TRANSPORTATION CRASH ANALYSIS AND COUNTERMEASURE IDENTIFICATION

Developed for:
Lawrence - Douglas County
Metropolitan Planning Organization

Prepared by:
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METROPOLITAN PLANNING ORGANIZATION

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MPO Policy Board approval of this study does not validate or guarantee the identified countermeasures will improve safety or be implemented.

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OVERVIEW

The goal of the Transportation Crash Analysis and Countermeasure Identification Study, hereafter referred to as the Crash Analysis, was to compile a current geodatabase that identifies locations with high traffic crash records for Lawrence and Douglas County, Kansas. These "hot spot" locations were prioritized in regards to a set of defined location variables and recommendations were made for cost-efficient crash countermeasures for the locations. The approach was centered on a repeatable methodology which utilizes geographic information systems (GIS) mapping and tools for calculating performance measures of the identified "hot spots."

This Crash Analysis represents a strategy to coordinate transportation safety improvement projects and apply funding to the intersections and road segments. The outcome of this effort is a list of recommended projects with specific and implementable improvements to roadway segments and intersections. These represent only a recommendation that will not be required to be addressed now or in the near future but are based on objective inputs and regional concerns outlined by the project's Steering Committee.

The main concept for this approach to GIS-oriented crash analysis steers away from the historical approach of considering locations based only on public complaint and other situational factors. The old method did not account for hot spots with high vehicle crash records, pedestrian and bike crash records, and traffic volumes; the more traffic volume passing through a given area, the more likely the possibility of a crash. For this new approach, an equally-weighted project location selection method was needed for the City, County, and State jurisdictions.

The methodology of this project focuses on a performance measure called Excess Expected Average Crash Frequency with Empirical Bayes Adjustments (EEACF). The basis of this performance measure is the Average Crash Frequency (ACF) which is determined based on how many crashes occur each year at a particular location. This is a good starting point for analysis, but, to go one step further, there needed to be an unbiased comparison between sites that will account for higher traffic volumes. EEACF is a performance measure which shows the extra amount of observed traffic crashes expected at a location for a year above the predicted amount of crashes based on traffic volumes. This performance measure uses an equivalent weighting method adjustment and is detailed in the Highway Safety Manual (HSM) published by the American Association of State Highway and Transportation Officials (AASHTO). The HSM provided the calculations to compare the frequency of crashes at each location with adjustments made to account for regression-to-the-mean and balances out any inherent randomness of crash locations.

The procedure of using GIS to determine hot spot locations with high crash rates can be repeated by City or County staff on a regular basis. A location was considered to be a hot spot if the calculated result of the EEACF was greater than zero. Another way to state this is that there is a greater amount of expected crashes at a location while accounting for any differences in higher or lower traffic volumes. As the hot spot analysis is repeated, any effect of recent major construction projects on traffic patterns is expected to change future results. Crash frequency in some areas is expected to change after future years of crash data and future traffic volumes are incorporated into the analysis.

OVERVIEW

Once a hot spot was determined using GIS software, a prioritization ranking method was applied to identify a list of the top highest hazard hot spot locations based on regional concerns as well as EEACF. Using a list of hot spot crash locations within Lawrence and Douglas County, the Steering Committee used a prioritization method to narrow down the list to several projects that could be implemented in the next few years. A separate list of priorities was created for urban sites and rural sites. Twelve total road safety audits were performed with half in the urban setting and half in the rural setting.

A list of possible crash countermeasures was compiled for each safety audit site to reduce the number of crashes. Crash countermeasures reduce the potential for crashes and consist of infrastructure improvements, access management, education campaigns, and/or enforcement. Some of the selected hot spot countermeasures could be incorporated with other ongoing planned construction projects or could be standalone projects depending on the site evaluations and recommendations. The HSM provided data on the potential for a countermeasure to reduce the number of crashes, but many of the countermeasures in the urban setting were not provided due to ongoing research. The Steering Committee reviewed the results of the safety audits and the benefit-cost ratio (for rural projects only) for each crash countermeasure to develop a plan for future implementation. The monetary benefit of each rural countermeasure was determined by multiplying the societal cost of each applicable crash to the amount of reduced crashes. Costs estimates for each countermeasure were developed based on 2017 unit prices. In combination with the safety audits, crash report records were also obtained for a more detailed analysis at the urban intersections. The urban crash reports helped to identify issues with needed auxiliary turn lanes, access management, bus stop improvements, and pedestrian and bicycle crossing movements.

The ultimate goal of this report is a repeatable process that can be used to identify high crash locations, where funds are best spent, and what types of implementable projects can improve safety. The results of the crash analysis provides justification for funding applications and can be easily incorporated into future transportation projects.

CHAPTER 1: REGIONAL PLANS

The main concepts of the regional plans were incorporated into the thought process behind the Crash Analysis. The main goal of these regional plans was to reduce crashes through engineering design and the application of education, enforcement, and emergency response. A condensed version of roadway safety strategies used to steer this study's organization and focus are listed below:

- Analyze regional/multi-jurisdictional crash records to identify high-risk locations that should undergo safety improvements.
  - Collect and analyze crash frequency and locations every few years.
  - The facilities with a high frequency of crashes need a roadway safety audit including options to reduce crash frequency using engineering design, public education, and enforcement.
  - Source: Transportation 2040 (2013)

- Provide public safety education material.
  - Advocate for improved safety infrastructure and services.
  - Encourage increased bicycle and pedestrian activity levels.
  - Source: Transportation 2040 (2013) and Lawrence-Douglas County Regional Pedestrian Plan (2016)

- Encourage increased law enforcement for traffic violations.
  - Targeting locations with excessively high crash rates can reduce aggressive driving behavior in areas expected to have the greatest number of excess future crashes.
  - Source: Transportation 2040 (2013)

- Continue to update the area's design standards for roadways and intersections regarding pedestrians, bicyclists, public transit, trucks, emergency response vehicles, and passenger vehicles.
  - Design standards should promote a balanced multi-modal use for all roadway facilities.
  - Design standards should accommodate accessibility needs as defined by federal and state law.
  - Multi-modal enhancements and traffic calming methods should be considered and/or coordinated with roadway improvement projects.
  - Source: Transportation 2040 (2013)

- Improve streetscapes and gateways.
  - Streetscaping can provide an increased comfort level for multi-modal facilities which promotes alternative travel methods.
  - Creating a community identity/aesthetics in the roadway environment can bring attention to perceived activity level and, therefore, increase the situational awareness of drivers.
  - Source: City of Lawrence, Parks and Recreation Master Plan (2017)

- Continue to update the real-time traffic management system to address congestion and increase travel time reliability for emergency response services.
  - Intelligent Transportation Systems (ITS) provide messages to the public to handle delays caused by crashes by promoting use of an alternative route.
  - Install traffic signal preemption for emergency responding vehicles.
  - Source: Transportation 2040 (2013)

CHAPTER 2: DATA COLLECTION & PROCESSING

The Crash Analysis included crash data for 2013, 2014, 2015, and 2016 for Lawrence and Douglas County. The crash records were provided by KDOT and geocoded into one GIS map. The HSM requires at least two years of data to be analyzed to account for the randomness of crash locations. Note that crashes within parking lots are not included in the analysis because parking lots are not part of the publicly-owned and maintained infrastructure. Furthermore, parking lots provide a challenge for safety analysis since they involve private land thus may not have a crash report on record and/or involve different driving behaviors and maneuvers compared roadway driving.

The initial features on the GIS map included geocoded crash locations, roadway centerlines, intersection locations, and traffic signal locations. The geocoded crash locations included the following **feature attributes**:

Year
Accident Key
Date
Time
Latitude
Longitude
State Reference Post
County Reference Post
City
On Road Street Name
Distance on Roadway
Direction
Number of Vehicles
Total Crashes
Fatal Crashes
Injury Crashes
Property-Damage-Only Crashes
Number of Deaths
Number of Injuries

Accident Class: Collision with Animal, Collision with Fixed Object, Collision with Other Motor Vehicle, Collision with Other Object, Collision with Parked Motor Vehicle, Collision with Bicycle, Collision with Pedestrian, Collision with Railway Train, Other Non-collision, Overturned, Unknown

Collision with Other Motor Vehicle Description: Angle - Side Impact, Backed Into, Head On, Other, Rear End, Sideswipe: Opposite Direction, Sideswipe: Same Direction, Unknown

Fixed Object Description: Barricade, Bridge Rail, Bridge Structure, Building, Crash Cushion (Barrels), Culvert, Curb, Ditch, Divider-Median Barrier, Embankment, Fence / Gate, Guardrail, Hydrant, Mailbox, Other, Other Post-pole, Overhead Sign Support, Railroad Crossing Fixtures, Sign Post, Tree, Unknown, Utility Devices: Pole, Meter, Etc., Wall

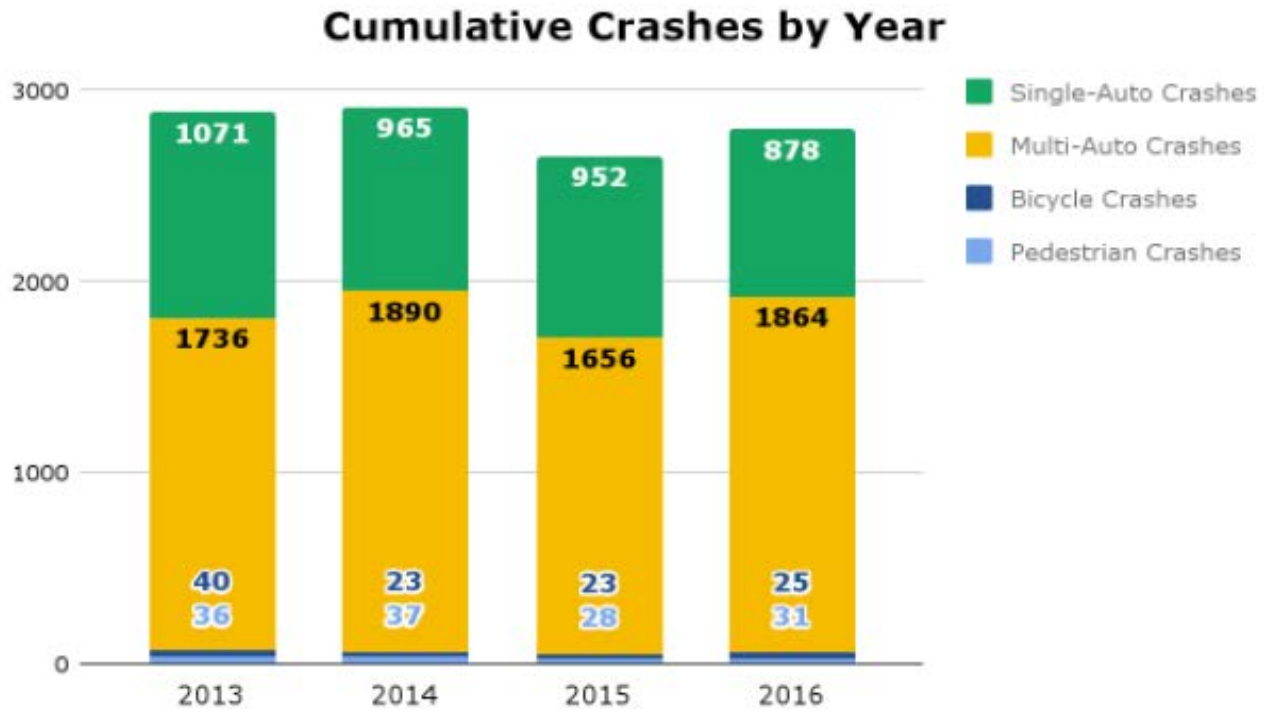
Accident Location Relative to Intersections and Traveled Way: Interchange Area - On Roadway, Intersection - On Roadway, Intersection-Related - On Roadway, Median - Off Roadway, Non-intersection - On Roadway, On Crossover - On Roadway, Other, Parking Lot - Driveway Access, Parking Lot, Rest Area Trafficway - Off Roadway, Roadside - No Shoulder - Off Roadway, Shoulder, Toll Plaza, Unknown

Weather Conditions: Blowing Dust, Sand, Etc., Fog, Freezing Rain, No Adverse Conditions, Other, Rain and Winds, Rain, Mist, or Drizzle, Sleet, Snow, Snow and Winds, Strong Winds, Unknown

Light Conditions: Dark - No Street Lights, Dark - Street lights On, Dawn, Daylight, Dusk, Unknown

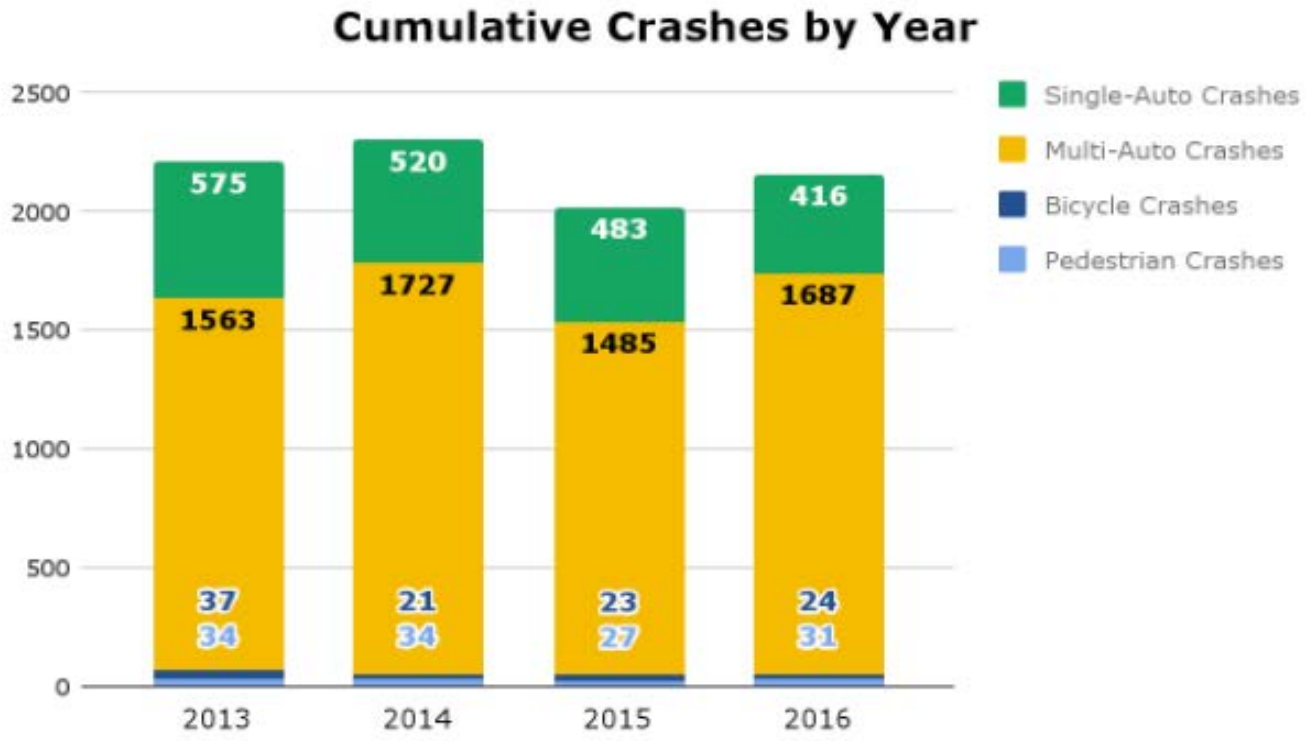
The roadway centerlines, intersection locations, and traffic signal locations were linear or point features provided by the City of Lawrence and included the following feature attributes: Length, Speed Limit, Number of Intersection Legs, Presence of a Traffic Signal

Several graphs and figures illustrating the summary of the crash data are shown below. Graph 1 shows the cumulative crashes separated by four categories: Single-Auto, Multi-Auto, Bicycle, and Pedestrian Crashes.



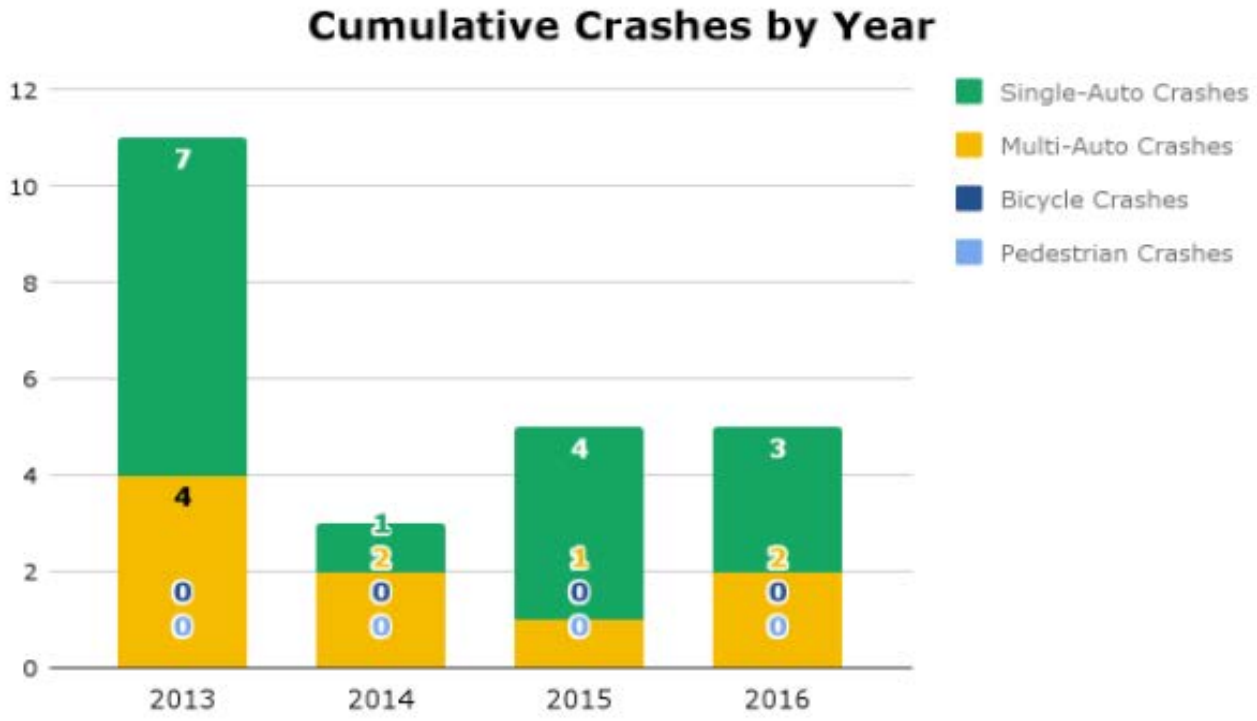
Graph 1: Cumulative Crashes by Year

The crashes were also checked per city within Douglas County including Lawrence, Eudora, Baldwin City, and Lecompton. Graph 2 shows the cumulative crashes by year for the City of Lawrence separated by four categories: Single-Auto, Multi-Auto, Bicycle, and Pedestrian Crashes.



