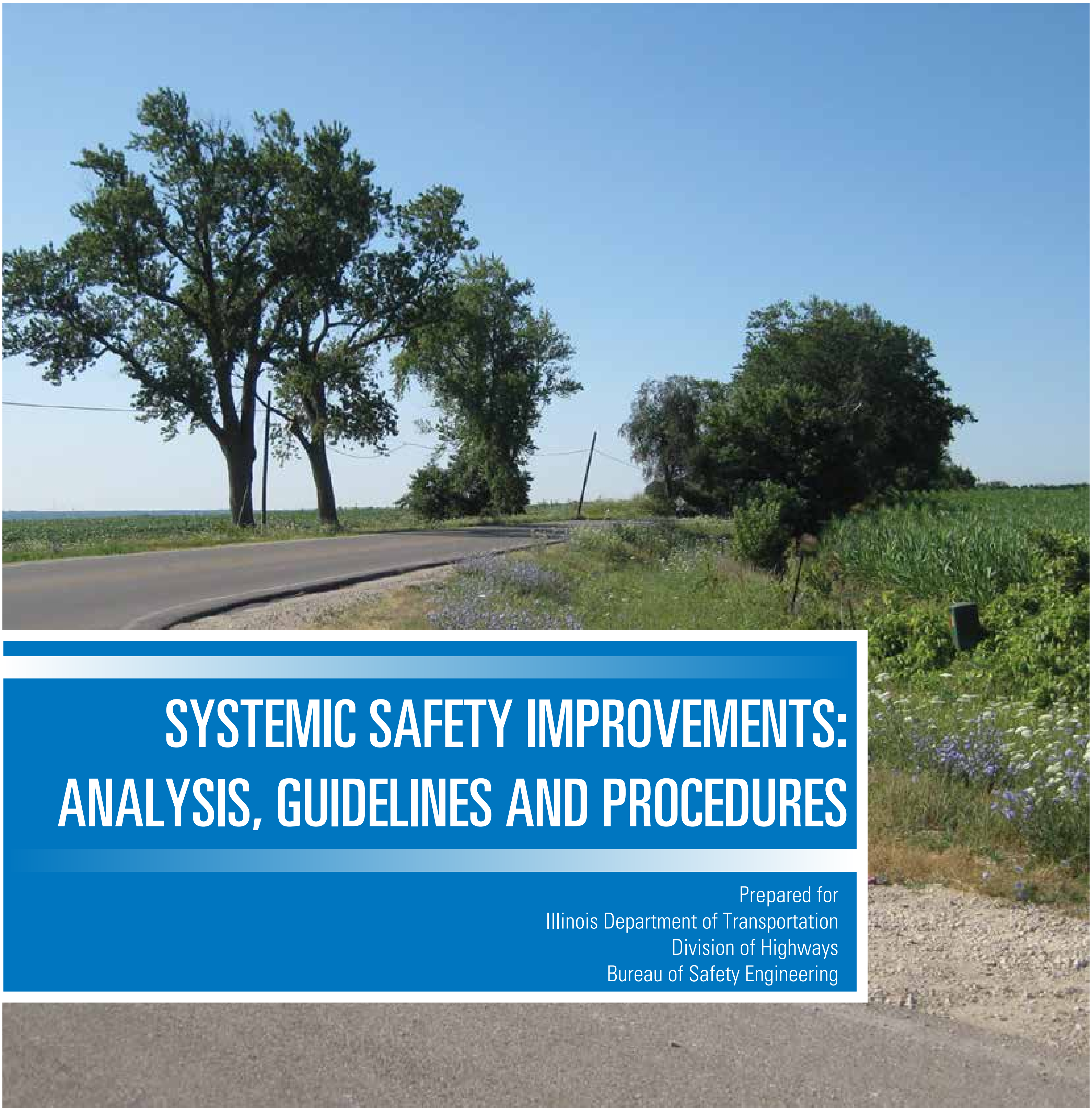
Illinois Department of Transportation

MAY 2014



# SYSTEMIC SAFETY IMPROVEMENTS: ANALYSIS, GUIDELINES AND PROCEDURES

Prepared for
Illinois Department of Transportation
Division of Highways
Bureau of Safety Engineering

*Driving Zero Fatalities to a Reality*
Partnering for Illinois

# Illinois Department of Transportation
# Division of Highways
# Bureau of Safety Engineering

Prepared by
CH2M HILL

**May 2014**

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# Acronyms and Abbreviations

| | |
|---|---|
| 4E | Engineering, Enforcement, Education, and Emergency Medical Services |
| AADT | Annual Average Daily Traffic |
| AASTHO | American Association of State Highway and Transportation Officials |
| BSE | Bureau of Safety Engineering |
| CMF | Crash Modification Factor |
| Department | Illinois Department of Transportation |
| FHWA | Federal Highway Administration |
| FO/OVT | Fixed Object/Overturned |
| GIS | Geographic Information System |
| HSM | Highway Safety Manual |
| ID | identification number |
| IDOT | Illinois Department of Transportation |
| K/A | Fatal/A-Injury crashes |
| KAB | Fatal, A-injury and B-Injury Combined |
| RD | Road Departure (fixed object, overturned, sideswipe opposite direction and head-on crashes) |
| RE/SSD | Rear End/Sideswipe Opposite Direction |
| RHR | Roadside Hazard Rating |
| SDM | Safety Data Mart |
| SHSP | Strategic Highway Safety Plan |
| TEV | Total Entering Vehicles |
| VMT | Vehicle Miles Traveled |

# 1.0 Introduction

As outlined in the Illinois Strategic Highway Safety Plan (ISHSP), Illinois is focused on saving lives and reducing severe injuries on Illinois roadways. The State of Illinois is planning to make zero fatalities a reality through a variety of data-driven, collaborative safety initiatives and programs. The 4E safety partners Engineering, Enforcement, Education, and Emergency Medical Services are collaborating to address safety needs.

As shown in Figure 1-1, roadway safety is a continuum. A completely safe road would have no crashes, and less safe roads would have more frequent and more severe crashes. By this standard, perfect safety is impossible, but it is possible to affect the frequency and severity of crashes to make the road more or less safe. The challenge is to apply limited resources to provide meaningful improvements to safety. The Illinois Department of Transportation (IDOT) is incorporating safety into the overall transportation management process, namely Planning and Programming, Scoping and Phase I, Design and Construction, Operations and Maintenance and Performance Management, to ensure that safety is considered explicitly in all decisions of the project development process. Incorporating safety in planning and programming allows for improvements to be addressed early in the process but safety improvements may be considered in all stages of the process.

FIGURE 1-1
**Safety in the Transportation Management Process**


A variety of tools have been developed to help identify high priority areas for improvement that may benefit from implementation of safety countermeasures. These tools include, but are not limited to, the American Association of State Highway and Transportation Officials (AASTHO) *Highway Safety Manual 1st Edition* (HSM), the Federal Highway Administration (FHWA) Systemic Tool, and the IDOT *Systemic Safety Improvements: Analysis, Guidelines and Procedures* document.

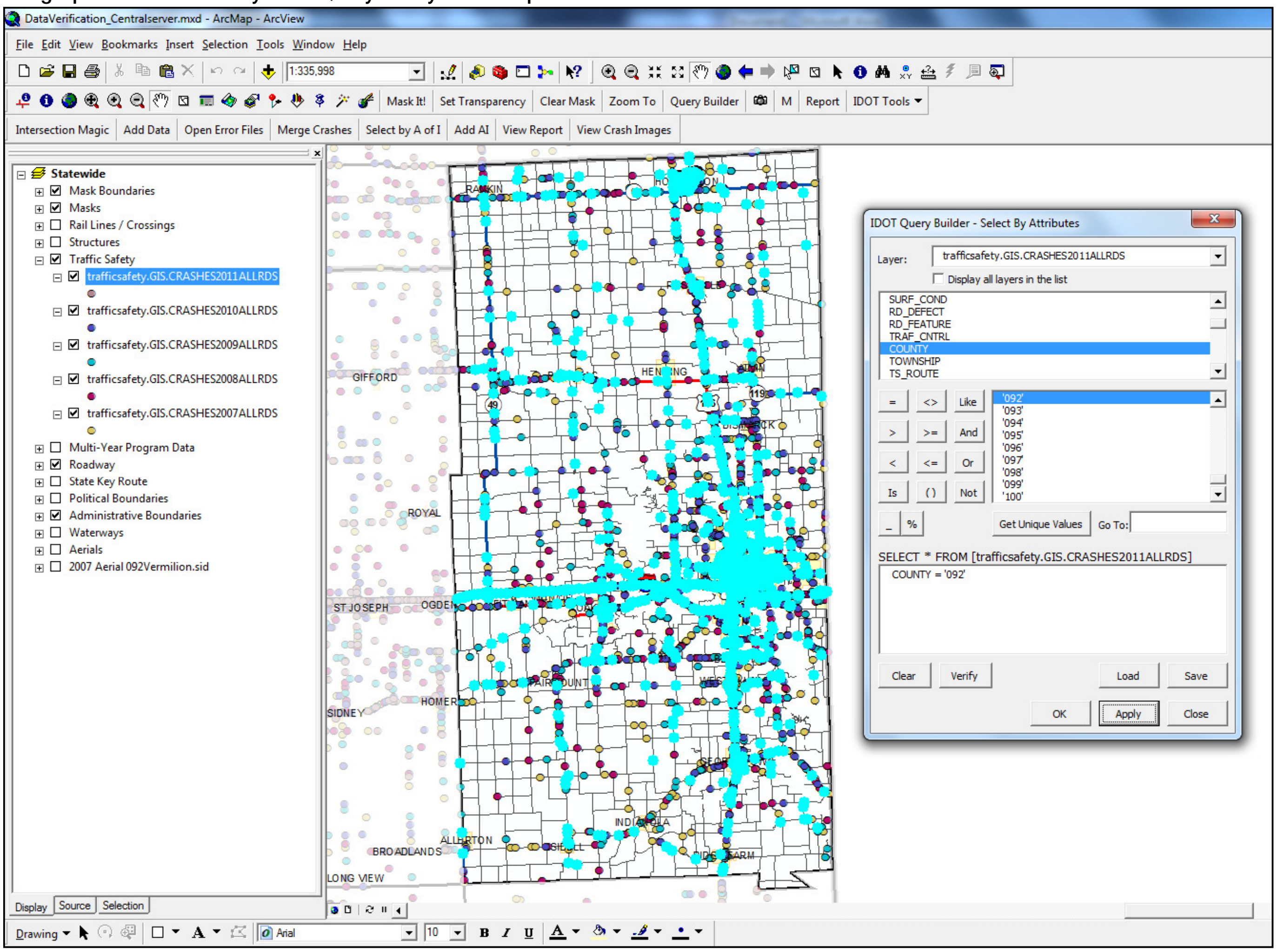
HSM Part B outlines the roadway safety management process, which includes network screening, diagnosis, countermeasure selection, economic appraisal, project prioritization, and safety effectiveness evaluation. The FHWA Systemic Tool outlines an approach for proactive safety screening and project development. The IDOT *Systemic Safety Improvements: Analysis, Guidelines and Procedures* are similar. The Guidelines outline an approach for identifying high priority areas to integrate safety into projects and plans throughout the transportation management process. These Guidelines are intended to be used by IDOT district staff, local municipalities, and others to help direct and enhance their safety programs.

This document explains how to collect crucial safety data that is not readily available, analyze safety data, use available resources to implement strategies effectively and make proactive infrastructure improvements, and to target enforcement and education programs. The information presented in this document will assist in better identifying potential safety performance issues on a roadway system and guide efforts to save lives. Specifically, this document includes the tools necessary for conducting safety analysis, network screening and the systemic approach. These Guidelines detail the systemic process which includes collecting data, organizing the data, obtaining critical values, compiling the results, field assessment and countermeasure selection. This document also includes an example of a systemic Benefit/Cost analysis using the Illinois Benefit/Cost Tool.

# 2.0 Systemic Safety Analysis Tools

Geographic Information Systems (GIS) is one of the primary tools used to analyze crash data. Being a very versatile program, ArcGIS allows the user to view and manipulate data layers as desired. Queries can be performed to focus on a certain aspect of a database which gives the ability to investigate on a crash by crash basis. Figure 2-1 shows how a certain type of crash can be selected and highlighted in blue to distinguish the selected data from all other data.

FIGURE 2-1
**Geographic Information System Query Analysis Example**

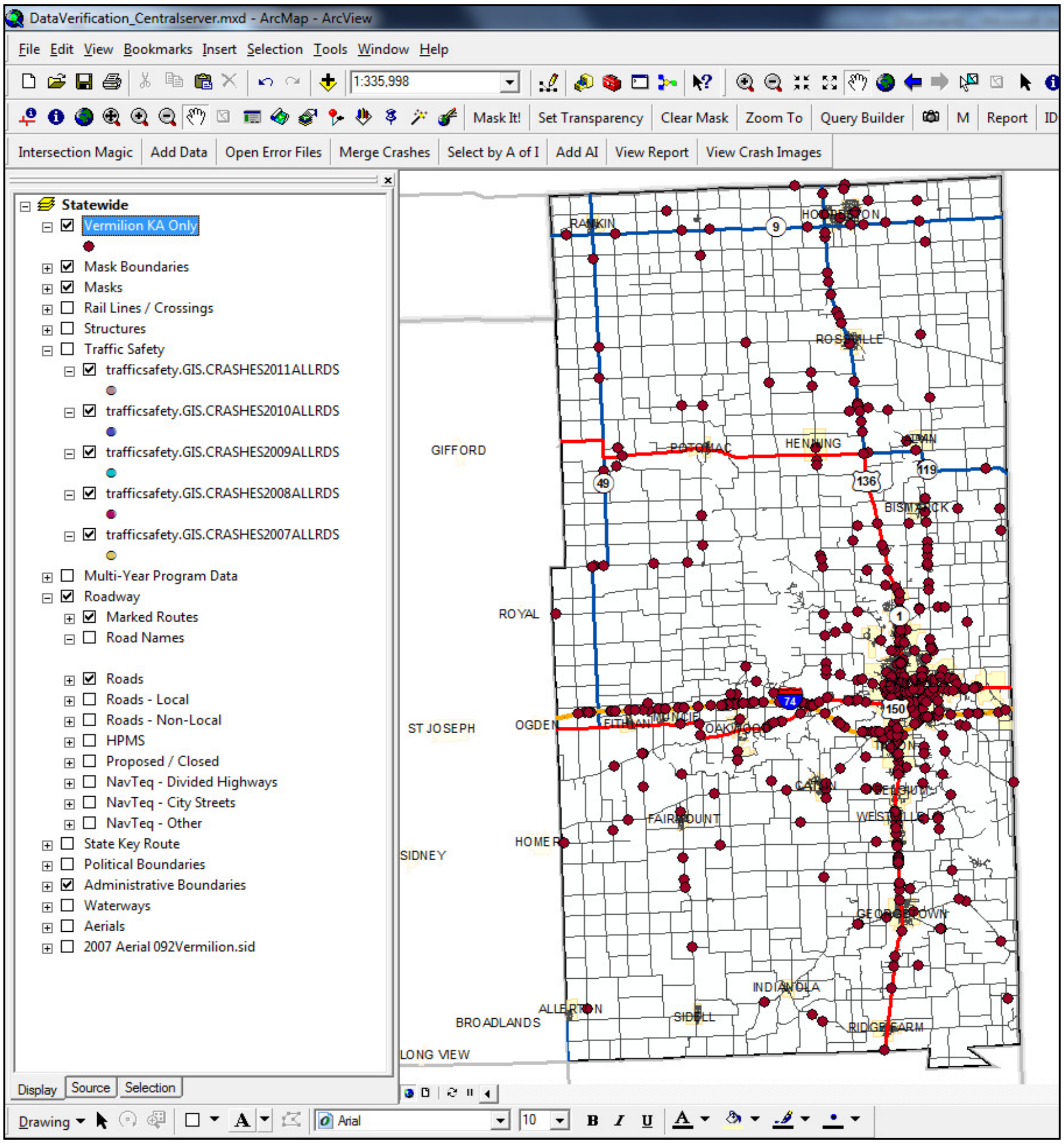



GIS layers should be used that contain crash data for the district, county or municipality of interest. If the data layer contains crashes for the entire state, the query builder is very useful in slimming down the specific crash data information to a specific area. This helps keep the data layer smaller and easier to use.

Because the main focus is on severe crashes, a query can be developed to highlight Fatal/A-injury (K/A) injury crashes within county borders, as shown in Figure 2-2. From here, any of the specific locations can be considered for further analysis and field assessment. The three major location categories are intersections, segments, and curves.

Safety Data Mart (SDM) is another valuable tool for analyzing crash data if GIS is not readily available. All 9 IDOT District offices have the internal SDM, and other safety stakeholders should be able to use the external SDM, which is readily available upon request through the Bureau of Safety Engineering (BSE).

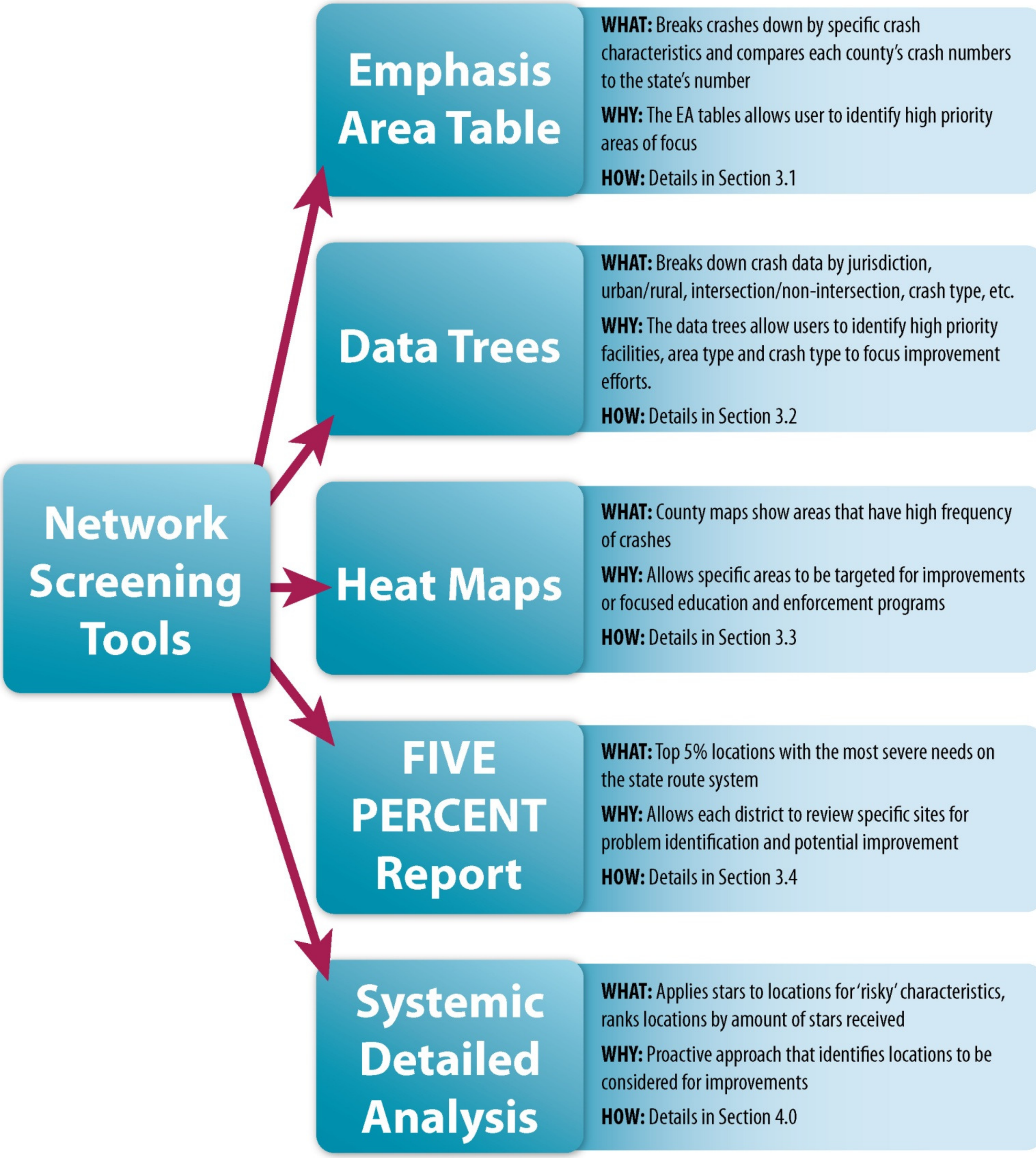
FIGURE 2-2
**Geographic Information System Fatal/A-Injury Crash Query Analysis**




ArcGIS is one of the major instruments used for creating network screening tools. Other programs which the user should have basic knowledge include Microsoft Excel, Microsoft Access, Google Earth Pro®, and the Illinois Benefit/Cost Tool.

# 3.0 Network Screening Tools

FIGURE 3-1
**Network Screening Tools**



## 3.1 Emphasis Area Tables

Emphasis Area (EA) tables compare a county's crash numbers to the entire state's numbers. Roadway systems are broke down into State and County/Local. This is similar to Data Trees, but unlike Data Trees, the Emphasis Area Tables also show overrepresented categories and behavioral categories. Overrepresented categories are highlighted by orange cells, as shown in Table 3-1. Section 4.5, Obtaining Critical Values explains the concept of overrepresentation.

These additional behavioral categories are younger drivers, older drivers, aggressive drivers, drug/alcohol related crashes, inattentive/distracted/sleeping drivers and unbelted/no safety restraint crashes. By comparing each Emphasis Area against the others, it can be seen which types of crashes should be considered for implementing safety efforts.

# Table 3.1
## Illinois County Emphasis Area Tables:
## Statewide Comparison (2007-2011 Collisions)

| | | Comparison [a] | | | | Illinois County | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | State System | | County/Local | | State System | | County/Local | |
| Emphasis Area | | Percent | Frequency | Percent | Frequency | Percent | Frequency | Percent | Frequency |
| Total Fatal and Serious Injury Collisions (K+A) | | | 28,894 | | 25,971 | | 1,326 | | 1,731 |
| Drivers | Younger Drivers (16-20) | 18.8% | 5,431 | 21.6% | 5,618 | 21.5% | 285 | 25.1% | 435 |
| | Older Drivers (65+) | 15.6% | 4,516 | 12.3% | 3,187 | 14.6% | 193 | 16.7% | 289 |
| | Aggressive Driving/Speed Related [b] | 41.0% | 11,856 | 37.9% | 9,847 | **51.9%** | 688 | 43.8% | 758 |
| | Drug/Alcohol Related | 14.6% | 4,231 | 16.3% | 4,221 | 11.6% | 154 | 11.8% | 204 |
| | Inattentive/Distracted/Asleep Drivers | 6.9% | 1,998 | 5.7% | 1,484 | 6.8% | 90 | 5.6% | 97 |
| | Unbelted/No Safety Restraint Occupants | 19.8% | 5,712 | 22.2% | 5,754 | 13.7% | 182 | 16.6% | 288 |
| Special Users | Pedestrian | 7.2% | 2,068 | 12.2% | 3,170 | 4.7% | 62 | 9.6% | 167 |
| | Bicycle | 2.6% | 756 | 5.5% | 1,430 | 1.6% | 21 | 6.9% | 119 |
| Vehicles | Motorcycle | 10.1% | 2,918 | 10.6% | 2,742 | 6.9% | 92 | 8.3% | 143 |
| | Heavy Vehicle | 10.2% | 2,948 | 4.3% | 1,110 | 12.4% | 165 | 4.4% | 77 |
| Highways | Train-Vehicle | 0.0% | 12 | 0.3% | 83 | 0.0% | 0 | 0.3% | 5 |
| | Road Departure [c] | 25.0% | 7,221 | 31.6% | 8,194 | 14.6% | 194 | 17.5% | 303 |
| | Head-On/Sideswipe Opposite Direction | 6.7% | 1,938 | 4.5% | 1,175 | 4.1% | 54 | 4.7% | 81 |
| | Intersection Related [d] | 44.1% | 12,736 | 40.9% | 10,633 | 48.9% | 648 | **54.1%** | 937 |
| | Work Zone Related | 2.1% | 614 | 1.1% | 276 | 3.2% | 42 | 1.6% | 27 |

Areas for Potential Safety Program Focus:

- Orange fill indicates overrepresentation

**0.00%** - Red text indicates largest category percentage

[a] Comparison data is from Statewide Crash Data

[b] Includes exceeding authorized speed limit, following too closely, exceeding safe speeds for conditions, failure to reduce speed to avoid crash, or operating vehicle in erratic, reckless, careless, negligent or aggressive manner.

[c] Includes Overturned, Fixed Object, and Other Object collision types

[d] Defined as collisions located within 250 feet of a rural intersection or 150 feet of an urban intersection and also coded as intersection related by the reporting officer. State system intersections are defined as intersection with at least one state roadway leg. County/Local intersection are defined as intersection with all County/Local roadway legs .

* Toll/Private systems are excluded due to insignificant number of crashes.

Emphasis Area categories types are NOT mutually exclusive, meaning one Emphasis Area collision type can occur with or without another Emphasis Area collision type. If mutliple Emphasis Area collision types occur in the same collision, the collision will be counted once for each Emphasis Area collision type. Hence, the sum of all Emphasis Area category collision types for each system may be greater than the overall frequency for that system.

## 3.2 Data Trees

To determine which roadway systems to analyze, safety engineers should look at County Data Trees, which are provided by BSE. These Data Trees will help determine a direct area of focus. The Data Tree separates crash data between the state, toll/private, county, township, and municipal roadway systems. Depending on the jurisdiction of interest, the Data Tree may branch out into more detail. The primary focus should be on severe crashes from the most recent 5-year period (for example, 2007 through 2011). 'A-injury' crashes are crashes that result in an incapacitating injury, which is any injury, other than fatal, that prevents the person from walking, driving, or normally continuing the activities that he or she was able to perform before the crash occurred. A-injuries include, but are not limited to severe lacerations, broken/distorted limbs, skull injuries, chest injuries, and abdominal injuries.

