Cuyahoga	68	8,479	24,345	32,892	68	8,458	24,285	32,811
Darke	7	293	1,056	1,356	7	305	1,099	1,411
Defiance	5	256	1,205	1,466	6	267	1,256	1,529
Delaware	17	1,209	3,614	4,840	20	1,443	4,312	5,775
Erie	7	606	2,086	2,699	8	653	2,249	2,910
Fairfield	15	987	2,734	3,736	18	1,152	3,191	4,361
Fayette	5	190	690	885	5	210	763	978
Franklin	84	9,090	26,359	35,533	91	9,797	28,411	38,299
Fulton	7	278	969	1,254	9	319	1,110	1,438
Gallia	3	257	543	803	3	267	564	834
Geauga	9	576	1,693	2,278	10	608	1,787	2,405
Greene	12	998	3,075	4,085	13	1,069	3,292	4,374
Guernsey	6	388	1,118	1,512	7	449	1,293	1,749
Hamilton	48	5,892	25,517	31,457	49	6,035	26,134	32,218
Hancock	9	564	2,058	2,631	10	611	2,228	2,849
Hardin	5	107	583	695	5	114	623	742
Harrison	3	111	259	373	3	135	317	455
Henry	6	176	685	867	6	183	713	902
Highland	7	264	930	1,201	7	291	1,028	1,326
Hocking	5	199	501	705	5	199	501	705
Holmes	6	225	826	1,057	7	260	957	1,224
Huron	8	370	1,091	1,469	9	396	1,169	1,574
Jackson	5	267	721	993	6	274	741	1,021
Jefferson	7	429	1,385	1,821	8	485	1,565	2,058
Knox	11	442	1,486	1,939	13	520	1,748	2,281
Lake	13	1,366	4,756	6,135	13	1,412	4,918	6,343
Lawrence	7	482	884	1,373	7	495	909	1,411
Licking	22	1,029	3,173	4,224	26	1,229	3,788	5,043
Logan	11	288	1,165	1,464	11	307	1,244	1,562

PROJECTED CRASHES								
	2025				2040			
	Fatal	Injury	PDO	Total	Fatal	Injury	PDO	Total
Lorain	26	1,838	5,516	7,380	27	1,936	5,810	7,773
Lucas	36	4,032	11,060	15,128	38	4,205	11,537	15,780
Madison	8	285	730	1,023	9	315	808	1,132
Mahoning	21	1,798	4,726	6,545	22	1,886	4,955	6,863
Marion	9	476	1,521	2,006	10	555	1,776	2,341
Medina	19	1,016	3,237	4,272	21	1,134	3,611	4,766
Meigs	4	153	313	470	5	162	330	497
Mercer	6	217	668	891	7	234	720	961
Miami	11	503	2,234	2,748	11	513	2,279	2,803
Monroe	3	87	219	309	3	90	225	318
Montgomery	43	3,592	8,679	12,314	44	3,660	8,843	12,547
Morgan	3	88	210	301	3	93	222	318
Morrow	7	278	840	1,125	8	322	975	1,305
Muskingum	12	742	2,601	3,355	14	871	3,053	3,938
Noble	3	65	257	325	3	71	281	355
Ottawa	7	228	799	1,034	7	245	858	1,110
Paulding	4	89	416	509	5	95	445	545
Perry	8	244	507	759	8	258	536	802
Pickaway	11	365	1,088	1,464	11	393	1,174	1,578
Pike	7	219	534	760	7	223	544	774
Portage	17	1,142	3,191	4,350	18	1,193	3,333	4,544
Preble	8	314	855	1,177	9	354	963	1,326
Putnam	5	121	420	546	6	130	452	588
Richland	12	1,052	3,303	4,367	14	1,162	3,649	4,825
Ross	14	644	1,857	2,515	15	697	2,009	2,721
Sandusky	8	411	1,555	1,974	8	445	1,685	2,138
Scioto	10	632	1,582	2,224	10	655	1,639	2,304
Seneca	7	316	1,216	1,539	8	335	1,287	1,630
Shelby	6	299	1,232	1,537	6	308	1,272	1,586
Stark	29	2,695	7,964	10,688	29	2,705	7,992	10,726
Summit	34	3,691	11,989	15,714	35	3,741	12,148	15,924
Trumbull	22	1,338	3,668	5,028	23	1,349	3,697	5,069
Tuscarawas	10	665	2,101	2,776	11	729	2,302	3,042
Union	6	314	1,150	1,470	7	383	1,404	1,794
Van Wert	3	181	625	809	3	200	691	894
Vinton	4	124	247	375	4	130	259	393
Warren	16	1,529	4,800	6,345	18	1,809	5,678	7,505
Washington	8	469	1,225	1,702	9	532	1,387	1,928
Wayne	14	788	2,099	2,901	15	874	2,328	3,217
Williams	6	246	1,233	1,485	7	280	1,405	1,692
Wood	19	873	3,080	3,972	21	965	3,403	4,389
Wyandot	5	105	608	718	6	121	700	827
Grand Total	1,114	80,798	248,273	330,185	1,199	85,963	264,176	351,338