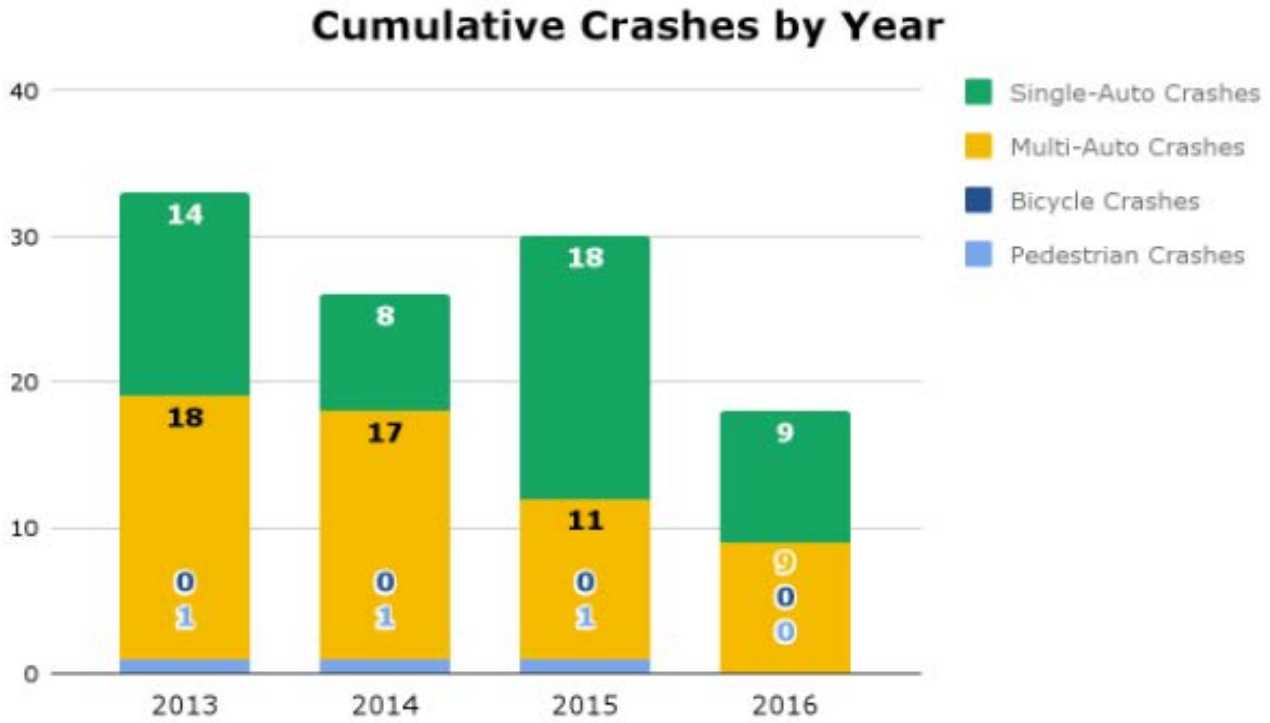
Graph 2: Cumulative Crashes by Year, City of Lawrence

Graph 3 shows the cumulative crashes by year for the City of Eudora separated by four categories: Single-Auto, Multi-Auto, Bicycle, and Pedestrian Crashes.



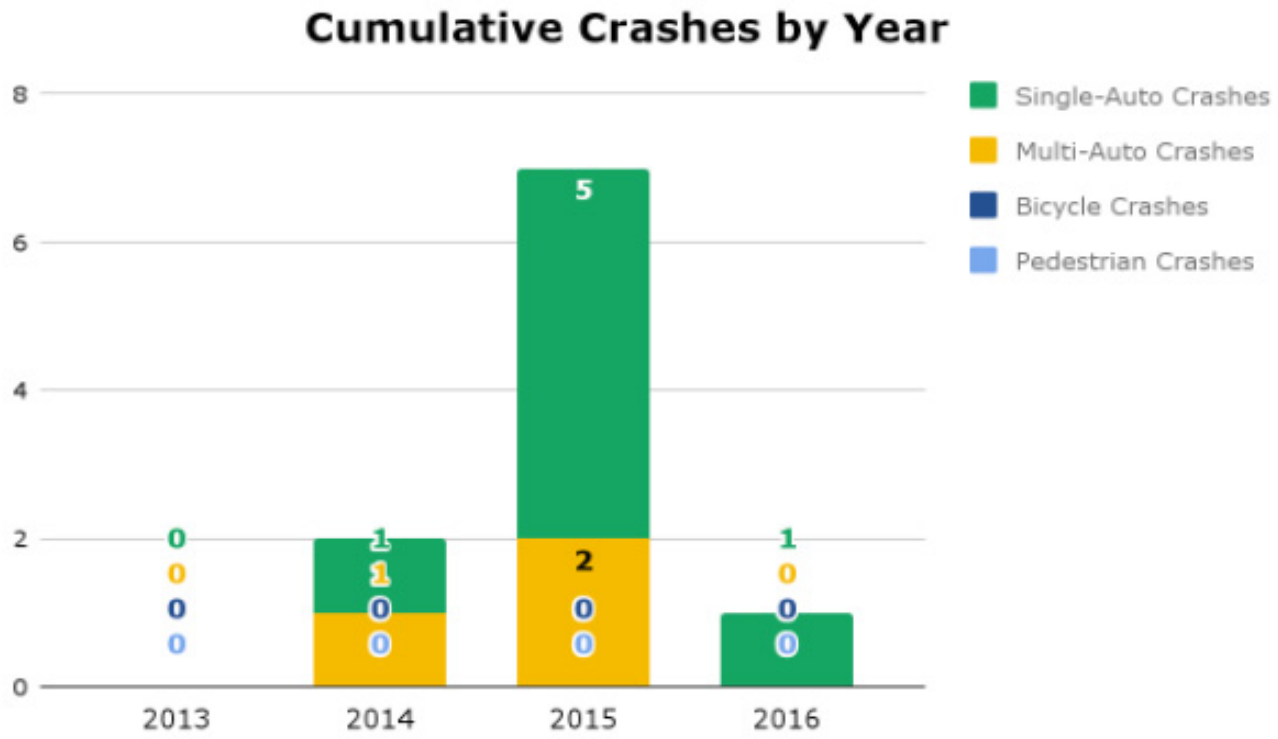
Graph 3: Cumulative Crashes by Year, City of Eudora

Graph 4 shows the cumulative crashes by year for the City of Baldwin separated by four categories: Single-Auto, Multi-Auto, Bicycle, and Pedestrian Crashes.



Graph 4: Cumulative Crashes by Year, City of Baldwin

Graph 5 shows the cumulative crashes by year for the City of Lecompton separated by four categories: Single-Auto, Multi-Auto, Bicycle, and Pedestrian Crashes.



Graph 5: Cumulative Crashes by Year, City of Lecompton

A shape, otherwise called a buffer in GIS software, was created surrounding all intersections and road segments to separate locations to be used in the hot spot analysis, see Figure 17 below. Buffers around intersections were circular to cover each directional approach while buffers around road segments were rectangular with a default length of 1/10th of a mile.

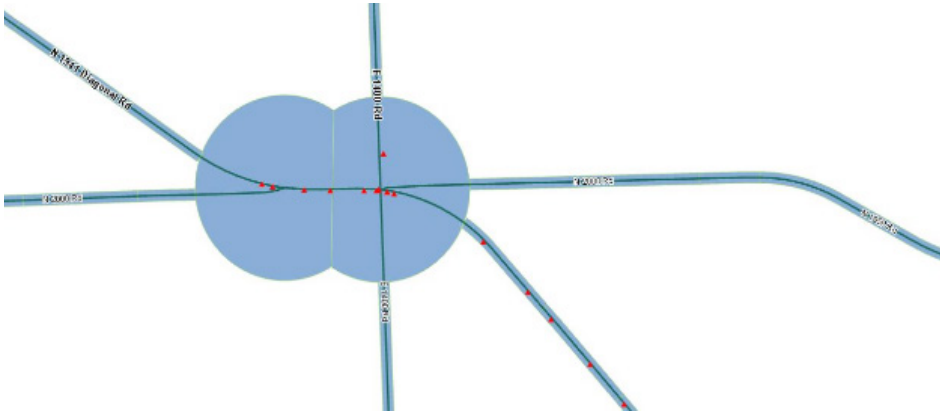


Figure 17: Illustration of Circular Intersection Buffers and Rectangular Roadway Segment Buffers

Intersection buffers were created based on the functional area of an intersection. The base assumption to accommodate the project's large quantity of crashes was that a crash is related to driving behavior at the intersection if the crash is within the functional area of the intersection. The functional area of an intersection is based on the minimal storage length of vehicles at an intersection and the stopping sight distance which depends on vehicle speed and if the location is within a central business district. By applying the distance of the functional area of an intersection within a radius, a circular buffer was created. Table 1 shows the size of intersection buffers used given the speed.

Table 1: Radii used for Intersection Buffers based on Functional Area of Intersections

Speed (mph)	Radius (ft)	Radius (ft) within Central Business District
10	130	130
15	130	130
20	165	135
25	205	165
30	250	205
35	300	250
40	355	300
45	410	-
50	475	-
55	545	-
60	620	-
65	695	-
70	780	-
75	870	-

If one intersection buffer overlapped another, the bisector between the shapes were used as the dividing line.

Since roadway segments had a different distance compared to intersection buffers, roadway segments were not directly compared to intersections. If the end of a roadway had a segment remainder less than 1/10th of a mile, then the remaining length was used as the length of the buffer. This simplified method for accounting for the remaining length had a negligible effect on this project's hot spot identification due to the proximity of adjacent intersection buffers.

Daily traffic data was supplied by the Travel Demand Model for 2016. For roadways without a known daily traffic flow, a default value of 250 vehicles per day was applied.

Five categories were used to split the buffers for comparison purposes. Each of the following categories had different associated equations found in the HSM used calculate the EEACF:

- Rural 2-Lane Road Segments
- Rural 2-Lane Intersections
- Rural Multilane Road Segments
- Rural Multilane Intersections
- Urban and Suburban Intersections

Urban road segments were excluded from the analysis since intersection buffers, which were in close proximity to each other, covered almost all of the urban area.

With the geocoded crash data, traffic data, and buffer locations set up, the next step was to analyze the locations using the EEACF.

CHAPTER 3: HOT SPOT IDENTIFICATION & PRIORITIZATION

The analysis methodology to identify GIS Hot Spots centered on using common methods for crash analysis provided by the HSM, published by AASHTO in 2010. The strategy worked towards utilizing GIS tools to perform an automated, objective-based analysis using the buffer generation tool. These buffers were assigned site specific data to be used in performance measure calculations and hot spot priority ranking.

The crash analysis formulas were modeled in GIS to run the calculations for each location based on site specific data. The GIS model performs complex queries to apply different formulas needed to calculate the hot spots. Once the model was ready, a trial run of the crash analysis was performed to calculate the EEACF. Any buffer with an EEACF greater than zero was considered to be a hot spot. In other words, a hot spot was identified when there was an expected amount of crashes greater than the predicted amount of crashes based on traffic volumes. Any hot spot locations that had recently undergone construction were not considered for further analysis because data after the project was completed would not have been sufficient to analyze. To ensure that this hot spot process is repeatable, an instructional reference guide has been created and provided to L-DC MPO staff.

With the initial trial run of the performance measures, the Steering Committee met to determine the prioritization elements for the region. Suggested prioritization elements were ranked based on severity and community priorities in other regional plans. The urban and rural results were discussed and were averaged to obtain a single value for ranking purposes. Only weighted values equal to or greater than the 50th percentile were included in the list of priority elements.

The results of the prioritization weighting is shown in Table 2 and Table 3. Based on review of GIS results, criteria were created and adjusted to apply to each hot spot location. If any of the identified criteria was applicable to a hot spot location, then a weighted relative value was applied based on a scale of 0.5 to 1.0. A value of 0.5 represented half of the relative value compared to a 1.0. Weighted relative values could be applicable for the location multiple times or only once depending on the element. For instance, a hot spot location had 1 fatal crash, was within 500 ft. of a park, and had 2 parked vehicle collisions. Therefore, the total weighted value was (1*1.0) + (1*0.8) + (2*0.5) = 2.8. Another example is a hot spot location had 2 bike crashes, had a bus stop, was within the Central Business District, and had 3 parked vehicle collisions. Therefore, the total weighted value was (1*0.9) + (1*0.7) + (1*0.7) + (3*0.5) = 3.8. Elements that could be applicable several times to a location were given a maximum value based on feedback to ensure they didn't overwhelm other crash location results. Note that adverse weather was considered to include snow, ice, or heavy precipitation during the crash event which would affect visibility of a driver.

Table 2: Urban Prioritization Ranking

Urban Elements	Weighted Value	Criteria Description
Fatal Crashes	1.0	Apply weight for each fatal crash within hot spot location
School Proximity	1.0	Apply weight for each school within 1000 ft. of hot spot location
Bicycle Crashes	0.9	Apply weight for each bike crash within hot spot location
Pedestrian Crashes	0.9	Apply weight for each pedestrian crash within hot spot location
Park Proximity	0.8	Apply weight if park within 500 ft. of hot spot location
Bike Facility Proximity	0.8	Apply weight if bike facility within hot spot location
Bus Stop Proximity	0.7	Apply weight for each bus stop within hot spot location
Central Business District Proximity	0.7	Apply weight if hot spot location is within the CBD
Lack of Traffic Signal Proximity	0.7	Apply weight if no traffic signal within hot spot location, excluding any roundabouts
KU Sporting Event Location Proximity	0.6	Apply weight if KU sporting event location within 1/2 mile of hot spot location
Parked Vehicle Crashes	0.5	Apply weight for each parked vehicle crash within hot spot location up to 2 crashes
Lack of Lighting Crashes	0.5	Apply weight for each dark and unlighted crash within hot spot location

Table 3: Rural Prioritization Ranking

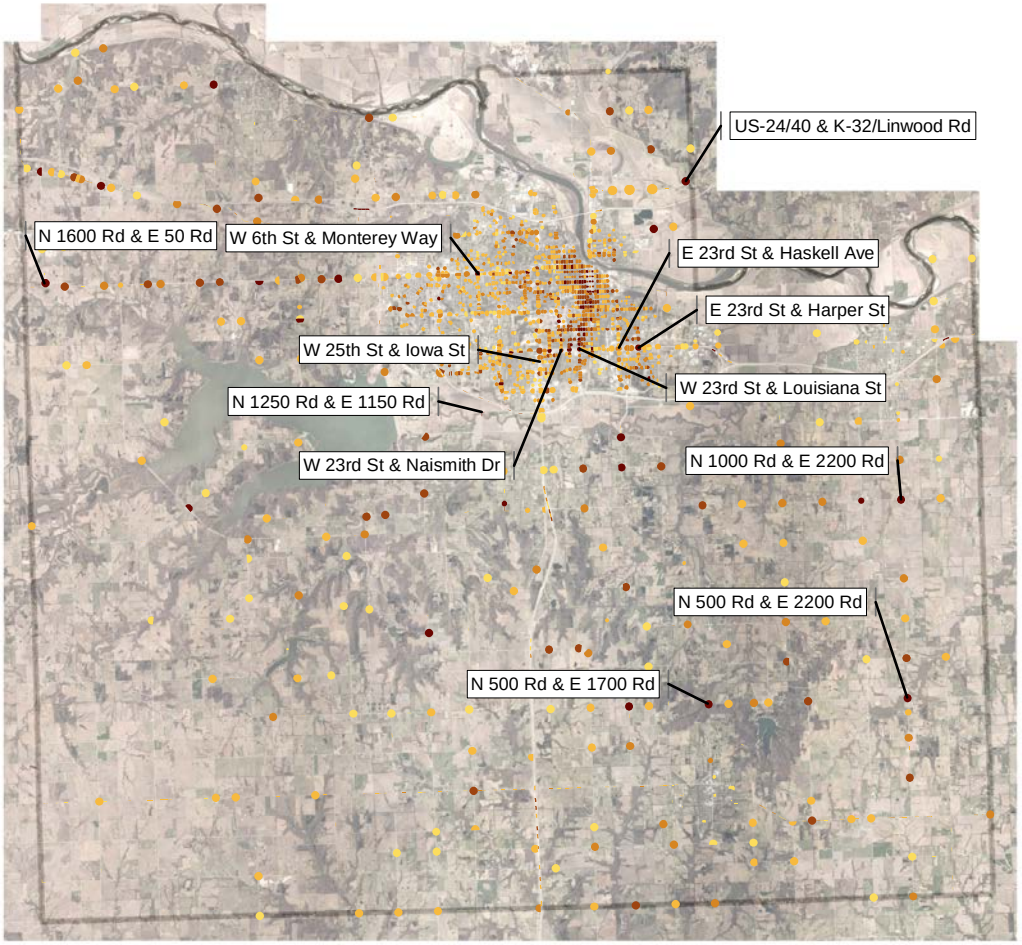
Urban Elements	Weighted Value	Criteria Description
Fatal Crashes	1.0	Apply weight for each fatal crash within hot spot location
Fixed Object Crashes	0.8	Apply weight for each fixed object crash within hot spot location
Overturning Crashes	0.8	Apply weight for each overturning crash within hot spot location
Bridges & Low Water Crossing Proximity	0.8	Apply weight for each water crossing within 500 ft. of hot spot location
Animal Collision Crashes	0.7	Apply weight for each animal collision crash within hot spot location
Adverse Weather Crashes	0.6	Apply weight for each adverse weather crash within hot spot location
Railroad Crossing Proximity	0.6	Apply weight for each railroad crossing within 500 ft. of hot spot location
Bicycle Crashes	0.5	Apply weight for each bike crash within hot spot location
Lack of Lighting Crashes	0.5	Apply weight for each dark and unlighted crash within hot spot location

These priority elements can be modified, excluded, added to, or re-ranked based on the changing regional activities or pressing concerns in future iterations of this process.