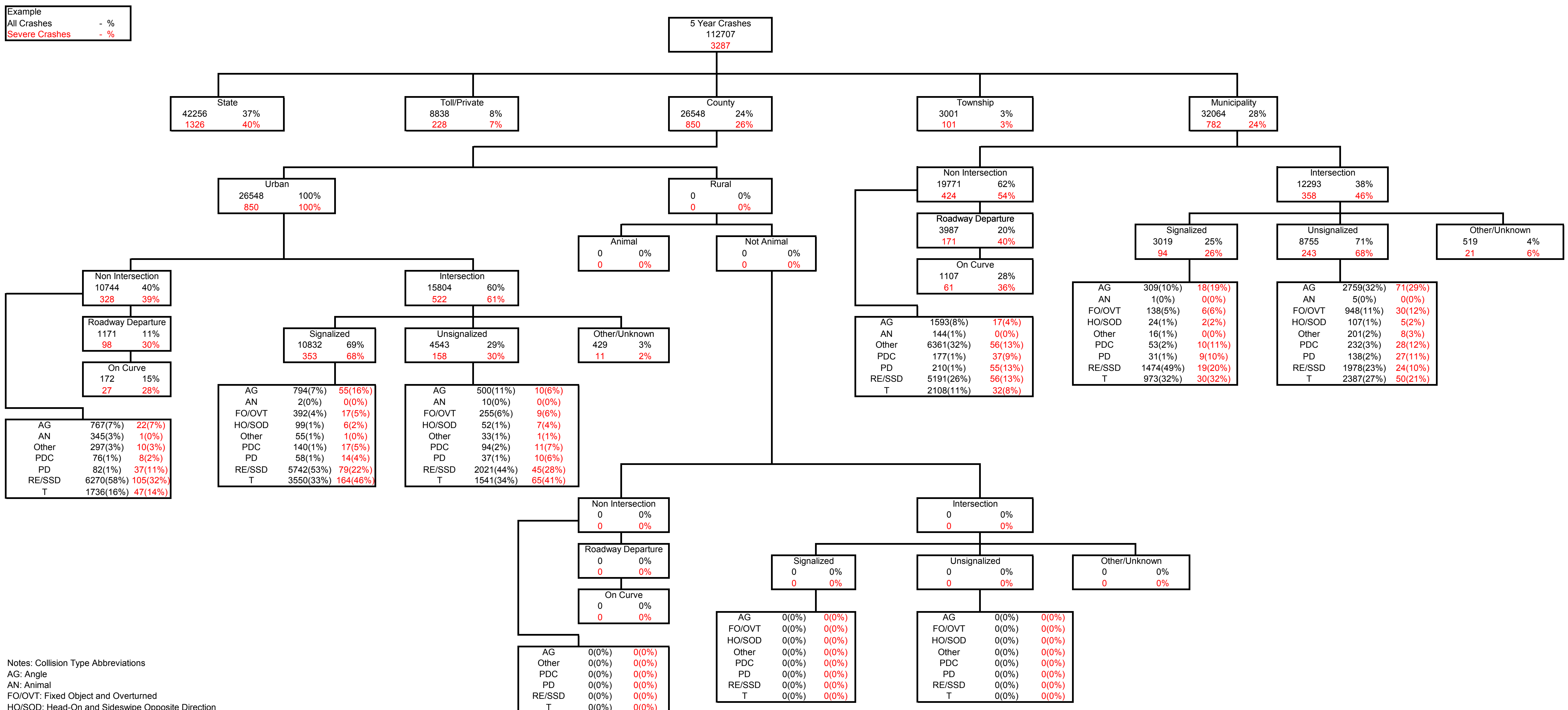
A 5-year period is used to give an overall understanding of the crashes, rather than looking at random crashes for each year. It is important to ensure that any and all locations where severe crashes have occurred are considered for safety improvements to reduce fatal and severe crashes in the near future. In the example Illinois County Data Trees illustrated in Figures 3-2, 3-3, and 3-4, the majority of the severe crashes are on state roads (40 percent). County routes have the second highest severe crash rate in the example Data Tree (26 percent). Because the majority of severe crashes are happening on state roads, these crashes can be investigated using the next branches of the Data Tree, shown in Figure 3-5.

These next branches break the crashes down into urban and rural areas. In the example, urban areas account for all of the severe crashes on state routes, so continuing to follow this branch would help to narrow down specific crashes that seem to be a frequent problem. Figure 3-5 also shows the last few branches for urban, state routes. This shows that crashes are next broken down between intersection crashes and non-intersection crashes. On the non-intersection branch, the green oval shows that 'Road Departure' (RD) and 'Rear End/Sideswipe Same Direction' (RE/SSD), severe crashes account for the largest percentages.

For the example Data Tree, the main focus would be on non-intersection, state routes that are in urban areas. Collecting data on these systems may be necessary to better understand why the system continues to have these types of problems. Data Trees are a highly beneficial first step in determining which jurisdiction of roadway systems should be the primary concern focus area.

# Figure 3-2
## Illinois County: 2007 to 2011 Crash Data Overview
## County and Municipality Roadway Systems

Source: IDOT Safety Analyst 2007 - 2011 Crash Data
All crashes include fatal, all injury and property damage only crashes
Severe crashes include fatal and serious injury crashes only (K + A)




Notes: Collision Type Abbreviations
AG: Angle
AN: Animal
FO/OVT: Fixed Object and Overturned
HO/SOD: Head-On and Sideswipe Opposite Direction
Other: Other Non-Collision, Other Object, Parked Car, Train, and Unknown
PDC: Pedalcyclist
PD: Pedestrian
RE/SSD: Rear End and Sideswipe Same Direction
T: Turning

Query Assumptions for Roadway Departure and On-Curve
Roadway Departure: Fixed Object, Overturned, Head-On, and Sideswipe Opposite Direction
On-Curve: Road Departure Crashes on Level Curve, Curve on Grade, and Curve on Hillcrest

Urban and Rural designations are defined by the Urban Area code in the Illinois Roadway Inventory System

Intersection crashes are defined as crashes located within 250 feet of a rural intersection or 150 feet of a urban intersection and also coded as intersection related by the reporting police officer

Intersection crashes are counted only once and are represented by only one jurisdiction using the following hierarchy.
S: State, C: County, T: Township, M: Municipality, T/P: Toll/Private

Results of the analyses shown in this table are based on data that was received from the Illinois Department of Transportation on May 23, 2012. Crash data represents years 2007 to 2011 and the roadway data represents the end of the 2009 year conditions. The data was used "as is" for analysis purposes and should be interpreted accordingly

| Intersection Crashes by Cross Street Jurisdiction | | |
|---|---|---|
| County | | |
| County-County | 2384(15%) | 82(16%) |
| County-Township | 1771(11%) | 59(11%) |
| County-Municipal | 11177(71%) | 375(72%) |
| County-Toll/Private | 472(3%) | 6(1%) |
| Municipality | | |
| Municipal-Municipal | 12225(99%) | 356(99%) |
| Municipal-Toll/Private | 68(1%) | 2(1%) |

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# Figure 3-3
## Illinois County: 2007 to 2011 Crash Data Overview
## Township Roadway System

Source: IDOT Safety Analyst 2007 - 2011 Crash Data
All crashes include fatal, all injury and property damage only crashes
Severe crashes include fatal and serious injury crashes only (K + A)

| Example | |
|---|---|
| All Crashes | - % |
| Severe Crashes | - % |

**5 Year Crashes**: 112707 / 3287

| | State | Toll/Private | County | Township | Municipality |
|---|---|---|---|---|---|
| All Crashes | 42256 (37%) | 8838 (8%) | 26548 (24%) | 3001 (3%) | 32064 (28%) |
| Severe Crashes | 1326 (40%) | 228 (7%) | 850 (26%) | 101 (3%) | 782 (24%) |

**Township**

| | Urban | Rural |
|---|---|---|
| All Crashes | 3001 (100%) | 0 (0%) |
| Severe Crashes | 101 (100%) | 0 (0%) |

**Urban**

| | Non Intersection | Intersection |
|---|---|---|
| All Crashes | 1406 (47%) | 1595 (53%) |
| Severe Crashes | 44 (44%) | 57 (56%) |

**Urban – Non Intersection**

| | Roadway Departure | On Curve |
|---|---|---|
| All Crashes | 398 (28%) | 93 (23%) |
| Severe Crashes | 15 (34%) | 0 (0%) |

| | All Crashes | Severe Crashes |
|---|---|---|
| AG | 92(7%) | 1(2%) |
| AN | 75(5%) | 1(2%) |
| Other | 393(28%) | 7(16%) |
| PDC | 15(1%) | 5(11%) |
| PD | 20(1%) | 7(16%) |
| RE/SSD | 330(23%) | 6(14%) |
| T | 83(6%) | 2(5%) |

**Urban – Intersection**

| | Signalized | Unsignalized | Other/Unknown |
|---|---|---|---|
| All Crashes | 547 (34%) | 975 (61%) | 73 (5%) |
| Severe Crashes | 23 (40%) | 32 (56%) | 2 (4%) |

| | Signalized All | Signalized Severe | Unsignalized All | Unsignalized Severe |
|---|---|---|---|---|
| AG | 58(11%) | 3(13%) | 278(29%) | 13(41%) |
| AN | 0(0%) | 0(0%) | 3(0%) | 0(0%) |
| FO/OVT | 23(4%) | 1(4%) | 144(15%) | 1(3%) |
| HO/SOD | 2(0%) | 1(4%) | 17(2%) | 1(3%) |
| Other | 3(1%) | 0(0%) | 24(2%) | 2(6%) |
| PDC | 2(0%) | 0(0%) | 13(1%) | 0(0%) |
| PD | 0(0%) | 0(0%) | 14(1%) | 5(16%) |
| RE/SSD | 274(50%) | 6(26%) | 226(23%) | 2(6%) |
| T | 185(34%) | 12(52%) | 256(26%) | 8(25%) |

**Rural**

| | Animal | Not Animal |
|---|---|---|
| All Crashes | 0 (0%) | 0 (0%) |
| Severe Crashes | 0 (0%) | 0 (0%) |

**Rural – Not Animal**

| | Non Intersection | Intersection |
|---|---|---|
| All Crashes | 0 (0%) | 0 (0%) |
| Severe Crashes | 0 (0%) | 0 (0%) |

**Rural – Non Intersection**

| | Roadway Departure | On Curve |
|---|---|---|
| All Crashes | 0 (0%) | 0 (0%) |
| Severe Crashes | 0 (0%) | 0 (0%) |

| | All Crashes | Severe Crashes |
|---|---|---|
| AG | 0(0%) | 0(0%) |
| Other | 0(0%) | 0(0%) |
| PDC | 0(0%) | 0(0%) |
| PD | 0(0%) | 0(0%) |
| RE/SSD | 0(0%) | 0(0%) |
| T | 0(0%) | 0(0%) |

**Rural – Intersection**

| | Signalized | Unsignalized | Other/Unknown |
|---|---|---|---|
| All Crashes | 0 (0%) | 0 (0%) | 0 (0%) |
| Severe Crashes | 0 (0%) | 0 (0%) | 0 (0%) |

| | Signalized All | Signalized Severe | Unsignalized All | Unsignalized Severe |
|---|---|---|---|---|
| AG | 0(0%) | 0(0%) | 0(0%) | 0(0%) |
| FO/OVT | 0(0%) | 0(0%) | 0(0%) | 0(0%) |
| HO/SOD | 0(0%) | 0(0%) | 0(0%) | 0(0%) |
| Other | 0(0%) | 0(0%) | 0(0%) | 0(0%) |
| PDC | 0(0%) | 0(0%) | 0(0%) | 0(0%) |
| PD | 0(0%) | 0(0%) | 0(0%) | 0(0%) |
| RE/SSD | 0(0%) | 0(0%) | 0(0%) | 0(0%) |
| T | 0(0%) | 0(0%) | 0(0%) | 0(0%) |

Notes: Collision Type Abbreviations
AG: Angle
AN: Animal
FO/OVT: Fixed Object and Overturned
HO/SOD: Head-On and Sideswipe Opposite Direction
Other: Other Non-Collision, Other Object, Parked Car, Train, and Unknown
PDC: Pedalcyclist
PD: Pedestrian
RE/SSD: Rear End and Sideswipe Same Direction
T: Turning

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Roadway Departure: Fixed Object, Overturned, Head-On, and Sideswipe Opposite Direction
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Urban and Rural designations are defined by the Urban Area code in the Illinois Roadway Inventory System

Intersection crashes are defined as crashes located within 250 feet of a rural intersection or 150 feet of a urban intersection and also coded as intersection related by the reporting police officer

Intersection crashes are counted only once and are represented by only one jurisdiction using the following hierarchy.
S: State, C: County, T: Township, M: Municipality, T/P: Toll/Private

Results of the analyses shown in this table are based on data that was received from the Illinois Department of Transportation on May 23, 2012. Crash data represents years 2007 to 2011 and the roadway data represents the end of the 2009 year conditions. The data was used "as is" for analysis purposes and should be interpreted accordingly

| Intersection Crashes by Cross Street Jurisdiction | | |
|---|---|---|
| Township | | |
| Township-Township | 466(29%) | 14(25%) |
| Township-Municipal | 1097(69%) | 41(72%) |
| Township-Toll/Private | 32(2%) | 2(4%) |

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# Figure 3-4
# Illinois County: 2007 to 2011 Crash Data Overview
## State and Private/Toll Roadway Systems

Source: IDOT Safety Analyst 2007 - 2011 Crash Data
All crashes include fatal, all injury and property damage only crashes
Severe crashes include fatal and serious injury crashes only (K + A)

Example
All Crashes - %
Severe Crashes - %

5 Year Crashes
112707
3287

State
42256 37%
1326 40%

Toll/Private
8838 8%
228 7%

County
26548 24%
850 26%

Township
3001 3%
101 3%

Municipality
32064 28%
782 24%

### State

Urban
42256 100%
1326 100%

Rural
0 0%
0 0%

#### Urban

Non Intersection
20535 49%
678 51%

Roadway Departure
3169 15%
203 30%

On Curve
728 23%
56 28%

| | | |
|---|---|---|
| AG | 737(4%) | 33(5%) |
| AN | 276(1%) | 2(0%) |
| Other | 677(3%) | 35(5%) |
| PDC | 57(0%) | 12(2%) |
| PD | 76(0%) | 34(5%) |
| RE/SSD | 13780(67%) | 307(45%) |
| T | 1763(9%) | 52(8%) |

Intersection
21721 51%
648 49%

Signalized
16115 74%
477 74%

| | | |
|---|---|---|
| AG | 826(5%) | 69(14%) |
| AN | 1(0%) | 0(0%) |
| FO/OVT | 341(2%) | 18(4%) |
| HO/SOD | 107(1%) | 7(1%) |
| Other | 72(0%) | 3(1%) |
| PDC | 81(1%) | 4(1%) |
| PD | 59(0%) | 16(3%) |
| RE/SSD | 9841(61%) | 142(30%) |
| T | 4787(30%) | 218(46%) |

Unsignalized
4630 21%
128 20%

| | | |
|---|---|---|
| AG | 408(9%) | 22(17%) |
| AN | 2(0%) | 0(0%) |
| FO/OVT | 201(4%) | 7(5%) |
| HO/SOD | 53(1%) | 2(2%) |
| Other | 48(1%) | 2(2%) |
| PDC | 27(1%) | 4(3%) |
| PD | 23(0%) | 9(7%) |
| RE/SSD | 2440(53%) | 37(29%) |
| T | 1428(31%) | 45(35%) |

Other/Unknown
976 4%
43 7%

#### Rural

Animal
0 0%
0 0%

Not Animal
0 0%
0 0%

Non Intersection
0 0%
0 0%

Roadway Departure
0 0%
0 0%

On Curve
0 0%
0 0%

| | | |
|---|---|---|
| AG | 0(0%) | 0(0%) |
| Other | 0(0%) | 0(0%) |
| PDC | 0(0%) | 0(0%) |
| PD | 0(0%) | 0(0%) |
| RE/SSD | 0(0%) | 0(0%) |
| T | 0(0%) | 0(0%) |

Intersection
0 0%
0 0%

Signalized
0 0%
0 0%

| | | |
|---|---|---|
| AG | 0(0%) | 0(0%) |
| FO/OVT | 0(0%) | 0(0%) |
| HO/SOD | 0(0%) | 0(0%) |
| Other | 0(0%) | 0(0%) |
| PDC | 0(0%) | 0(0%) |
| PD | 0(0%) | 0(0%) |
| RE/SSD | 0(0%) | 0(0%) |
| T | 0(0%) | 0(0%) |

Unsignalized
0 0%
0 0%

| | | |
|---|---|---|
| AG | 0(0%) | 0(0%) |
| FO/OVT | 0(0%) | 0(0%) |
| HO/SOD | 0(0%) | 0(0%) |
| Other | 0(0%) | 0(0%) |
| PDC | 0(0%) | 0(0%) |
| PD | 0(0%) | 0(0%) |
| RE/SSD | 0(0%) | 0(0%) |
| T | 0(0%) | 0(0%) |

Other/Unknown
0 0%
0 0%

### Toll/Private

Non Intersection
8820 100%
227 100%

Roadway Departure
2018 23%
84 37%

On Curve
271 13%
12 14%

| | | |
|---|---|---|
| AG | 62(1%) | 4(2%) |
| AN | 65(1%) | 1(0%) |
| Other | 302(3%) | 14(6%) |
| PDC | 0(0%) | 0(0%) |
| PD | 6(0%) | 3(1%) |
| RE/SSD | 6302(71%) | 117(52%) |
| T | 65(1%) | 4(2%) |

Intersection
18 0%
1 0%

Signalized
11 61%
1 100%

| | | |
|---|---|---|
| AG | 0(0%) | 0(0%) |
| AN | 0(0%) | 0(0%) |
| FO/OVT | 1(9%) | 1(100%) |
| HO/SOD | 0(0%) | 0(0%) |
| Other | 0(0%) | 0(0%) |
| PDC | 0(0%) | 0(0%) |
| PD | 0(0%) | 0(0%) |
| RE/SSD | 7(64%) | 0(0%) |
| T | 3(27%) | 0(0%) |

Unsignalized
3 17%
0 0%

| | | |
|---|---|---|
| AG | 0(0%) | 0(0%) |
| AN | 0(0%) | 0(0%) |
| FO/OVT | 0(0%) | 0(0%) |
| HO/SOD | 0(0%) | 0(0%) |
| Other | 1(33%) | 0(0%) |
| PDC | 0(0%) | 0(0%) |
| PD | 0(0%) | 0(0%) |
| RE/SSD | 2(67%) | 0(0%) |
| T | 0(0%) | 0(0%) |

Other/Unknown
4 22%
0 0%

Notes: Collision Type Abbreviations
AG: Angle
AN: Animal
FO/OVT: Fixed Object and Overturned
HO/SOD: Head-On and Sideswipe Opposite Direction
Other: Other Non-Collision, Other Object, Parked Car, Train, and Unknown
PDC: Pedalcyclist
PD: Pedestrian
RE/SSD: Rear End and Sideswipe Same Direction
T: Turning

Query Assumptions for Roadway Departure and On-Curve
Roadway Departure: Fixed Object, Overturned, Head-On, and Sideswipe Opposite Direction
On-Curve: Road Departure Crashes on Level Curve, Curve on Grade, and Curve on Hillcrest

Urban and Rural designations are defined by the Urban Area code in the Illinois Roadway Inventory System

Intersection crashes are defined as crashes located within 250 feet of a rural intersection or 150 feet of a urban intersection and also coded as intersection related by the reporting police officer

Intersection crashes are counted only once and are represented by only one jurisdiction using the following hierarchy.
S: State, C: County, T: Township, M: Municipality, T/P: Toll/Private

Results of the analyses shown in this table are based on data that was received from the Illinois Department of Transportation on May 23, 2012. Crash data represents years 2007 to 2011 and the roadway data represents the end of the 2009 year conditions. The data was used "as is" for analysis purposes and should be interpreted accordingly

| Intersection Crashes by Cross Street Jurisdiction | | |
|---|---|---|
| County | | |
| State-State | 1859(9%) | 40(6%) |
| State-County | 7307(34%) | 216(33%) |
| State-Township | 2130(10%) | 77(12%) |
| State-Municipal | 9819(45%) | 298(46%) |
| State-Toll/Private | 606(3%) | 17(3%) |
| Toll/Private | | |
| Toll/Private-Toll/Private | 18(100%) | 1(100%) |

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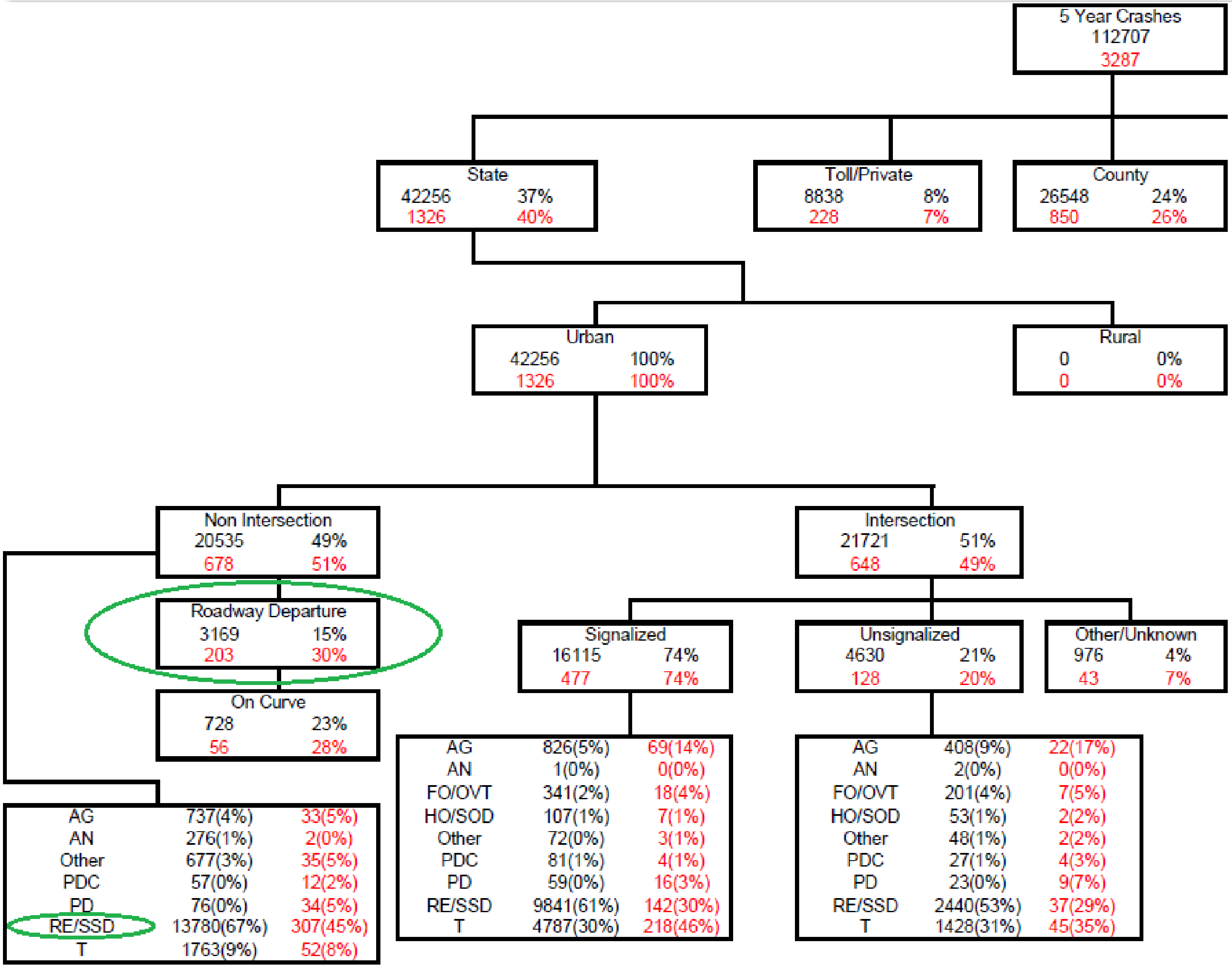
FIGURE 3-5
**Illinois County Data Tree – State Routes Urban Areas Branches**

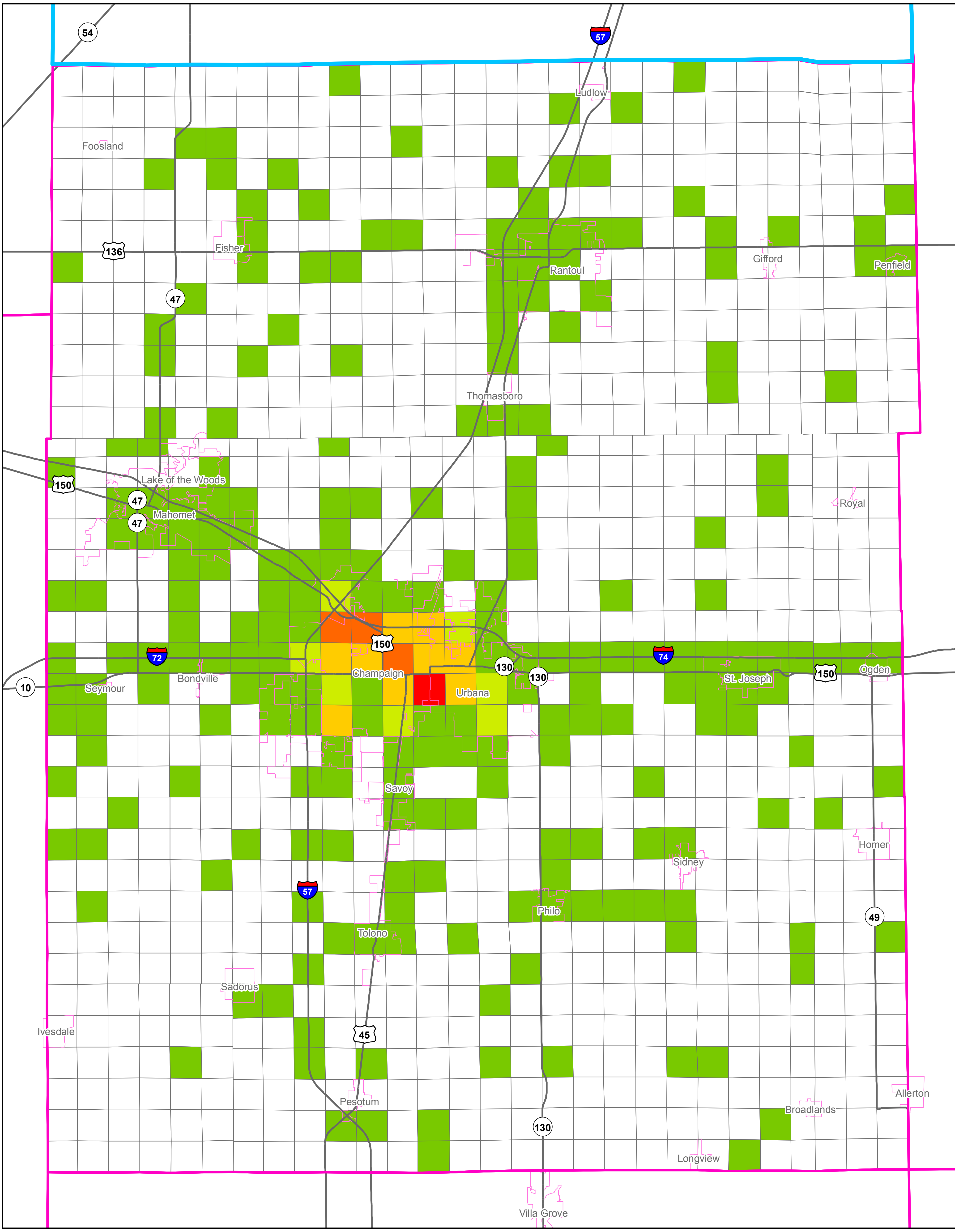


## 3.3 Heat Maps

Reviewing Heat Maps is another way to screen locations based on driver behavior and crash patterns. These maps cover a range of engineering and non-engineering focus areas, such as impaired drivers, older drivers, unrestrained drivers and/or occupants, younger drivers, intersection related crashes, non-intersection related crashes, and roadway departure crashes. Using the crash count intervals per section square in the legend (Figure 3-6), different colors show how an area “behaves.” Areas with a high frequency of red and orange squares are experiencing high levels of a certain problem.