Table A-4: Cost to Society of Projected Crashes

COST TO SOCIETY-HUMAN CAPITAL COSTS					
County	2025	2040	County	2025	2040
Adams	\$29,087,592	\$30,207,448	Licking	\$116,783,840	\$139,031,808
Allen	\$83,211,976	\$86,460,848	Logan	\$42,597,256	\$44,276,920
Ashland	\$47,503,824	\$54,192,280	Lorain	\$186,333,264	\$195,656,392
Ashtabula	\$85,031,120	\$97,740,056	Lucas	\$367,023,968	\$383,512,032
Athens	\$43,434,480	\$46,103,952	Madison	\$34,152,016	\$38,006,152
Auglaize	\$30,077,680	\$33,154,600	Mahoning	\$169,818,264	\$178,066,992
Belmont	\$53,743,408	\$58,264,280	Marion	\$52,593,304	\$60,561,888
Brown	\$37,012,440	\$41,654,208	Medina	\$111,848,392	\$124,495,832
Butler	\$247,473,296	\$270,258,408	Meigs	\$17,226,736	\$19,438,296
Carroll	\$20,438,280	\$21,266,552	Mercer	\$26,770,912	\$29,703,816
Champaign	\$25,889,296	\$28,244,872	Miami	\$63,026,808	\$63,938,648
Clark	\$105,307,376	\$112,158,632	Monroe	\$11,276,664	\$11,489,256
Clermont	\$147,368,424	\$162,497,368	Montgomery	\$334,717,064	\$341,345,312
Clinton	\$41,081,304	\$45,857,696	Morgan	\$11,258,120	\$11,628,696
Columbiana	\$75,171,360	\$81,117,640	Morrow	\$33,081,928	\$38,163,872
Coshocton	\$23,738,320	\$26,752,504	Muskingum	\$80,643,008	\$94,525,120
Crawford	\$31,069,080	\$34,409,648	Noble	\$10,384,152	\$10,906,872
Cuyahoga	\$768,467,408	\$766,832,960	Ottawa	\$30,018,280	\$31,426,168
Darke	\$35,656,696	\$36,661,496	Paulding	\$14,569,008	\$16,714,280
Defiance	\$31,683,448	\$34,280,576	Perry	\$30,100,544	\$31,100,768
Delaware	\$122,288,168	\$145,485,520	Pickaway	\$46,176,216	\$48,404,248
Erie	\$61,120,840	\$66,594,192	Pike	\$27,372,888	\$27,672,600
Fairfield	\$99,848,728	\$117,319,280	Portage	\$115,191,288	\$120,712,384
Fayette	\$23,893,400	\$25,578,904	Preble	\$36,751,648	\$41,395,704
Franklin	\$843,513,280	\$909,873,176	Putnam	\$17,930,888	\$20,264,368
Fulton	\$34,130,440	\$40,679,240	Richland	\$103,277,344	\$115,260,336
Gallia	\$23,193,496	\$23,910,264	Ross	\$72,408,016	\$78,119,608
Geauga	\$59,452,120	\$63,545,520	Sandusky	\$47,738,224	\$50,651,536
Greene	\$98,475,328	\$105,698,184	Scioto	\$63,189,872	\$64,909,152
Guernsey	\$39,766,480	\$46,101,880	Seneca	\$38,213,160	\$41,409,712
Hamilton	\$605,084,288	\$619,490,120	Shelby	\$35,832,960	\$36,649,552
Hancock	\$61,763,544	\$67,293,792	Stark	\$257,775,400	\$258,549,064
Hardin	\$18,491,240	\$19,198,616	Summit	\$352,789,728	\$358,394,392
Harrison	\$12,912,376	\$14,694,392	Trumbull	\$137,681,072	\$140,099,384
Henry	\$24,670,160	\$25,280,000	Tuscarawas	\$69,210,368	\$75,920,920
Highland	\$33,048,936	\$35,319,896	Union	\$35,985,584	\$43,399,960
Hocking	\$22,848,680	\$22,848,680	Van Wert	\$19,709,784	\$21,283,784
Holmes	\$28,492,000	\$33,049,960	Vinton	\$15,106,656	\$15,531,840
Huron	\$41,727,904	\$45,363,608	Warren	\$147,820,624	\$173,411,072
Jackson	\$28,350,184	\$30,476,912	Washington	\$48,223,248	\$54,562,200
Jefferson	\$45,757,496	\$51,860,496	Wayne	\$82,238,544	\$90,378,056
Knox	\$53,615,976	\$63,168,760	Williams	\$32,946,864	\$37,783,464
Lake	\$133,816,152	\$137,644,856	Wood	\$102,763,352	\$113,576,456
Lawrence	\$44,579,592	\$45,492,696	Wyandot	\$18,585,224	\$21,788,640
Grand Total	\$8,192,430,096	\$8,738,202,520			