Once the individual weighted values were incorporated into the GIS model, the hot spots could be ranked using the sum total of the weighted values. For all urban intersection hot spots, the top twenty results were tabulated according to the Total Weighted Priority Ranking Value as well as the EEACF. For all rural roadway segment and intersection hot spots, the top ten results were tabulated according to the Total Weighted Priority Ranking Value as well as the EEACF. Rural results were separated and reorganized into County and State jurisdictions. Results of the ordered hot spot locations are included in the appendix.

The Steering Committee reviewed the results from the top hot spot locations and selected six urban locations and six rural locations to proceed with a roadway safety audit. Locations were chosen based on EEACF, priority rankings, capital improvement plans and budgeted projects, and the ability to incorporate additional safety improvements into projects. The number of project sites that could be analyzed in the future is subject to change depending on analysis results; however, the twelve sites for this project represents a minimum estimated number of sites needed to provide a well-rounded group of examples for the initial study.

Transportation Crash Safety Analysis - Priority Ranking of Hot Spots



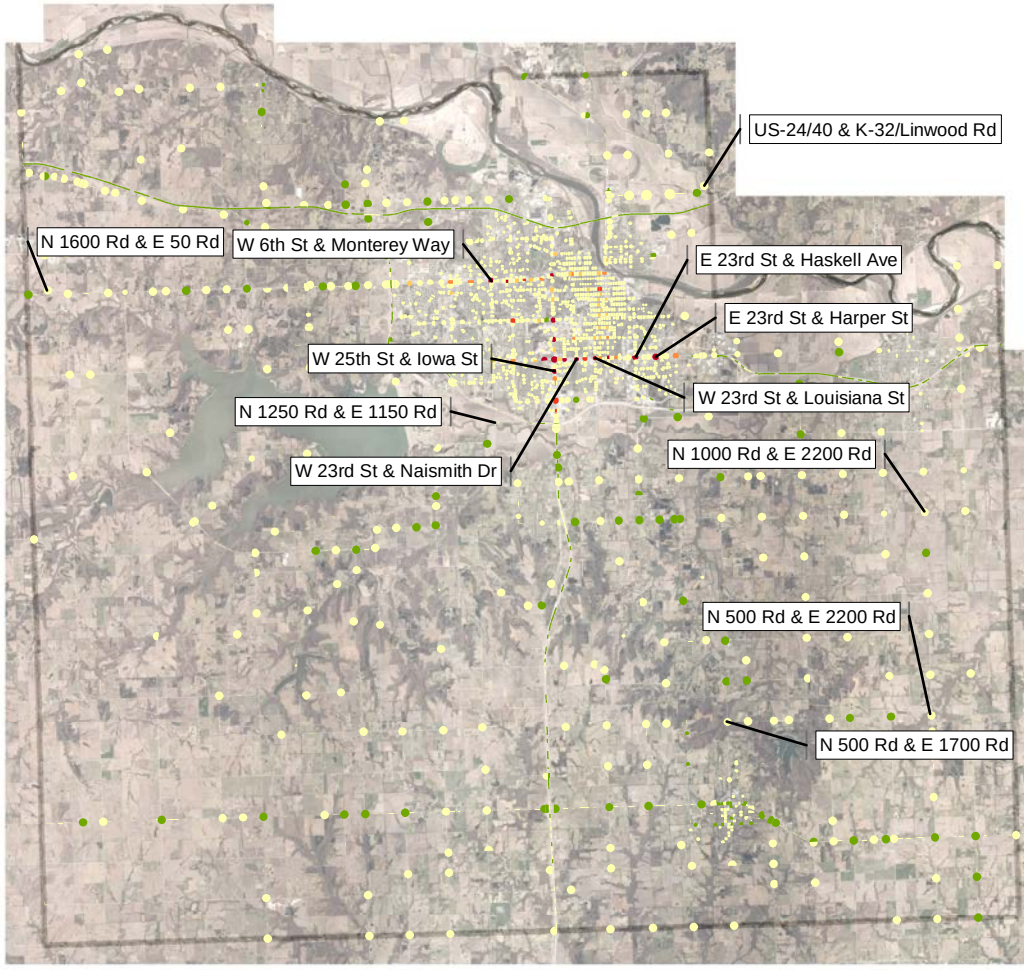
For Urban areas, ranking is based on (in order of importance):

Fatal Crashes, School Proximity, Bicycle Crashes, Pedestrian Crashes, Park Proximity, Bike Facility Proximity, Bus Stop Proximity, Central Business District Proximity, Lack of Traffic Signal Proximity, KU Sporting Event Location Proximity, Parked Vehicle Crashes, Lack of Lighting Crashes.

For Rural areas, ranking is based on (in order of importance):

Fatal Crashes, Fixed Object Crashes, Overturning Crashes, Bridges and Low Water Crossing Proximity, Animal Collision Crashes , Adverse Weather Crashes, Railroad Crossing Proximity, Bicycle Crashes, Lack of Lighting Crashes.

Douglas County Safety Analysis: Excess Expected Average Crash Frequency (EEACF)



Locations were ranked based on Excess Expected Average Crash Frequency. The value represented by EEACF was generally calculated based on annual traffic counts, number and type of crashes and other details of an intersection or roadway. A negative value means that fewer crashes occurred than what was expected for that location. A positive value indicates more than the expected number of crashes occurred for that location.

Roadway Safety Audits are a formal on-site review of issues and safety opportunities within a roadway or intersection by a team of experienced professional transportation engineers. For this project, the roadway safety audits were performed by CFS Engineers, P.A. who developed recommendations to address safety concerns taking into account right-of-way, multi-modal and ADA access, and geometric alignment. The twelve safety audits did not identify any specific educational or enforcement campaign recommendations although these methods are integrally important to transportation safety. Each visited site was evaluated using a detailed site description checklist. Countermeasures to reduce crashes were discussed based on apparent crash evidence including damaged guardrail and tire skid marks.

To conclude the safety audit, engineers discussed the site using a comprehensive checklist of all applicable crash countermeasures. The HSM provided data values about the effectiveness of certain countermeasures which are called Crash Modification Factors (CMF). If the value of a CMF is less than 1, then the effect of the countermeasure means a potential reduction in expected crashes. For instance, adding rumble strips along the shoulder of the roadway has a CMF of 0.84 and can therefore reduce crashes by 16%. The list of all applicable CMFs provided by the HSM includes the list below.

List of All Crash Countermeasures with CMF Values

Roadway Segments: Modify lane width, Add lanes by narrowing existing lanes and shoulders, Remove through lanes or use "road diets", Add or widen paved shoulder, Modify shoulder type, Provide a raised median, Change width of existing median

Roadside Elements: Flatten sideslopes, Increase distance to roadside features, Change roadside barrier along embankment to less rigid type, Install median barrier, Install crash cushion at fixed roadside features, Reduce roadside hazard rating

Roadway Signage: Install combination horizontal alignment/advisory speed signs, Install changeable crash ahead warning signs, Install changeable "Queue Ahead" warning signs, Install changeable speed warning signs
Delineation: Install post-mounted delineators (PMDs), Place standard edgeline markings, Place wide edgeline markings, Place centerline markings, Place edgeline markings and centerline markings, Install edgelines, centerlines, and PMDs, Install snowplowable, permanent raised pavement markings (RPMs)

Rumble Strips: Install continuous shoulder rumble strips, Install centerline rumble strips

Traffic Calming: Install speed humps

On-Street Parking: Prohibit on-street parking, Convert free to regulated on-street parking, Implement time-limited on-street parking restrictions, Convert angle parking to parallel parking

Lighting: Provide highway lighting

Access Management: Modify access point density

Weather: Implement faster response times for winter maintenance

Intersections: Convert four-leg intersection to two three-leg intersections, Convert signalized intersection to a modern roundabout, Convert stop-controlled intersection to a modern roundabout, Convert minor-road stop control to all-way stop control, Remove unwarranted signal on one-way streets (i.e., convert from signal to stop control on one-way street), Convert stop control to signal control

Intersection Elements: Reduce intersection skew angle, Provide a left-turn lane on approach(es) to three-leg intersections, Provide a left-turn lane on approach(es) to four-leg intersections, Provide a channelized left-turn lane at three-leg intersections, Provide a channelized left-turn lane at four-leg intersections, Provide a right-turn lane on approach(es) to an intersection, Increase intersection median width, Provide intersection lighting

Traffic Control: Prohibit left-turns and/or U-turns with "No Left Turn," "No U-Turn" signs, Provide "Stop Ahead" pavement markings, Provide flashing beacons at stop-controlled intersections, Modify left-turn phase, Replace direct left-turns with right-turn/U-turn combination, Permit right-turn on red, Modify change and clearance interval, Install red-light cameras

Interchanges: Convert intersection to grade-separated interchange, Design interchange with crossroad above freeway, Modify speed change lane design, Modify two-lane-change merge/diverge area to one-lane-change

Railroad: Install flashing lights and sound signals, Install automatic gates

Work Zone: Modify work zone duration and length

Two-Way Left-Turn Lane (TWLTL): Provide TWLTL

Passing and Climbing Lanes: Provide a passing/climbing lane or a short four-lane section

Network Traffic: Implement area-wide traffic calming, Install automated speed enforcement, Install changeable speed warning signs

There are many more crash countermeasures in the HSM that do not have CMF values available at this time since research is currently ongoing. In the future iterations of this study, more CMFs can be incorporated into the benefit-cost analysis as they become available. The crash reduction potential of each crash countermeasure can then be determined through the use of the HSM and a benefit-cost ratio could be calculated. The list of all countermeasures without CMFs includes the list below.

List of All Crash Countermeasures without CMF Values

Roadway Segments: Increase median width

Roadside Elements: Install clear roadside recovery distance, Install curbs, Increase the distance to utility poles and decrease utility pole density, Install roadside barrier along embankments

Roadway Signage: Install signs to conform to the Manual of Uniform Traffic Control Devices (MUTCD)

Delineation: Install chevron signs on horizontal curves, Provide distance markers, Place converging chevron pattern markings, Place edgeline and directional pavement markings on horizontal curves

Rumble Strips: Install continuous shoulder rumble strips and wider shoulders, Install transverse rumble strips

Traffic Calming: Install transverse rumble strips, Apply several traffic calming measures to a road segment

Pedestrians and Bicyclists: Provide a sidewalk or shoulder, Install raised pedestrian crosswalks, Install pedestrian-activated flashing yellow beacons with overhead signs and advance pavement markings, Install overhead electronic signs with pedestrian activated crosswalk flashing beacons, Reduce posted speed limit through school zones during school times, Provide pedestrian overpasses and underpasses, Mark crosswalks at uncontrolled locations, intersection or mid-block, Use alternative crosswalk devices at mid-block locations, Provide a raised median or refuge island at marked and unmarked crosswalks, Provide a raised or flush median or center two-way left-turn lane at marked and unmarked crosswalks, Install pedestrian refuge islands or split pedestrian crossovers, Widen median, Provide dedicated bicycle lanes, Provide wide curb lanes, Provide shared bus/bicycle lanes, Re-stripe roadway to provide bicycle lane, Pave highway shoulders for bicycles, Provide separate bicycle facilities

Access Management: Reduce number of median crossings and intersections

Weather: Apply preventive chemical anti-icing during the whole winter season, Install changeable fog warning signs, Install snow fences for the whole winter season, Raise the state of preparedness for winter maintenance

Intersection Elements: Provide bicycle lanes or wide curb lanes at intersections, Narrow roadway at pedestrian crossing, Install raised pedestrian crosswalk, Install raised bicycle crossing, Mark crosswalks at uncontrolled locations, intersection, or mid-block, Provide a raised median or refuge island at marked and unmarked crosswalks

Traffic Control: Place transverse markings on roundabout approaches, Install pedestrian signal heads at signalized intersections, Modify pedestrian signal heads, Install pedestrian countdown signals, Install automated pedestrian detectors, Install stop lines and other crosswalk enhancements, Provide exclusive pedestrian signal timing pattern, Provide leading pedestrian interval signal timing pattern, provide actuated control, Operate signals in "night-flash" mode, Provide advance static warning signs and beacons, Provide advance warning flashers and warning beacons, Provide advance overhead guide signs, Install additional pedestrian signs, Modify pavement color for bicycle crossings, Place "slalom" profiled pavement markings at bicycle lanes, Install rumble strips on intersection approaches

Interchanges: Redesign interchange to modify interchange configuration, Modify interchange spacing, Modify ramp type or configuration, Provide right-hand exit and entrance ramps, Increase horizontal curve radius of ramp roadway, Increase lane width of ramp roadway, Increase length of weaving areas between adjacent entrance and exit ramps, Redesign interchange to provide collector-distributor roads, Provide bicycle facilities at interchange ramp terminals, Provide pedestrian facilities on ramp terminals

Railroad: Install crossbucks, Install vehicle-activated strobe light and supplemental signs, Install four-quadrant automatic gates, Install four-quadrant flashing light signals, Install pre-signals, Provide constant warning time devices

Work Zone: Use crossover closure or single lane closure, Use Indiana Lane Merge System (ILMS)

Network Planning: Apply elements of self-explaining roadway design, Apply elements of Transportation Safety Planning in transportation network design

Network Traffic: Convert two-way streets to one-way streets, Convert one-way streets to two-lane, two-way streets, Modify the level of access control on transportation network

Road-Use Culture Network: Deploy mobile patrol vehicles, Deploy stationary patrol vehicles, Deploy aerial enforcement, Deploy radar and laser speed monitoring equipment, Install drone radar, Modify posted speed limit, Conduct enforcement to reduce red-light running, Conduct enforcement to reduce impaired driving, Conduct enforcement to increase seat belt and helmet use, Implement network-wide engineering consistency, Mitigate aggressive driving through engineering, Conduct public education campaigns, Implement young drivers and graduated driver licensing programs, Implement older driver education and retesting programs

In the urban setting, the monetary benefits of the countermeasures recommended by the safety audit results could not be calculated because the CMFs for the applicable urban countermeasures are still undergoing testing and review. Cost estimates for implementing the countermeasures are still provided by this report to apply for funding the projects. As CMFs become available in the future, the monetary benefits can be incorporated into this process further showing the advantage of implementing the safety audit recommendations.

Table 4: Rural Safety Audit Locations

#	Location:	Total Crashes Over 4 Yrs	Total Pedestrian Crashes Over 4 Yrs	Total Bike Crashes Over 4 Yrs	Average Crash Frequency (ACF)	Excess Expected Average Crash Frequency (EEACF)
1	N1000 Rd & E 2200 Rd	10	0	0	2.5	0.437
2	N 500 Rd & E 2200 Rd	12	0	0	3.0	1.390
3	N 500 Rd & E 1700 Rd	7	0	0	1.75	0.606
4	N 1250 Rd & E 1150 Rd	9	0	0	2.0	0.771
5	N 1600 Rd & E 50 Rd	7	0	0	1.75	0.752
6	US-24/40 & K-32/Linwood Rd	12	0	0	3.0	0.708

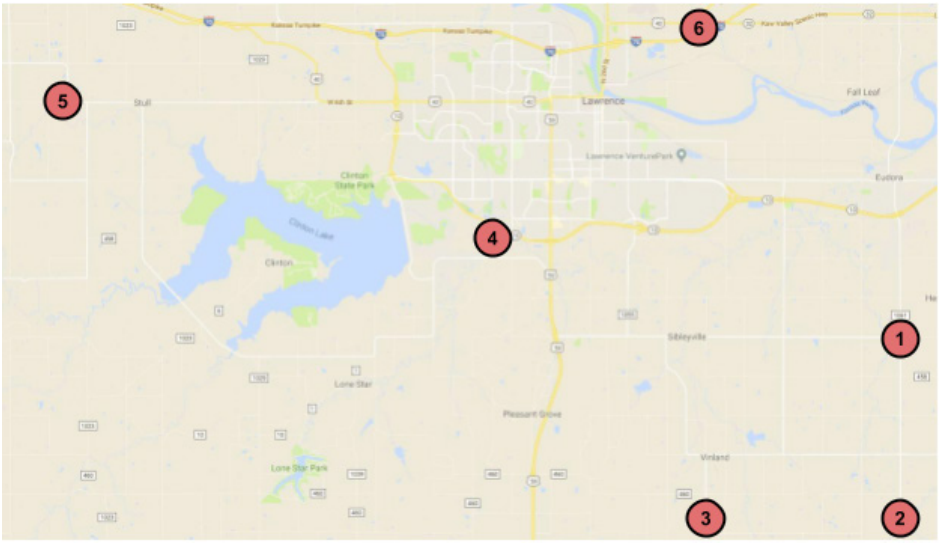


Figure 18: Rural Safety Audit Locations

N 1000 Rd & 2200 Rd | 1 of 6 Rural

Figure 19: Overhead View of N 1000 Rd & E 2200 Rd

Location: N 1000 Rd & E 2200 Rd, 1 of 6 Rural Locations
Date of Audit: November 8, 2017
Weather: Fair, Sunny

Major Road, Speed Limit: E 2200 Rd, 55 mph
Minor Road, Speed Limit: N 1000 Rd, 55 mph
Pavement Surface Type: Asphalt, East Leg is Gravel
Pavement Surface Condition: Good
Shoulder Surface Type: Gravel
Shoulder Surface Condition: Poor, Damaged, Non-recoverable Rutting
Curb Condition: N/A
Sidewalk Condition: N/A
Crosswalks: N/A
Roadside Conditions: North Leg on West Side is Non-recoverable
Adjacent Roadway Feature: N/A
Special Roadway Use: Agricultural

Non-ADA Sidewalk Ramps: N/A
Traffic Signal: No
Intersection Approach without Vehicle Detection: N/A
Intersection Approach without Emergency Vehicle Detection: N/A
Sight Distance: Acceptable
Intersection Lighting: None
Drainage: Good
Driveways within Stopping Distance of Intersection: 0

Signage: No Intersection Warning Signs on North and South Legs
Pavement Markings: No Stop Bar for East and West Leg
Bike Markings: N/A
Damage: None
Tire Marks: None

Street Classification: N 1000 Rd is a principal arterial on the west leg of the intersection. N 1000 Rd on the west leg is also Douglas County Route 458 and then Route 458 heads south to N 900 Rd before continuing east-west. N 1000 Rd on the east leg is a township road that is not maintained with county maintenance funding. E 2200 Rd is a principal arterial and is also Douglas County Route 1061.