Heat Maps can be very beneficial as a screening tool for law enforcement by pinpointing areas that show overrepresentation of crashes involving impaired or unrestrained drivers. Law enforcement can patrol these areas to prevent those drivers from causing severe injuries. Heat Maps also enable the use of the 4E concept of Engineering, Enforcement, Education, and Emergency Medical Services working together to reduce crashes and improve the safety of all roadway users.

The Heat Maps are readily available through BSE on a county by county basis.




# FIGURE 3-6

## EXAMPLE ILLINOIS COUNTY

### KAB Younger Driver Crashes Per Section Square (All Routes Included)

### Analysis Period: 2007-2011

**Legend**

- City Boundary
- County Boundary
- District Boundary

**KAB Younger Driver Crashes Per Section Square**

- 0
- 1 - 7
- 8 - 14
- 15 - 22
- 23 - 29
- 30 - 36

*Legend intervals are based on KAB younger driver crashes that occured in the Example Illinois County.

0 1.5 3 Miles

N

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*Note: On average, section squares have an area of approximately 1 square mile.*

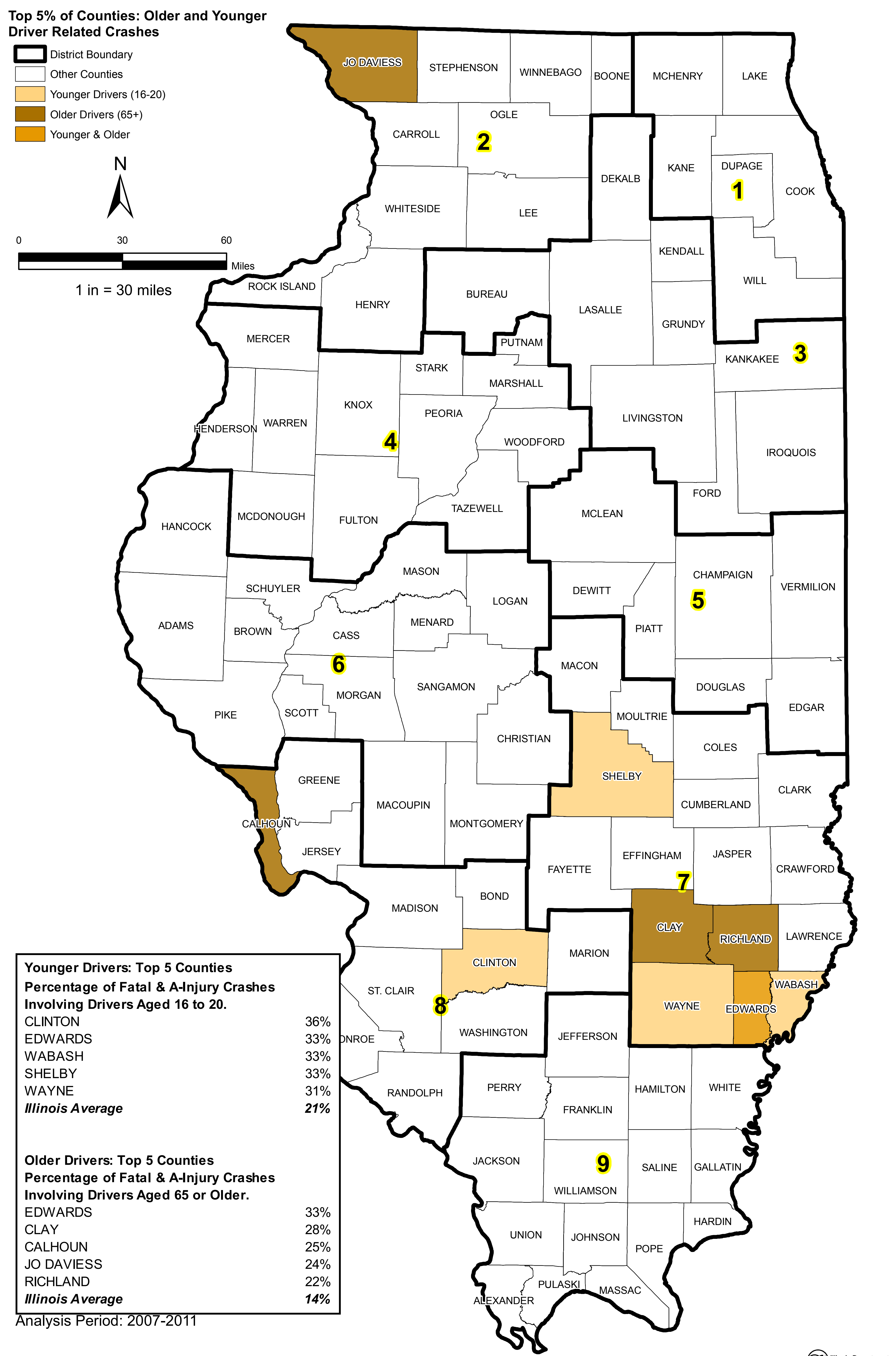
DISCLAIMER: Results of the analyses shown in this table are based on data that was received from the Illinois Department of Transportation. Crash data represents years 2007 to 2011 and was obtained from the state police and other enforcement agencies. Crash data for 2007 was received from IDOT on December 20, 2008, and Crash data for 2008 was received from IDOT on October 6, 2009. Crash data for 2009 was received from IDOT on September 10, 2010. Crash data for 2010 was received from IDOT on September 12, 2011 and Provisional Crash data for 2011 was received from IDOT on May 31, 2012. The roadway and intersection data was developed by IDOT and represents the end of the 2011 year conditions. The data was used "as is" for analysis purposes and should be interpreted accordingly.

Draft_June 21, 2013 WOXX_CountySafety\County_SHSPs\Champaign Template\Databases Spatial\SHSP maps

## 3.4 FIVE PERCENT Report

The FIVE PERCENT Report is submitted annually to the Federal Highway Administration describing at least 5 percent of state jurisdiction highway locations exhibiting the most pressing safety needs. The FIVE PERCENT Report can help gain a better understanding of the characteristics of the roads and the nature of the road's safety problems, help steer efforts towards areas that are in need of safety investments and provide a basis for tracking the progress toward improving their county. Utilizing the FIVE PERCENT Report is another network screening tool that gives users more insight on where to implement the most cost-effective countermeasures.

Figure 3-7 shows one of the many maps that are included in the FIVE PERCENT Report. This figure concentrates on crashes that involved younger or older drivers. The top 5 counties are shown in the lower left box for each of the two categories. Their respective percentage is also listed and can be compared to the Illinois average. Visuals like this are just another tool that can help in the network screening process.




**Younger Drivers: Top 5 Counties**
**Percentage of Fatal & A-Injury Crashes Involving Drivers Aged 16 to 20.**

| | |
|---|---|
| CLINTON | 36% |
| EDWARDS | 33% |
| WABASH | 33% |
| SHELBY | 33% |
| WAYNE | 31% |
| ***Illinois Average*** | ***21%*** |

**Older Drivers: Top 5 Counties**
**Percentage of Fatal & A-Injury Crashes Involving Drivers Aged 65 or Older.**

| | |
|---|---|
| EDWARDS | 33% |
| CLAY | 28% |
| CALHOUN | 25% |
| JO DAVIESS | 24% |
| RICHLAND | 22% |
| ***Illinois Average*** | ***14%*** |

Analysis Period: 2007-2011

DISCLAIMER: Results of the analyses shown in this presentation are based on data that was received from the Illinois Department of Transportation. Crash data represents years 2007 to 2011 and was obtained from the state police and other enforcement agencies. Crash data for 2007 was received from IDOT on December 20, 2008, and Crash data for 2008 was received from IDOT on October 6, 2009. Crash data for 2009 was received from IDOT on September 10, 2010. Crash data for 2010 was received from IDOT on September 12, 2011 and Provisional Crash data for 2011 was received from IDOT on May 31, 2012. The roadway and intersection data was developed by IDOT and represents the end of the 2011 year conditions. The data was used "as is" for analysis purposes and should be interpreted accordingly.

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**FIGURE 3-7**
**BEHAVIORAL CRASH SUMMARIES BY COUNTY**
**Older and Younger Drivers**

# 4.0 Detailed Systemic Analysis Process

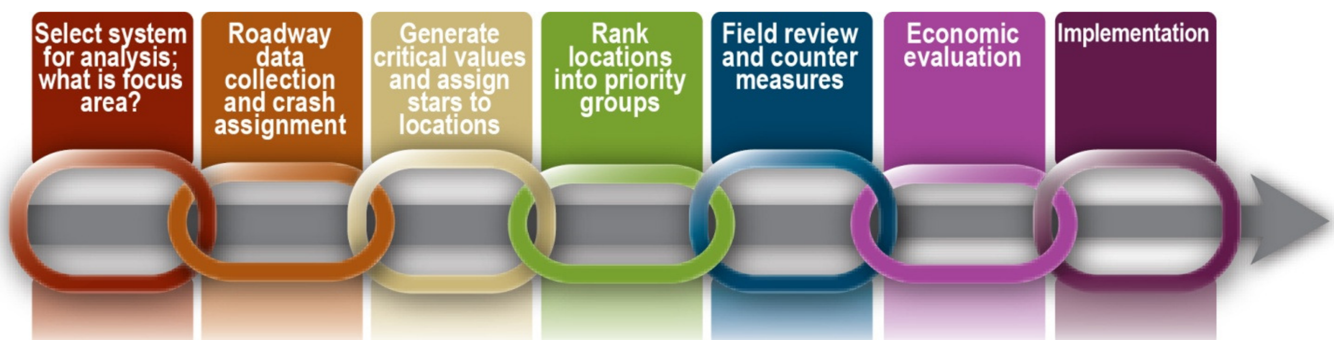
To isolate each component of study, the roadways can be broken down into categories. Each piece should be considered as an intersection or segment. Within the segments, there are corridors and curves. One approach is to see where severe K/A crashes are occurring on a map using GIS, like shown in Figure 2-2. If a cluster of K/A crashes is occurring on a specific stretch of road, this stretch can be identified as a potential “site” to review. Once these types of locations are identified, it is recommended that all the crash data for that particular segment/corridor or intersection be gathered. Simply reviewing the crash data for crashes at the same location may help to determine the contributing factors of a crash.

Another approach is a method developed that considers several elements using a star rating system as explained in Section 4.6. Stars are assigned to locations based on certain risk features, such as skewed intersections, curves with intersections, or segments with hazardous roadside characteristics. If a location acquires multiple stars, it is an indication that the location needs further attention.

This detailed analysis methodology is discussed in the following sections of the report and the general process is shown in Figure 4-1 below. Some of the items that are eligible to receive stars were AADT, RD crash density, total K/A crashes, and access density, among others.

A complete list of the items that earned stars is in Section 4.5, Obtaining Critical Values.

FIGURE 4-1
**IDOT Systemic Safety Detailed Analysis Process**



# 4.1 Location Types

## 4.1.1 Intersections

Intersections are examined first. Data collection should include urban or rural setting, how many vehicles travel through the intersection, the angular skew of the intersection, and the presence/absence of crosswalks, among others. Each intersection should be given a unique identification number (ID). Data collection through use of Google Earth Pro® can help populate the data fields of interest. Vehicular crashes should be assigned to the respective intersections in GIS for comparison and review.

A buffer zone can be used when assigning crashes to an intersection. If a crash occurs within this buffer zone, it would be considered an intersection-related crash. This method is used because it would be inefficient to go through large numbers of crash reports (in some cases, thousands) to determine whether a crash should be considered an intersection-related crash.

## 4.1.2 Segments

The next step is to examine each segment, which are usually broken into 1- to 3-mile-long segments. All crashes that have not been assigned to an intersection would now be considered a segment crash.

## 4.1.3 Curves

Isolating the curves of each segment is the next step in the data collection process. Using Google Earth Pro®, all curves with radii of 3,000 feet or smaller can be identified. The information documented includes length of curve, presence of chevrons, warnings, and advisories, visual traps, and whether or not there was an intersection at the curve.

When all of the crashes have been correctly assigned and all necessary data have been collected, the team can use the crash database to add specific crash information to the Excel spreadsheet. Crash types, severity, time of day, and so forth, can all be catalogued. By combining all of the data, the team is able to provide an accurate summary of all important elements of vehicle-related crashes within all of the study locations.

The complete list of desired characteristics for intersections, segments and curves is included in Section 4.3, Table/Data Formatting.

# 4.2 Process of Data Collection

Once all of the location types are correctly identified, the process of collecting all necessary data can begin. The majority of non-crash related data can be obtained using Google Earth, although some measurements require Google Earth Pro®. Both versions allow the user to “fly” over an area with the Aerial View, and also “drive” down a street or through an intersection with the Street View feature. If the presence of signage/chevrons or shoulder type is being considered, then Street View is ideal because it would be much easier to view a sign from street-level than from an Aerial View. For measuring lane width or checking if intersection skew is present, the Aerial View works best. Yet many roadway features can be found in either view, like the presence of commercial buildings or access points. It is up to the user to decide which view works best for them.

To determine roadway characteristics, each corridor was observed for the following: length and type of on-street parking (parallel, angle, or no street parking in urban and suburban areas only within the right-of-way); presence of passing lanes and short, four-lane sections; two-way left turn lanes; and number of lanes, among others. Some categories may not be included for the entirety of the segment or curve, such as the presence of two-way, left-turn lanes and lighting. The features are rounded to the majority answer. For example, if lighting was present for 10 percent of a 2.2 mile segment, it would be considered absent for the overall corridor.

Many of the roadway or intersection characteristics are self-explanatory, but a few, more complicated ones are shown below with brief descriptions of how to collect the data.

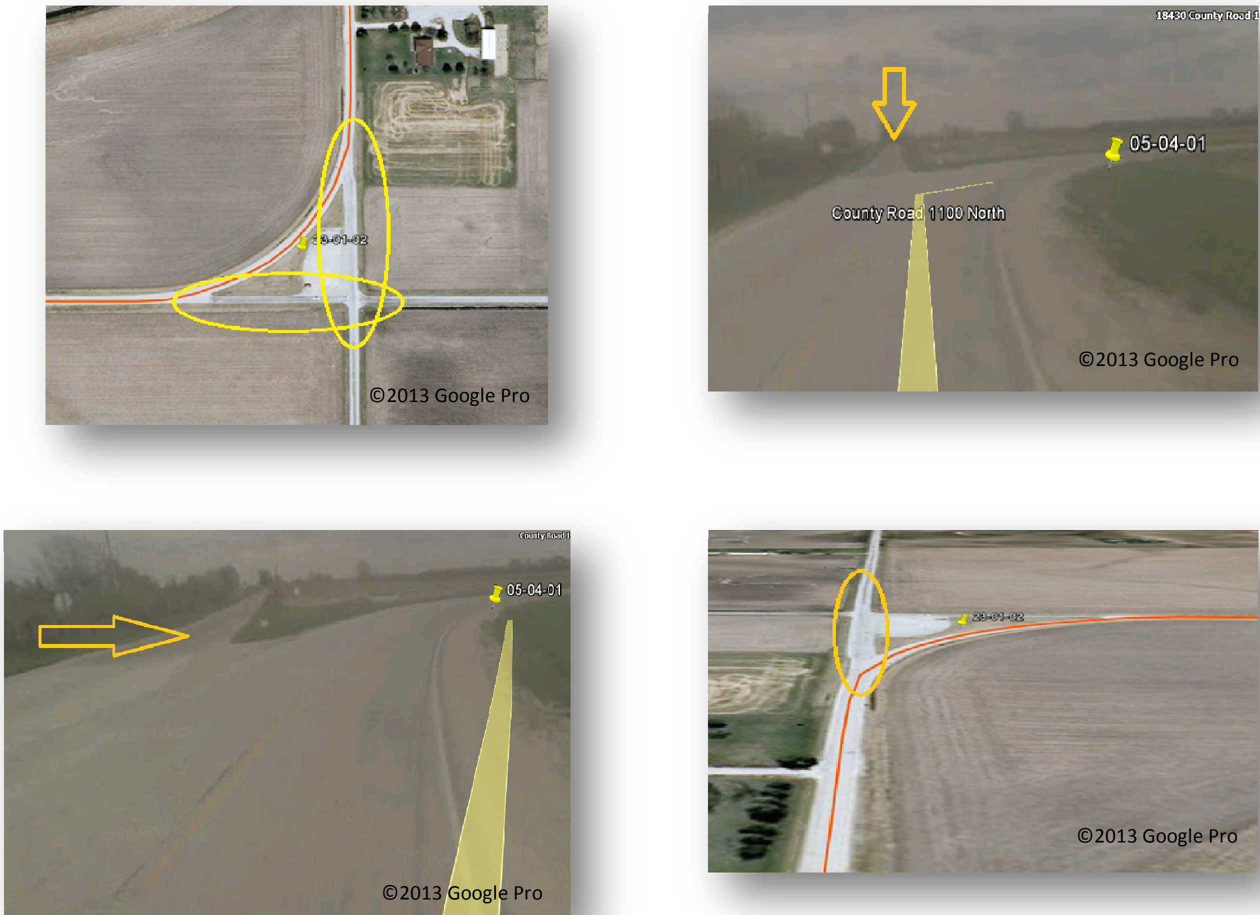
“Curve Critical Radius Density” is one ranking factor that is star eligible. Consider a segment that measures 1.6 miles. Along this segment, there are six horizontal curves. Of these six horizontal curves, two of them have a radius that falls into the critical radius interval (explained in Section 4.5). To find the density of curves that have a critical radius measurement, we would simply divide the count of curves along this segment that have a critical radius, two, by the length, 1.6 miles. This gives us a “Curve Critical Radius Density” of 1.25 critical curves per mile. If any segment has a density over 0.5, it receives a star.

“Road Departure Crash Density” is simply a measurement of how many road departure crashes occur along a segment’s length. Recall that road departure crashes are considered any of the following crash types: fixed object, overturned, sideswipe opposite direction or head-on. By taking the count of road departure crashes and dividing by the segment’s length, the “Road Departure Crash Density” is obtained.

A ranking factor for intersections is “Previous Stop 5+ Miles”. If all legs have the nearest stop at least five miles from the intersection, an additional star would be assigned to this intersection.

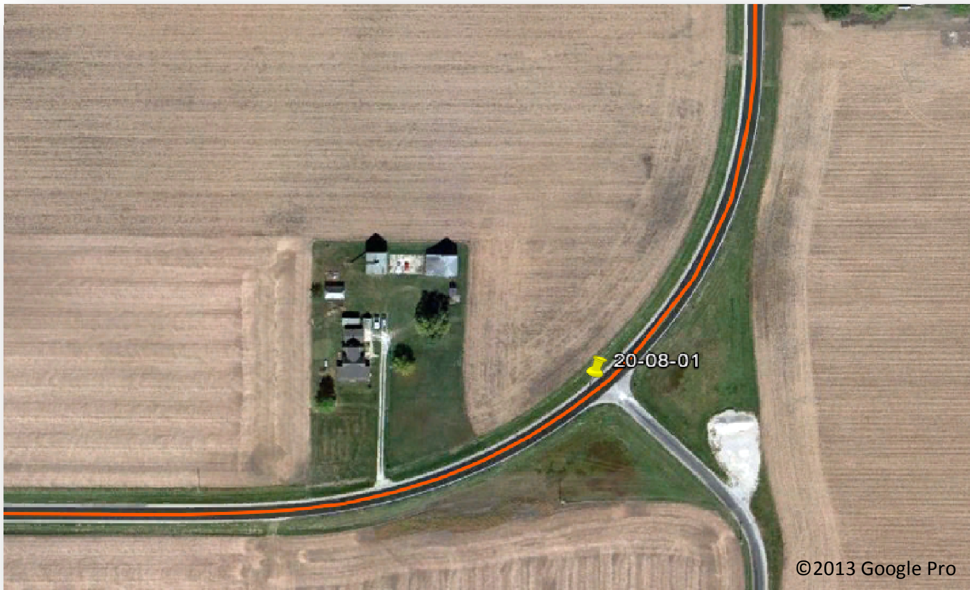
**Visual Traps.** Upon approaching a curve, the existence of the road appearing to continue straight can be considered a visual trap. In reality, the vehicle path follows a curve instead of the tangent road. The arrows in the two Figure 4-2 photos show visual traps.

FIGURE 4-2
**Visual Traps**



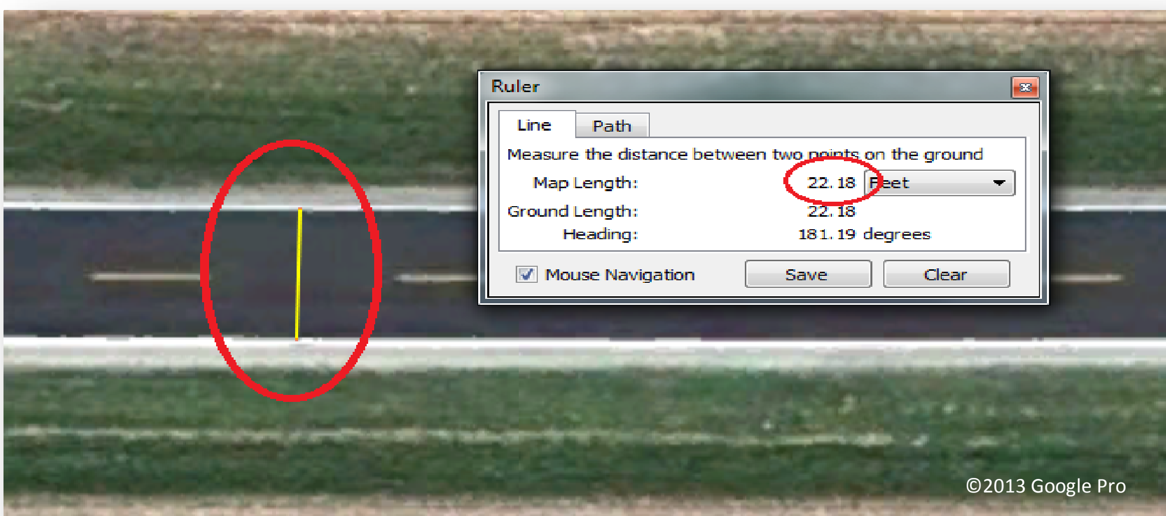
**Intersection on Curve.** A curve that has one or more intersections somewhere between the beginning and end points of the curve (residential drives are not considered for intersection on curves). See Figure 4-3.

FIGURE 4-3
Intersection on Curve




**Lane/Shoulder Widths.** Lane/shoulder widths are measured with the ruler tool in Google Earth (Figure 4-4). Measurements can only be made from the Aerial View in Google Earth, and the unit of measurement can be switched to miles or feet, depending on which is needed.

FIGURE 4-4
Lane/Shoulder Widths

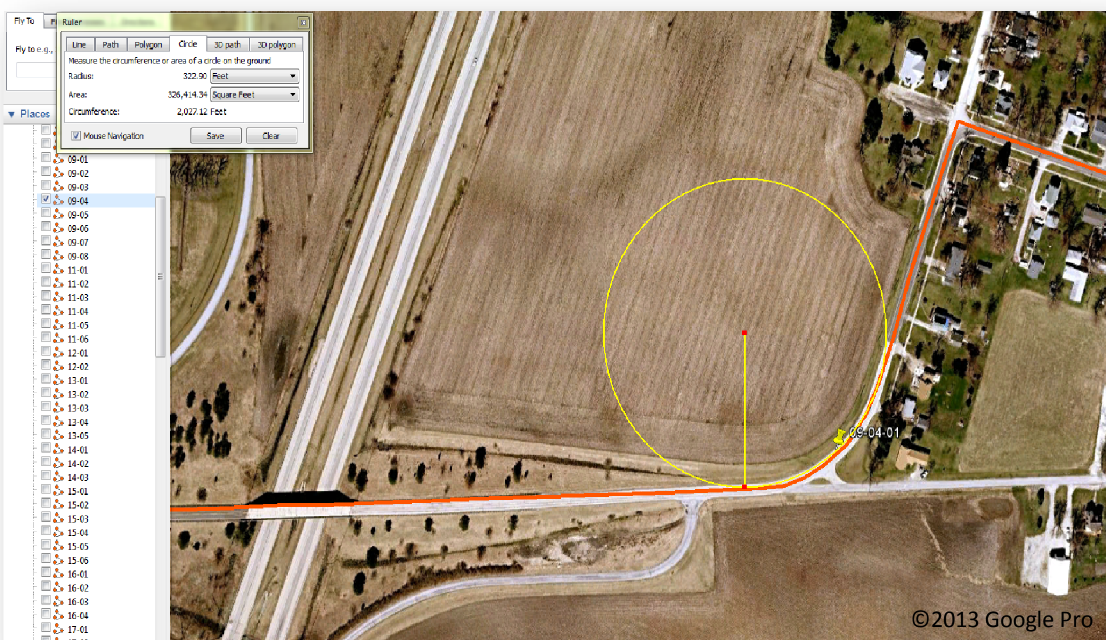


**Roadway Features.** Roadway features include Shoulder Type, Roadside Signage, Intersection Signage, Median Type, Road Hazard Rating (RHR), Pedestrian Signals, Traffic Control Device, Turn Lanes, Photo Speed Enforcement Equipment, and so forth. All of these, and more, can be observed in Street View; see Figure 4-5. Roadway GIS layers may also be available through BSE that provide other crucial roadway features. This layer may reduce the effort level spent performing data collection.