Table A-5: Per Capita Cost to Society of Projected Crashes

COST TO SOCIETY PER PERSON-HUMAN CAPITAL COSTS					
County	2025	2040	County	2025	2040
Adams	\$987	\$979	Licking	\$688	\$744
Allen	\$869	\$988	Logan	\$893	\$976
Ashland	\$865	\$996	Lorain	\$662	\$694
Ashtabula	\$880	\$1,064	Lucas	\$949	\$1,123
Athens	\$717	\$822	Madison	\$810	\$925
Auglaize	\$645	\$700	Mahoning	\$808	\$971
Belmont	\$899	\$1,096	Marion	\$854	\$1,023
Brown	\$744	\$807	Medina	\$612	\$635
Butler	\$645	\$660	Meigs	\$793	\$976
Carroll	\$648	\$661	Mercer	\$649	\$702
Champaign	\$627	\$654	Miami	\$646	\$681
Clark	\$813	\$905	Monroe	\$924	\$1,073
Clermont	\$682	\$700	Montgomery	\$704	\$779
Clinton	\$873	\$926	Morgan	\$837	\$1,002
Columbiana	\$737	\$849	Morrow	\$970	\$1,097
Coshocton	\$689	\$839	Muskingum	\$946	\$1,117
Crawford	\$788	\$955	Noble	\$691	\$742
Cuyahoga	\$658	\$721	Ottawa	\$843	\$1,013
Darke	\$744	\$814	Paulding	\$848	\$1,068
Defiance	\$864	\$976	Perry	\$809	\$821
Delaware	\$556	\$532	Pickaway	\$852	\$913
Erie	\$805	\$935	Pike	\$949	\$985
Fairfield	\$594	\$575	Portage	\$779	\$867
Fayette	\$878	\$933	Preble	\$887	\$1,048
Franklin	\$724	\$751	Putnam	\$539	\$638
Fulton	\$763	\$908	Richland	\$870	\$996
Gallia	\$753	\$811	Ross	\$934	\$987
Geauga	\$608	\$643	Sandusky	\$921	\$1,077
Greene	\$687	\$755	Scioto	\$886	\$979
Guernsey	\$1,030	\$1,221	Seneca	\$804	\$1,029
Hamilton	\$887	\$1,049	Shelby	\$750	\$794
Hancock	\$861	\$970	Stark	\$771	\$831
Hardin	\$616	\$691	Summit	\$685	\$745
Harrison	\$933	\$1,165	Trumbull	\$732	\$875
Henry	\$904	\$994	Tuscarawas	\$785	\$863
Highland	\$725	\$752	Union	\$542	\$468
Hocking	\$805	\$829	Van Wert	\$759	\$923
Holmes	\$645	\$717	Vinton	\$1,076	\$1,163
Huron	\$713	\$806	Warren	\$532	\$495
Jackson	\$880	\$945	Washington	\$849	\$1,076
Jefferson	\$876	\$1,178	Wayne	\$677	\$714
Knox	\$872	\$1,006	Williams	\$934	\$1,171
Lake	\$630	\$693	Wood	\$826	\$865
Lawrence	\$769	\$831	Wyandot	\$876	\$1,110
State Total	\$741	\$806			



GLOSSARY

AASHTO	American Association of State Highway and Transportation Officials
CFR	Code of Federal Regulations
CMV	Commercial Motor Vehicle
FARS	Fatality Analysis Reporting System
FHWA	Federal Highway Administration
FRA	Federal Railroad Administration
HSM	Highway Safety Manual
MAP-21	Moving Ahead for Progress in the 21st Century Act
MVMT	Million Vehicle Miles Traveled
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
ODOT	Ohio Department of Transportation
PDO	Property Damage Only
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
SHSP	Strategic Highway Safety Plan
SRTS	Safe Routes to Schools
VMT	Vehicle Miles Traveled