Site Observations: During the safety audit, it was noted that the north-south lanes of E 2200 Rd had been recently overlayed accompanied with new pavement markings for the centerline and edge lines. N 1000 Rd to the east was gravel surface and approximately ten vehicles were observed using this roadway during the 45 minutes the safety team spent at the site which was more than expected

considering the gravel surface. The slopes of the roadside ditches along the western sides of E 2200 Rd on both the north and south approaches were not recoverable. The field on the northeast corner was fenced, and the other three corners were open fields with crop land. Overhead power lines ran along the eastern side of E 2200 Rd, and along the northern side of N 1000 Rd. The grade approaches from all legs of the intersection were relatively level with good site distance in all directions.

Fatal Crashes: 0
Fixed Object Crashes: 5
Overturning Crashes: 0
Animal Crashes: 3
Adverse Weather Crashes: 0

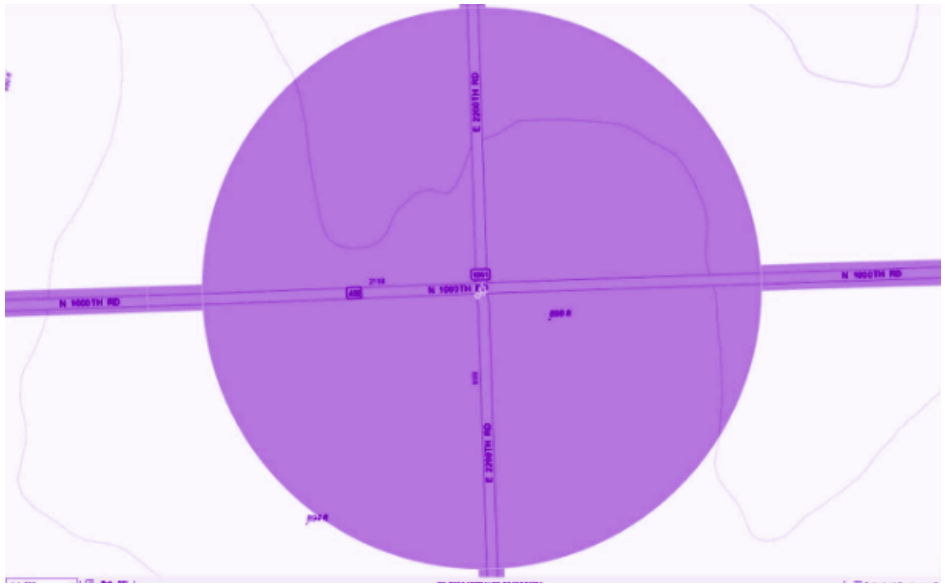


Figure 20: Buffer Area and Crash Spot Locations at N 1000 Rd & E 2200 Rd

Countermeasures: Improvements include paving the east leg with asphalt to provide better traction for stopping vehicles, widening the shoulder and adding shoulder rumble strips to north and south legs, re-grading applicable steep sideslopes, adding an overhead light, adding stop bars and white edgelines to the east and west legs, installing intersection ahead warning signs to north and south legs, and adding an illuminated stop sign to the west leg. The cost of implementation is estimated at $56,136 with a potential crash reduction benefit equivalent to $76,205. The benefit : cost ratio is therefore 1.4 : 1.

Summary Table

1. Rural Location: N 1000 Road & E 2200 Road

Crash Countermeasure	Percent Crash Reduction	Benefit	Cost	Benefit : Cost Ratio
Pave East-Leg Gravel Approach w/ Asphalt (100’ x 25’)	Unknown	Unknown	$12,500.00	Unknown
Add 2’ Wide Shoulder	20%	$16,712.00	$5,700.00	2.9 : 1
Add Shoulder Rumble Strips, North and South Legs	16%	$13,369.00	$8,208.00	1.6 : 1
Re-Grade Applicable Steep Sideslopes	12%	$10,027.00	$19,000.00	0.5 : 1
Add Overhead Light	38%	$31,752.00	$5,700.00	5.6 : 1
Add Stop Bars to East & West Legs	Unknown	Unknown	$288.00	Unknown
Add Solid White Edge Lines to East Leg	Unknown	Unknown	$240.00	Unknown
Add Intersection Ahead Warning Signs to North & South Legs	Unknown	Unknown	$1,000.00	Unknown
Add Illuminated Stop Sign to West Leg	13%	$4,345.00	$3,500.00	1.2 : 1
	Total	$76,205.00	$56,136.00	1.4 : 1

Intersection N 1000 Road & E 2200 Road

01 – Rural	Major Road AADT	3818	VPD
	Posted Speed Limit	55	MPH
	SSD-Sight-Stopping Distance (Posted)	495	ft
	85th Percentile Driving Speed	60	MPH
	SSD-Sight-Stopping Distance (85th %)	570	ft

From Jan 2013 to Dec 2016,

Fatal Crashes	
Injury Crashes	2
Multi-Vehicle, Side Impact Crash	1
Multi-Vehicle, Rear End Crash	1
Bicycle Involved Crashes	
Pedestrian Involved Crashes	
Parked Vehicle Involved Crashes	
Fixed Object Crashes	5
Over Turned Vehicle Crashes	
Animal Involved Crashes	3
Total Crashes	12
Darkness Factor	5
Weather Factor	

Recommended Safety Treatment Improvements

Pave East-Leg Gravel Approach w/ Asphalt (100' x 25')	277.8	SY @	$45.00	$12,500.00
Add 2' Wide Shoulder	126.7	SY @	$45.00	$5,700.00
Add Shoulder Rumble Strips, North and South Legs	2280.0	LF @	$3.60	$8,208.00
Re-Grade Applicable Steep Sideslopes	1266.7	CY @	$15.00	$19,000.00
Add Overhead Light	1	EA @	$5,700.00	$5,700.00
Add Stop Bars to East & West Legs	24	LF @	$12.00	$288.00
Add Solid White Edge Lines to East Leg	200.0	LF @	$1.20	$240.00
Add Intersection Ahead Warning Signs to North & South Legs	2	EA @	$500.00	$1,000.00
Add Illuminated Stop Signs to West Leg	1	EA @	$3,500.00	$3,500.00
Total Monetary Cost of Safety Improvements				$56,136.00

Safety Improvement Remedy		Existing Conditions CMF	Proposed Remedy CMF	Difference	Percent Crash Reduction	Applicable Crashes	Reduced Number of Total Crashes	Reduced Number of Injury Crashes	Injury Crash Cost	Reduced Number of PDO Crashes	PDO Crash Cost	
Add or Widen Paved Shoulder		1.5	1.3	0.2	20%	5	1.00	0.17	$13,898	0.83	$2,813	CMF for Shoulder Width on Rural Two-Lane Roadway Segments (Table 13-7, pg 13-11)
Flatten Sideslopes		1	0.88	0.12	12%	5	0.60	0.10	$8,339	0.50	$1,688	Potential Crash Effects on Total Crashes of Flattening Sideslopes (Table 13-18, pg 13-20)
Install Combination Horizontal Alignment/Advisory Speed Signs		1	0.87	0.13	13%		0.00	0.00	$0	0.00	$0	Potential Crash Effects of Installing Combination Horizontal Alignment/Advisory Speed Signs (Table 13-30, pg 13-30)
Install Continuous Shoulder Rumble Strips		1	0.84	0.16	16%	5	0.80	0.13	$11,119	0.67	$2,251	Potential Crash Effects of Installing Continuous Shoulder Rumble Strips on Multilane Highways (Table 13-44, pg 13-38)
Install Centerline Rumble Strips		1	0.86	0.14	14%		0.00	0.00	$0	0.00	$0	Potential Crash Effects of Installing Centerline Rumble Strips on Multilane Highways (Table 13-46, pg 13-40)
Provide Intersection Lighting		1	0.62	0.38	38%	5	1.90	0.32	$26,407	1.58	$5,345	Potential Crash Effects of Providing Intersection Illumination (Table 14-18, pg 14-29)
Provide Flashing Beacons at Stop-Controlled Intersections		1	0.87	0.13	13%	2	0.26	0.04	$3,614	0.22	$731	Potential Crash Effects of Providing Flashing Beacons at Stop-Controlled, Four-Leg Intersections on Two-Lane Roads (Table 14-22, pg 14-34)
							4.56	0.76	$63,376	3.80	$12,829	Total Crashes
							0					Fatal Crashes
							0.76					Injury Crashes
							3.80					PDO – Property Damage Only Crashes

Comprehensive Crash Costs (2017)	Cost per Incident
Fatal Crash	$4,965,624
Disabling Injury Crash	$4,169,090
Evident Injury Crash	$83,390
Possible Injury Crash	$43,912
PDO-Property Damage Only Crash	$3,376

Reduced Number of Total Crashes	4.56		
Reduced Number of Fatal Crashes	0	$0	
Reduced Number of Injury Crashes	0.76	$63,376	(Rounded)
Reduced Number of PDO Crashes	3.80	$12,829	(Rounded)
Total Monetary Benefit of Safety Improvements		$76,205	

N 500 Rd & E 2200 Rd | 2 of 6 Rural

Figure 21: Overhead View of N 500 Rd & E 2200 Rd

Location: N 500 Rd & E 2200 Rd, 2 of 6 Rural Locations
Date of Audit: November 8, 2017
Weather: Fair, Sunny

Major Road, Speed Limit: E 2200 Rd, 45 mph
Minor Road, Speed Limit: N 500 Rd, 30 mph
Pavement Surface Type: Asphalt, East Leg is Gravel
Pavement Surface Condition: Good
Shoulder Surface Type: Gravel
Shoulder Surface Condition: Poor, Damaged, Non-recoverable Rutting
Curb Condition: N/A
Sidewalk Condition: N/A
Pavement Markings: No Stop Bar for East and West Leg No Break in Centerline Through Intersection
Bike Markings: N/A
Crosswalks: N/A
Roadside Conditions: Non-recoverable in Areas, Large Drop Off at Culvert

Non-ADA Sidewalk Ramps: N/A
Traffic Signal: No
Intersection Approach without Vehicle Detection: N/A
Intersection Approach without Emergency Vehicle Detection: N/A
Sight Distance: Vegetation Restricting View
Intersection Lighting: None
Drainage: Good
Driveways within Stopping Distance of Intersection: 1

Signage: No Intersection Warning Signs on North and South Legs, Add Object Markers at Culvert Drop Off

Adjacent Roadway Feature: Wildlife Crossing Sign In Place for Area
Special Roadway Use: Agricultural

Damage: None
Tire Marks: None

Street Classification: N 500 Rd on the east leg is a local road that currently serves four properties. E 2200 Rd is a principal arterial and is also Douglas County Route 1061.

Site Observations: During the safety evaluation field inspection of the intersection, it was noted that the north and south legs of E 2200 Rd had been recently overlayed with new pavement and pavement markings for the centerline and edge lines. N 500 Rd to the east was gravel surface. The slopes of the roadside ditches along both the east and west sides of E 2200 Rd on both the north and

south approaches were not recoverable. The field on the northeast corner was fenced, the southeast corner was an private residential property, and the western side of the road was open field with a large, well-wooded creek meandering between 50 to 200 ft. away from E 2200 Rd. Deer tracks were readily observed along the southern side of N 500 Rd. Overhead power lines ran along the eastern side of E 2200 Rd, and along the northern side of N 500 Rd. There was a hill crest on E 2200 Rd to the south of the intersection which limited long-distance visibility of the intersection. Some wheel-ruts from errant vehicles leaving the roadway were observed on both sides of E 2200 Rd.

Fatal Crashes: 0
Fixed Object Crashes: 4
Overturning Crashes: 1
Animal Crashes: 3
Adverse Weather Crashes: 0

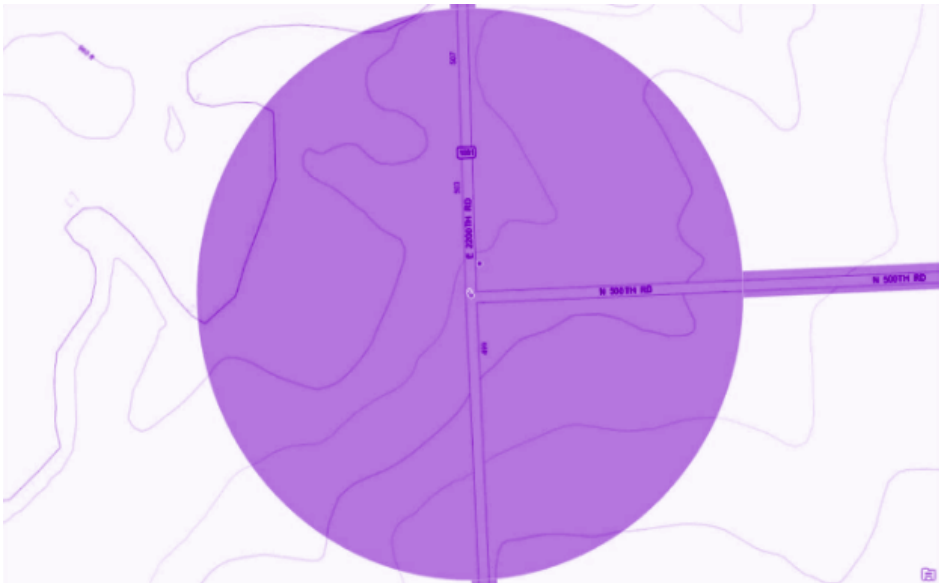


Figure 22: Buffer Area and Crash Spot Locations at N 500 Rd & E 2200 Rd

Countermeasures: Improvements include paving the east leg with asphalt to provide better traction for stopping vehicles, widening the shoulder and adding shoulder rumble strips to north and south legs, re-grading applicable steep sideslopes, adding an overhead light, adding a stop bar and white edgelines to the east leg, installation of object markers for the culvert drop-off, clearing overgrown vegetation, installing intersection ahead warning signs to north and south legs, and adding an illuminated stop sign to the east leg. The cost of implementation is estimated at $49,570.67 with a potential crash reduction benefit equivalent to $59,827. The benefit : cost ratio is therefore 1.2 : 1.

Summary Table

2. Rural Location: N 500 Road & E 2200 Road

Crash Countermeasure	Percent Crash Reduction	Benefit	Cost	Benefit : Cost Ratio
Pave East-Leg Gravel Approach w/ Asphalt (100' x 25')	Unknown	Unknown	$12,500.00	Unknown
Add 2' Wide Shoulder	20%	$13,369.00	$4,250.00	3.1 : 1
Add Shoulder Rumble Strips, North and South Legs	16%	$10,695.00	$6,120.00	1.7 : 1
Re-Grade Applicable Steep Sideslopes	12%	$8,022.00	$14,166.67	0.6 : 1
Add Overhead Light	38%	$19,051.00	$5,700.00	3.3 : 1
Add Stop Bar to East Leg	Unknown	Unknown	$144.00	Unknown
Add Solid White Edge Lines to East Leg	Unknown	Unknown	$240.00	Unknown
Add Object Markers	Unknown	Unknown	$1,200.00	Unknown
Clear Overgrown Trees and Vegetation	Unknown	Unknown	$750.00	Unknown
Add Intersection Ahead Warning Signs to North & South Legs	Unknown	Unknown	$1,000.00	Unknown
Add Illuminated Stop Sign to East Leg	13%	$8,690.00	$3,500.00	2.5 : 1
	Total	$59,827.00	$49,570.67	1.2 : 1

Intersection N 500 Road & E 2200 Road
02 – Rural

Major Road AADT	3188	VPD
Posted Speed Limit	45	MPH
SSD-Sight-Stopping Distance (Posted)	360	ft
85th Percentile Driving Speed	50	MPH
SSD-Sight-Stopping Distance (85th %)	425	ft

From Jan 2013 to Dec 2016,

Fatal Crashes	
Injury Crashes	2
Multi-Vehicle, Side Impact Crash	3
Multi-Vehicle, Rear End Crash	1
Bicycle Involved Crashes	
Pedestrian Involved Crashes	
Parked Vehicle Involved Crashes	
Fixed Object Crashes	4
Over Turned Vehicle Crashes	1
Animal Involved Crashes	3
Total Crashes	12
Darkness Factor	3
Weather Factor	

Recommended Safety Treatment Improvements

Pave East-Leg Gravel Approach w/ Asphalt (100' x 25')	277.8	SY @	$45.00	$12,500.00
Add 2' Wide Shoulder	94.4	SY @	$45.00	$4,250.00
Add Shoulder Rumble Strips, North and South of Intersection	1700.0	LF @	$3.60	$6,120.00
Re-Grade Applicable Steep Sideslopes	944.4	CY @	$15.00	$14,166.67
Add Overhead Light	1	EA @	$5,700.00	$5,700.00
Add Stop Bar to East Leg	12	LF @	$12.00	$144.00
Add Solid White Edge Lines to East Leg	200.0	LF @	$1.20	$240.00
Add Object Markers	1	LS @	$1,200.00	$1,200.00
Clear Overgrown Trees and Vegetation	1	LS @	$750.00	$750.00
Add Intersection Ahead Warning Signs to North & South Legs	2	EA @	$500.00	$1,000.00
Add Illuminated Stop Sign to East Leg	1	EA @	$3,500.00	$3,500.00
Total Monetary Cost of Safety Improvements				$49,570.67