FIGURE 4-5
**Roadway Features**


**Curve Radius and Length.** The ‘circle’ option within the ruler tool in Google Earth Pro® can measure the radius of curves (Figure 4-6).

FIGURE 4-6
**Curve Radius and Length**

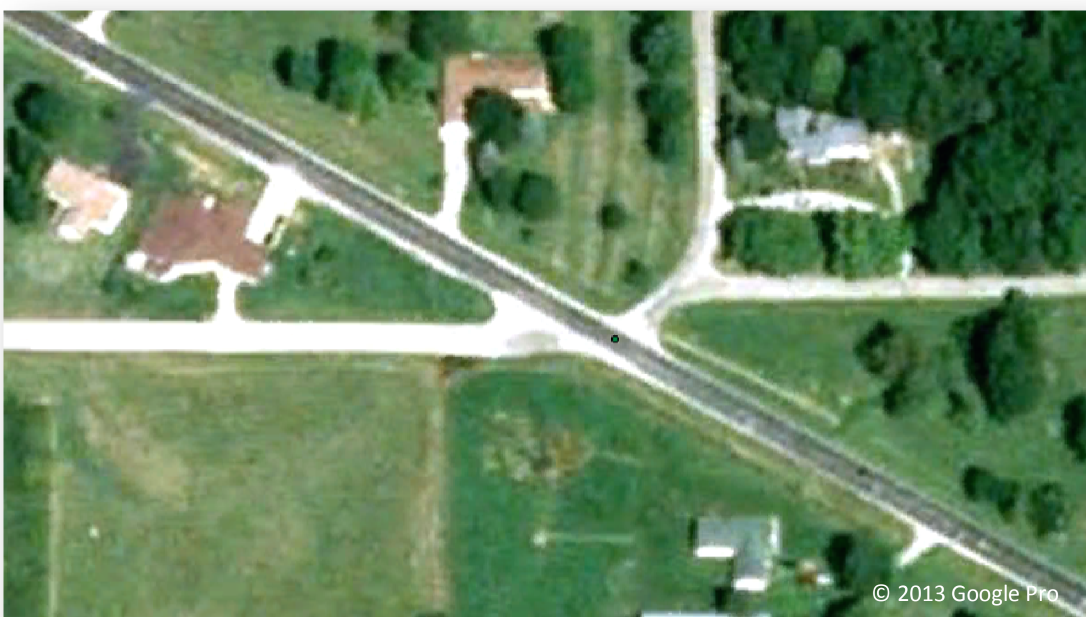


**Commercial Development and On/Near Curve.** An intersection with any type of commercial building access nearby can be seen from either Aerial or Street View. If the commercial building access is within 500 feet of the intersection, it should be considered. Also, an intersection in close proximity to a curved segment can also be seen from the Aerial View. See Figure 4-7.

FIGURE 4-7
**Commercial Development and On/Near Curve**


**Skewed Intersection.** Any intersection with legs that intersect at angles other than 90 degrees should be measured. Intersections with skew of more than 15 degrees in either direction earn a star. These can be measured in Google Earth Pro®. See Figure 4-8.

FIGURE 4-8
**Skewed Intersection**



**Access Density.** To determine the frequency of access to corridors, each corridor should be examined for the following categories:

Major Access

- Commercial: Commercial parking lots with approximately 50 or more spaces, including department stores, restaurants, shopping malls, office buildings, churches, sports facilities, and so forth.
- Residential: Residential parking lots with approximately 50 or more spaces, including apartment complexes and condominiums with group parking; example shown in red line in the figure below.
- Industrial: Industrial or manufacturing parking lots with approximately 50 or more spaces.

Minor Access

- Commercial: Commercial parking lots with 1 to 50 spaces.
- Residential: Residential parking lots with 1 to 50 spaces, including single-family homes.
- Industrial: Industrial or manufacturing parking lots with 1 to 50 spaces.

The number of access points divided by the length of each corridor (measured in miles) yields the access density (number of access points per mile).

FIGURE 4-9
**Major Residential Access Point**

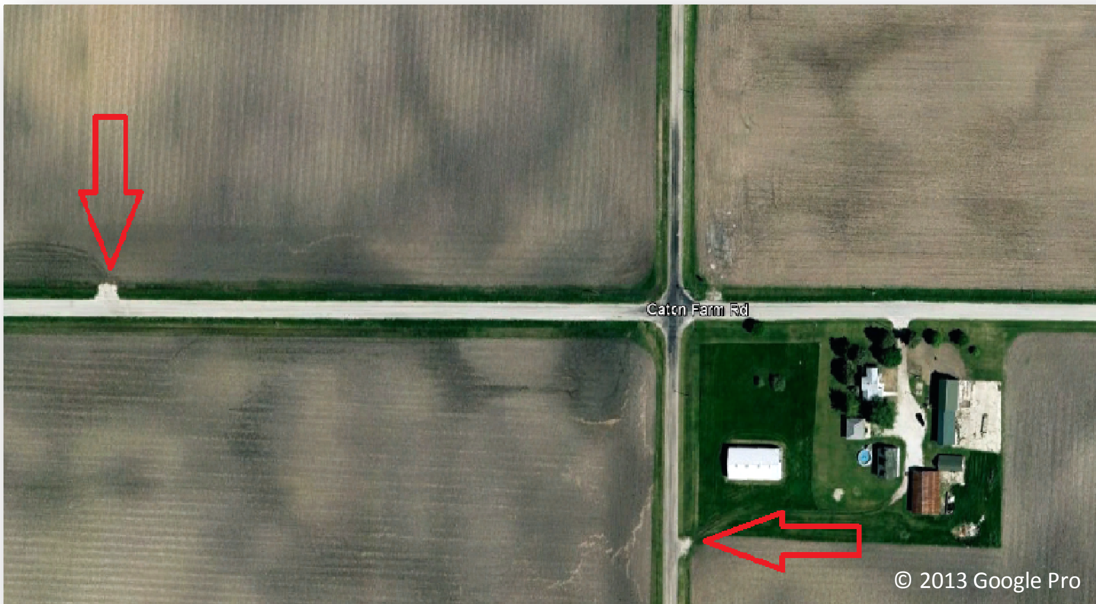

Intersection Access

Access to a corridor via an intersection with another roadway and all points of access are considered. For example, a four-way intersection would have two points of access for a segment that continued through an intersection.

### Other Access Entry Points

Any other entry point that does not qualify for other categories, such as graveyards, parks, farm entrances, and indistinguishable sites are considered. Two examples are shown by the red arrows in Figure 4-10.

FIGURE 4-10
**Other Access Density Entry Points**



### 4.2.1 Highway Safety Manual Roadside Hazard Rating (RHR)

**Roadside Hazards.** The Roadside Hazard Rating, (RHR), is assigned based on a scale of 1 to 7, with 1 meaning nonhazardous conditions exist and 7 meaning extremely hazardous conditions exist. Hazardous conditions include high frequency, density, and proximity of foreign objects along the corridor. The average of the conditions makes up the RHR for a segment. The RHR can be collected by entering Street View in Google Earth by following the segment from start to finish. The following is an example of determining the average for a segment:

Segment Example 1:

- 2-mile segment of road
- Very rural area with farmland on both sides of road
- Flat, paved shoulders
- No light/utility poles along the side of the road

Segment Example 1 would be a very forgiving system because drivers would have the opportunity to correct any mistakes on 100 percent of the system; this should be considered an RHR of 1.

Segment Example 2:

- 1-mile segment of road
- Very rural area with farmland on both sides of road
- Flat, paved shoulders
- No light/utility poles along the side of the road
- 30 percent of this segment is narrow bridge with:
  - 4-foot concrete barrier walls as shoulder
  - No median
  - Narrow lanes

Roughly two-thirds of the road is very forgiving, just like Example 1, but the other third of the roadway is relatively dangerous. It deserves neither a 1 nor a 7. The entire 1-mile stretch of road could be considered a 3 or 4 on the RHR scale.

Consistency while assigning the RHR is essential. Since this is such a subjective process, the data collection process for RHR should be a frequently discussed topic among the group performing the data collection. This rating system is listed in Table 4-1 and is explained in more detail in Appendix D of FHWA's publication, *Prediction of the Expected Safety Performance of Rural Two-Way Highways*, which is available at: http://www.fhwa.dot.gov/publications/research/safety/99207/appd.cfm.

TABLE 4-1
**Roadside Hazard Ratings**

| Rating | Criteria |
|---|---|
| 1 | • Wide clear zones greater than or equal to 9 meters (30 feet) from the pavement edge line<br>• Sideslope flatter than 1:4<br>• Recoverable |
| 2 | • Clear zone between 6 and 7.5 meters (20 and 25 feet) from pavement edge line<br>• Sideslope about 1:4<br>• Recoverable |
| 3 | • Clear zone about 3 meters (10 feet) from pavement edge line<br>• Sideslope about 1:3 or 1:4<br>• Rough roadside surface<br>• Marginally recoverable |
| 4 | • Clear zone between 1.5 and 3 meters (5 to 10 feet) from pavement edge line<br>• Sideslope about 1:3 or 1:4<br>• May have guardrail (1.5 to 2 meters [5 to 6.5 feet] from pavement edge line)<br>• May have exposed trees, poles, or other objects (about 3 meters or 10 feet from pavement edge line)<br>• Marginally forgiving, but increased chance of a reportable roadside collision |
| 5 | • Clear zone between 1.5 and 3 meters (5 to 10 feet) from pavement edge line<br>• Sideslope about 1:3<br>• May have guardrail within 0 to 1.5 meters (0 to 5 feet) from pavement edge line<br>• May have rigid obstacles or embankment within 2 to 3 meters (6.5 to 10 feet) of pavement edge line<br>• Virtually non-recoverable |
| 6 | • Clear zone less than or equal to 1.5 meters (5 feet)<br>• Sideslope about 1:2<br>• No guardrail<br>• Exposed rigid obstacles within 0 to 2 meters (0 to 6.5 feet) of the pavement edge line<br>• Non-recoverable |
| 7 | • Clear zone less than or equal to 1.5 meters (5 feet)<br>• Sideslope 1:2 or steeper<br>• Cliff or vertical rock cut<br>• No guardrail<br>• Non-recoverable with high likelihood of severe injuries from roadside collision |

Source: FHWA, 2000.[1]

[1] Photo examples are available at http://www.fhwa.dot.gov/publications/research/safety/99207/appd.cfm

## 4.3 Table/Data Formatting

The tables in this section show information that should be considered during the data collection process. Some of the items may be supplied by BSE, such as AADT and traffic control. Others, such as street lighting and HSM RHR, can be obtained in Google Earth. The left side of Table 4-2, 4-3 and 4-4 shows the data that should be considered for data collection while the right side refers to one of the bullet points listed below. A brief description and some examples are provided here to elaborate on the options.

- The units that should be used – Units can be listed in feet, degrees, miles, miles per hour, and so forth. Ex: The skew angle of an intersection should be measured in degrees.

- Possible options for identifying a feature – Possible options for a feature are suggested. Ex: If the shoulder type is being collected, five options are available: Earth/Sod, Aggregate, Paved, "V" Gutter, Curb and Gutter.

- A blank space is left to be filled – Features like township, ending street, or minor cross street name are left blank because there are endless choices.

- Yes/No – These typically are looking at the presence of something, like street lights, two-way left-turn lanes, restricted right-turn signage, bus stops, and so forth.

- A listing as "Count" – Taking a count of a feature, such as number of lanes, crash counts, and through lanes.

TABLE 4-2
**Intersections Inputs and Conventions**

| Excel Column Header Name | | Excel Cell Input Format |
|---|---|---|
| Unique Intersection ID | | |
| Major Cross Street Name | | |
| Minor Cross Street Name | | |
| Urban/Rural | | |
| Total Approaches/Legs | | Count |
| Township | | |
| EB AADT | | Count |
| WB AADT | | Count |
| NB AADT | | Count |
| SB AADT | | Count |
| TEV | | |
| Skew Angle | | In Degrees |
| Traffic Control Device | | 1 or 2 Way Stop, All Way Stop, Traffic Signals (2-Phase, Multi-Phase) |
| On/Near Curve | | Yes/No |
| Right-Turn Lane Present | | Yes/No (must have storage available) |
| Left-Turn Lane Present | | Yes/No (must have storage available) |
| Major Route Through Lanes Present | | Count |
| Minor Route Through Lanes Present | | Count |
| Commercial Development Nearby | | Yes/No |
| Access Point(s) within 500 feet of Intersection | | Yes/No |
| 500 feet from Railroad Crossing | | Yes/No |
| Pedestrian Signal Present? | | Yes/No |
| Restricted Right Turn Signing | | Yes/No |
| Photo Speed Enforcement Present | | Yes/No |
| Bus Stop(s) Present | | Yes/No |
| Street Lights present | | Yes/No |
| Flashers Approaching Intersection? | | Yes/No |
| Nearest Stop more than 5 miles? | | Yes/No |
| Crash Severity Counts | K | Count |
| | A | Count |
| | B | Count |
| | C | Count |
| | PDO | Count |

Notes:
EB = eastbound
NB = northbound
SB = southbound
TEV =Total Entering Vehicles
WB = westbound

TABLE 4-3
**Segments Inputs and Conventions**

| Excel Column Header Name | | Excel Cell Input Format |
|---|---|---|
| Unique Corridor ID | | |
| Route Number | | |
| Starting Street | | |
| Ending Street | | |
| Alternate Road Name | | |
| Urban/Rural | | |
| Facility | | |
| Township | | |
| Length | | Feet |
| Length | | Miles |
| AADT | | Count |
| Shoulder Type | | Earth/Sod, Aggregate, Paved, “V” Gutter, Curb and Gutter |
| Shoulder Width | | Feet |
| Number of lanes | | Count |
| Median Type | | Divided/Undivided, Sod/Earth/Gravel, Curbed, Barrier, Rumble Strip, Painted, Traversable Low Profile Median |
| Median Width | | Feet |
| Posted Speed Limit | | List as XX mph or NA |
| On-street Parking Type, Length Available in % | | Parallel, Angle, 90 degree, None (Urban/Suburban only) |
| HSM RHR | | 1 to 7 according to Section 4.2.1 |
| Access Points/Types | | Count by each type according to Section 4.2 |
| Street Lighting | | Yes/No |
| Two-way Left-turn Lane | | Yes/No |
| Passing Lane or Short Four-Lane Section | | Yes/No |
| Crash Severity Counts | K | Count |
| | A | Count |
| | B | Count |
| | C | Count |
| | PDO | Count |
| Road Departure Crash Types (All Severity) | FO/OVT | Count |
| | HO/SOD | Count |

Notes:
FO/OVT =Fixed Object/Overturned
HO/SOD = Head On/Sideswipe Opposite Direction
mph = miles per hour
NA = not applicable

TABLE 4-4

**Curves Inputs and Conventions**

| Excel Column Header Name | | Excel Cell Input Format |
|---|---|---|
| Unique Corridor ID | | |
| Route Number | | |
| Urban/Rural | | |
| Facility | | |
| Horizontal Curve Length | | Miles |
| Horizontal Curve Length | | Feet |
| Curve Radius | | Feet |
| AADT | | Count |
| Chevrons Installed | | Yes/No |
| Curve Warning/Speed Advisory Sign Installed | | Yes/No |
| Shoulder Type | | Earth/Sod, Aggregate, Paved, “V” Gutter, Curb and Gutter |
| Shoulder Width | | Feet |
| Number of lanes | | Count |
| Median Type | | Divided/Undivided, Sod/Earth/Gravel, Curbed, Barrier, Rumble Strip, Painted, Traversable Low Profile Median |
| Median Width | | Feet |
| Posted Speed Limit | | List as XX mph or NA |
| On-Street Parking Type, Length Available in % (Urban and Suburban only) | | Parallel, Angle, 90 degree, None |
| Intersection on Curve | | Yes/No |
| Visual Trap on Curve | | Yes/No |
| HSM RHR | | 1 to 7 according to Section 4.2.1 |
| Access Points/Types | | Count by each type according to Section 4.2 |
| Street Lighting | | Yes/No |
| Two-way Left-turn Lane | | Yes/No |
| Passing Lane or Short Four-Lane Section | | Yes/No |
| Crash Severity Counts | K | Count |
| | A | Count |
| | B | Count |
| | C | Count |
| | PDO | Count |
| Road Departure Crash Types (All Severity) | FO/OVT | Count |
| | HO/SOD | Count |

Notes:
FO/OVT =Fixed Object/Overturned
HO/SOD = Head On/Sideswipe Opposite Direction
mph = miles per hour
NA = not applicable

## 4.4 Data Organization

Arranging all of the data listed in Section 4.3, Tables/Data Formatting can be intimidating and time consuming. For some locations, the data sheet containing all of the information can exceed 50 columns wide. It is best to take an organized and consistent approach. An intersection file is shown in two parts in Table 4-5 and 4-6. Since these files can contain so much information, it is beneficial to group some columns together if they describe a similar attribute. For example, columns in Table 4-6 that have a red heading show the priority group the location was assigned to and the rank of each location.

It is also beneficial to keep columns organized because it makes the data sheet easier to read. Consider the columns in Table 4-6 that have green headers. These columns contain information about whether or not a star was assigned. If the cell contains a “0” the star was not assigned, but if the cell contains a “1” the star has in fact been assigned to that location for that specific star category. This allows a simple equation to be written in Excel to sum how many stars have been earned for each location, shown in the red “Stars” column in Table 4-6. Since more stars translate to more risk, all locations can then be sorted based on how many stars they have. From here, ranks and priority groups can be assigned. For reasons like this, grouping all of the columns that are related helps keep the data sheet functional and easy to use.

TABLE 4-5

**Data Collection Excel Intersection Layout 1**

| Intersection Data Sheet | | | | | | | | | | | | | | | | | | | | | | 2007-2011 Crashes | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | | | | | | | | Crash Severity | | | | |
| Intx ID | Intersection Streets | Rural/Urban | Traffic Control | Leg Count | Township | Right Turn Lane Present | Left Turn Lane Present | Major Route Through Lanes | Minor Route Through Lanes | NB AADT | SB AADT | NB/SB Max | EB AADT | WB AADT | EB/WB Max | Major AADT | Minor AADT | Total Entering Vehicles | Min/Maj Ratio Value | Street Lights | Flashers | K | A | B | C | PDO |
| 06-03 | CH 6 & Hwy 10 | Rural | 1 or 2 Way Stop | 4 | Scott | No | No | 2 | 2 | 150 | 1,500 | 1,500 | 2,800 | 1,900 | 2,800 | 2,800 | 1,500 | 3,175 | 0.536 | No | No | 0 | 2 | 0 | 0 | 2 |
| 25-03 | CH 25 & Hwy 10 | Urban | Signalized; Mulit-Phase; Actuated | 4 | Champaign | Yes | Yes | 2 | 2 | 5,800 | 9,200 | 9,200 | 7,900 | 5,500 | 7,900 | 9,200 | 7,900 | 14,200 | 0.859 | Yes | No | 0 | 2 | 0 | 0 | 13 |
| 50-06 | CH 50 & US Hwy 150 | Rural | Signalized; 2-Phase; Actuated | 4 | Mahomet | Yes | Yes | 2 | 2 | 7,900 | 450 | 7,900 | 7,700 | 9,700 | 9,700 | 9,700 | 7,900 | 12,875 | 0.814 | Yes | No | 0 | 1 | 2 | 1 | 14 |
| 01-01 | CH 1 & CH 20 | Rural | 1 or 2 Way Stop | 4 | Hensley | No | No | 2 | 2 | 3,850 | 2,700 | 3,850 | 1,200 | 800 | 1,200 | 3,850 | 1,200 | 4,275 | 0.312 | No | No | 0 | 1 | 3 | 1 | 2 |
| 18-07 | CH 18 & IL 130 | Rural | 1 or 2 Way Stop | 4 | Philo | No | Yes | 2 | 2 | 10,700 | 9,700 | 10,700 | 4,200 | 200 | 4,200 | 10,700 | 4,200 | 12,400 | 0.393 | Yes | No | 0 | 1 | 2 | 0 | 3 |
| 22-01 | CH 22 & US Hwy 136 | Rural | 1 or 2 Way Stop | 4 | Kerr | No | No | 2 | 2 | 275 | 1,300 | 1,300 | 2,050 | 2,250 | 2,250 | 2,250 | 1,300 | 2,938 | 0.578 | No | No | 0 | 1 | 0 | 1 | 3 |
| 06-02 | CH 6 & CH 18 | Rural | 1 or 2 Way Stop | 4 | Colfax | No | No | 2 | 2 | 700 | 950 | 950 | 2,650 | 2,250 | 2,650 | 2,650 | 950 | 3,275 | 0.358 | Yes | No | 0 | 1 | 0 | 0 | 0 |
| 09-02 | CH 9 & US Hwy 45 | Rural | 1 or 2 Way Stop | 4 | Ludlow | No | No | 2 | 2 | 3,300 | 3,450 | 3,450 | 650 | 550 | 650 | 3,450 | 650 | 3,975 | 0.188 | Yes | No | 0 | 0 | 0 | 0 | 4 |
| 11-01 | CH 11 & US Hwy 45 | Rural | 1 or 2 Way Stop | 4 | Rantoul | No | No | 4 | 2 | 8,650 | 10,350 | 10,350 | 1,550 | 2,000 | 2,000 | 10,350 | 2,000 | 11,275 | 0.193 | Yes | No | 0 | 3 | 2 | 3 | 8 |
| 55-01 | CH 55 & US Hwy 136 | Urban | Signalized; 2-Phase; Fixed | 4 | Ludlow | Yes | Yes | 4 | 4 | 9,500 | 7,800 | 9,500 | 7,100 | 9,900 | 9,900 | 9,900 | 9,500 | 17,150 | 0.960 | Yes | No | 0 | 1 | 4 | 5 | 13 |
| 15-01 | CH 15 & Hwy 130 | Rural | 1 or 2 Way Stop | 4 | Philo | No | Yes | 2 | 2 | 7,400 | 5,800 | 7,400 | 4,200 | 79 | 4,200 | 7,400 | 4,200 | 8,740 | 0.568 | Yes | No | 1 | 0 | 0 | 1 | 8 |
| 18-02 | CH 18 & CH 25 | Rural | 1 or 2 Way Stop | 4 | Tolono | No | No | 2 | 2 | 2,050 | 275 | 2,050 | 4,000 | 3,300 | 4,000 | 4,000 | 2,050 | 4,813 | 0.513 | No | No | 0 | 1 | 1 | 2 | 1 |
| 16-02 | CH 16 & Hwy 130 | Rural | 1 or 2 Way Stop | 4 | Crittenden | No | No | 2 | 2 | 3,300 | 3,550 | 3,550 | 150 | 750 | 750 | 3,550 | 750 | 3,875 | 0.211 | No | No | 0 | 1 | 0 | 0 | 1 |
| 18-04 | CH 18 & I-57 NB Ramps | Rural | Unknown | 4 | Tolono | Yes | Yes | 2 | 0 | 0 | 500 | 500 | 4,900 | 4,900 | 4,900 | 4,900 | 500 | 5,400 | 0.102 | Yes | No | 0 | 1 | 0 | 0 | 1 |
| 11-03 | CH 11 & CH 32 | Rural | 1 or 2 Way Stop | 3 | Compromise | No | No | 2 | 2 | 2,100 | 275 | 2,100 | 1,050 | 250 | 1,050 | 2,100 | 1,050 | 1,838 | 0.500 | No | No | 0 | 0 | 0 | 1 | 1 |
| 15-02 | CH 15 (West) & Hwy 49 | Rural | 1 or 2 Way Stop | 4 | South Homer | No | No | 2 | 2 | 3,100 | 2,650 | 3,100 | 250 | 2,700 | 2,700 | 3,100 | 2,700 | 4,350 | 0.871 | Yes | No | 0 | 0 | 0 | 0 | 0 |
| 25-02 | CH 25 & Kirby Rd | Urban | Signalized; 2-Phase; Actuated | 4 | Champaign | Yes | Yes | 2 | 2 | 7,200 | 5,800 | 7,200 | 4,600 | 2,950 | 4,600 | 7,200 | 4,600 | 10,275 | 0.639 | No | No | 0 | 2 | 2 | 0 | 8 |
| 20-03 | CH 20 & US Hwy 45 | Rural | 1 or 2 Way Stop | 4 | Somer | Yes | Yes | 4 | 2 | 10,350 | 8,550 | 10,350 | 800 | 2,900 | 2,900 | 10,350 | 2,900 | 11,300 | 0.280 | Yes | No | 0 | 2 | 2 | 1 | 6 |
| 12-01 | CH 12 & CH 20 | Rural | Unknown | 4 | Stanton | No | No | 2 | 2 | 850 | 1,100 | 1,100 | 1,000 | 950 | 1,000 | 1,100 | 1,000 | 1,950 | 0.909 | No | Yes | 0 | 2 | 2 | 0 | 1 |
| 14-01 | CH 14 & Hwy 49 | Rural | 1 or 2 Way Stop | 4 | South Homer | No | No | 2 | 2 | 2,800 | 2,800 | 2,800 | 200 | 450 | 450 | 2,800 | 450 | 3,125 | 0.161 | No | No | 0 | 2 | 0 | 0 | 2 |
| 18-06 | CH 18 & US Hwy 45 | Rural | 1 or 2 Way Stop | 3 | Tolono | Yes | Yes | 4 | 2 | 9,700 | 8,500 | 9,700 | 200 | 2,900 | 2,900 | 9,700 | 2,900 | 10,650 | 0.299 | No | No | 0 | 1 | 1 | 0 | 8 |
| 18-01 | CH 18 & CH 19 | Rural | 1 or 2 Way Stop | 4 | Tolono | No | No | 2 | 2 | 75 | 750 | 750 | 3,300 | 1,000 | 3,300 | 3,300 | 750 | 2,563 | 0.227 | Yes | No | 0 | 1 | 1 | 0 | 3 |
| 18-05 | CH 18 & US Hwy 45 | Urban | Signalized; 2-Phase; Fixed | 3 | Tolono | Yes | Yes | 4 | 0 | 11,500 | 10,500 | 11,500 | 0 | 4,200 | 4,200 | 11,500 | 4,200 | 13,100 | 0.365 | Yes | No | 0 | 0 | 2 | 1 | 10 |
| 51-04 | CH 51 & US Hwy 136 | Urban | Signalized; 2-Phase; Fixed | 3 | Rantoul | Yes | Yes | 4 | 0 | 4,100 | 0 | 4,100 | 9,900 | 10,000 | 10,000 | 10,000 | 4,100 | 12,000 | 0.410 | Yes | No | 0 | 0 | 0 | 0 | 4 |
| 51-01 | CH 51 & US Hwy 136 | Urban | 1 or 2 Way Stop | 4 | Rantoul | No | Yes | 4 | 2 | 1,200 | 500 | 1,200 | 12,600 | 12,600 | 12,600 | 12,600 | 1,200 | 13,450 | 0.095 | Yes | No | 0 | 0 | 1 | 1 | 1 |
| 32-01 | CH 32 & US Hwy 136 | Rural | 1 or 2 Way Stop | 4 | Harwood | No | No | 2 | 2 | 1,200 | 2,400 | 2,400 | 2,250 | 3,100 | 3,100 | 3,100 | 2,400 | 4,475 | 0.774 | Yes | Yes | 0 | 0 | 1 | 0 | 2 |
| 50-02 | CH 50 & CH 54 West | Rural | 1 or 2 Way Stop | 4 | Mahomet | Yes | No | 2 | 2 | 2,300 | 3,600 | 3,600 | 2,100 | 250 | 2,100 | 3,600 | 2,100 | 4,125 | 0.583 | Yes | No | 0 | 0 | 1 | 1 | 1 |
| 01-02 | CH 1 & CH 11 | Rural | 1 or 2 Way Stop | 3 | Hensley | No | No | 2 | 0 | 0 | 2,350 | 2,350 | 750 | 2,850 | 2,850 | 2,850 | 2,350 | 2,975 | 0.825 | No | No | 0 | 0 | 0 | 0 | 1 |
| 13-01 | CH 13 & CH 15 | Rural | 1 or 2 Way Stop | 4 | South Homer | No | No | 2 | 2 | 250 | 700 | 700 | 2,500 | 2,700 | 2,700 | 2,700 | 700 | 3,075 | 0.259 | No | No | 0 | 0 | 0 | 0 | 0 |
| 11-02 | CH 11 & CH 12 | Rural | 1 or 2 Way Stop | 4 | Compromise | No | No | 2 | 2 | 450 | 800 | 800 | 1,050 | 1,200 | 1,200 | 1,200 | 800 | 1,750 | 0.667 | No | No | 0 | 0 | 0 | 0 | 0 |
| 15-03 | CH 15 (East) & Hwy 49 | Rural | 1 or 2 Way Stop | 4 | South Homer | No | No | 2 | 2 | 3,100 | 3,100 | 3,100 | 2,150 | 250 | 2,150 | 3,100 | 2,150 | 4,300 | 0.694 | Yes | No | 0 | 0 | 0 | 0 | 0 |
| 06-01 | CH 6 & CH 17 | Rural | 1 or 2 Way Stop | 4 | Sadorus | No | No | 2 | 2 | 1,100 | 25 | 1,100 | 700 | 1,600 | 1,600 | 1,600 | 1,100 | 1,713 | 0.688 | No | No | 0 | 0 | 0 | 0 | 0 |
| 08-02 | CH 8 & CH 30 | Rural | 1 or 2 Way Stop | 4 | East Bend | No | No | 2 | 2 | 300 | 650 | 650 | 400 | 400 | 400 | 650 | 400 | 875 | 0.615 | No | No | 0 | 0 | 0 | 0 | 0 |
| 17-01 | CH 17 & CH 19 | Rural | 1 or 2 Way Stop | 4 | Pesotum | No | No | 2 | 2 | 900 | 250 | 900 | 1,100 | 1,150 | 1,150 | 1,150 | 900 | 1,700 | 0.783 | No | No | 0 | 0 | 0 | 0 | 0 |
| 51-03 | CH 51 (East) & Hwy 45 | Urban | Signalized; 2-Phase; Fixed | 4 | Ludlow | Yes | Yes | 4 | 2 | 5,300 | 7,100 | 7,100 | 4,550 | 4,300 | 4,550 | 7,100 | 4,550 | 10,625 | 0.641 | Yes | No | 0 | 0 | 2 | 0 | 10 |
| 01-03 | CH 1 & US Hwy 136 | Rural | 1 or 2 Way Stop | 4 | East Bend | No | No | 2 | 2 | 750 | 2,600 | 2,600 | 2,650 | 2,500 | 2,650 | 2,650 | 2,600 | 4,250 | 0.981 | No | No | 0 | 0 | 2 | 0 | 8 |
| 50-04 | CH 50 & I-74 WB Ramps | Rural | Unknown | 4 | Mahomet | Yes | Yes | 2 | 0 | 9,700 | 9,700 | 9,700 | 0 | 1,300 | 1,300 | 9,700 | 1,300 | 11,000 | 0.134 | Yes | No | 0 | 0 | 0 | 1 | 8 |
| 18-03 | CH 18 & I-57 SB Ramps | Rural | Unknown | 4 | Tolono | No | No | 2 | 0 | 900 | 0 | 900 | 4,000 | 4,000 | 4,000 | 4,000 | 900 | 4,900 | 0.225 | Yes | No | 0 | 0 | 1 | 0 | 5 |
| 50-01 | CH 50 & US Hwy 150 | Rural | 1 or 2 Way Stop | 3 | Mahomet | No | Yes | 2 | 0 | 2,550 | 0 | 2,550 | 10,400 | 10,400 | 10,400 | 10,400 | 2,550 | 11,675 | 0.245 | Yes | No | 0 | 0 | 0 | 1 | 5 |
| 17-02 | CH 17 & US Hwy 45 | Rural | 1 or 2 Way Stop | 4 | Pesotum | Yes | Yes | 2 | 2 | 8,500 | 3,650 | 8,500 | 300 | 1,300 | 1,300 | 8,500 | 1,300 | 6,875 | 0.153 | Yes | No | 0 | 0 | 1 | 0 | 3 |
| 50-05 | CH 50 & I-74 EB Ramps | Rural | Unknown | 4 | Mahomet | No | Yes | 2 | 0 | 7,900 | 7,900 | 7,900 | 0 | 1,200 | 1,200 | 7,900 | 1,200 | 9,100 | 0.152 | Yes | No | 0 | 0 | 1 | 0 | 3 |
| 50-03 | CH 50 & CH 54 East | Rural | All-Way Stop | 4 | Mahomet | No | No | 2 | 2 | 6,500 | 9,700 | 9,700 | 650 | 2,550 | 2,550 | 9,700 | 2,550 | 9,700 | 0.263 | Yes | No | 0 | 0 | 0 | 1 | 2 |
| 20-02 | CH 20 & I-57 NB Ramps | Rural | Unknown | 4 | Hensley | No | No | 2 | 0 | 0 | 950 | 950 | 5,600 | 5,600 | 5,600 | 5,600 | 950 | 6,550 | 0.170 | No | No | 0 | 0 | 0 | 0 | 2 |
| 51-02 | CH 51 (West) & Hwy 45 | Urban | Signalized; 2-Phase; Fixed | 4 | Rantoul | Yes | Yes | 4 | 2 | 7,100 | 7,100 | 7,100 | 700 | 450 | 700 | 7,100 | 700 | 7,675 | 0.099 | Yes | No | 0 | 0 | 0 | 0 | 2 |
| 25-01 | CH 25 & Windsor Rd | Urban | All-Way Stop | 4 | Champaign | No | Yes | 2 | 2 | 5,600 | 2,650 | 5,600 | 5,400 | 2,850 | 5,400 | 5,600 | 5,400 | 8,250 | 0.964 | No | No | 0 | 0 | 0 | 0 | 1 |
| 20-05 | CH 20 & CH 22 | Rural | 1 or 2 Way Stop | 4 | Ogden | No | No | 2 | 2 | 950 | 800 | 950 | 650 | 1,050 | 1,050 | 1,050 | 950 | 1,725 | 0.905 | Yes | No | 0 | 0 | 0 | 0 | 1 |
| 20-04 | CH 20 & CH 24 | Rural | 1 or 2 Way Stop | 4 | Stanton | No | No | 2 | 2 | 275 | 400 | 400 | 950 | 800 | 950 | 950 | 400 | 1,213 | 0.421 | No | No | 0 | 0 | 0 | 0 | 1 |
| 30-01 | CH 30 & US Hwy 136 | Rural | 1 or 2 Way Stop | 3 | Brown | No | No | 2 | 0 | 1,800 | 0 | 1,800 | 2,500 | 2,500 | 2,500 | 2,500 | 1,800 | 3,400 | 0.720 | No | No | 0 | 0 | 0 | 0 | 1 |
| 08-01 | CH 8 & Hwy 47 | Rural | 1 or 2 Way Stop | 4 | Brown | No | No | 2 | 2 | 3,400 | 3,550 | 3,550 | 175 | 250 | 250 | 3,550 | 250 | 3,688 | 0.070 | No | No | 0 | 0 | 0 | 0 | 1 |
| 09-04 | CH 9 & CH 22 | Rural | 1 or 2 Way Stop | 4 | Kerr | No | No | 2 | 2 | 175 | 175 | 175 | 75 | 200 | 200 | 200 | 175 | 313 | 0.875 | No | No | 0 | 0 | 0 | 0 | 1 |
| 55-02 | CH 55 & US Hwy 45 | Rural | 1 or 2 Way Stop | 4 | Ludlow | No | No | 2 | 2 | 3,450 | 3,300 | 3,450 | 600 | 375 | 600 | 3,450 | 600 | 3,863 | 0.174 | Yes | No | 0 | 0 | 0 | 0 | 1 |
| 20-01 | CH 20 & I-57 SB Ramps | Rural | Unknown | 4 | Hensley | No | No | 2 | 0 | 1,500 | 0 | 1,500 | 1,350 | 1,350 | 1,350 | 1,500 | 1,350 | 2,850 | 0.900 | No | No | 0 | 0 | 0 | 0 | 0 |
| 09-01 | CH 9 & CH 23 | Rural | 1 or 2 Way Stop | 4 | East Bend | No | No | 2 | 2 | 1,050 | 950 | 1,050 | 250 | 59 | 250 | 1,050 | 250 | 1,155 | 0.238 | No | No | 0 | 0 | 0 | 0 | 0 |
| 09-03 | CH 9 & CH 32 | Rural | All-Way Stop | 4 | Harwood | No | No | 2 | 2 | 200 | 450 | 450 | 550 | 400 | 550 | 550 | 450 | 800 | 0.818 | No | No | 0 | 0 | 0 | 0 | 0 |
| 16-01 | CH 16 & US Hwy 45 | Rural | 1 or 2 Way Stop | 3 | Pesotum | No | Yes | 2 | 2 | 3,650 | 3,650 | 3,650 | 250 | 0 | 250 | 3,650 | 250 | 3,775 | 0.068 | Yes | Yes | 0 | 0 | 0 | 0 | 0 |
| 23-01 | CH 23 & US Hwy 136 | Rural | 1 or 2 Way Stop | 3 | Condit | No | No | 2 | 0 | 500 | 0 | 500 | 2,850 | 2,650 | 2,850 | 2,850 | 500 | 3,000 | 0.175 | No | No | 0 | 0 | 0 | 0 | 0 |
| 24-01 | CH 24 & US Hwy 150 | Rural | 1 or 2 Way Stop | 4 | St Joseph | No | No | 2 | 2 | 650 | 200 | 650 | 4,950 | 5,700 | 5,700 | 5,700 | 650 | 5,750 | 0.114 | Yes | No | 0 | 0 | 0 | 0 | 0 |

TABLE 4-6

## Data Collection Excel Intersection Layout 2

| Intersection Data Sheet | | | | | | | | | | Stars | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Intx ID | Total All Severity Crashes | Total K+A Crashes | Crash Rate (All Severity Crashes) | Skewed Intx | On/Near Curve | RR X-ing Within 500 ft. | Nearest Stop Distance (miles) | Nearest Stop >5 miles? | Commercial Development Nearby | Skewed Intx | On/Near Curve | RR X-ing Within 500 ft. | Previous Stop >5 miles | Commercial Development Nearby | Total Crashes (K+A) | Min/Maj Ratio | Stars | Priority Group | Rank |
| 06-03 | 4 | 2 | 0.690 | Yes | Yes | No | 0.91 | No | No | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 4 | 1 | 1 |
| 25-03 | 15 | 2 | 0.579 | No | No | Yes | 0.99 | No | Yes | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 3 | 1 | 2 |
| 50-06 | 18 | 1 | 0.766 | Yes | Yes | No | 0.63 | No | No | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 3 | 1 | 3 |
| 01-01 | 7 | 1 | 0.897 | No | No | No | 1.00 | No | Yes | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 1 | 4 |
| 18-07 | 6 | 1 | 0.265 | No | No | No | 1.00 | No | Yes | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 1 | 5 |
| 22-01 | 5 | 1 | 0.933 | No | No | No | 3.03 | No | Yes | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 1 | 6 |
| 06-02 | 1 | 1 | 0.167 | No | No | No | >5.00 | Yes | No | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 3 | 1 | 7 |
| 09-02 | 4 | 0 | 0.551 | Yes | Yes | No | 0.36 | No | Yes | 1 | 1 | 0 | 0 | 1 | 0 | 0 | 3 | 1 | 8 |
| 11-01 | 16 | 3 | 0.778 | No | No | No | >5.00 | Yes | No | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 1 | 9 |
| 55-01 | 23 | 1 | 0.735 | No | No | No | 0.27 | No | Yes | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 2 | 1 | 10 |
| 15-01 | 10 | 1 | 0.627 | No | No | No | 1.01 | No | No | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 1 | 11 |
| 18-02 | 5 | 1 | 0.569 | No | No | No | 2.01 | No | No | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 2 | 1 | 12 |
| 16-02 | 2 | 1 | 0.283 | No | Yes | No | 3.04 | No | No | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 1 | 13 |
| 18-04 | 2 | 1 | 0.203 | No | Yes | No | 2.37 | No | No | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 1 | 14 |
| 11-03 | 2 | 0 | 0.596 | No | Yes | No | 1.01 | No | No | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 2 | 2 | 15 |
| 15-02 | 0 | 0 | 0.000 | No | No | No | >5.00 | Yes | Yes | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 2 | 16 |
| 25-02 | 12 | 2 | 0.640 | No | No | No | 0.99 | No | No | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 17 |
| 20-03 | 11 | 2 | 0.533 | No | No | No | 3.52 | No | No | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 18 |
| 12-01 | 5 | 2 | 1.405 | No | No | No | 4.18 | No | No | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 19 |
| 14-01 | 4 | 2 | 0.701 | No | No | No | 2.44 | No | No | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 20 |
| 18-06 | 10 | 1 | 0.515 | No | No | No | 1.65 | No | No | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 21 |
| 18-01 | 5 | 1 | 1.069 | No | No | No | 2.04 | No | No | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 22 |
| 18-05 | 13 | 0 | 0.544 | No | No | No | 1.01 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 23 |
| 51-04 | 4 | 0 | 0.183 | No | Yes | No | 0.27 | No | No | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 24 |
| 51-01 | 3 | 0 | 0.122 | Yes | No | No | 0.15 | No | No | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 25 |
| 32-01 | 3 | 0 | 0.367 | No | No | No | >5.00 | Yes | No | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 26 |
| 50-02 | 3 | 0 | 0.399 | No | No | No | 0.70 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 27 |
| 01-02 | 1 | 0 | 0.184 | No | Yes | No | 2.56 | No | No | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 28 |
| 13-01 | 0 | 0 | 0.000 | No | Yes | No | 1.92 | No | No | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 29 |
| 11-02 | 0 | 0 | 0.000 | No | No | No | 4.17 | No | Yes | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 30 |
| 15-03 | 0 | 0 | 0.000 | No | No | No | 0.27 | No | Yes | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 31 |
| 06-01 | 0 | 0 | 0.000 | No | No | Yes | 0.95 | No | No | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 32 |
| 08-02 | 0 | 0 | 0.000 | No | Yes | No | 1.02 | No | No | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 33 |
| 17-01 | 0 | 0 | 0.000 | Yes | No | No | 0.12 | No | No | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 34 |
| 51-03 | 12 | 0 | 0.619 | No | No | No | 0.08 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35 |
| 01-03 | 10 | 0 | 1.289 | No | No | No | 3.03 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 36 |
| 50-04 | 9 | 0 | 0.448 | No | No | No | 0.32 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 37 |
| 18-03 | 6 | 0 | 0.671 | No | No | No | 2.67 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 |
| 50-01 | 6 | 0 | 0.282 | No | No | No | 0.42 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 39 |
| 17-02 | 4 | 0 | 0.319 | No | No | No | 1.36 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40 |
| 50-05 | 4 | 0 | 0.241 | No | No | No | 0.09 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 41 |
| 50-03 | 3 | 0 | 0.169 | No | No | No | 0.70 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 42 |
| 20-02 | 2 | 0 | 0.167 | No | No | No | 0.45 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 43 |
| 51-02 | 2 | 0 | 0.143 | No | No | No | 0.08 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 44 |
| 25-01 | 1 | 0 | 0.066 | No | No | No | 0.99 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 45 |
| 20-05 | 1 | 0 | 0.318 | No | No | No | 2.99 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 46 |
| 20-04 | 1 | 0 | 0.452 | No | No | No | 2.66 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 47 |
| 30-01 | 1 | 0 | 0.161 | No | No | No | 0.40 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 48 |
| 08-01 | 1 | 0 | 0.149 | No | No | No | 2.01 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 49 |
| 09-04 | 1 | 0 | 1.753 | No | No | No | 0.98 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 50 |
| 55-02 | 1 | 0 | 0.142 | No | No | No | 0.46 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 51 |
| 20-01 | 0 | 0 | 0.000 | No | No | No | 0.27 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 52 |
| 09-01 | 0 | 0 | 0.000 | No | No | No | 1.00 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 53 |
| 09-03 | 0 | 0 | 0.000 | No | No | No | 1.00 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 54 |
| 16-01 | 0 | 0 | 0.000 | No | No | No | 0.05 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 55 |
| 23-01 | 0 | 0 | 0.000 | No | No | No | 4.20 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 56 |
| 24-01 | 0 | 0 | 0.000 | No | No | No | 2.02 | No | No | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 57 |
| | | | | | | | | | Total Stars Earned | 5 | 10 | 2 | 4 | 9 | 19 | 10 | | | |
| | | | | | | | | | % That Earn Star | 8.8% | 17.5% | 3.5% | 7.0% | 15.8% | 33.3% | 17.5% | | | |