Safety Improvement Remedy		Existing Conditions CMF	Proposed Remedy CMF	Difference	Percent Crash Reduction	Applicable Crashes	Reduced Number of Total Crashes	Reduced Number of Injury Crashes	Injury Crash Cost	Reduced Number of PDO Crashes	PDO Crash Cost	
Add or Widen Paved Shoulder		1.5	1.3	0.2	20%	4	0.80	0.13	$11,119	0.67	$2,251	CMF for Shoulder Width on Rural Two-Lane Roadway Segments (Table 13-7, pg 13-11)
Flatten Sideslopes		1	0.88	0.12	12%	4	0.48	0.08	$6,671	0.40	$1,350	Potential Crash Effects on Total Crashes of Flattening Sideslopes (Table 13-18, pg 13-20)
Install Combination Horizontal Alignment/Advisory Speed Signs		1	0.87	0.13	13%		0.00	0.00	$0	0.00	$0	Potential Crash Effects of Installing Combination Horizontal Alignment/Advisory Speed Signs (Table 13-30, pg 13-30)
Install Continuous Shoulder Rumble Strips		1	0.84	0.16	16%	4	0.64	0.11	$8,895	0.53	$1,801	Potential Crash Effects of Installing Continuous Shoulder Rumble Strips on Multilane Highways (Table 13-44, pg 13-38)
Install Centerline Rumble Strips		1	0.86	0.14	14%		0.00	0.00	$0	0.00	$0	Potential Crash Effects of Installing Centerline Rumble Strips on Multilane Highways (Table 13-46, pg 13-40)
Provide Intersection Lighting		1	0.62	0.38	38%	3	1.14	0.19	$15,844	0.95	$3,207	Potential Crash Effects of Providing Intersection Illumination (Table 14-18, pg 14-29)
Provide Flashing Beacons at Stop-Controlled Intersections		1	0.87	0.13	13%	4	0.52	0.09	$7,227	0.43	$1,463	Potential Crash Effects of Providing Flashing Beacons at Stop-Controlled, Four-Leg Intersections on Two-Lane Roads (Table 14-22, pg 14-34)
							3.58	0.60	$49,756	2.98	$10,072	Total Crashes

Comprehensive Crash Costs (2017)	Cost per Incident		
Fatal Crash	$4,965,624	0	Fatal Crashes
Disabling Injury Crash	$4,169,090	0.60	Injury Crashes
Evident Injury Crash	$83,390	2.98	PDO – Property Damage Only Crashes
Possible Injury Crash	$43,912		
PDO-Property Damage Only Crash	$3,376		

Total Crashes	3.58		
Fatal Crashes	0	$0	
Injury Crashes	0.60	$49,756	(Rounded)
PDO – Property Damage Only Crashes	2.98	$10,072	(Rounded)
Total Monetary Benefit of Safety Improvements		$59,827	

N 500 Rd & E 1700 Rd | 3 of 6 Rural

Figure 23: Overhead View of N 500 Rd & E 1700 Rd

Location: N 500 Rd & E 1700 Rd, 3 of 6 Rural Locations
Date of Audit: November 8, 2017
Weather: Fair, Sunny

Major Road, Speed Limit: E 1700 Rd, 55 mph
Minor Road, Speed Limit: N 500 Rd, 30 mph
Pavement Surface Type: Asphalt, East Leg is Gravel
Pavement Surface Condition: Good
Shoulder Surface Type: Asphalt
Shoulder Surface Condition: Good, Non-recoverable Rutting on South Leg
Curb Condition: N/A
Sidewalk Condition: N/A
Pavement Markings: No Stop Bar for East Leg
Bike Markings: N/A
Crosswalks: N/A

Roadside Conditions: Non-recoverable in Areas, Large Drop Off at Culvert

Non-ADA Sidewalk Ramps: N/A
Traffic Signal: No
Intersection Approach without Vehicle Detection: N/A
Intersection Approach without Emergency Vehicle Detection: N/A
Sight Distance: Vegetation Restricting Partial View
Intersection Lighting: None
Drainage: Good
Driveways within Stopping Distance of Intersection: 1

Signage: No Intersection Warning Signs on North and South Legs, Add Object Markers at Culvert Drop Off

Adjacent Roadway Feature: N/A
Special Roadway Use: Agricultural

Damage: None
Tire Marks: Yes and Skidding Grooves in Gravel

Street Classification: N 500 Rd on the east leg is a rural minor collector road that currently provides access to the Rice Woodland Kansas Ecological Reserves for the University of Kansas. E 1700 Rd is a principal arterial and is also Douglas County Route 1055.

Site Observations: Both sides of E 1700 Rd appear to be heavily wooded with a large creek flowing along the western side of the road and crossing at a bridge north of the intersection. There was a single-family private residential property on the northeast corner. The Rice Woodland Ecological Reserve was on the southeast corner. With the heavily wooded areas on both sides of E 1700 Rd,

long distance sight distance was inhibited. The northern approach of E 1700 Rd has widened paved shoulders on both sides that taper and at the south leg of the intersection. N 500 Rd is a gravel surface with an ascending slope for vehicles towards the intersection. During the field inspection, it was noted that about five lawn care trucks pulling equipment trailers were observed on N 500 Rd. There were overhead power lines along the western side of E 1700 Rd and along the south side of N 500 Rd.

Fatal Crashes: 0
Fixed Object Crashes: 2
Overturning Crashes: 0
Animal Crashes: 3
Adverse Weather Crashes: 1

Figure 24: Buffer Area and Crash Spot Locations at N 500 Rd & E 1700 Rd

Countermeasures: Improvements include paving the east leg with asphalt to provide better traction for stopping vehicles, widening the shoulder and adding shoulder rumble strips to north and south legs, re-grading applicable steep sideslopes, adding an overhead light, adding a stop bar and white edgelines to the east legs, installing intersection ahead warning signs to north and south legs, and adding an illuminated stop sign to the east leg. The cost of implementation is estimated at $66,037.33 with a potential crash reduction benefit equivalent to $71,890. The benefit : cost ratio is therefore 1.1 : 1.

Summary Table

3. Rural Location: N 500 Road & E 1700 Road

Crash Countermeasure	Percent Crash Reduction	Benefit	Cost	Benefit : Cost Ratio
Pave East-Leg Gravel Approach w/ Asphalt (100’ x 25')	Unknown	Unknown	$12,500.00	Unknown
Add 2’ Wide Shoulder	20%	$10,495.00	$8,500.00	1.2 : 1
Add Shoulder Rumble Strips, North and South Legs	16%	$8,396.00	$6,120.00	1.4 : 1
Re-Grade Applicable Steep Sideslopes	12%	$6,297.00	$28,333.33	0.2 : 1
Add Overhead Light	38%	$39,880.00	$5,700.00	7.0 : 1
Add Stop Bar to East Leg	Unknown	Unknown	$144.00	Unknown
Add Solid White Edge Lines to East Leg	Unknown	Unknown	$240.00	Unknown
Add Intersection Ahead Warning Signs to North & South Legs	Unknown	Unknown	$1,000.00	Unknown
Add Illuminated Stop Sign to East Leg	13%	$6,822.00	$3,500.00	1.9 : 1
	Total	$71,890.00	$66,037.33	1.1 : 1

Intersection N 500 Road & E 1700 Road
03 – Rural

Major Road AADT	2326	VPD
Posted Speed Limit	45	MPH
SSD-Sight-Stopping Distance (Posted)	360	ft
85th Percentile Driving Speed	50	MPH
SSD-Sight-Stopping Distance (85th %)	425	ft

From Jan 2013 to Dec 2016,

Fatal Crashes	
Injury Crashes	2
Multi-Vehicle, Side Impact Crash	1
Multi-Vehicle, Rear End Crash	1
Bicycle Involved Crashes	
Pedestrian Involved Crashes	
Parked Vehicle Involved Crashes	
Fixed Object Crashes	2
Over Turned Vehicle Crashes	
Animal Involved Crashes	3
Total Crashes	7
Darkness Factor	4
Weather Factor	

Recommended Safety Treatment Improvements

Pave East-Leg Gravel Approach w/ Asphalt (100' x 25')	277.8	SY @	$45.00	$12,500.00
Add 2' Wide Shoulder	188.9	SY @	$45.00	$8,500.00
Add Shoulder Rumble Strips, North and South Legs	1700.0	LF @	$3.60	$6,120.00
Re-Grade Applicable Steep Sideslopes	1888.9	CY @	$15.00	$28,333.33
Add Overhead Light	1	EA @	$5,700.00	$5,700.00
Add Stop Bar to East Leg	12	LF @	$12.00	$144.00
Add Solid White Edge Lines to East Leg	200.0	LF @	$1.20	$240.00
Add Intersection Ahead Warning Signs to North & South Legs	2	EA @	$500.00	$1,000.00
Add Illuminated Stop Sign to East Leg	1	EA @	$3,500.00	$3,500.00
Total Monetary Cost of Safety Improvements				$66,037.33

Safety Improvement Remedy		Existing Conditions CMF	Proposed Remedy CMF	Difference	Percent Crash Reduction	Applicable Crashes	Reduced Number of Total Crashes	Reduced Number of Injury Crashes	Injury Crash Cost	Reduced Number of PDO Crashes	PDO Crash Cost	
Add or Widen Paved Shoulder		1.5	1.3	0.2	20%	2	0.40	0.11	$9,530	0.29	$965	CMF for Shoulder Width on Rural Two-Lane Roadway Segments (Table 13-7, pg 13-11)
Flatten Sideslopes		1	0.88	0.12	12%	2	0.24	0.07	$5,718	0.17	$579	Potential Crash Effects on Total Crashes of Flattening Sideslopes (Table 13-18, pg 13-20)
Install Combination Horizontal Alignment/Advisory Speed Signs		1	0.87	0.13	13%		0.00	0.00	$0	0.00	$0	Potential Crash Effects of Installing Combination Horizontal Alignment/Advisory Speed Signs (Table 13-30, pg 13-30)
Install Continuous Shoulder Rumble Strips		1	0.84	0.16	16%	2	0.32	0.09	$7,624	0.23	$772	Potential Crash Effects of Installing Continuous Shoulder Rumble Strips on Multilane Highways (Table 13-44, pg 13-38)
Install Centerline Rumble Strips		1	0.86	0.14	14%		0.00	0.00	$0	0.00	$0	Potential Crash Effects of Installing Centerline Rumble Strips on Multilane Highways (Table 13-46, pg 13-40)
Provide Intersection Lighting		1	0.62	0.38	38%	4	1.52	0.43	$36,215	1.09	$3,665	Potential Crash Effects of Providing Intersection Illumination (Table 14-18, pg 14-29)
Provide Flashing Beacons at Stop-Controlled Intersections		1	0.87	0.13	13%	2	0.26	0.07	$6,195	0.19	$627	Potential Crash Effects of Providing Flashing Beacons at Stop-Controlled, Four-Leg Intersections on Two-Lane Roads (Table 14-22, pg 14-34)
							2.74	0.78	$65,282	1.96	$6,607	Total Crashes
							0					Fatal Crashes
							0.78					Injury Crashes
							1.96					PDO – Property Damage Only Crashes

Comprehensive Crash Costs (2017)	Cost per Incident
Fatal Crash	$4,965,624
Disabling Injury Crash	$4,169,090
Evident Injury Crash	$83,390
Possible Injury Crash	$43,912
PDO-Property Damage Only Crash	$3,376

Total Crashes	2.74		
Fatal Crashes	0	$0	
Injury Crashes	0.78	$65,282	(Rounded)
PDO – Property Damage Only Crashes	1.96	$6,607	(Rounded)
Total Monetary Benefit of Safety Improvements		$71,890	

N 1250 Rd & E 1150 Rd | 4 of 6 Rural

Figure 25: Overhead View of N 1250 Rd & E 1150 Rd

Location: N 1250 Rd & E 1150 Rd, 4 of 6 Rural Locations
Date of Audit: November 8, 2017
Weather: Fair, Sunny

Major Road, Speed Limit: N 1250 Rd, 30 mph
Minor Road, Speed Limit: E 1150 Rd, 30 mph
Pavement Surface Type: Asphalt, Bridge Deck is Concrete
Pavement Surface Condition: Good Except Cracking at Transition to Bridge
Shoulder Surface Type: Gravel
Shoulder Surface Condition: Poor, Damaged, Non-recoverable Rutting
Curb Condition: N/A
Roadside Conditions: Non-recoverable in Areas, Large Drop Off at Culvert
Adjacent Roadway Feature: Bridge
Sidewalk Condition: N/A
Non-ADA Sidewalk Ramps: N/A
Traffic Signal: No
Intersection Approach without Vehicle Detection: N/A
Intersection Approach without Emergency Vehicle Detection: N/A
Sight Distance: Acceptable
Intersection Lighting: None
Drainage: Good
Driveways within Stopping Distance of Intersection: 2

Signage: No Chevrons
Pavement Markings: Faded Color
Bike Markings: N/A
Crosswalks: N/A

Special Roadway Use: Agricultural

Damage: End of Guardrail, Signage
Tire Marks: Yes

Street Classification: Both N 1250 Rd and E 1150 Rd are rural minor collector roadways. Access to K-10 will eventually be closed off for these roadways which will decrease traffic flow.

Site Observations: The L-shaped intersection is situated on the northern side of the Wakarusa River. The guardrail on the west side of the north approach of the bridge was visibly crumpled from a recent crash. The road bed leading up to the intersection was raised above the surrounding fields. The grades along both approaches to the intersection were very flat but were non-recoverable adjacent to the horizontal curve. Peel-out tire marks were readily visible on the bridge from possible racing using the south

segment of E 1150 Rd as a drag strip. The inside southeast corner along the river was heavily wooded with a large diameter oak tree located approximately 20 ft. away from the roadways. There were no shoulders and there was a farmer's field entrance on the outside of the curve leading down to cropland in the alluvial ground along the river.

Fatal Crashes: 0
Fixed Object Crashes: 12
Overturning Crashes: 0
Animal Crashes: 2
Adverse Weather Crashes: 0

Figure 26: Buffer Area and Crash Spot Locations at N 1250 Rd & E 1150 Rd

Countermeasures: Improvements include relocating the field access driveway away from the curve, repairing the asphalt at the bridge deck transition, widening the shoulder and adding shoulder rumble strips, centerlines rumble strips, and transverse rumble strips, re-grading applicable steep sideslopes, adding two overhead lights, re-striping pavement markings, extending the guardrail around the curve, and installing chevron signs. The cost of implementation is estimated at $81,333.33 with a potential crash reduction benefit equivalent to $132,020. The benefit : cost ratio is therefore 1.6 : 1.

Summary Table

4. Rural Location: N 1250 Road & E 1150 Road

Crash Countermeasure	Percent Crash Reduction	Benefit	Cost	Benefit : Cost Ratio
Relocate Field Access Driveway Away From Curve	Unknown	Unknown	$2,500.00	Unknown
Add 2’ Wide Shoulder and Repair Asphalt at Bridge Deck Transition	20%	$29,620.00	$14,500.00	2.0 : 1
Add Shoulder Rumble Strips	16%	$23,696.00	$3,600.00	6.6 : 1
Add Centerline Rumble Strips	14%	$20,734.00	$1,800.00	11.5 : 1
Add Transverse Rumble Strips	Unknown	Unknown	$2,000.00	Unknown
Re-Grade Applicable Steep Sideslopes	12%	$17,772.00	$33,333.33	0.5 : 1
Add Overhead Lights	38%	$40,198.00	$11,400.00	3.5 : 1
Re-Stripe Pavement Markings	Unknown	Unknown	$1,000.00	Unknown
Extend Guardrail Around Curve	Unknown	Unknown	$8,000.00	Unknown
Add Chevron Marker Signs Around Curve	Unknown	Unknown	$3,200.00	Unknown
	Total	$132,020.00	$81,333.33	1.6 : 1

Intersection N 1250 Road & E 1150 Road
04 – Rural

Major Road AADT	3448	VPD
Posted Speed Limit	30	MPH
SSD-Sight-Stopping Distance (Posted)	200	ft
85th Percentile Driving Speed	35	MPH
SSD-Sight-Stopping Distance (85th %)	250	ft

From Jan 2013 to Dec 2016,

Fatal Crashes	
Injury Crashes	2
Multi-Vehicle, Side Impact Crash	
Multi-Vehicle, Rear End Crash	
Bicycle Involved Crashes	
Pedestrian Involved Crashes	
Parked Vehicle Involved Crashes	
Fixed Object Crashes	7
Over Turned Vehicle Crashes	
Animal Involved Crashes	2
Total Crashes	9
Darkness Factor	5
Weather Factor	

Recommended Safety Treatment Improvements

Relocate Field Access Driveway Away From Curve	1	LS @	$2,500.00	$2,500.00
Add 2' Wide Shoulder and Repair Asphalt at Bridge Deck Transition	322.2	SY @	$45.00	$14,500.00
Add Shoulder Rumble Strips	1000.0	LF @	$3.60	$3,600.00
Add Centerline Rumble Strips	500.0	LF @	$3.60	$1,800.00
Add Transverse Rumble Strips	2	EA @	$1,000.00	$2,000.00
Re-Grade Applicable Steep Sideslopes	2222.2	CY @	$15.00	$33,333.33
Add Overhead Lights	2	EA @	$5,700.00	$11,400.00
Re-Stripe Pavement Markings	1	LS @	$1,000.00	$1,000.00
Extend Guardrail Around Curve	100	LF @	$80.00	$8,000.00
Add Chevron Marker Signs Around Curve	8	EA @	$400.00	$3,200.00
Total Monetary Cost of Safety Improvements				$81,333.33

Safety Improvement Remedy		Existing Conditions CMF	Proposed Remedy CMF	Difference	Percent Crash Reduction	Applicable Crashes	Reduced Number of Total Crashes	Reduced Number of Injury Crashes	Injury Crash Cost	Reduced Number of PDO Crashes	PDO Crash Cost	
Add or Widen Paved Shoulder		1.5	1.3	0.2	20%	7	1.40	0.31	$25,944	1.09	$3,676	CMF for Shoulder Width on Rural Two-Lane Roadway Segments (Table 13-7, pg 13-11)
Flatten Sideslopes		1	0.88	0.12	12%	7	0.84	0.19	$15,566	0.65	$2,206	Potential Crash Effects on Total Crashes of Flattening Sideslopes (Table 13-18, pg 13-20)
Install Combination Horizontal Alignment/Advisory Speed Signs		1	0.87	0.13	13%		0.00	0.00	$0	0.00	$0	Potential Crash Effects of Installing Combination Horizontal Alignment/Advisory Speed Signs (Table 13-30, pg 13-30)
Install Continuous Shoulder Rumble Strips		1	0.84	0.16	16%	7	1.12	0.25	$20,755	0.87	$2,941	Potential Crash Effects of Installing Continuous Shoulder Rumble Strips on Multilane Highways (Table 13-44, pg 13-38)
Install Centerline Rumble Strips		1	0.86	0.14	14%	7	0.98	0.22	$18,160	0.76	$2,573	Potential Crash Effects of Installing Centerline Rumble Strips on Multilane Highways (Table 13-46, pg 13-40)
Provide Intersection Lighting		1	0.62	0.38	38%	5	1.90	0.42	$35,209	1.48	$4,989	Potential Crash Effects of Providing Intersection Illumination (Table 14-18, pg 14-29)
Provide Flashing Beacons at Stop-Controlled Intersections		1	0.87	0.13	13%		0.00	0.00	$0	0.00	$0	Potential Crash Effects of Providing Flashing Beacons at Stop-Controlled, Four-Leg Intersections on Two-Lane Roads (Table 14-22, pg 14-34)
							6.24	1.39	$115,634	4.85	$16,385	Total Crashes
							0					Fatal Crashes
							1.39					Injury Crashes
							4.85					PDO – Property Damage Only Crashes

Comprehensive Crash Costs (2017)	Cost per Incident
Fatal Crash	$4,965,624
Disabling Injury Crash	$4,169,090
Evident Injury Crash	$83,390
Possible Injury Crash	$43,912
PDO-Property Damage Only Crash	$3,376

Total Crashes	6.24		
Fatal Crashes	0	$0	
Injury Crashes	1.39	$115,634	(Rounded)
PDO – Property Damage Only Crashes	4.85	$16,385	(Rounded)
Total Monetary Benefit of Safety Improvements		$132,020	

N 1600 Rd & E 50 Rd | 5 of 6 Rural

Figure 27: Overhead View of N 1600 Rd & E 50 Rd

Location: N 1600 Rd & E 50 Rd, 5 of 6 Rural Locations
Date of Audit: November 8, 2017
Weather: Fair, Sunny

Major Road, Speed Limit: N 1600 Rd, 35 mph
Minor Road, Speed Limit: E 50 Rd, 35 mph
Pavement Surface Type: Gravel
Pavement Surface Condition: Poor
Shoulder Surface Type: Gravel
Shoulder Surface Condition: Poor
Curb Condition: N/A
Sidewalk Condition: N/A
Non-ADA Sidewalk Ramps: N/A
Traffic Signal: No
Roadside Conditions: Non-recoverable in Areas
Adjacent Roadway Feature: N/A
Special Roadway Use: Agricultural

Intersection Approach without Vehicle Detection: N/A
Intersection Approach without Emergency Vehicle Detection: N/A
Sight Distance: Stone Wall Limits View
Intersection Lighting: None
Drainage: Good
Driveways within Stopping Distance of Intersection: 3

Signage: No Chevrons, Need New Curve Ahead with Advisory Speed Signs
Pavement Markings: N/A
Bike Markings: N/A
Crosswalks: N/A

Damage: Mailbox Dented
Tire Marks: Skidding Grooves in Gravel and Grass

Street Classification: N 1600 Rd & E 50 Rd is the right angle turn directly south of the horizontal curve of Douglas County Route 442. Both roads in this section are considered local and are township roads. The County has a storage facility along the east side of E 50 Rd.

Site Observations: The L-shaped intersection is located approximately 450 ft. south of the intersection of E 50 Rd with Stull Road. The street is gravel surfaced, and the inspection crew noted several vehicles using the roadway during the field observation session. N 1600 Rd continues west to the Shawnee County Line where it becomes SE 53rd Street and is a paved roadway section. There is an abrupt vertical curve west of the intersection dropping steeply to the west, and it is likely that eastbound drivers gather speed to overcome the vertical crest curve. There

are old stone walls along both the north and south sides of N 1600 Rd, portions of the south side near the intersection curve have been struck by vehicles over the years. There were wheel ruts from errant vehicles visible in this area.

Fatal Crashes: 0
Fixed Object Crashes: 6
Overturning Crashes: 2
Animal Crashes: 0
Adverse Weather Crashes: 2

Figure 28: Buffer Area and Crash Spot Locations at N 1600 Rd & E 50 Rd

Countermeasures: Improvements include paving the curve with asphalt, widening the shoulder and adding shoulder rumble strips, centerlines rumble strips, and transverse rumble strips, re-grading applicable steep sideslopes, adding two overhead lights, re-striping pavement markings, installing chevron signs, and installing new curve ahead signs with speed advisory plaques. The cost of implementation is estimated at $177,154.67 with a potential crash reduction benefit equivalent to $70,686. The benefit : cost ratio is therefore 0.4 : 1.

Summary Table

5. Rural Location: N 1600 Road & E 50 Road

Crash Countermeasure	Percent Crash Reduction	Benefit	Cost	Benefit : Cost Ratio
Pave Gravel Street w/ Asphalt	Unknown	Unknown	$93,750.00	Unknown
Add 2’ Wide Shoulder	18%	$13,089.00	$15,000.00	0.9 : 1
Add Shoulder Rumble Strips	16%	$11,845.00	$4,392.00	2.7 : 1
Add Centerline Rumble Strips	14%	$10,365.00	$2,196.00	4.7 : 1
Add Transverse Rumble Strips	Unknown	Unknown	$2,000.00	Unknown
Re-Grade Applicable Steep Sideslopes	12%	$8,884.00	$40,666.67	0.2 : 1
Add Overhead Lights	38%	$16,879.00	$11,400.00	1.5 : 1
Add Double Solid Yellow Centerlines	Unknown	Unknown	$1,350.00	Unknown
Add Solid White Edge Lines	Unknown	Unknown	$1,800.00	Unknown
Add Chevron Marker Signs Around Curve	Unknown	Unknown	$3,200.00	Unknown
Add New Curve Ahead Signs to Both Approaches	13%	$9,624.00	$1,000.00	9.6 : 1
Add Advisory Speed Plaque below Curve Ahead Signs	Unknown	Unknown	$400.00	Unknown
	Total	$70,686.00	$177,154.67	0.4 : 1

Intersection N 1600 Road & E 50 Road
05 – Rural

Major Road AADT	1772	VPD
Posted Speed Limit	35	MPH
SSD-Sight-Stopping Distance (Posted)	250	ft
85th Percentile Driving Speed	40	MPH
SSD-Sight-Stopping Distance (85th %)	305	ft

From Jan 2013 to Dec 2016,

Fatal Crashes	
Injury Crashes	1
Multi-Vehicle, Side Impact Crash	
Multi-Vehicle, Rear End Crash	1
Bicycle Involved Crashes	
Pedestrian Involved Crashes	
Parked Vehicle Involved Crashes	
Fixed Object Crashes	5
Over Turned Vehicle Crashes	1
Animal Involved Crashes	
Total Crashes	7
Darkness Factor	3
Weather Factor	

Recommended Safety Treatment Improvements

Pave Gravel Street w/ Asphalt	2083.3	SY @	$45.00	$93,750.00
Add 2' Wide Shoulder	333.3	SY @	$45.00	$15,000.00
Add Shoulder Rumble Strips	1220.0	LF @	$3.60	$4,392.00
Add Centerline Rumble Strips	610.0	LF @	$3.60	$2,196.00
Add Transverse Rumble Strips	2	EA @	$1,000.00	$2,000.00
Re-Grade Applicable Steep Sideslopes	2711.1	CY @	$15.00	$40,666.67
Add Overhead Lights	2.0	EA @	$5,700.00	$11,400.00
Add Double Solid Yellow Centerlines	750.0	LF @	$1.80	$1,350.00
Add Solid White Edge Lines	1500.0	LF @	$1.20	$1,800.00
Add Chevron Marker Signs Around Curve	8	EA @	$400.00	$3,200.00
Add New Curve Ahead Signs to Both Approaches	2	EA @	$500.00	$1,000.00
Add Advisory Speed Plaque below Curve Ahead Signs	2	EA @	$200.00	$400.00
Total Monetary Cost of Safety Improvements				$177,154.67

Safety Improvement Remedy		Existing Conditions CMF	Proposed Remedy CMF	Difference	Percent Crash Reduction	Applicable Crashes	Reduced Number of Total Crashes	Reduced Number of Injury Crashes	Injury Crash Cost	Reduced Number of PDO Crashes	PDO Crash Cost	
Add or Widen Paved Shoulder		1.44	1.27	0.18	18%	5	0.88	0.13	$10,531	0.76	$2,558	CMF for Shoulder Width on Rural Two-Lane Roadway Segments (Table 13-7, pg 13-11)
Flatten Sideslopes		1	0.88	0.12	12%	5	0.60	0.09	$7,148	0.51	$1,736	Potential Crash Effects on Total Crashes of Flattening Sideslopes (Table 13-18, pg 13-20)
Install Combination Horizontal Alignment/Advisory Speed Signs		1	0.87	0.13	13%	5	0.65	0.09	$7,743	0.56	$1,881	Potential Crash Effects of Installing Combination Horizontal Alignment/Advisory Speed Signs (Table 13-30, pg 13-30)
Install Continuous Shoulder Rumble Strips		1	0.84	0.16	16%	5	0.80	0.11	$9,530	0.69	$2,315	Potential Crash Effects of Installing Continuous Shoulder Rumble Strips on Multilane Highways (Table 13-44, pg 13-38)
Install Centerline Rumble Strips		1	0.86	0.14	14%	5	0.70	0.10	$8,339	0.60	$2,026	Potential Crash Effects of Installing Centerline Rumble Strips on Multilane Highways (Table 13-46, pg 13-40)
Provide Intersection Lighting		1	0.62	0.38	38%	3	1.14	0.16	$13,581	0.98	$3,299	Potential Crash Effects of Providing Intersection Illumination (Table 14-18, pg 14-29)
Provide Flashing Beacons at Stop-Controlled Intersections		1	0.87	0.13	13%		0.00	0.00	$0	0.00	$0	Potential Crash Effects of Providing Flashing Beacons at Stop-Controlled, Four-Leg Intersections on Two-Lane Roads (Table 14-22, pg 14-34)
							4.77	0.68	$56,872	4.09	$13,815	Total Crashes
							0					Fatal Crashes
							0.68					Injury Crashes
							4.09					PDO – Property Damage Only Crashes

Comprehensive Crash Costs (2017)	Cost per Incident
Fatal Crash	$4,965,624
Disabling Injury Crash	$4,169,090
Evident Injury Crash	$83,390
Possible Injury Crash	$43,912
PDO-Property Damage Only Crash	$3,376

Total Crashes	4.77		
Fatal Crashes	0	$0	
Injury Crashes	0.68	$56,872	(Rounded)
PDO – Property Damage Only Crashes	4.09	$13,815	(Rounded)
Total Monetary Benefit of Safety Improvements		$70,686	

US-24/40 & K-32/Linwood Rd | 6 of 6 Rural

Figure 29: Overhead View of US-24/40 & K-32/Linwood Rd

Location: US-24/40 & K-32/Linwood Rd, 6 of 6 Rural Locations
Date of Audit: November 8, 2017
Weather: Fair, Sunny

Major Road, Speed Limit: US-24/40, 65 mph
Minor Road, Speed Limit: K-32/Linwood Rd, 65 mph
Pavement Surface Type: Asphalt
Pavement Surface Condition: Good
Shoulder Surface Type: Some Asphalt Along US-24/40 and Gravel
Shoulder Surface Condition: Good, Some Areas with Non-recoverable Rutting
Curb Condition: N/A
Pavement Markings: No Left-turn and Right-turn symbols
Bike Markings: N/A
Crosswalks: N/A
Roadside Conditions: Non-recoverable in Areas
Sidewalk Condition: N/A
Non-ADA Sidewalk Ramps: N/A
Traffic Signal: No
Intersection Approach without Vehicle Detection: N/A
Intersection Approach without Emergency Vehicle Detection: N/A
Sight Distance: Acceptable
Intersection Lighting: Yes on One Side of the Median, Needed on Both Sides
Drainage: Good
Driveways within Stopping Distance of Intersection: 0

Signage: Replace Chevrons with MUTCD Approved Double Arrow Sign
Adjacent Roadway Feature: N/A
Special Roadway Use: Agricultural

Damage: Median is Crumbling
Tire Marks: Yes, Spin out on Pavement

Street Classification: Both US-24/40 and K-32/Linwood Rd are principal arterials.

Site Observations: This rural intersection easily surpassed the other rural intersections studied in terms of traffic volume. The intersection's pavement appeared to be recently overlaid within the last few months. Pavement markings were intact and well-defined. All of the lanes had wide paved shoulders with edge markings. The area was fairly level with long sight distances in any direction from the intersection or its approaches. The area along the northwest side of US-24/40 Highway was heavily wooded. There were skidding marks readily visible where a westbound vehicle on US-24/40 had spun around after

a crash. The roadbed was raised approximately 6 to 12 ft. relative to the ground at toe of slope of the roadside areas. The slopes outside of the paved shoulders were not recoverable, and there were several wheel ruts visible where vehicles had left the roadway.

Fatal Crashes: 0
Fixed Object Crashes: 3
Overturning Crashes: 0
Animal Crashes: 4
Adverse Weather Crashes: 0

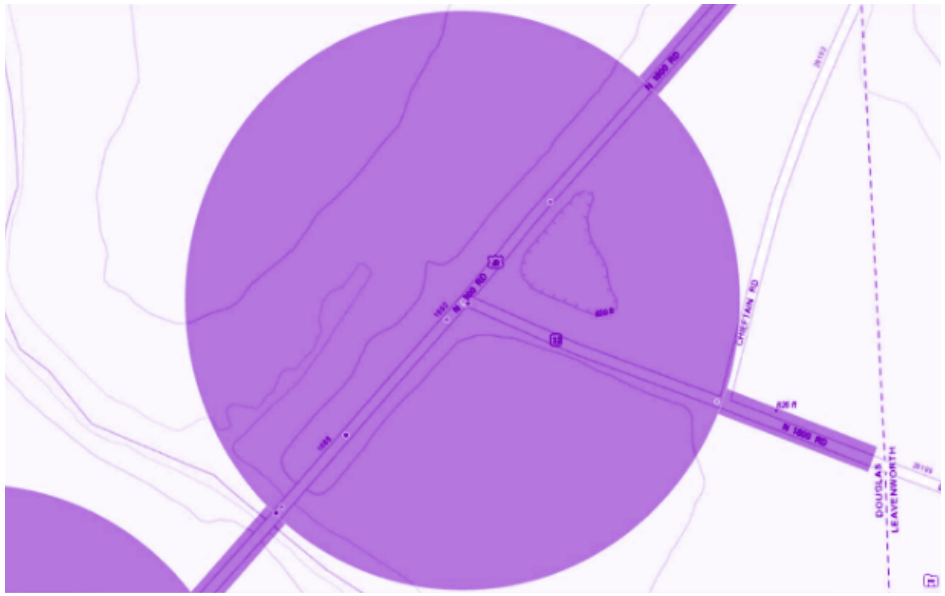


Figure 30: Buffer Area and Crash Spot Locations at US-24/40 & K-32/Linwood Rd

Countermeasures: Improvements include repairing the existing raised median island, widening the shoulder and adding shoulder rumble strips, re-grading applicable steep sideslopes, adding right and left-turn arrow pavement markings, adding an additional overhead light to illuminate the median on the other side, adding an illuminated stop sign, and replacing the chevron signs at the far side of the t-intersection with a directional arrow. The cost of implementation is estimated at $92,243.33 with a potential crash reduction benefit equivalent to $104,606. The benefit : cost ratio is therefore 1.1 : 1.