TABLE 4-7

## Data Collection Excel Layout - Segment

| Segments Data Sheet | | | | | 2007-2011 Crashes | | | | | | | | | | | | | | | | | Stars | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Crash Severity | | | | | RD Crash Types (All Sev.) | | | | | | | | | | | | | | | | | | | | |
| Segment ID | County Highway | Alt. Road Name | Length (mi.) | AADT | K | A | B | C | PDO | FO/OVT | HO/SOD | Total All Severity Crashes | Total K+A Crashes | Roadway Description | Shoulder Type | Lane Width (ft.) | Posted Speed Limit | On-Street Parking Type, Length Available | RD Crash Density Value | HSM RHR | Access Density Values | ADT Range | RD Crash Density | Critical Curve Radius Density | HSM RHR | Total K+A Crashes | Access Density | Stars | Priority Group | Individual Rank |
| 55-01 | CH 55 | Maplewood Dr/Co Rd 1700 E | 1.49 | 7,130 | 0 | 1 | 2 | 2 | 19 | 3 | 1 | 24 | 1 | Urban, Multilane, Undivided | Composite, 2 | 11 | N/A | None | 0.535 | 4 | 70.94 | 1 | 1 | 0 | 1 | 1 | 1 | 5 | 1 | 1 |
| 50-02 | CH 50 | Co Rd 525 E/Prairie View Rd | 1.62 | 7,450 | 1 | 4 | 1 | 0 | 18 | 4 | 0 | 24 | 5 | Rural, 2-Lane, Undivided | Composite, 6 | 11 | N/A | None | 0.495 | 4 | 29.71 | 1 | 0 | 0 | 1 | 1 | 1 | 4 | 1 | 2 |
| 15-02 | CH 15 | Co Rd 1000 N/Co Rd 15/Main St | 3.03 | 4,400 | 0 | 4 | 2 | 1 | 19 | 9 | 0 | 26 | 4 | Rural, 2-Lane, Undivided | Composite, 4 | 12 | 40 | None | 0.593 | 3 | 21.42 | 1 | 1 | 0 | 0 | 1 | 1 | 4 | 1 | 3 |
| 20-02 | CH 20 | Market St/ Leverett Rd | 1.80 | 3,750 | 0 | 1 | 1 | 0 | 7 | 2 | 3 | 9 | 1 | Rural, 2-Lane, Undivided | Gravel, 6 | 12 | 55 | None | 0.557 | 3 | 5.01 | 1 | 1 | 1 | 0 | 1 | 0 | 4 | 1 | 4 |
| 51-02 | CH 51 | Grove Ave | 0.77 | 4,220 | 0 | 1 | 0 | 0 | 5 | 1 | 0 | 6 | 1 | Urban, 2-Lane, Undivided | Paved, 10 | 17 | 35 | Parallel, 59% | 0.261 | 4 | 87.52 | 1 | 0 | 0 | 1 | 1 | 1 | 4 | 1 | 5 |
| 18-04 | CH 18 | Co Rd 18 | 2.45 | 3,450 | 1 | 2 | 0 | 0 | 7 | 7 | 0 | 10 | 3 | Rural, 2-Lane, Undivided | Gravel, 4 | 11 | N/A | None | 0.573 | 2 | 9.00 | 1 | 1 | 0 | 0 | 1 | 0 | 3 | 1 | 6 |
| 18-05 | CH 18 | Co Rd 18/Co Rd 1000 N | 2.53 | 4,340 | 1 | 1 | 3 | 3 | 17 | 9 | 1 | 25 | 2 | Rural, 2-Lane, Undivided | Gravel, 2 | 12 | N/A | None | 0.790 | 3 | 9.08 | 1 | 1 | 0 | 0 | 1 | 0 | 3 | 1 | 7 |
| 15-01 | CH 15 | Co Rd 15 | 2.01 | 4,200 | 1 | 1 | 0 | 0 | 6 | 5 | 1 | 8 | 2 | Rural, 2-Lane, Undivided | Gravel, 4 | 12 | 55 | None | 0.597 | 2 | 5.47 | 1 | 1 | 0 | 0 | 1 | 0 | 3 | 1 | 8 |
| 30-01 | CH 30 | 3rd St | 1.15 | 1,190 | 0 | 1 | 0 | 0 | 4 | 1 | 0 | 5 | 1 | Rural, 2-Lane, Undivided | Paved, 2 | 11 | N/A | Angle, 13% | 0.174 | 4 | 72.26 | 0 | 0 | 0 | 1 | 1 | 1 | 3 | 1 | 9 |
| 50-01 | CH 50 | Lake of the Woods Rd/Co Rd 50/Golf Dr | 2.14 | 2,100 | 0 | 0 | 0 | 0 | 14 | 7 | 1 | 14 | 0 | Rural, 2-Lane, Undivided | Paved, 4 | 11 | N/A | None | 0.748 | 4 | 28.04 | 0 | 1 | 0 | 1 | 0 | 1 | 3 | 1 | 10 |
| 25-03 | CH 25 | Staley Rd | 2.01 | 7,100 | 0 | 0 | 4 | 0 | 7 | 6 | 2 | 11 | 0 | Urban, 2-Lane, Undivided | Paved, 6 | 12 | 25 | None | 0.796 | 3 | 26.37 | 1 | 1 | 0 | 0 | 0 | 1 | 3 | 1 | 11 |
| 54-01 | CH 54 | Co Rd 2175 | 0.70 | 2,310 | 0 | 0 | 2 | 0 | 3 | 2 | 0 | 5 | 0 | Rural, 2-Lane, Undivided | Paved, 4 | 11 | N/A | Parallel, 14% | 0.571 | 4 | 31.39 | 0 | 1 | 0 | 1 | 0 | 1 | 3 | 1 | 12 |
| 18-01 | CH 18 | Co Rd 18 | 1.97 | 2,250 | 1 | 1 | 2 | 0 | 4 | 6 | 1 | 8 | 2 | Rural, 2-Lane, Undivided | Gravel, 2 | 12 | N/A | None | 0.710 | 2 | 6.08 | 0 | 1 | 0 | 0 | 1 | 0 | 2 | 2 | 13 |
| 01-01 | CH 01 | Co Rd 1 | 1.94 | 3,100 | 1 | 1 | 3 | 0 | 3 | 4 | 0 | 8 | 2 | Rural, 2-Lane, Undivided | Gravel, 4 | 12 | N/A | None | 0.412 | 2 | 8.76 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 2 | 14 |
| 22-05 | CH 22 | Co Rd 22 | 3.26 | 320 | 0 | 2 | 3 | 0 | 2 | 7 | 0 | 7 | 2 | Rural, 2-Lane, Undivided | Gravel, 2 | 10 | 55 | None | 0.430 | 3 | 6.14 | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 2 | 15 |
| 18-06 | CH 18 | Co Rd 900 N | 2.62 | 3,130 | 0 | 1 | 1 | 0 | 9 | 4 | 0 | 11 | 1 | Rural, 2-Lane, Undivided | Gravel, 4 | 11 | 55 | None | 0.305 | 2 | 8.00 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 2 | 16 |
| 20-08 | CH 20 | Co Rd 2100 N/Co Rd 20 | 2.18 | 1,000 | 1 | 0 | 0 | 1 | 2 | 2 | 1 | 4 | 1 | Rural, 2-Lane, Undivided | Composite, 2 | 11 | 55 | None | 0.275 | 2 | 6.88 | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 2 | 17 |
| 11-01 | CH 11 | Co Rd 2400 N/ Co Rd 1100 E | 2.52 | 750 | 1 | 0 | 1 | 0 | 1 | 2 | 0 | 3 | 1 | Rural, 2-Lane, Undivided | Composite, 4 | 11 | 55 | None | 0.158 | 2 | 7.92 | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 2 | 18 |
| 18-07 | CH 18 | Co Rd 900 N/Monroe St | 2.52 | 3,800 | 0 | 1 | 0 | 0 | 1 | 2 | 0 | 2 | 1 | Rural, 2-Lane, Undivided | Gravel, 4 | 11 | 55 | None | 0.159 | 2 | 13.90 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 2 | 19 |
| 22-01 | CH 22 | Co Rd 2700 E/Co Rd 22 | 2.39 | 950 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 2 | 1 | Rural, 2-Lane, Undivided | Gravel, 2 | 11 | N/A | None | 0.084 | 3 | 7.95 | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 2 | 20 |
| 01-03 | CH 01 | Co Rd 1 | 1.93 | 2,850 | 0 | 0 | 1 | 1 | 7 | 5 | 2 | 9 | 0 | Rural, 2-Lane, Undivided | Gravel, 4 | 12 | N/A | None | 0.725 | 2 | 5.69 | 0 | 1 | 1 | 0 | 0 | 0 | 2 | 2 | 21 |
| 51-01 | CH 51 | Meyers St/Sangamon Ave | 0.43 | 1,070 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 8 | 0 | Urban, 2-Lane, Undivided | Paved, 4 | 16 | 30 | Angle, 28% | 0.000 | 4 | 57.69 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 2 | 22 |
| 01-04 | CH 01 | Co Rd 1 | 2.52 | 2,750 | 0 | 2 | 2 | 0 | 3 | 6 | 0 | 7 | 2 | Rural, 2-Lane, Undivided | Gravel, 4 | 12 | N/A | None | 0.476 | 2 | 5.96 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 3 | 23 |
| 09-06 | CH 09 | Co Rd 3500 N | 2.04 | 470 | 0 | 2 | 0 | 0 | 1 | 3 | 0 | 3 | 2 | Rural, 2-Lane, Undivided | Gravel, 2 | 12 | 55 | None | 0.294 | 2 | 6.37 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 3 | 24 |
| 13-03 | CH 13 | Co Rd 2500 E | 3.02 | 770 | 1 | 1 | 0 | 0 | 1 | 2 | 0 | 3 | 2 | Rural, 2-Lane, Undivided | Gravel, 4 | 9 | 55 | None | 0.133 | 2 | 6.30 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 3 | 25 |
| 22-04 | CH 22 | Co Rd 22/West St | 2.00 | 1,200 | 0 | 2 | 0 | 0 | 1 | 1 | 0 | 3 | 2 | Rural, 2-Lane, Undivided | Gravel, 2 | 11 | N/A | None | 0.100 | 3 | 16.97 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 3 | 26 |
| 11-03 | CH 11 | Co Rd 33/Flatville Rd | 2.22 | 1,700 | 0 | 1 | 1 | 0 | 2 | 4 | 0 | 4 | 1 | Rural, 2-Lane, Undivided | Composite, 4 | 11 | N/A | None | 0.360 | 2 | 15.74 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 3 | 27 |
| 06-01 | CH 06 | Co Rd 6 | 2.11 | 1,100 | 0 | 1 | 0 | 0 | 2 | 3 | 0 | 3 | 1 | Rural, 2-Lane, Undivided | Gravel, 4 | 11 | 55 | None | 0.284 | 2 | 7.58 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 3 | 28 |
| 17-01 | CH 17 | Co Rd 17 | 3.03 | 1,230 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 2 | 1 | Rural, 2-Lane, Undivided | Composite, 2 | 11 | N/A | None | 0.066 | 2 | 9.23 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 3 | 29 |
| 08-02 | CH 08 | Co Rd 3300 N | 2.09 | 200 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | Rural, 2-Lane, Undivided | Gravel, 4 | 11 | N/A | None | 0.000 | 2 | 4.79 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 3 | 30 |
| 01-02 | CH 01 | Co Rd 1 | 2.59 | 2,930 | 0 | 0 | 4 | 1 | 10 | 7 | 1 | 15 | 0 | Rural, 2-Lane, Undivided | Gravel, 4 | 12 | N/A | None | 0.617 | 2 | 10.41 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 31 |
| 17-06 | CH 17 | Co Rd 600 N | 2.00 | 1,050 | 0 | 0 | 3 | 1 | 4 | 7 | 0 | 8 | 0 | Rural, 2-Lane, Undivided | Gravel, 4 | 12 | 55 | None | 0.700 | 3 | 5.50 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 32 |
| 32-03 | CH 32 | Co Rd 2300 E/Co Rd 32 | 2.02 | 1,830 | 0 | 0 | 0 | 1 | 6 | 1 | 0 | 7 | 0 | Rural, 2-Lane, Undivided | Composite, 2 | 11 | 55 | Angle, 6% | 0.099 | 3 | 40.17 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 33 |
| 15-05 | CH 15 | Co Rd 15/ Sidney Rd/ 1st St | 1.93 | 2,540 | 0 | 0 | 3 | 0 | 3 | 2 | 1 | 6 | 0 | Rural, 2-Lane, Undivided | Composite, 4 | 12 | 35 | Parallel, 1% | 0.312 | 3 | 21.81 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 34 |
| 22-02 | CH 22 | Co Rd 22 | 2.10 | 900 | 0 | 0 | 1 | 0 | 2 | 1 | 0 | 3 | 0 | Rural, 2-Lane, Undivided | Gravel, 2 | 11 | N/A | None | 0.095 | 2 | 8.10 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 35 |
| 22-06 | CH 22 | Co Rd 22 | 2.95 | 310 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 3 | 0 | Rural, 2-Lane, Undivided | Gravel, 2 | 10 | 55 | None | 0.068 | 3 | 6.78 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 36 |
| 20-04 | CH 20 | Leverett Rd/Co Rd 2100 N | 2.08 | 800 | 0 | 0 | 1 | 0 | 1 | 2 | 0 | 2 | 0 | Rural, 2-Lane, Undivided | Gravel, 4 | 11 | 55 | None | 0.192 | 2 | 4.80 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 37 |
| 15-06 | CH 15 | Co Rd 15/ 2nd St | 1.09 | 1,930 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | Rural, 2-Lane, Undivided | Composite, 4 | 11 | 35 | None | 0.183 | 2 | 24.77 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 38 |
| 20-09 | CH 20 | Co Rd 20/Co Rd 2150 N | 1.77 | 1,120 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | Rural, 2-Lane, Undivided | Gravel, 2 | 11 | 55 | None | 0.113 | 3 | 39.64 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 39 |
| 09-04 | CH 09 | Co Rd 3500 N/Thomas St | 2.13 | 340 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | Rural, 2-Lane, Undivided | Composite, 4 | 11 | N/A | None | 0.000 | 2 | 24.41 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 40 |
| 12-02 | CH 12 | Co Rd 2400 N/ Co Rd 12 | 1.52 | 800 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Rural, 2-Lane, Undivided | Gravel, 2 | 11 | 55 | Parallel, 3% | 0.000 | 2 | 14.46 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 41 |
| 55-03 | CH 55 | Co Rd 3200 N | 0.45 | 1,670 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Rural, 2-Lane, Undivided | Composite, 4 | 12 | N/A | None | 0.000 | 2 | 57.78 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 42 |
| 19-01 | CH 18 | Co Rd 19 | 2.12 | 900 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Rural, 2-Lane, Undivided | Gravel, 2 | 12 | 35 | None | 0.000 | 3 | 20.30 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 43 |
| 15-03 | CH 15 | Co Rd 1000 N/Co Rd 12 | 2.07 | 2,680 | 0 | 0 | 1 | 0 | 12 | 2 | 0 | 13 | 0 | Rural, 2-Lane, Undivided | Composite, 2 | 12 | 40 | None | 0.194 | 2 | 10.16 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 44 |
| 15-04 | CH 15 | Co Rd 15 | 1.90 | 2,700 | 0 | 0 | 2 | 0 | 9 | 4 | 0 | 11 | 0 | Rural, 2-Lane, Undivided | Composite, 2 | 12 | 55 | None | 0.420 | 2 | 9.98 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 45 |
| 16-04 | CH 16 | Co Rd 200 N | 3.02 | 830 | 0 | 0 | 0 | 0 | 10 | 1 | 0 | 10 | 0 | Rural, 2-Lane, Undivided | Composite, 4 | 11 | 55 | None | 0.066 | 3 | 7.29 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 46 |
| 14-02 | CH 14 | Co Rd 14 | 1.55 | 850 | 0 | 0 | 0 | 0 | 8 | 1 | 0 | 8 | 0 | Rural, 2-Lane, Undivided | Gravel, 4 | 11 | 56 | None | 0.129 | 2 | 14.20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 47 |
| 20-03 | CH 20 | Leverett Rd | 2.04 | 2,900 | 0 | 0 | 0 | 0 | 8 | 1 | 0 | 8 | 0 | Rural, 2-Lane, Undivided | Gravel, 4 | 12 | 55 | None | 0.098 | 2 | 11.28 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 48 |
| 24-01 | CH 24 | Co Rd 24 | 2.50 | 650 | 0 | 0 | 2 | 0 | 5 | 1 | 0 | 7 | 0 | Rural, 2-Lane, Undivided | Gravel, 2 | 11 | N/A | None | 0.080 | 3 | 13.61 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 49 |
| 11-02 | CH 11 | Co Rd 33 | 2.75 | 1,790 | 0 | 0 | 0 | 1 | 5 | 3 | 0 | 6 | 0 | Rural, 2-Lane, Undivided | Gravel, 4 | 11 | 30 | None | 0.218 | 2 | 6.17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 50 |
| 17-05 | CH 17 | Market St/ Co Rd 17/Co Rd 600 N | 2.13 | 1,060 | 0 | 0 | 1 | 0 | 5 | 2 | 0 | 6 | 0 | Rural, 2-Lane, Undivided | Gravel, 4 | 12 | 35 | Parallel, 4% | 0.188 | 2 | 16.43 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 51 |
| 01-05 | CH 01 | Co Rd 1 | 2.01 | 2,600 | 0 | 0 | 1 | 0 | 5 | 4 | 0 | 6 | 0 | Rural, 2-Lane, Undivided | Composite, 4 | 12 | N/A | None | 0.397 | 2 | 5.46 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 52 |
| 20-07 | CH 20 | Co Rd 2100 N | 2.01 | 980 | 0 | 0 | 0 | 0 | 4 | 1 | 0 | 4 | 0 | Rural, 2-Lane, Undivided | Gravel, 2 | 10 | 55 | None | 0.099 | 3 | 14.41 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 53 |
| 11-06 | CH 11 | Co Rd 11 | 1.94 | 1,050 | 0 | 0 | 2 | 1 | 1 | 4 | 0 | 4 | 0 | Rural, 2-Lane, Undivided | Gravel, 4 | 11 | 55 | Parallel, 1% | 0.413 | 2 | 9.81 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 54 |
| 17-04 | CH 17 | Co Rd 500 N | 1.53 | 800 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 4 | 0 | Rural, 2-Lane, Undivided | Gravel, 4 | 10 | 55 | None | 0.000 | 2 | 7.86 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 55 |
| 14-03 | CH 14 | Co Rd 14 | 1.24 | 450 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 4 | 0 | Rural, 2-Lane, Undivided | Gravel, 4 | 11 | N/A | None | 0.000 | 2 | 8.84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 56 |
| 06-04 | CH 06 | Co Rd 6 | 2.03 | 700 | 0 | 0 | 1 | 0 | 2 | 2 | 0 | 3 | 0 | Rural, 2-Lane, Undivided | Gravel, 4 | 11 | 55 | None | 0.197 | 2 | 9.36 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 57 |
| 09-07 | CH 09 | Co Rd 3500 N | 2.67 | 490 | 0 | 0 | 1 | 0 | 2 | 1 | 0 | 3 | 0 | Rural, 2-Lane, Undivided | Gravel, 6 | 11 | N/A | None | 0.075 | 2 | 6.74 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 58 |
| 11-04 | CH 11 | Co Rd 11 | 3.04 | 1,430 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 3 | 0 | Rural, 2-Lane, Undivided | Gravel, 4 | 11 | N/A | None | 0.066 | 2 | 7.57 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 59 |
| 11-05 | CH 11 | Co Rd 11 | 2.03 | 1,200 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 2 | 0 | Rural, 2-Lane, Undivided | Gravel, 4 | 11 | N/A | None | 0.098 | 2 | 9.36 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 60 |
| 17-03 | CH 17 | Co Rd 17/Co Rd 6/Co Rd 500 N | 3.06 | 1,010 | 0 | 0 | 1 | 0 | 1 | 2 | 0 | 2 | 0 | Rural, 2-Lane, Undivided | Gravel, 4 | 10 | 55 | None | 0.131 | 1 | 3.59 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 61 |
| 20-01 | CH 20 | Hensley Rd/ Co Rd 2100 N/Market St | 1.87 | 1,230 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 0 | Rural, 2-Lane, Undivided | Gravel, 4 | 11 | 30 | None | 0.000 | 3 | 10.70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 62 |
| 25-02 | CH 25 | Staley Rd | 2.01 | 2,650 | 0 | 0 | 0 | 0 | 2 | 2 | 0 | 2 | 0 | Urban, 2-Lane, Undivided | Gravel, 4 | 12 | 35 | None | 0.199 | 2 | 12.43 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 63 |
| 17-07 | CH 17 | Co Rd 600 N | 1.52 | 1,300 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 2 | 0 | Rural, 2-Lane, Undivided | Gravel, 2 | 12 | 35 | None | 0.132 | 2 | 11.86 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 64 |
| | | | | | | | | | | | | | | | | | | | | | Total Stars Earned | 12 | 13 | 10 | 7 | 25 | 16 | | | |
| | | | | | | | | | | | | | | | | | | | | | % That Earn Star | 12.0% | 13.0% | 10.0% | 7.0% | 25.0% | 16.0% | | | |

## 4.5 Obtaining Critical Values

Critical values are used to help determine the risk potential at a particular location(s). Risk is measure by both infrastructure features and crashes that occurred at the location. Some critical values are based on answering simple yes or no questions; while others are to be quantified, as shown in the list at the end of this section. Determining the other critical values that need to be quantified can require much more effort.

Critical values that require more effort are determined by observing overrepresentation. In Figure 4-11, the distribution of curve radii is shown in intervals of 250 feet. By comparing the three colored bars for each interval, it can be seen where overrepresentation occurs. The intervals from 750 to 999, 1,250 to 1,499, and 1,750 to 1,999 feet in the yellow boxes are considered to be overrepresented for Figure 4-11. Since this process is not immediately obvious, the next few paragraphs discuss the process.

Imagine that all necessary data collection steps were performed, each curve radius had been measured and crashes were properly assigned to each curve. A table can then be constructed, as shown in Table 4-8, to represent how many curves fall into each radii range; this is shown in the first and second columns. Next, a tally can be made for each of these intervals to find how many crashes occur in the respective interval. Remember, the crashes need to be assigned to each curve prior to this step. Once the crashes have been assigned to each curve, the crashes can be manipulated in Excel to produce a table similar to Table 4-8. After the second, third and fourth columns on the left of Table 4-8 are populated, the right half (percentage of county curves, percentage of total crashes, percentage of severe crashes) can be easily calculated.

The percentages generated on the right half of Table 4-8 aid in creating Figure 4-11. In Figure 4-11, three of the intervals have red (percentage of total crashes) and green (percentage of severe crashes) bars that show a higher percentage than the blue (percentage of county curves) bar. The blue bar shows what percent a specific curve radius range represents over the entire system. Fifteen (15) percent of county curves have a radius that falls in the range of 750 to 999 feet (see Table 4-8). Since the percentage of severe crashes, shown by the green bar, that occur in the same range of 750 to 999 feet is noticeably larger than 15 percent, it can be considered overrepresented or “critical”. The same can be said for the range of 1,250 to 1,499 and 1,750 to 1,999 feet.

For curves with a radius that falls in the range of 750 to 999, 1,250 to 1,499, or 1,750 to 1,999 feet, all of the red and green bars are larger than their coordinating blue bars, which is why these curve radius intervals were chosen to be critical value intervals. If all crashes were distributed evenly across the entire system, then one would expect the blue, red and green bars to represent the same percentages; however, this is not the case. Some curve radii intervals simply account for more crashes than they do curves. This is why the process of generating critical values is possible.

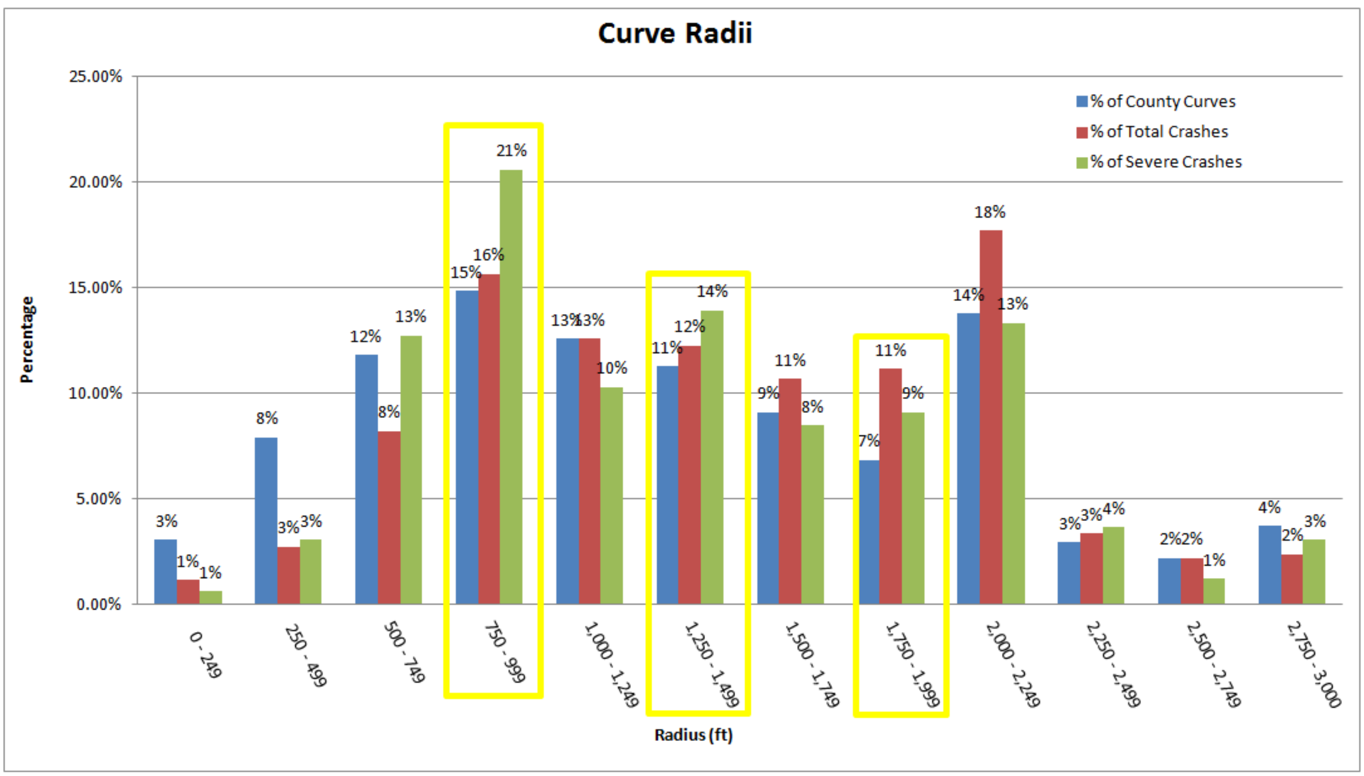
It should be noted that this is a subjective process. Two individuals may look at the same crash distribution and come up with different results. For this reason, a rule of thumb was developed. Identify intervals that show severe crash overrepresentation of at least 10%. For example, if a blue bar in Figure 4-11 were to represent 20% of the system, the corresponding green bar should be at least 22%, or an overrepresentation of 10%, to be considered a critical interval.

Another matter that should be discussed is whether or not these critical values can be used interchangeably between districts, counties or municipalities. Multiple agencies could work together in compiling data to produce these various critical values. As the database for the critical value calculations becomes larger, the statistical reliability also increases. But, the characteristics of these agencies should also be considered. If one agency is rural with relatively low vehicle miles traveled (VMT), and many unsignalized intersections, it may not be a good decision to compare it to an urban area with many signalized intersections and high VMT. These two locations are very different and one wouldn’t expect them to behave similarly. If it is expected that these locations do not behave similarly, it may be best to calculate critical values for each location individually, or to pair them with another location that is similar. Again, factors like this should be considered throughout the entire process of generating critical values.

TABLE 4-8
Curves Radius Data Distribution

| Radii Range | Curves | Total Crashes | Total Severe Crashes | % of County Curves | % of Total Crashes | % of K+A Crashes |
|---|---|---|---|---|---|---|
| 0 - 249 | 28 | 36 | 1 | 3.04% | 1.15% | 0.61% |
| 250 - 499 | 73 | 85 | 5 | 7.92% | 2.72% | 3.03% |
| 500 - 749 | 109 | 257 | 21 | 11.82% | 8.21% | 12.73% |
| 750 - 999 | 137 | 490 | 34 | 14.86% | 15.65% | 20.61% |
| 1,000 - 1,249 | 116 | 394 | 17 | 12.58% | 12.59% | 10.30% |
| 1,250 - 1,499 | 104 | 384 | 23 | 11.28% | 12.27% | 13.94% |
| 1,500 - 1,749 | 84 | 334 | 14 | 9.11% | 10.67% | 8.48% |
| 1,750 - 1,999 | 63 | 349 | 15 | 6.83% | 11.15% | 9.09% |
| 2,000 - 2,249 | 127 | 554 | 22 | 13.77% | 17.70% | 13.33% |
| 2,250 - 2,499 | 27 | 105 | 6 | 2.93% | 3.35% | 3.64% |
| 2,500 - 2,749 | 20 | 68 | 2 | 2.17% | 2.17% | 1.21% |
| 2,750 - 3,000 | 34 | 74 | 5 | 3.69% | 2.36% | 3.03% |
| | 922 | 3,130 | 165 | | | |

FIGURE 4-11
Critical Values for Curve Radii



Other critical values were used to assign stars but detailed bar charts and numerical analysis were not necessary since they were a simple “yes/no” relating to the existence of a particular characteristic of each curve. The entire list of features that can be used to assign stars includes:

Segments

- Roadside Hazard Rating (ranked from 1 to 7 with stars assigned to values 4 or greater 3)
- Total Severe Crashes (earning a star determined by critical value)
- Access Density (earning a star determined by critical value)
- Road Departure Crash Density (earning a star determined by critical value)
- Critical Curve Radius Density (greater than 0.5 curves with a critical radius per mile earned a star)
- AADT (earning a star determined by critical value)

Intersections

- Total Severe Crashes (earning a star determined by critical value)
- Skewed Intersection (skew angle of +/- 15 degrees in either direction earned a star)
- Being on or Near a Curve (yes/no; yes earned a star)
- Commercial Development Nearby (yes/no; yes earned a star)
- Previous Stop was 5+ Miles Away (yes/no; yes earned a star; rural intersections only)
- Railroad Crossing Being within 500 Feet of Intersection (yes/no; yes earned a star)
- Minor Road/Major Road Volume Ratio (earning a star determined by critical value)

Curves

- Intersection on the Curve (yes/no; yes earned a star)
- Total Severe Crashes (earning a star determined by critical value)
- Visual Trap on the Curve (yes/no; yes earned a star)
- Radius (earning a star determined by critical value)
- AADT (earning a star determined by critical value)

## 4.6 Compilation and Presentation of Results

Once all of the data is collected and analyzed, the data can be sorted into priority groups. The priority groups are determined by the number of stars a location has earned, the count of severe crashes and the total amount of all severity crashes. For example, if Intersection ABC has 5 stars, and Intersection XYZ has 2 stars, then Intersection ABC would be placed in a higher priority. If multiple locations have the same amount of stars, the count of how many severe and all severity crashes can be used as tie breakers. Typically, three priority groups should be sufficient for one system in one county. Locations included in Priority Group 1 would require the most attention. An example of the criteria used to pick priority groups is shown in Table 4-9.

Once the priority groups are chosen and the locations are ranked, all of the collected data can be presented in the format shown in Figure 4-12. In this template, the upper right corner shows an aerial view of the location. The top portion provides the name and some of the intersection infrastructure features. Pie charts and crash tables show vital information about the location's crashes. The pie charts can be displayed as a weighted chart (as shown in Figure 4-12) or as a non-weighted chart. If weights are used to emphasize severe crashes, fatal crashes have a 25:1 ratio, incapacitating crashes have a 10:1 ratio, and all other crashes have a 1:1 ratio.

The crash tables are simply pivot tables that can be developed in Excel or Access, with crash severity on the horizontal axis and collision type, driver behavior, surface condition or lighting condition on the vertical axis. Then, the frequency of each crash occurrence can aid in populating the table.

The bottom portion of the template shows the 'Ranking Factors' and their respective values that make them eligible to receive a star; these are the factors used to rank each location against other locations. These values are compared to the critical value for that specific characteristic. If the value qualifies for a star, then a star is assigned. The intersection example in Figure 4-12 shows seven characteristics that qualify for a star. The 'Skewed Intersection' is listed as 'Yes' (shown in 'This Intersection's Value' column), and the 'Critical Value' for 'Skewed Intersection' is 'Yes'. Because the value for this location matches the critical value, it earns a star. The same process would be done if the critical value was a number instead of a 'Yes' or 'No' answer.

Consider the 'Total Severe Crashes (K+A)' in Figure 4-12. The value listed is '1'. Since the 'Critical Value' is '1+' and 'This Intersection's Value' is '1', the critical value is met. This implies a star would be assigned. The same process is applied for the other 'Ranking Factors'. Remember, earning stars indicates more risk is associated with the locations.