Summary Table

6. Rural Location: US-24/40 Hwy & K-32

Crash Countermeasure	Percent Crash Reduction	Benefit	Cost	Benefit : Cost Ratio
Repair Existing Raised Median Island	Unknown	Unknown	$22,500.00	Unknown
Add 2’ Wide Shoulder Along NW Side of US-24/40 Highway	20%	$30,031.00	$15,000.00	2.0 : 1
Add Shoulder Rumble Strips	16%	$24,024.00	$12,960.00	1.9 : 1
Re-Grade Applicable Steep Sideslopes	12%	$18,018.00	$24,333.33	0.7 : 1
Add Right & Left-Turn Arrow Pavement Markings	Unknown	Unknown	$2,250.00	Unknown
Add Additional Overhead Light to Illuminate the Median on the Other Side	Unknown	Unknown	$5,700.00	Unknown
Add Illuminated Stop Sign to Northbound Approach	13%	$32,533.00	$7,000.00	4.6 : 1
Remove Existing Chevron Signs at Intersection and Replace with Directional Arrow	Unknown	Unknown	$2,500.00	Unknown
	Total	$104,606.00	$92,243.33	1.1 : 1

Intersection US-24/40 & K-32
06 – Rural

Major Road AADT	5881	VPD
Posted Speed Limit	65	MPH
SSD-Sight-Stopping Distance (Posted)	645	ft
85th Percentile Driving Speed	70	MPH
SSD-Sight-Stopping Distance (85th %)	730	ft

From Jan 2013 to Dec 2016,

Fatal Crashes	
Injury Crashes	7
Multi-Vehicle, Side Impact Crash	5
Multi-Vehicle, Rear End Crash	
Bicycle Involved Crashes	
Pedestrian Involved Crashes	
Parked Vehicle Involved Crashes	
Fixed Object Crashes	3
Over Turned Vehicle Crashes	
Animal Involved Crashes	4
Total Crashes	12
Darkness Factor	4
Weather Factor	

Recommended Safety Treatment Improvements

Repair Existing Raised Median Island	1	LS @	$22,500.00	$22,500.00
Add 2' Wide Shoulder Along NW Side of US-24/40 Highway	333	SY @	$45.00	$15,000.00
Add Shoulder Rumble Strips	3600	LF @	$3.60	$12,960.00
Re-Grade Applicable Steep Sideslopes	1622.2	CY @	$15.00	$24,333.33
Add Right & Left-Turn Arrow Pavement Markings	1	LS @	$2,250.00	$2,250.00
Add Additional Overhead Light to Illuminate the Median on the Other Side	1	LS @	$5,700.00	$5,700.00
Add Illuminated Stop Sign to Northbound Approach	2	EA @	$3,500.00	$7,000.00
Remove Existing Chevron Signs at Intersection and Replace with Directional Arrow	2	EA @	$1,250.00	$2,500.00
Total Monetary Cost of Safety Improvements				$92,243.33

Safety Improvement Remedy		Existing Conditions CMF	Proposed Remedy CMF	Difference	Percent Crash Reduction	Applicable Crashes	Reduced Number of Total Crashes	Reduced Number of Injury Crashes	Injury Crash Cost	Reduced Number of PDO Crashes	PDO Crash Cost	
Add or Widen Paved Shoulder		1.5	1.3	0.2	20%	3	0.60	0.35	$29,187	0.25	$844	CMF for Shoulder Width on Rural Two-Lane Roadway Segments (Table 13-7, pg 13-11)
Flatten Sideslopes		1	0.88	0.12	12%	3	0.36	0.21	$17,512	0.15	$506	Potential Crash Effects on Total Crashes of Flattening Sideslopes (Table 13-18, pg 13-20)
Install Combination Horizontal Alignment/Advisory Speed Signs		0.87	0.87	0	0%		0.00	0.00	$0	0.00	$0	Potential Crash Effects of Installing Combination Horizontal Alignment/Advisory Speed Signs (Table 13-30, pg 13-30)
Install Continuous Shoulder Rumble Strips		1	0.84	0.16	16%	3	0.48	0.28	$23,349	0.20	$675	Potential Crash Effects of Installing Continuous Shoulder Rumble Strips on Multilane Highways (Table 13-44, pg 13-38)
Install Centerline Rumble Strips		1	0.86	0.14	14%		0.00	0.00	$0	0.00	$0	Potential Crash Effects of Installing Centerline Rumble Strips on Multilane Highways (Table 13-46, pg 13-40)
Provide Intersection Lighting		0.62	0.62	0	0%	4	0.00	0.00	$0	0.00	$0	Potential Crash Effects of Providing Intersection Illumination (Table 14-18, pg 14-29)
Provide Flashing Beacons at Stop-Controlled Intersections		1	0.87	0.13	13%	5	0.65	0.38	$31,619	0.27	$914	Potential Crash Effects of Providing Flashing Beacons at Stop-Controlled, Four-Leg Intersections on Two-Lane Roads (Table 14-22, pg 14-34)
							2.09	1.22	$101,666	0.87	$2,940	Total Crashes
							0					Fatal Crashes
							1.22					Injury Crashes
							0.87					PDO – Property Damage Only Crashes

Comprehensive Crash Costs (2017)	Cost per Incident
Fatal Crash	$4,965,624
Disabling Injury Crash	$4,169,090
Evident Injury Crash	$83,390
Possible Injury Crash	$43,912
PDO-Property Damage Only Crash	$3,376

Total Crashes	2.09		
Fatal Crashes	0	$0	
Injury Crashes	1.22	$101,666	(Rounded)
PDO – Property Damage Only Crashes	0.87	$2,940	(Rounded)
Total Monetary Benefit of Safety Improvements		$104,606	

Table 5: Urban Safety Audit Locations

#	Location:	Total Crashes Over 4 Yrs	Total Pedestrian Crashes Over 4 Yrs	Total Bike Crashes Over 4 Yrs	Average Crash Frequency (ACF)	Excess Expected Average Crash Frequency (EEACF)
1	E 23rd St & Harper St	79	3	0	19.75	10.203
2	E 23rd St & Haskell Ave	219	1	1	54.75	31.920
3	W 23rd St & Louisiana St	134	1	0	33.5	18.964
4	W 23rd St & Naismith Dr	83	1	0	20.75	11.894
5	W 25th St & Iowa St	79	6	1	19.75	10.902
6	W 6th St & Monterey Way	71	2	1	17.75	10.412

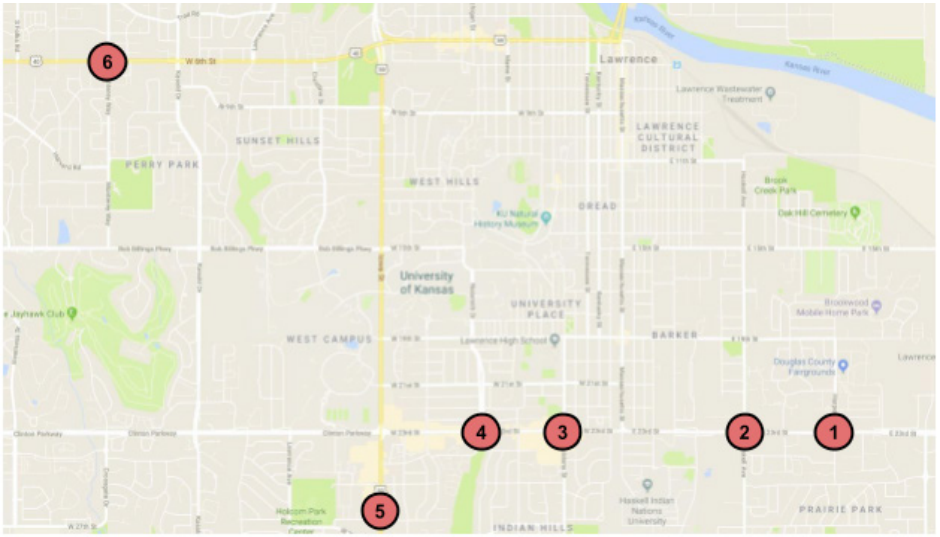


Figure 31: Urban Safety Audit Locations

E 23rd St & Harper | 1 of 6 Urban

Figure 32: Overhead View of E 23rd St & Harper

Location: E 23rd St & Harper St, 1 of 6 Urban Locations
Date of Audit: November 10, 2017
Weather: Fair, Cloudy

Major Road, Speed Limit: E 23rd St, 45 mph
Minor Road, Speed Limit: Harper St, 35 mph
Pavement Surface Type: Asphalt
Pavement Surface Condition: Fair, Some Small Potholes
Shoulder Surface Type: N/A
Shoulder Surface Condition: N/A
Curb Condition: Low, Covering Overgrowth Along 23rd St
Sidewalk Condition: N/A
Roadside Conditions: Light Pole Close to Curb
Adjacent Roadway Feature: Bus Stops, Additional Amenities Not Recommended
Non-ADA Sidewalk Ramps: 2
Traffic Signal: Yes
Intersection Approach without Vehicle Detection: 0
Intersection Approach without Emergency Vehicle Detection: 0
Sight Distance: Acceptable
Intersection Lighting: Yes
Drainage: Good
Driveways within Stopping Distance of Intersection: 5

Signage: No issues Identified
Pavement Markings: Faded
Bike Markings: Sharrows on Harper St
Crosswalks: Faded

Special Roadway Use: None

Damage: None
Tire Marks: None

Site Observations: 23rd & Harper is the second signalized intersection that westbound drivers on K-10 encounter when coming to Lawrence. The surrounding area has been well-developed so that there is a regular flow of cross-street traffic on Harper. There is also a sheltered bus stop with turn-out off of 23rd St for eastbound traffic located approximately 150 ft. east of the intersection. The closest full-access driveway entrance on E 23rd Street is on the westbound leg approximately 350 ft. west of the intersection. There are sidewalks along both sides of every approach street, but some of the ramps are not ADA compliant. The north leg of Harper leads to and from 19th Street and other east-west cross-streets in Lawrence that can serve as bypass routes during peak hour and heavy event traffic from the University. The pavement shows

signs of patching and the pavement markings show wear, but are generally visible.

Street Classification: 23rd St - principal arterial, Harper St - collector

Bikeway Classification: 23rd St - None, Harper St - existing bike route

Total Crashes: 79 (2013-2016)
Ped / Bike Crashes: 3 pedestrian / 0 bicyclist (2013-2016)
Fatal Crashes: 0 (2013-2016)
Animal Crashes: 4
Number of Schools Within Close Proximity:
2, To North and South

Figure 33: Buffer Area and Crash Spot Locations at E 23rd St & Harper

Countermeasures: On 23rd St, the nearest driveway entrance was 350 ft. from the intersection, indicating that access management to eliminate or consolidate driveways would not be applicable. In the four years of crash data, only one crash involved turning maneuvers from any of the nearby access driveways. Adding a right-turn auxiliary lane was not recommended as a safety measure to help alleviate any the rear-end crashes recorded at the intersection. A typical year had only one crash that could have been prevented by construction of an eastbound or westbound right-turn lane. The improvements recommended for the intersection were basic housekeeping measures that included replacing the non-ADA-compliant sidewalk ramps at the NE and NW corners and re-marking the faded pavement markings at the intersection. The detailed analysis did not indicate any special accommodations were needed for bikes or buses due to the low number of crashes. The estimated cost for the improvements is $7,000.

Intersection	23rd & Harper		
01 – Urban	Major Road AADT	20361	VPD
	Posted Speed Limit	45	MPH
	SSD-Sight-Stopping Distance (Posted)	360	ft
	85th Percentile Driving Speed	50	MPH
	SSD-Sight-Stopping Distance (85th %)	425	ft

Recommended Safety Treatment Improvements, Engineer's Estimate

Replace Sidewalk Ramps at NE & NW Corners w/ ADA Compliant Ramps	2	EA @	$2,500.00	$5,000.00
Re-Mark Faded Pavement Markings	1	LS @	$2,000.00	$2,000.00
				$7,000.00

E 23rd St & Haskell | 2 of 6 Urban

Figure 34: Overhead View of E 23rd St & Haskell

Location: E 23rd St & Haskell Ave, 2 of 6 Urban Locations
Date of Audit: November 10, 2017
Weather: Fair, Cloudy

Major Road, Speed Limit: E 23rd St, 45 mph
Minor Road, Speed Limit: Haskell Ave, 30 mph on North Leg, 35 mph on South Leg
Pavement Surface Type: Asphalt
Pavement Surface Condition: Good on North Leg, Otherwise Fair, Some Small Potholes
Shoulder Surface Type: N/A
Shoulder Surface Condition: N/A
Pavement Markings: Faded except North Leg
Bike Markings: Sharrows on Harper St
Crosswalks: Faded except North Leg

Roadside Conditions: No Issues Identified
Curb Condition: Low, Covering Overgrowth Along 23rd St
Sidewalk Condition: Good

Non-ADA Sidewalk Ramps: 1
Traffic Signal: Yes
Intersection Approach without Vehicle Detection: 0
Intersection Approach without Emergency Vehicle Detection: 0
Sight Distance: Acceptable
Intersection Lighting: Yes
Drainage: Issue in SW Corner
Driveways within Stopping Distance of Intersection: 17

Signage: No issues Identified
Adjacent Roadway Feature: Bus Stops, Additional Amenities Not Recommended
Special Roadway Use: None

Damage: None
Tire Marks: None

Site Observations: The north leg of Haskell at the intersection was recently overlaid and the pavement markings are in very good condition. Pavement markings on the other intersection legs are worn but visible. There is a large QuikTrip store on the northeast corner that appears to be a significant traffic generator. There are driveway entrances off of E 23rd Street located approximately 170 ft. from the intersection. Both the north and southbound approaches of Haskell were widened to three lanes for separate left, thru and right-turn lanes. There are sidewalks along both sides of every approach street, but some of the ramps are not ADA compliant. The north leg of Haskell, like Harper Street, leads to and from 19th Street

and other east-west cross-streets in Lawrence, that can serve as bypass routes during peak hour and heavy event traffic from the University including football and basketball games. The southwest corner of the intersection has grate inlets located approximately five feet from the edge of curb that do not appear to be able to intercept much surface drainage.

Street Classification: 23rd St - principal arterial, Haskell Ave - principal arterial south of 23rd St and a minor arterial north of 23rd St

Bikeway Classification: 23rd St - future shared use path is planned for 23rd St west of Haskell, Haskell Ave - future bike lane

Total Crashes: 219 (2013-2016)
Highest crash count intersection in Lawrence
Ped / Bike Crashes: 1 pedestrian / 1 bicyclist (2013-2016)
Fatal Crashes: 0 (2013-2016)
Number of Schools Within Close Proximity: 0

Figure 35: Buffer Area and Crash Spot Locations at E 23rd St & Haskell

Countermeasures: On 23rd St, there were three driveway entrances on the northwest, southwest, and southeast quadrants, all located approximately 170 ft. from the intersection. The intersection is located along the commercialized segment of 23rd St where driveways on both sides of the street are frequent and relatively closely spaced. Access management to eliminate or consolidate driveways would be practical considering that, in the four years of crash data, several crashes involved turning maneuvers from the nearby access driveways. Along the west leg, approximately six crashes involved the access driveway for 800 E 23rd St. Along the east leg, approximately six crashes involved the access driveway for 1003 E 23rd St. The QuikTrip and Sonic driveways had a combined six crashes. All of these driveways are recommended to be changed to a left-in, right-in, right-out configuration because most crashes were left-out

maneuvers. No crashes involving turning maneuvers from the property at the northwest corner of the intersection, 946 E 23rd St. Access management on Haskell Ave is not recommended since there was only one crash in four years that involved turning maneuvers from the access driveways. This intersection does experience a relatively high volume of eastbound and westbound right-turn movements and adding right-turn auxiliary lanes was recommended as a safety measure to help alleviate some of the rear-end crashes recorded at the intersection and to improve traffic operations. A typical year had three crashes that could have been prevented by construction of a westbound right-turn lane and two crashes that could have been prevented by construction of a eastbound right-turn lane. The improvements recommended for the intersection also included replacing the non-ADA-compliant sidewalk ramps at the SW corner, re-marking the faded pavement markings at the intersection, and stormwater drainage improvements to supplement the existing grate inlets in the open pavement on the southwestern corner of the intersection. The detailed analysis did not indicate any special accommodations were needed for bikes or buses due to the low number of crashes. The estimated cost for the improvements is $218,500 with each turn lane costing about $90,000. The addition of the right-turn lanes could mean a crash reduction monetary benefit of about $17,564.80 per year (Five crashes * Potential to Reduce Crashes at 8% * Cost of Possible Injury Crash at $43,912).

Intersection	23rd & Haskell		
02 – Urban	Major Road AADT	25019	VPD
	Posted Speed Limit	45	MPH
	SSD-Sight-Stopping Distance (Posted)	360	ft
	85th Percentile Driving Speed	50	MPH
	SSD-Sight-Stopping Distance (85th %)	425	ft

Recommended Safety Treatment Improvements, Engineer's Estimate

Replace Sidewalk Ramp at SW Corners w/ ADA Compliant Ramp	1	EA @	$2,500.00	$2,500.00
Re-Mark Faded Pavement Markings	1	LS @	$3,000.00	$3,000.00
Storm Sewer Improvements – Add Two Curb Inlets to SW Corner	1	LS @	$33,000.00	$33,000.00
Add Auxiliary Right-Turn Lanes on 23rd Street	2	EA @	$90,000.00	$180,000.00
				$218,500.00

W 23rd St & Louisiana | 3 of 6 Urban

Figure 36: Overhead View of E 23rd St & Louisiana

Location: W 23rd St & Louisiana St, 3 of 6 Urban Locations
Date of Audit: November 10, 2017
Weather: Fair, Cloudy

Major Road, Speed Limit: W 23rd St, 35 mph
Minor Road, Speed Limit: Louisiana St, 30 mph
Pavement Surface Type: Asphalt
Pavement Surface Condition: Fair, Some Small Potholes
Shoulder Surface Type: N/A
Shoulder Surface Condition: N/A
Curb Condition: Deteriorated Dividing Median
Sidewalk Condition: Good
Pavement Markings: Faded, Paint Raised Dividing Median Reflective Yellow
Bike Markings: Sharrows on Harper St
Crosswalks: Faded, Manhole Cover Tripping Hazard on East Leg
Roadside Conditions: Signal Pole Close to Curb and Restricts Wheelchair Use

Non-ADA Sidewalk Ramps: 2
Traffic Signal: Yes
Intersection Approach without Vehicle Detection: 0
Intersection Approach without Emergency Vehicle Detection: 0
Sight Distance: Vegetation Limits View for Right-turns from East and West Leg
Intersection Lighting: Yes
Drainage: Need Inlets on South Leg
Driveways within Stopping Distance of Intersection: 15

Signage: No issues Identified
Adjacent Roadway Feature: Bus Stops
Special Roadway Use: None

Damage: None
Tire Marks: None

Site Observations: The sidewalks and building setbacks along all four corners of this intersection appear to be constricted in space. Pavement shows signs of patching of potholes and pavement joint ruts. Lawrence High School is located north of this intersection. The existing British Petroleum (BP) Station on the southwest corner has driveway connections very close to the intersection that could be a potential source of collisions turning either from east or westbound traffic on W 23rd street. The existing traffic signal pole on the southeastern corner is located too close to the intersection, and there is not adequate clearance for a wheelchair to negotiate the sidewalk without

having to enter the street. Pavement markings are worn and in need of re-marking.