Figure 4-12
County Detailed Location Template

Intersection at:

# CH 50 & US Hwy 350

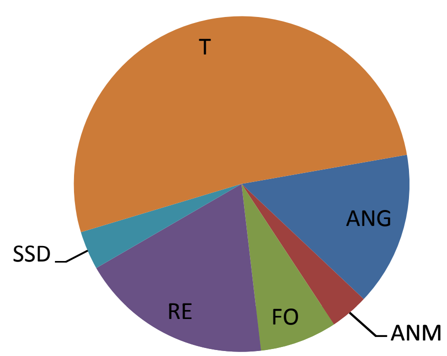

## Intersection Data

| | | | |
|---|---|---|---|
| Description | Rural, 4 Legs | Street Lights: | Yes |
| Traffic Control: | Signalized; 2-Phase; Actuated | Flashers: | No |
| Major AADT: | 9,700 | Presence of Right Turn Lane: | Yes |
| Minor AADT: | 7,900 | Presence of Left Turn Lane: | Yes |
| TEV: | 12,875 | Number of Through Lanes on Major Route: | 2 |
| Crash Rate: | 0.766 | Number of Through Lanes on Minor Route: | 2 |
| Township: | Mahomet | | |

## Crash Data

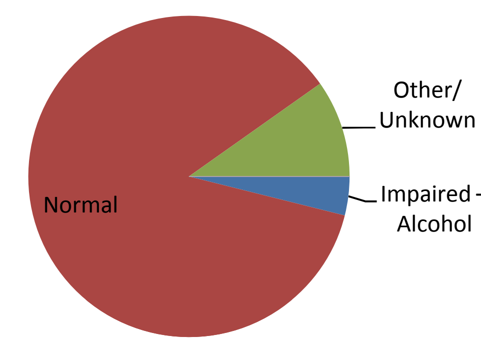
*Weighted values: K=25, A=10, B/C/PDO=1

**Weight By Crash Type**



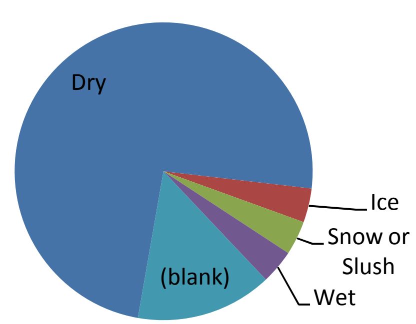

| | Crashes Type K | A | B | C | PDO | Weighted Totals* | Crash Type Frequency |
|---|---|---|---|---|---|---|---|
| ANG | | | 1 | | 3 | 4 | 22.2% |
| ANM | | | | | 1 | 1 | 5.6% |
| FO | | | | | 2 | 2 | 11.1% |
| RE | | | | 1 | 4 | 5 | 27.8% |
| SSD | | | | | 1 | 1 | 5.6% |
| T | | 1 | 1 | | 3 | 14 | 27.8% |

**Weight By Driver Behavior**



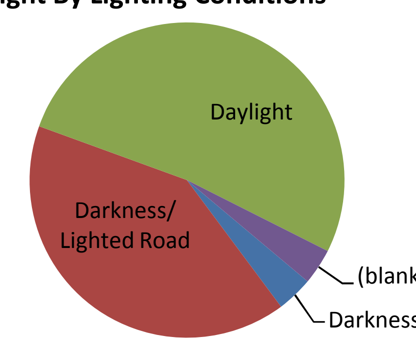

| | Driver 1/2/3/4 Behaviors K | A | B | C | PDO | Weighted Totals* | Crash Type Frequency |
|---|---|---|---|---|---|---|---|
| Impaired – Alcohol | | | 2 | | | 2 | 6.1% |
| Normal | | 2 | 2 | 2 | 20 | 44 | 78.8% |
| Other/ Unknown | | | | | 5 | 5 | 15.2% |

**Weight By Surface Conditions**




| | Surface Conditions K | A | B | C | PDO | Weighted Totals* | Crash Type Frequency |
|---|---|---|---|---|---|---|---|
| Dry | | 1 | 2 | 1 | 7 | 20 | 61.1% |
| Ice | | | | | 1 | 1 | 5.6% |
| Snow or Slush | | | | | 1 | 1 | 5.6% |
| Wet | | | | | 1 | 1 | 5.6% |
| (blank) | | | | | 4 | 4 | 22.2% |

**Weight By Lighting Conditions**




| | Lighting Conditions K | A | B | C | PDO | Weighted Totals* | Crash Type Frequency |
|---|---|---|---|---|---|---|---|
| Darkness | | | | | 1 | 1 | 5.6% |
| Darkness/ Lighted Road | | 1 | | | 1 | 11 | 11.1% |
| Daylight | | | 2 | 1 | 11 | 14 | 77.8% |
| (blank) | | | | | 1 | 1 | 5.6% |

## Ranking Factors

| | This Intersection's Value | Critical Value | Star Given? |
|---|---|---|---|
| Skewed Intersection | Yes | Yes | ★ |
| On/Near Curve | Yes | Yes | ★ |
| Railroad Crossing Within 500 feet | No | Yes | |
| Previous Stop 5+ miles? | No | Yes | |
| Commercial Development Nearby | No | Yes | |
| Total Severe Crashes (K+A) | 1 | 1+ | ★ |
| Minor/Major AADT Ratio | 0.814 | 0.3-0.399 or 0.5-0.599 | |

Intersection ID: 50-06
Stars Acquired for this Intersection: ★★★
Priority Group: 1
Individual Rank: 3

Once all possible stars are assigned, a summary is presented near the bottom of the template. The location ID, total number of stars acquired, which priority group the location belongs to, and potential countermeasures are typically listed. A list of potential countermeasures is included in Section 5.0, Countermeasures Selection. If other attributes are desired, they can also be shown here.

If an entire system was considered for analysis, all locations can be displayed by priority groups, as shown in Figure 4-13. In this figure, each color represents a different priority group. The legend shows what shapes and colors represent each location and priority group. For example, the yellow circles represent intersections in the 2nd priority group, while light blue lines represent the 1st priority group for segments. For convenience, the location ID is also displayed on the map. This location ID can be matched with the location ID shown near the bottom of Figure 4-12.

Mapping these locations helps to expose areas of concern. If one area has many locations in high priority groups, these locations can be potentially be grouped as a corridor and packaged for an HSIP project.

FIGURE 4-13
**Map of Priority Group Locations Shown by Color**

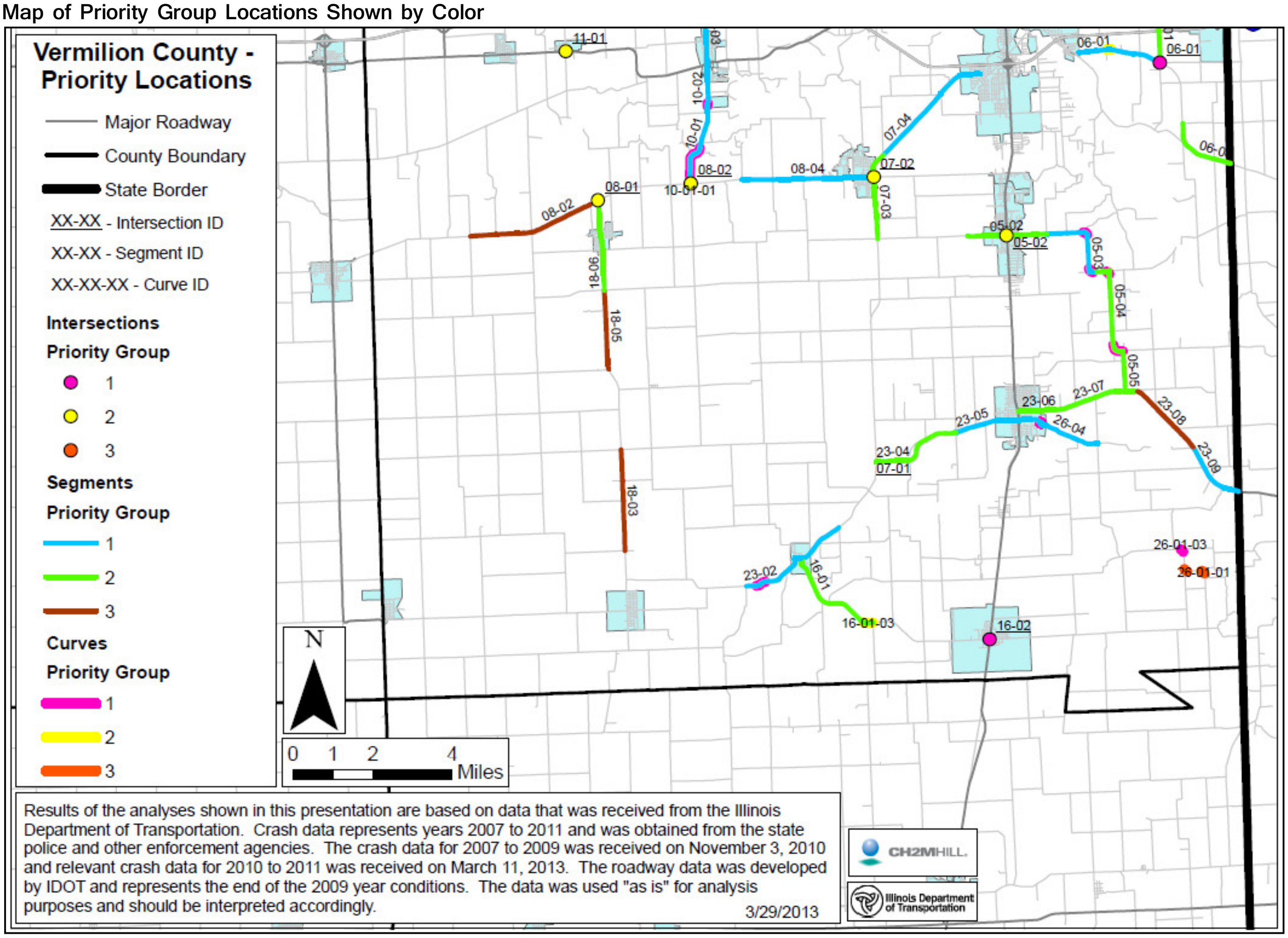


Table 4-9 shows how intersections, segments, and curves may be eligible for a high priority list. Note that the qualifiers will be unique to each system. For example, curves on *state* routes in County XYZ would not necessarily have the same qualifiers as curves on *county* routes in County XYZ. For reasons like this, choosing these groups is a very subjective process.

TABLE 4-9
**Sample of Priority Group (PG) Qualifiers**

| Intersections | Segments | Curves |
|---|---|---|
| PG1: Any locations with 3 or more stars<br>PG2: Any 2-star locations<br>PG3: Any 1-star location with at least 1 severe crash | PG1: Any locations with 4 or more stars<br>PG2: Any 3-star location with<br>PG3: Any 2-star location with at least 1 severe crash | PG1: Any locations with 2 or more stars<br>PG2: Any 1-star location with at least 5 all severity crashes |

Once the qualifiers are determined, a GIS layer can be updated to include all desired data (star ratings, high priority group of 1, 2, or 3, and so forth). Layers can be used, along with unique symbology, to display the priority groups or high priority list in different colors, as shown in Figure 4-13.

## 4.7 Field Assessment

Once locations have been identified as high priority, a field assessment can be conducted. The goal of a field assessment is to visualize, characterize, and record the typical experience of a person travelling through the site. Once a field assessment is complete, all site information can be compiled to identify specific crash patterns. The crash patterns can be addressed through implementing appropriate safety countermeasures. Comparing observations from the field assessment, crash data review, and supporting documentation assessment may lead to observations that would not have otherwise been identified.

# 5.0 Countermeasure Selection

The tables included in this section are examples of what types of countermeasures may be selected. In order to maximize safety dollars, selecting ideal countermeasures that are low-cost and effective across any roadway system should be considered for implementation.

Once the user knows what and where their problem is, one or many countermeasures should be selected. There may be many countermeasures available to address a certain problem, but identifying the most efficient and appropriate countermeasure will only increase the benefit of the effort.

If the desired countermeasure cannot be found in Tables 5-1 through 5-15[2] of this section, other resources are available. NCHRP 500 and CMF Clearinghouse may be good sources for identifying any additional countermeasures.

TABLE 5-1
**Comprehensive List of Older Driver Safety Strategies**

| Objectives | Strategies | Effectiveness |
|---|---|---|
| 3.1 A – Plan for an aging population | 3.1 A1 Establish a broad-based coalition to plan to address older adults' transportation needs | Tried |
| 3.1 B – Improve the roadway and driving environment to better accommodate the special needs of older drivers | 3.1 B1 Provide advance warning signs | Tried |
| | 3.1 B2 Provide advance-guide and street name signs | Tried |
| | 3.1 B3 Increase the size and letter height of roadway signs | Tried |
| | 3.1 B4 Provide all-red clearance intervals at signalized intersections | Tried |
| | 3.1 B5 Provide more protected left-turn signal phases at high-volume intersections | Tried |
| | 3.1 B6 Provide offset left-turn lanes at intersections | Tried |
| | 3.1 B7 Improve lighting at intersections, horizontal curves, and railroad grade crossings | Tried |
| | 3.1 B8 Improve roadway delineation | Tried |
| | 3.1 B9 Replace painted channelization with raised channelization | Proven |
| | 3.1 B10 Reduce intersection skew angle | Tried |
| | 3.1 B11 Improve traffic control at work zones | Tried |
| 3.1 C – Identify older drivers at increased risk of crashing and intervene | 3.1 C1 Strengthen the role of medical advisory boards | Tried |
| | 3.1 C2 Update procedures for assessing medical fitness to drive | Proven |
| | 3.1 C3 Encourage external reporting of at-risk drivers to licensing authorities | Tried |
| | 3.1 C4 Provide remedial assistance to help functionally impaired older drivers lower their crash risk | Tried |
| 3.1 D – Improve the driving competency of older adults in the general driving population | 3.1 D1 Establish resource centers within communities to promote safe mobility choices | Tried |
| | 3.1 D2 Provide educational and training opportunities to the general older driver population | Tried |
| 3.1 E – Reduce the risk of injury and death to older drivers and passengers involved in crashes | 3.1 E1 Increase seatbelt use by older drivers and passengers | Proven |

Source: Transportation Research Board of the National Academies (TRB) 2004b.

[2] This plan contains many references. See Section 7 for complete list of references.

TABLE 5-2
**Comprehensive List of Young Driver Safety Strategies**

| Objectives | Strategies | Effectiveness |
|---|---|---|
| A. Implement or Improve Graduated Driver Licensing Systems | A1. – Enact a Graduated Licensing System | Proven |
| | A2. – Require at Least 6 Months of Supervised Driving for Beginners Starting at Age 16 | Proven |
| | A3. – Implement a Nighttime Driving Restriction that Begins at 9 p.m. | Proven |
| | A4. – Engage parents through outreach programs designed to educate parents about driving tips for their teens | Tried |
| | A5. – Develop parent-teen driver's education presentations and handbook aimed at educating individuals on the risk of teen driving | Tried |
| B. Publicize, enforce, and adjudicate laws pertaining to young drivers | B1. – Publicize and Enforce GDL Restrictions | Experimental |
| | B2. – Publicize and Enforce Laws Pertaining to Underage Drinking and Driving | Proven |
| | B3. – Publicize and Enforce Safety Belt Laws | Proven |
| C. Assist parents in managing their teens' driving | C1. – Facilitate Parental Supervision of Learners | Tried |
| | C2. – Facilitate Parental Management of Intermediate Drivers | Experimental |
| | C3. – Encourage Selection of Safer Vehicles for Young Drivers | Experimental |
| D. Improve young driver training | D1. – Improve Content and Delivery of Driver Education/Training | Tried |
| E. Employ School-Based Strategies | E1. – Eliminate Early School Start Times | Tried |
| | E2. – Review Transportation Plans for New/Expanded High School Sites | Experimental |

Source: Transportation Research Board of the National Academies (TRB) 2007.
Note:
GDL = Graduated Driver's License

TABLE 5-3
**Comprehensive List of Aggressive Driving Safety Strategies**

| Objectives | Strategies | Effectiveness | *Programs and Tactics |
|---|---|---|---|
| 4.1 A – Deter aggressive driving in specific populations, including those with a history of such behavior, and at specific locations | 4.1 A1-Target enforcement | Tried | Publicizing is best done through community events for the local media and a public education campaign in the community about the enforcement. High visibility enforcement is when multiple jurisdictions and/or multiple squads are out at the same time, patrolling in brightly colored vests, in conjunction with signage about the enforcement. |
| | 4.1 A2-Conduct educational and public information campaigns | Tried | |
| | 4.1 A3-Educate and impose sanctions against repeat offenders | Experimental | |
| 4.1 B – Improve the driving environment to eliminate or minimize the external "triggers" of aggressive driving | 4.1 B1-Change or mitigate the effects of identified elements in the environment | Experimental | |
| | 4.1 B2-Reduce nonrecurring delays and provide better information about these delays | Experimental | |

Source: Transportation Research Board of the National Academies (TRB) 2003a.

TABLE 5-4
**Comprehensive List of Impaired Driving Safety Strategies**

| Objectives | Strategies | Effectiveness |
|---|---|---|
| 5.1 A – Reduce Excessive Drinking and Underage Drinking | 5.1 A1-Increase the State Excise Tax on Beer | Tried |
| | 5.1 A2-Require Responsible Beverage Service Policies for Alcohol Servers and Retailers | Proven |
| | 5.1 A3-Conduct Well-Publicized Compliance Checks of Alcohol Retailers to Reduce Sales to Underage Persons | Tried |
| | 5.1 A4-Employ Screening and Brief Interventions in Health Care Settings | Tried |
| 5.1 B – Enforce DWI Laws | 5.1 B1-Conduct Regular Well-Publicized DWI Checkpoints | Proven |
| | 5.1 B2-Enhance DWI Detection Through Special DWI Patrols and Related Traffic Enforcement | Tried |
| | 5.1 B3-Publicize and Enforce Zero Tolerance Laws for Drivers Under Age 21 | Proven |
| 5.1 C – Prosecute, Impose Sanctions on, and Treat DWI Offenders | 5.1 C1-Suspend Driver's License Administratively Upon Arrest | Proven |
| | 5.1 C2-Establish Stronger Penalties for BAC Test Refusal Than for Test Failure | Tried |
| | 5.1 C3 – Eliminate Diversion Programs and Plea Bargains to Non-Alcohol Offenses | Tried |
| | 5.1 C4 – Incarcerate Offenders | Proven |
| 5.1 D – Control High-BAC and Repeat Offenders | 5.1 D1 – Seize Vehicles or Vehicle License Plates Administratively Upon Arrest | Proven |
| | 5.1 D2 – Require Ignition Interlocks as a Condition for License Reinstatement | Proven |
| | 5.1 D3 – Monitor All Convicted DWI Offenders Closely | Proven |
| | 5.1 D4 – Incarcerate Offenders | Proven |

Source: Transportation Research Board of the National Academies (TRB) 2005c.
Notes:
BAC = blood alcohol content
DWI = Driving While Intoxicated

TABLE 5-5
Comprehensive List of Seat Belt Usage Safety Strategies

| Objectives | Strategies | Effectiveness |
| --- | --- | --- |
| 8.1 A – Maximize use of occupant restraints by all vehicle occupants | 8.1 A1 – Conduct highly publicized enforcement campaigns to maximize restraint use. | Proven |
| | 8.1 A2 – Provide enhanced public education to population groups with lower than average restraint use rates. | Proven |
| | 8.1 A3 – Encourage the enactment of local laws that will permit standard enforcement of restraint laws. | Tried |
| 8.1 B – Insure that restraints, especially child and infant restraints, are properly used | 8.1 B1 – Provide community locations for instruction in proper child restraint use, including both public safety agencies and health care providers that are almost always available. | Tried |
| | 8.1 B2 – Conduct high-profile “child restraint inspection” events at multiple community locations. | Proven |
| | 8.1 B3 – Train law enforcement personnel to check for proper child restraint use in all motorist encounters. | Tried |
| 8.1 C – Provide access to appropriate information, materials, and guidelines for those implementing programs to increase occupant restraint use | 8.1 C1 – Create state-level clearing houses for materials that offer guidance in implementing programs to increase restraint use. | Experimental |

Source: Transportation Research Board of the National Academies (TRB) 2004d.

TABLE 5-6
**Comprehensive List of Road Departure Safety Strategies**

| Objectives | Strategies | Effectiveness |
|---|---|---|
| 15.1 A – Keep vehicles from encroaching on the roadside | 15.1 A1 – Install shoulder rumble strips | Tried |
| | 15.1 A2 – Install edge lines "profile marking", edge line rumble strips or modified shoulder rumble strips on section with narrow or no paved shoulders | Experimental |
| | 15.1 A3 – Install midlane rumble strips | Experimental |
| | 15.1 A4 – Provide enhanced shoulder or delineation and marking for sharp curves | Tried / Proven |
| | 15.1 A5 – Provide improved highway geometry for horizontal curves | Proven |
| | 15.1 A6 – Provide enhanced pavement markings | Tried |
| | 15.1 A7 – Provide skid-resistance pavement surfaces | Proven |
| | 15.1 A8 – Apply shoulder treatments<br>*Eliminate shoulder drop-offs *Shoulder wedge<br>*Widen and/or pave shoulders | Experimental / Proven |
| 15.1 B – Minimize the likelihood of crashing into an object or overturning if the vehicle travels off the shoulder | 15.1 B1 – Design safer slopes and ditches to prevent rollovers | Proven |
| | 15.1 B2 – Remove/relocate objects in hazardous locations | Proven |
| | 15.1 B3 – Delineate trees or utility poles with retroreflective tape | Experimental |
| 15.1 C – Reduce the severity of the crash | 15.1 C1 – Improve design of roadside hardware | Tried |
| | 15.1 C2 – Improve design and application of barrier and attenuation systems | Tried |
| 15.1 C – Reduce the severity of the crash | 18.1 A1 – Install centerline rumble strips for two-lane roads | Tried |
| | 18.1 B2 – Install median barriers for narrow-width medians on multilane roads | Tried |

Source: Transportation Research Board of the National Academies (TRB) 2003c.

TABLE 5-7
**Comprehensive List of Curve Safety Strategies**

| Objectives | Strategies | Effectiveness |
|---|---|---|
| A. Reduce the likelihood of a vehicle leaving its lane and either crossing the roadway centerline or leaving the roadway at a horizontal curve | A1. – Provide advance warning of unexpected changes in horizontal alignment | Tried |
| | A2. – Enhance delineation along the curve | Tried |
| | A3. – Provide adequate sight distance | Tried |
| | A4. – Install shoulder rumble strips | Proven |
| | A5. – Install centerline rumble strips | Tried |
| | A6. – Prevent edge drop-offs | Tried |
| | A7. – Provide skid-resistant pavement surfaces | Tried |
| | A8. – Provide grooved pavement | Tried |
| | A9. – Provide lighting of the curve | Tried |
| | A10. – Provide dynamic curve warning system | Tried |
| | A11. – Widen the roadway | Proven |
| | A12. – Improve or restore superelevation | Proven |
| | A13. – Modify horizontal alignment | Proven |
| | A14. – Install automated anti-icing systems | Tried |
| | A15. – Prohibit/restrict trucks with very long semitrailers on roads with horizontal curves that cannot accommodate truck offtracking | Tried |
| B. Minimize the adverse consequences of leaving the roadway at a horizontal curve | B1. – Design safer slopes and ditches to prevent rollovers | Proven |
| | B2. – Remove/relocate objects in hazardous locations | Proven |
| | B3. – Delineate roadside objects | Experimental |
| | B4. – Add or improve roadside hardware | Tried |
| | B5. – Improve design and application of barrier and attenuation systems | Tried |

Source: Transportation Research Board of the National Academies (TRB) 2004a.

TABLE 5-8
**Comprehensive List of Signalized Intersection Safety Strategies**

| Objectives | Strategies | Effectiveness |
|---|---|---|
| 17.2 A – Reduce frequency and severity of intersection conflicts through traffic control and operational improvements | 17.2 A1 – Employ multiphase signal operation | Tried / Proven |
| | 17.2 A2 – Optimize clearance intervals | Proven |
| | 17.2 A3 – Restrict or eliminate turning maneuvers (including right turns on red) | Tried |
| | 17.2 A4 – Employ signal coordination along a corridor or route | Proven |
| | 17.2 A5 – Employ emergency vehicle preemption | Proven |
| | 17.2 A6 – Improve operation of pedestrian and bicycle facilities at signalized intersections | Tried / Proven |
| | 17.2 A7 – Remove unwarranted signal | Proven |
| 17.2 B – Reduce frequency and severity of intersection conflicts through geometric improvements | 17.2 B1 – Provide/improve left-turn channelization | Proven |
| | 17.2 B2 – Provide/improve right-turn channelization | Proven |
| | 17.2 B3 – Improve geometry of pedestrian and bicycle facilities | Tried / Proven |
| | 17.2 B4 – Revise geometry of complex intersections | Tried / Proven |
| | 17.2 B5 – Construct special solutions | Tried |
| 17.2 C – Improve sight distance at signalized intersections | 17.2 C1 – Clear sight triangles | Tried |
| | 17.2 C2 – Redesign intersection approaches | Proven |
| 17.2 D – Improve driver awareness of intersections and signal control | 17.2 D1 – Improve visibility of intersections on approach(es) | Tried |
| | 17.2 D2 – Improve visibility of signals and signs at intersections | Tried |
| 17.2 E – Improve driver compliance with traffic control devices | 17.2 E1 – Provide public information and education | Tried |
| | 17.2 E2 – Supplement conventional enforcement of red-light running with confirmation lights | Tried |
| | 17.2 E3 – Implement automated enforcement of red-light running (cameras) | Tried |
| | 17.2 E4 – Implement automated enforcement of approach speeds (camera) | Tried |
| | 17.2 E5 – Control speed approaches | Experimental |
| 17.2 F – Improve access management near signalized intersections | 17.2 F1 – Restrict access to properties using driveway closures or turn restrictions | Tried |
| | 17.2 F2 – Restrict cross-median access near intersections | Tried |
| 17.2 G – Improve safety through other infrastructure treatments | 17.2 G1 – Improve drainage in intersection and on approaches | Tried |
| | 17.2 G2 – Provide skid resistance in intersection and on approaches | Tried |
| | 17.2 G3 – Coordinate closely spaced signals near at-grade railroad crossings | Tried |
| | 17.2 G4 – Relocate signal hardware out of the clear zone | Tried |
| | 17.2 G5 – Restrict or eliminate parking on intersection approaches | Proven |

Source: Transportation Research Board of the National Academies (TRB) 2004e.

TABLE 5-9
**Comprehensive List of Unsignalized Intersection Safety Strategies**

| Objectives | Strategies | Effectiveness |
|---|---|---|
| 17.1 A – Improve management of access near unsignalized intersections | 17.1 A1 – Implement driveway closure/relocations | Tried |
| | 17.1 A2 – Implement driveway turn restrictions | Tried |
| 17.1 B – Reduce the frequency and severity of intersection conflicts through geometric design improvements | 17.1 B1 – Provide left-turn lanes at intersections | Proven |
| | 17.1 B2 – Provide longer left-turn lanes at intersections | Tried |
| | 17.1 B3 – Provide offset left-turn lanes at intersections | Tried |
| | 17.1 B4 – Provide bypass lanes on shoulders at T-intersections | Tried |
| | 17.1 B5 – Provide left-turn acceleration lanes at divided highway intersections | Tried |
| | 17.1 B6 – Provide right-turn lanes at intersections | Proven |
| | 17.1 B7 – Provide longer right-turn lanes at intersections | Tried |
| | 17.1 B8 – Provide offset right-turn lanes at intersections | Tried |
| | 17.1 B9 – Provide right-turn acceleration lanes at intersections | Tried |
| | 17.1 B10 – Provide full-width paved shoulders in intersection areas | Tried |
| | 17.1 B11 – Restrict or eliminate turning maneuvers by signing | Tried |
| | 17.1 B12 – Restrict or eliminate turning maneuvers by providing channelization or closing median openings | Tried |
| | 17.1 B13 – Close or relocate "high-risk" intersections | Tried |
| | 17.1 B14 – Convert four-legged intersections to two T-intersections | Tried |
| | 17.1 B15 – Convert offset T-intersections to four legged intersections | Tried |
| | 17.1 B16 – Realign intersection approaches to reduce or eliminate intersection skew | Proven |
| | 17.1 B17 – Use indirect left-turn treatments to minimize conflicts at divided highway intersections | Tried |
| | 171. B18 – Improve pedestrian and bicycle facilities to reduce conflicts between motorists and nonmotorists | Varies |
| 17.1 C – Improve sight distance at unsignalized intersections | 17.1 C1 – Clear sight triangle on stop- or yield-controlled approaches to intersections | Tried |
| | 17.1 C2 – Clear sight triangles in the medians of divided highways near intersections | Tried |
| | 17.1 C3 – Change horizontal and/or vertical alignment of approaches to provide more sight distance | Tried |
| | 17.1 C4 – Eliminate parking that restricts sight distance | Tried |

TABLE 5-9
**Comprehensive List of Unsignalized Intersection Safety Strategies (continued)**

| Objectives | Strategies | Effectiveness |
|---|---|---|
| 17.1 D – Improve availability of gaps in traffic and assist drivers in judging gap sizes at unsignalized intersections | 17.1 D1 – Provide an automated real-time system to inform drivers of suitability of available gaps for making turning and crossing maneuvers | Experimental |
| | 17.1 D2 – Provide roadside markers or pavement markings to assist drivers in judging the suitability of available gaps for making turning and crossing maneuvers | Experimental |
| | 17.1 D3 – Retime adjacent signals to create gaps at stop-controlled intersections | Tried |
| 17.1 E – Improve driver awareness of intersections as viewed from the intersection approach | 17.1 E1 – Improve visibility of intersections by providing enhanced signing and delineation | Tried |
| | 17.1 E2 – Improve visibility of intersections by providing lighting | Proven |
| | 17.1 E3 – Install splitter islands on the minor-road approach to an intersection | Tried |
| | 17.1 E4 – Provide a stop bar (or provide a wider stop bar) on minor-road approaches | Tried |
| | 17.1 E5 – Install larger regulatory and warning signs at intersections | Tried |
| | 17.1 E6 – Call attention to the intersection by installing rumble strips on intersection approaches | Tried |
| | 17.1 E7 – Provide dashed markings (extended left edge lines) for major-road continuity across the median opening at divided highway intersections | Tried |
| | 17.1 E8 – Provide supplementary stop signs mounted over the roadway | Tried |
| | 17.1 E9 – Provide pavement markings with supplementary messages, such as STOP AHEAD | Tried |
| | 17.1 E10 – Provide improved maintenance of stop signs | Tried |
| | 17.1 E11 – Install flashing beacons at stop-controlled intersections | Tried |
| 17.1 F – Choose appropriate intersection traffic control to minimize crash frequency and severity | 17.1 F1 – Avoid signalizing through roads | Tried |
| | 17.1 F2 – Provide all-way stop control at appropriate intersections | Proven |
| | 17.1 F3 – Provide roundabouts at appropriate locations | Proven |
| 17.1 G – Improve driver compliance with traffic control devices and traffic laws at intersections | 17.1 G1 – Provide targeted enforcement to reduce stop sign violations | Tried |
| | 17.1 G2 – Provide targeted public information and education on safety problems at specific intersections | Tried |
| 17.1 H – Reduce operating speeds on specific intersection approaches | 17.1 H1 – Provide targeted speed enforcement | Proven |
| | 17.1 H2 – Provide traffic calming on intersection approaches through a combination of geometrics and traffic control devices | Proven |
| | 17.1 H3 – Post appropriate speed limit on intersection approaches | Tried |
| 17.1 I – Guide motorists more effectively through complex intersections | 17.1 I1 – Provide turn path markings | Tried |
| | 17.1 I2 – Provide a double yellow centerline on the median opening of a divided highway at intersections | Tried |
| | 17.1 I3 – Provide lane assignment signing or marking at complex intersections | Tried |

Source: Transportation Research Board of the National Academies (TRB) 2003b.

TABLE 5-10
Comprehensive List of Head-on Safety Strategies

| Objectives | Strategies | Effectiveness |
|---|---|---|
| 18.1 A – Keep vehicles from encroaching into opposite lane | 18.1 A1 – Install centerline rumble strips for two-lane roads | Tried |
| | 18.1 A2 – Install profiled thermoplastic strips for centerlines | Tried |
| | 18.1 A3 – Provide wider cross sections on two-lane roads | Experimental |
| | 18.1 A4 – Provide center two-way left-turn lanes for four- and two-lane roads | Tried |
| | 18.1 A5 – Reallocate total two-lane roadway width (lane and shoulder) to include a narrow “buffer median” | Tried |
| 18.1 B – Minimize the likelihood of crashing into an oncoming vehicle | 18.1 B1 – Use alternating passing lanes or four-lane sections at key locations | Tried |
| | 18.1 B2 – Install median barriers for narrow-width medians on multilane roads | Tried |

Source: Transportation Research Board of the National Academies (TRB) 2003d.

TABLE 5-11
**Comprehensive List of Heavy Vehicle Safety Strategies**

| Objectives | Strategies | Effectiveness |
|---|---|---|
| 12.1 A – Reduce fatigue-related crashes | 12.1 A1 – Increase efficiency of use of existing parking spaces | Experimental |
| | 12.1 A2 – Create additional parking spaces | Tried |
| | 12.1 A3 – Incorporate rumble strips into new and existing roadways | Proven |
| 12.1 B – Strengthen CDL program | 12.1 B1 – Improve test administration for the CDL | Tried |
| | 12.1 B2 – Increase fraud detection by state and third-party testers | Experimental |
| 12.1 C – Increase knowledge about sharing the road | 12.1 C1 – Incorporate Share the Road information into driver materials | Tried |
| | 12.1 C2 – Promulgate Share the Road information through print and electronic media | Tried |
| 12.1 D – Improve maintenance of heavy trucks | 12.1 D1 – Increase and strengthen truck maintenance programs and inspection performance | - |
| | 12.1 D2 – Conduct post-crash inspections to identify major problems and problem conditions | Experimental |
| 12.1 E – Identify and correct unsafe roadway infrastructure and operational characteristics | 12.1 E1 – Identify and treat truck crash roadway segments—signing | Experimental |
| | 12.1 E2 – Install interactive truck rollover signing | Proven |
| | 12.1 E3 – Modify speed limits and increase enforcement to reduce truck and other vehicle speeds | Tried |
| 12.1 F – Improve and enhance truck safety data | 12.1 F1 – Increase the timeliness, accuracy, and completeness of truck safety data | - |
| 12.1 G – Promote industry safety initiatives | 12.1 G1 – Perform safety consultations with carrier safety management | Proven |
| | 12.1 G2 – Promote development and deployment of truck safety technologies | Experimental |

Source: Transportation Research Board of the National Academies (TRB) 2004f.
Note:
CDL =commercial Drivers License

TABLE 5-12
**Comprehensive List of Emergency Services Safety Strategies**

| Objectives | Strategies | Effectiveness |
|---|---|---|
| 20.1 A – Integrate services to enhance emergency medical capabilities | 20.1 A1 – Establish programs with organizations to utilize nontraditional employees as EMS responders | Tried |
| | 20.1 A2 – Facilitate development of regional resources and/or cooperatives | Tried |
| | 20.1 A3 – Integrate support of EMS into rural hospital financing programs | Tried |
| | 20.1 A4 – Integrate information systems and highway safety activities | Tried |
| | 20.1 A5 – Integrate EMS systems into the Safe Communities effort | Tried |
| | 20.1 A6 – Use mobile data technologies that are interoperable with hospital systems | Tried |
| | 20.1 A7 – Require all communication systems to be interoperable with surrounding and state jurisdictions | Tried |
| 20.1 B – Provide or improve management and decision-making tools | 20.1 B1 – Develop resource and performance standards unique to the specific rural EMS | Tried |
| | 20.1 B2 – Identify, provide, and mandate efficient and effective methods for collection of necessary EMS data | Tried |
| | 20.1 B3 – Identify and evaluate model rural EMS operations | Tried |
| | 20.1 B4 – Provide evaluation results to elected and administrative officials at the county and local levels | Tried |
| 20.1 C – Provide better education opportunities for rural EMS | 20.1 C1 – Utilize technology-based instruction for rural EMS training | Proven |
| | 20.1 C2 – Establish an exchange program to allow rural EMS providers to spend a specified number of hours in urban/suburban systems | Experimental |
| | 20.1 C3 – Include principles of traffic safety and injury prevention as part of EMS continuing education | Experimental |
| | 20.1 C4 – Require first care training for all public safety emergency response personnel, including law enforcement officers | Tried |
| | 20.1 C5 – Educate rural residents about the availability, capability, and limitations of existing systems | Tried |
| | 20.1 C6 – Provide “bystander care” training programs targeting new drivers, rural residents, truck drivers, interstate commercial bus drivers, and motorcyclists | Tried |
| | 20.1 C7 – Provide EMS training programs in high schools in rural areas | Tried |
| 20.1 D – Reduce time from injury to appropriate definitive care | 20.1 D1 – Improve cellular telephone coverage in rural areas | Tried |
| | 20.1 D2 – Improve compliance of rural 9-1-1 centers with Federal Communications Commission wireless “Phase II” automatic location capability | Tried |
| | 20.1 D3 – Utilize geographic positioning system (GPS) technology to improve response time | Tried |
| | 20.1 D4 – Integrate automatic vehicle location (AVL) and computer-aided navigation (CAN) technologies into all computer-aided dispatch (CAD) systems | Tried |
| | 20.1 D5 – Equip EMS vehicles with multi-service and/or satellite-capable telephones | Tried |

Source: Transportation Research Board of the National Academies (TRB) 2005b.
Notes:
EMS = emergency medical services

TABLE 5-13
**Comprehensive List of Motorcycle Collision Safety Strategies**

| Objectives | Strategies | Effectiveness |
|---|---|---|
| 11.1 A – Incorporate motorcycle-friendly roadway design, traffic control, construction, and maintenance policies and practices | 11.1 A3 – Identify pavement markings, surface material, and other treatments that reduce traction for motorcycles and treat or replace with high-traction material | Tried |
| | 11.1 A8 – Incorporate motorcycle safety considerations into routine roadway inspections | Experimental |
| 11.1 B – Reduce the number of motorcycle crashes due to rider impairment | 11.1 B1 – Increase motorcyclist awareness of the risks of impaired motorcycle operation | Tried |
| 11.1 C — Reduce the number of motorcycle crashes due to unlicensed or untrained motorcycle riders | 11.1 C1 – Increase awareness of the causes of crashes due to unlicensed or untrained motorcycle riders | Experimental |
| | 11.1 C2 – Ensure that licensing and rider training programs adequately teach and measure skills and behaviors required for crash avoidance | Tried |
| 11.1 D – Increase the visibility of motorcyclists | 11.1 D1 – Increase the awareness of the benefit of high-visibility clothing | Experimental |
| | 11.1 D2 – Identify and promote night visibility-enhancement methods and technology | Tried |
| 11.1 E – Reduce the severity of motorcycle crashes | 11.1 E1 – Increase the use of FMVSS 218 compliant helmets | Proven |
| 11.1 F – Increase motorcycle rider safety awareness | 11.1 E2 – Increase the use of protective clothing | Tried |
| | 11.1 F1 – Form strategic alliances with motorcycle user community to foster and promote motorcycle safety | Tried |
| | 11.1 F2 – Increase awareness of the consequences of aggressive riding, riding while fatigued or impaired, unsafe riding, and poor traffic strategies | Tried |
| | 11.1 F3 – Educate operators of other vehicles to be more conscious of the presence of motorcyclists | Tried |

Source: Transportation Research Board of the National Academies (TRB) 2009.

TABLE 5-14
Comprehensive List of Distracted, Inattentive, and Asleep Driver Safety Strategies

| Objectives | Strategies | Effectiveness |
| --- | --- | --- |
| Objective 6.1 A – Make roadways safer for drowsy or distracted drivers | Strategy 6.1 A1 – Install shoulder and/or centerline rumble strips | Proven |
| | Strategy 6.1 A2 – Implement other roadway improvements to reduce the likelihood and severity of run-off-road and/or head-on collisions | Proven |
| | Strategy 6.1 A3 – Implement roadway improvements to reduce the likelihood and severity of other types of distracted and drowsy driving crashes | Tried |
| Objective 6.1 B – Provide safe stopping and resting areas | Strategy 6.1 B1 – Improve access to safe stopping and resting areas | Tried |
| | Strategy 6.1 B2 – Improve rest area security and services | Tried |
| Objective 6.1 C – Increase driver awareness of the risks of drowsy and distracted driving and promote driver focus | Strategy 6.1 C1 – Conduct education and awareness campaigns targeting the general driving public | Tried |
| | Strategy 6.1 C2 – Visibly enforce existing statutes to deter distracted and drowsy driving | Experimental |
| Objective 6.1 D – Implement programs that target populations at increased risk of drowsy and distracted driving crashes | Strategy 6.1 D1 – Strengthen graduated driver licensing requirements for young novice drivers | Proven |
| | Strategy 6.1 D2 – Incorporate information on distracted and fatigued driving into education programs and materials for young drivers | Tried |
| | Strategy 6.1 D3 – Encourage employers to offer fatigue management programs to employees working nighttime or rotating shifts | Proven |
| | Strategy 6.1 D4 – Enhance enforcement of commercial motor vehicle hours-of-service regulations | Proven |
| | Strategy 6.1 D5 – Encourage trucking companies and other fleet operators to implement fatigue management programs | Tried |
| | Strategy 6.1 D6 – Implement targeted interventions for other high-risk populations | Experimental |

Source: Transportation Research Board of the National Academies (TRB) 2005a.

TABLE 5-15
**Comprehensive List of Pedestrian Safety Strategies**

| Objectives | Strategies | Effectiveness |
|---|---|---|
| 9.1 A – Reduce pedestrian exposure to vehicular traffic | 9.1 A1 – Provide sidewalks/walkways and curb ramps | Proven |
| | 9.1 A2 – Install or upgrade traffic and pedestrian signals | Varies |
| | 9.1 A3 – Construct pedestrian refuge islands and raised medians | Proven |
| | 9.1 A4 – Provide vehicle restriction/diversion measures | Proven |
| | 9.1 A5 – Install overpasses/underpasses | Proven |
| 9.1 B – Improve sight distance and/or visibility between motor vehicles and pedestrians | 9.1 B1 – Provide crosswalk enhancements | Varies |
| | 9.1 B2 – Implement lighting/crosswalk illumination measures | Proven |
| | 9.1 B3 – Eliminate screening by physical objects | Tried |
| | 9.1 B4 – Signals to alert motorists that pedestrians are crossing | Experimental |
| | 9.1 B5 – Improve reflectorization/conspicuity of pedestrians | Tried |
| 9.1 C – Reduce vehicle speed | 9.1 C1 – Implement road narrowing measures | Tried |
| | 9.1 C2 – Install traffic calming – road sections | Proven/Tried |
| | 9.1 C3 – Install traffic calming – intersections | Proven/Tried |
| | 9.1 C4 – Provide school route improvements | Tried |
| 9.1 D – Improve pedestrian and motorist safety awareness and behavior | 9.1 D1 – Provide education, outreach, and training | Proven |
| | 9.1 D2 – Implement enforcement campaigns | Tried |

Source: Transportation Research Board of the National Academies (TRB) 2004c.

# 6.0 Benefit/Cost Analysis

Once countermeasures are chosen for a specific site, the impact of these countermeasures can be measured. Using the Benefit/Cost Tool allows the ability to fairly assess the effectiveness of the countermeasures that have been selected for implementation at a site.

By considering the number of crashes occurring at a site, along with their respective severity level, and the cost of the desired countermeasures, a measurement of benefit can be calculated. This tool takes into account many pieces of information. Some of these pieces of information include the cost of the countermeasure, the type of collisions the countermeasure is meant to reduce/eliminate, the amount of crashes that have occurred at the site, and so forth.

An example "Summary Sheet" produced by the Benefit/Cost Tool is shown in Figure 6-1. The figure shows what type of information is used. Crash counts by crash severity and countermeasure type are the most important aspects but simply having crash counts and countermeasures does not guarantee promising results. Choosing the best sites for implementation will help maximize the potential benefit.

Benefit/Cost Example:

This example shows how the user identified multiple curves throughout the county that have a considerable number of RD crashes. Once these potential curves are chosen, data can be collected and the curves can be prioritized. Understanding the issues at the priority locations will help in the countermeasures selection. It should be remembered that Data Trees or any of the other network screening tools can assist in determining these problematic areas.

For the curves considered by the user in this example, the major crash types are fixed object, head-on and overturned. The suggested countermeasures to reduce, or potentially eliminate these crashes, are shown in the bottom, left portion of the figure as "2.1.8.S1.1 - Pavement Treatments – Install Rumble Strips (Shoulder)" and "2.6.7.S1.1 - Curves – Install Chevron Signs on Horizontal Curves". It is important to make sure the suggested countermeasures directly affect the most common crash types.

After choosing the desired countermeasures, a cost estimate can be prepared for shoulder rumble strips and chevron installation. Once the cost calculations and all of the necessary information is inserted, the user can calculate the Benefit/Cost ratio. This step shows the value and impact of the selected countermeasures.

In general, a higher Benefit/Cost ratio is more desirable. This indicates the countermeasure having a large impact on the troublesome crash types.

Figure 6-1
Summary Sheet from Benefit/Cost Tool

## PROJECT DESCRIPTION - PROJECT DATA INPUT (SEGMENTS)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| *Project:* | Curve Improvements | | | | | *Prepared by:* | TJM |
| *District:* | 21 | *County:* | Clearskies | *City:* | Safetytown | *Date* | 11/1/2013 |
| *Key Route:* | Various | *Marked Route:* | Various | *MilePost:* | Various | *Current AADT:* | 450-11,000 |
| *Location Descriptio* | Multiple horizontal curves throughout county | | | | | | |
| | | | | | | *Length (miles):* | Approx. 3 miles |
| *Crash data:* | 5 | Years | | | | *Traffic Growth factor* | 3.0% |
| | From | 2008 | to | 2012 | | *Interest rate* | 4.0% |
| *Peer Group:* | Peer Group 1 - Rural Two-Lane Highway | | | | | | |

| *Messages* |
|---|
| 2.6.7.S1.1 - Curves - Install Chevron Signs on Horizontal Curves AADT is not within HSM limits |

## SEGMENTS CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD

| *Crash Type* | All Crashes | Angle | Animal | Fixed Object | Head On | Left Turn | Other Noncollision | Other Object | Overturned | Pedestrian | Pedalcyclist | Parked Vehicle | Rear End | Right Turn | Sideswipe Same Direction | Sideswipe Opposite Direction | Turning | Train | Night Time | Wet Pavement | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Crash Severity* | *ALL* | *AG* | *AN* | *FO* | *HO* | *LT* | *OtherNC* | *OtherO* | *OVT* | *PD* | *PDC* | *PKV* | *RE* | *RT* | *SSD* | *SOD* | *T* | *TR* | *NGT* | *WP* | *TOT* |
| Fatal Crashes | | | | | 1 | | | | | | | | | | | | | | | | 1 |
| A-Injury Crashes | | 1 | | 3 | 2 | | | | 1 | | | | | | | 1 | | | | | 8 |
| B-Injury Crashes | | | 1 | 5 | 2 | | 1 | 2 | 5 | | 1 | 1 | | | | 1 | | | | | 19 |
| C-Injury Crashes | | | | 13 | 2 | | | | 7 | | | | | | | 3 | | | | | 25 |
| PDO Crashes | | | | 16 | 8 | | | | 12 | | | 4 | | | | | | | | | 40 |

## SEGMENTS BENEFIT COST ANALYSIS

| BENEFIT CALCULATIONS | | | COUNTERMEASURE COST CALCULATIONS | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| *COUNTERMEASURE* | *CMF ** | *Crash Type affected by this improvement* | *Unit Cost* | *Quantity* | *Units* | *Total Cost* | *Service Life* | *Present worth* | *EUAC *** |
| 2.1.8.S1.1 - Pavement Treatments - Install Rumble Strips (Shoulder) | 0.78 | FO, OVT | $25,000 | 3 | Miles | $75,000 | 8 | $75,000 | $11,140 |
| 2.6.7.S1.1 - Curves - Install Chevron Signs on Horizontal Curves | 0.84 | All | $5,000 | 12 | Unit Qnty | $60,000 | 4 | $111,288 | $16,529 |
| | | All | | | | | | | |
| | | All | | | | | | | |
| ***TOTAL BENEFIT*** ***$587,962*** | | | ***TOTAL COST*** | | | | | | ***$27,669*** |

| | |
|---|---|
| **BENEFIT/ COST** | **21.20** |
| **ANNUAL NUMBER OF FATALITIES POTENTIALLY PREVENTED** | **0.03** |
| **TOTAL FATALITIES PREVENTED** | **0.15** |

* CMF = Crash Modification Factor
** EUAC = Estimated Uniform Annual Cost

# 7.0 References and Additional Resources


Federal Highway Administration (FHWA). 2000. *Prediction of the Expected Safety Performance of Rural Two-Lane Highways.* Appendix D: Publication No. FHWA-RD-99-207. Available at: http://www.fhwa.dot.gov/publications/research/safety/99207/appd.cfm.

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Transportation Research Board of the National Academies (TRB). 2007. *NCHRP 500 Series, Volume 19: A Guide for Reducing Collisions Involving Younger Drivers.*

Transportation Research Board of the National Academies (TRB). 2009. *NCHRP 500 Series, Volume 22: A Guide for Addressing Collisions Involving Motorcycles.*

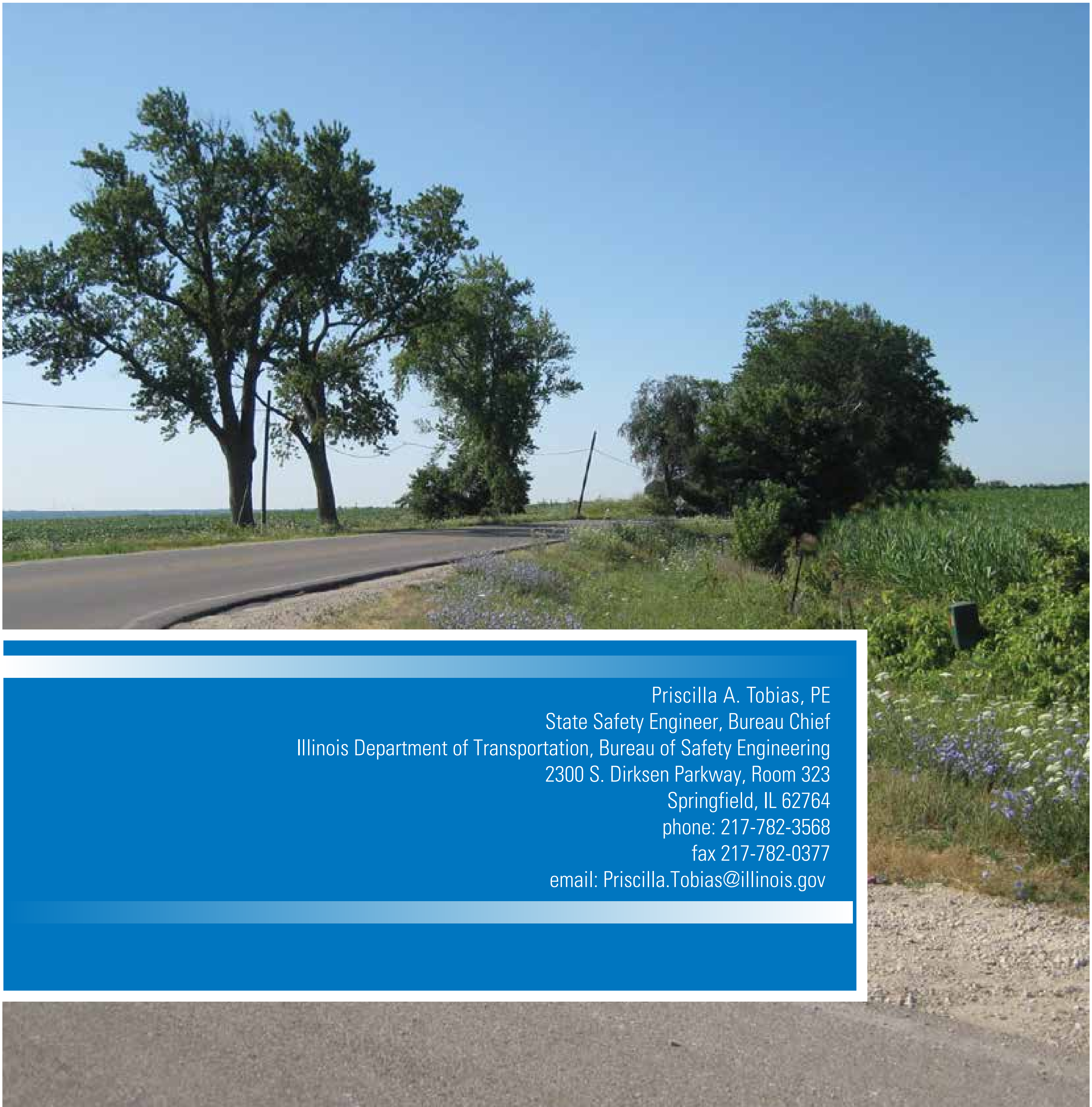

## Other helpful resources

CMFClearinghouse.org

Highwaysafetymanual.org

Illinois Department of Transportation

CH2MHILL



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