Street Classification: 23rd St - principal arterial, Louisiana St - minor arterial

Bikeway Classification: 23rd St - future shared use path, Louisiana St - existing bike route

Total Crashes: 134 (2013-2016)
Third highest crash count intersection in Lawrence
Ped / Bike Crashes: 1 pedestrian / 0 bicyclist (2013-2016)
Fatal Crashes: 0 (2013-2016)
Number of Schools Within Close Proximity: 1, to the North

Figure 37: Buffer Area and Crash Spot Locations at W 23rd St & Louisiana

Countermeasures: The surrounding street frontage on both sides of 23rd St are heavily commercialized, and driveways are very closely spaced. It is recommended to close and consolidate the entrance into the British Petroleum station on the south leg of Louisiana with the next intersection to the south. The existing driveway entrance is only 60 ft. south of the 23rd St intersection and is a potential source of crashes for eastbound motorists making left-turns or westbound motorists making right-turns onto the southern leg of Louisiana. Along the west leg, four crashes involved the access driveway for the BP station. This driveway is recommended to be changed to a right-in, right-out configuration due to the proximity of the intersection. Adding a right-turn auxiliary lane was not recommended as a safety measure to help alleviate any the rear-end crashes recorded at the intersection. A typical year had only one crash that could have been

prevented by construction of a westbound right-turn lane. The intersection also has conflicts with an existing traffic signal pole on the southeast corner and with storm sewer curb inlet on the northwest corner. The existing traffic signal pole on the southeast corner needs to be relocated further away from the intersection to allow the sidewalk to continue around the corner without being constricted. In its present state, a wheelchair cannot negotiate the sidewalk without swerving into the gutter line. On the northwest corner, the existing curb inlet is angled along the corner curb alignment and is set in the path of the sidewalk ramp. There are segments of sidewalk with no buffering setback distance from the curbline on the north, south, and east legs of the intersection. The existing median island on the east leg has deteriorated and should be repaired and painted. The pavement markings in the intersection have worn and faded and need to be re-marked. For the property at the northeast corner, the access driveway on Louisiana St has vegetation at the end of the fence that partially restricts sight distance which should be cleared back. The detailed analysis did not indicate any special accommodations were needed for bikes or buses due to the low number of crashes. The estimated cost for the improvements is $113,700.

Intersection	23rd & Louisiana		
03 – Urban	Major Road AADT	25019	VPD
	Posted Speed Limit	35	MPH
	SSD-Sight-Stopping Distance (Posted)	360	ft
	85th Percentile Driving Speed	40	MPH
	SSD-Sight-Stopping Distance (85th %)	425	ft

Recommended Safety Treatment Improvements, Engineer's Estimate

Replace Sidewalk Ramps at NW & SE Corners w/ ADA Compliant Ramps	2	EA @	$2,500.00	$5,000.00
Replace Exist Median Island	270	LF @	$85.00	$22,950.00
Reconstruct Sidewalk on North Leg of Intersection away from Curb	150	LF @	$50.00	$7,500.00
Reconstruct Sidewalk on South Leg of Intersection away from Curb	225	LF @	$50.00	$11,250.00
Reconstruct Sidewalk on East Leg of Intersection away from Curb	210	LF @	$50.00	$10,500.00
Relocate Exist Traffic Signal at SE Corner	1	LS @	$30,000.00	$30,000.00
Storm Sewer Improvements – Relocate Curb Inlet at NW Corner	1	LS @	$15,000.00	$15,000.00
Storm Sewer Improvements – Replace Exist Curb Inlet at NE Corner	1	LS @	$7,500.00	$7,500.00
Re-Mark Faded Pavement Markings	1	LS @	$4,000.00	$4,000.00
				$113,700.00

W 23rd St & Naismith | 4 of 6 Urban

Figure 38: Overhead View of E 23rd St & Naismith

Location: W 23rd St & Naismith Dr, 4 of 6 Urban Locations
Date of Audit: November 10, 2017
Weather: Fair, Cloudy

Major Road, Speed Limit: W 23rd St, 35 mph
Minor Road, Speed Limit: Naismith Dr, 30 mph
Pavement Surface Type: Asphalt
Pavement Surface Condition: Fair, Some Small Potholes
Shoulder Surface Type: N/A
Shoulder Surface Condition: N/A
Curb Condition: Fair
Sidewalk Condition: Good, South Leg on One Side Only
Roadside Conditions: No Issues Identified
Adjacent Roadway Feature: Bus Stops, Additional Amenities Not Recommended
Non-ADA Sidewalk Ramps: 3
Traffic Signal: Yes
Intersection Approach without Vehicle Detection: 0
Intersection Approach without Emergency Vehicle Detection: 0
Sight Distance: Acceptable
Intersection Lighting: Yes
Drainage: Good
Driveways within Stopping Distance of Intersection: 8

Signage: No issues Identified
Pavement Markings: Faded
Bike Markings: Sharrows on Naismith Dr, Non-compliant
Crosswalks: Faded

Special Roadway Use: None

Damage: None
Tire Marks: None

Site Observations: During the field observation of this intersection, the northern side of W 23rd Street is undergoing street repairs. The traffic signal mast arm controlling east and westbound traffic on W 23rd Street is unique in that it spans the entire width of the street between poles set in the opposing center medians. Naismith Drive is the major gateway street leading to the south entrance of the University campus, and the street undoubtedly sees a regular flow of traffic during school hours during the days and evenings. Naismith Drive is divided four lanes with a large open drainage channel extending along the center median, but the pavement lanes are very narrow due to constrained right-of-way.

Street Classification: 23rd St - principal arterial, Naismith Dr - collector

Bikeway Classification: 23rd St - future shared use path, Naismith Dr - shared use path exists on Naismith south of 23rd St and Naismith Dr is an existing bike route north of 23rd St with sharrows

Total Crashes: 83 (2013-2016)
Ped / Bike Crashes: 1 pedestrian / 0 bicyclist (2013-2016)
Fatal Crashes: 0 (2013-2016)
Number of Schools Within Close Proximity: 0
Park Within 500 ft: Yes

Figure 39: Buffer Area and Crash Spot Locations at E 23rd St & Naismith

Countermeasures: On 23rd St, the nearest driveway entrance was 100 ft. from the intersection, indicating that access management to eliminate or consolidate driveways is applicable. Access management to change the driveways at the southwest corner to a left-in, right-in, right-out configuration was completed in 2012. The access driveway on 23rd St in the northwest corner should also be changed to a left-in, right-in, right-out configuration. Adding a right-turn auxiliary lane was not recommended as a safety measure to help alleviate any the rear-end crashes recorded at the intersection due to the low number of applicable crashes. The improvements recommended for the intersection included re-marking the faded pavement markings at the intersection. The detailed analysis did not indicate any special accommodations were needed for bikes or buses due to the low number of crashes. The estimated cost for the improvements is $4,000.

Intersection	23rd & Naismith		
04 – Urban	Major Road AADT	26145	VPD
	Posted Speed Limit	35	MPH
	SSD-Sight-Stopping Distance (Posted)	360	ft
	85th Percentile Driving Speed	40	MPH
	SSD-Sight-Stopping Distance (85th %)	425	ft

Recommended Safety Treatment Improvements, Engineer's Estimate

Re-Mark Faded Pavement Markings	1	LS @	$4,000.00	$4,000.00
				$4,000.00

W 25th St & Iowa | 5 of 6 Urban

Figure 40: Overhead View of W 25th St & Iowa

Location: W 25th St & Iowa St, 5 of 6 Urban Locations
Date of Audit: November 10, 2017
Weather: Fair, Cloudy

Major Road, Speed Limit: Iowa St, 40 mph
Minor Road, Speed Limit: W 25th St, 30 mph
Pavement Surface Type: Asphalt
Pavement Surface Condition: Good
Shoulder Surface Type: N/A
Shoulder Surface Condition: N/A
Curb Condition: Fair
Sidewalk Condition: Good
Non-ADA Sidewalk Ramps: 2
Traffic Signal: Yes
Roadside Conditions: No Issues Identified
Adjacent Roadway Feature: Bus Stops

Intersection Approach without Vehicle Detection: 0
Intersection Approach without Emergency Vehicle Detection: 0
Sight Distance: Acceptable
Intersection Lighting: Yes
Drainage: Issues at NE and SW Corner
Driveways within Stopping Distance of Intersection: 13

Signage: No issues Identified
Pavement Markings: Paint Access Management Median Reflective Yellow
Bike Markings: Sharrows on W 25th St
Crosswalks: No Issues Identified

Special Roadway Use: None

Damage: None
Tire Marks: None

Site Observations: The existing intersection is fairly level for both approaches of Iowa St. The east approach of W 25th St has a slight upgrade and the western approach has a slight downgrade. There is a driveway entrance on the east side of Iowa located approximately 160 ft. north of the intersection. On the eastern approach of W 25th St, there are opposing driveway entrances located approximately 50 ft. east of the intersection that the City has installed a narrow median separator to prevent traffic crossing directly across the street and limiting turn movements. The existing curb inlets on the north and western legs of the intersection are old and appear undersized. The existing inlet on the north is a combination grate/curb inlet with only 2.5 ft. of curb opening length. The curb leading to

the existing inlet on the west leg is broken and the inlet has minimal setback from the edge of lane. At the time of the field inspection, the pavement markings had been recently re-dressed and appeared to be in good shape and readily visible. The eastern leg of W 25th St feeds into a residential area with some older apartments. The western leg feeds into some retail centers fronting Iowa, and then to some large apartment complexes further west.

Street Classification: Iowa St - principal arterial, 25th St - local road west of Iowa and collector roadway east of Iowa

Bikeway Classification: Iowa St - future shared use path, 25th St - future bike route

Total Crashes: 79 (2013-2016)
Ped / Bike Crashes: 1 pedestrian / 1 bicyclist (2013-2016)
Fatal Crashes: 0 (2013-2016)
Number of Schools Within Close Proximity: 0

Figure 41: Buffer Area and Crash Spot Locations at W 25th St & Iowa

Countermeasures: The closest driveway along Iowa in the northeast corner was approximately 130 ft. to the intersection with W 25th St. The next driveway is approximately 25 ft. to the north. Due to the proximity of these driveways to the intersection, the recommendation is to change the driveways to a left-in, right-in, right-out configuration. In the four years of crash data, about two crashes involved turning maneuvers from each of the nearby access driveways indicating that access management to eliminate or consolidate driveways would be applicable. The City installed a narrow median barrier between the opposing driveways on the east leg on W 25th St that should be painted a bright yellow and the damaged safety reflectors replaced. Adding a right-turn auxiliary lane was not recommended as a safety measure to help alleviate any crashes since a typical year had only one crash that could have been prevented by construction of

an eastbound right-turn lane. The existing drainage inlet on the northeast corner along Iowa should be replaced or supplemented with a larger setback curb inlet. A new curb inlet should be installed on the southwest corner along 25th St. The existing sidewalk ramps on the northeast and southeast corners are non-ADA-compliant and need to be replaced. Bus stop improvements including a shelter should also be considered along the northbound lanes of Iowa on the south side of the intersection. Although the presence of a bus stop at an intersection can increase the potential for a pedestrian crash up to 178%, implementing improvements to bus stops can reduce the crash potential. The detailed analysis did not indicate any special accommodations were needed for bikes due to only one bike crash in four years. The estimated cost for the improvements is $74,500.

Intersection	25th & Iowa		
05 – Urban	Major Road AADT	23717	VPD
	Posted Speed Limit	40	MPH
	SSD-Sight-Stopping Distance (Posted)	360	ft
	85th Percentile Driving Speed	45	MPH
	SSD-Sight-Stopping Distance (85th %)	425	ft

Recommended Safety Treatment Improvements, Engineer's Estimate

Paint Access Management Median w/ Safety Yellow & Repair Reflectors	1	EA @	$1,000.00	$1,000.00
Replace Sidewalk Ramps at NE & SE Corners w/ ADA Compliant Ramps	2	EA @	$12,000.00	$24,000.00
Storm Sewer Improvements – Replace Exist Curb Inlet at NE Corner	1	LS @	$7,500.00	$7,500.00
Storm Sewer Improvements – Add Curb Inlet at SW Corner along 25th Street	1	LS @	$17,000.00	$17,000.00
Bus Stop Improvements	1	EA @	$25,000.00	$25,000.00
				$74,500.00

6th & Iowa | 6 of 6 Urban

Figure 40: Overhead View of W 6th St & Monterey Way

Location: W 6th St & Monterey Way, 6 of 6 Urban Locations
Date of Audit: November 10, 2017
Weather: Fair, Cloudy

Major Road, Speed Limit: W 6th St, 40 mph East Leg, 45 mph West Leg
Minor Road, Speed Limit: Monterey Way, 35 mph
Pavement Surface Type: Asphalt
Pavement Surface Condition: Good
Shoulder Surface Type: N/A
Shoulder Surface Condition: N/A
Curb Condition: Fair
Sidewalk Condition: Good
Non-ADA Sidewalk Ramps: 3
Traffic Signal: Yes

Bike Markings: Sharrows on Monterey Way
Crosswalks: Faded
Roadside Conditions: Fire Hydrant Close to Curb
Adjacent Roadway Feature: Bus Stops

Intersection Approach without Vehicle Detection: 0
Intersection Approach without Emergency Vehicle Detection: 0
Sight Distance: Acceptable
Intersection Lighting: Yes
Drainage: Good
Driveways within Stopping Distance of Intersection: 4

Signage: Pedestrian Crossing Pushbutton Sign is Not Secured in Northeast Corner and Another is Missing in Northwest Corner
Pavement Markings: Faded on South Leg

Special Roadway Use: None

Damage: Pedestrian Push Buttons
Tire Marks: None

Site Observations: The existing intersection is fairly level and long distance visibility appeared acceptable for all approaches on both 6th St and on Monterey Way. The north leg of Monterey Way has been recently overlaid and pavement markings on this street segment are in very good shape. Pavement markings on the other three approaches show some wear but are visible. There is an existing sheltered bus stop on the eastbound approach of W 6th St approximately 70 ft. west of the intersection. The existing signal pole on the southeastern corner is located approximately 15 ft. east of the sidewalk crosswalk ramp and consideration should be made to install a pushbutton

pedestal pole closer to the ramps to be ADA compliant. Lane widths are standard 12 ft, and the curb & gutter on all approaches appear to be in good shape. There are some large commercial shopping centers fronting W 6th St to the west of the intersection.

Street Classification: 6th St - principal arterial, Monterey Way - collector

Bikeway Classification: 6th St - shared use path west of Monterey Way and future shared use path east of Monterey Way, Monterey Way - future bike lanes with existing sharrows on south leg

Total Crashes: 71 (2013-2016)
Ped / Bike Crashes: 2 pedestrian / 1 bicyclist (2013-2016)
Fatal Crashes: 0 (2013-2016)
Number of Schools Within Close Proximity: 0

Figure 43: Buffer Area and Crash Spot Locations at W 6th St & Monterey Way

Countermeasures: This area of western Lawrence was recently developed, and the driveways along 6th St are well spaced from the intersections. In the four years of crash data, only one crash involved turning maneuvers from any of the nearby access driveways. Adding a right-turn auxiliary lane was not recommended as a safety measure to help alleviate any crashes. A typical year had only two crashes that could have been prevented by construction of an eastbound or westbound right-turn lane. Adding right-turn auxiliary lanes was recommended as a safety measure to help alleviate some of the rear-end crashes recorded at the intersection and to improve traffic operations. A typical year had two crashes that could have been prevented by construction of a westbound right-turn lane and two crashes that could have been prevented by construction of a eastbound right-turn lane. The existing sidewalk ramps on the northwest, southwest, and southeast corners are non-

ADA-compliant and need to be replaced. The pedestrian pushbutton on the existing traffic signal pole on the southeast corner is too far from the crossing ramp, and a supplemental pedestal pole for the pedestrian pushbuttons should be added. The existing pedestrian pushbutton instruction signs on the signal poles on the the northeast and northwest corners were either missing or required repairs to the sign fastener. The pavement markings in the intersection need to be re-marked. The detailed analysis did not indicate any special accommodations were needed for bikes or buses due to the low number of crashes. The estimated cost for the improvements is $213,300 with each turn lane costing about $90,000. The addition of the right-turn lanes could mean a crash reduction monetary benefit of about $14,051.84 per year (Four crashes * Potential to Reduce Crashes at 8% * Cost of Possible Injury Crash at $43,912).

Intersection	6th & Monterey		
06 – Urban	Major Road AADT	28476	VPD
	Posted Speed Limit	40	MPH
	SSD-Sight-Stopping Distance (Posted)	360	ft
	85th Percentile Driving Speed	45	MPH
	SSD-Sight-Stopping Distance (85th %)	425	ft

Recommended Safety Treatment Improvements, Engineer's Estimate

Replace Sidewalk Ramps on NW, SW & SE Corners w/ ADA Compliant Ramps	3	EA @	$3,000.00	$9,000.00
Add Pedestrian Push-Button Pole Close to SE Corner Ramp	1	LS @	$20,000.00	$20,000.00
Repair Damaged Pedestrian Push-Buttons	1	LS @	$2,000.00	$2,000.00
Re-Mark Faded Pavement Markings	1	LS @	$2,000.00	$2,000.00
Pedestrian Push-Button Operation Sign Replacement	2	EA @	$150.00	$300.00
Add Auxiliary Right-Turn Lanes on 6th Street	2	EA @	$90,000.00	$180,000.00
				$213,300.00

APPENDIX | HOT SPOTS - URBAN - URBAN INTERSECTIONS

				Fatal Crashes			School Proximity			Bicycle Crashes		
Ordered Hot Spots	Urban Intersections	Weighted Priority Ranking Value Total	EEACF	Crash Count	Weighted Value per Crash	Total Weighted Value	Number of Schools within 1000 ft	Weighted Value per School	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
1	W 25th St & Iowa St	9.2	10.9	0	1.0	0	0	1.0	0	1	0.9	0.9
2	E 23rd St & Harper St	8.6	10.2	0	1.0	0	2	1.0	2	0	0.9	0
3	W 9th St & Ohio St	8.2	2.1	0	1.0	0	1	1.0	1	2	0.9	1.8
4	W 21st St & Naismith Dr	7.1	1.6	0	1.0	0	1	1.0	1	3	0.9	2.7
5	W 13th St & Massachusetts St	7.1	1.7	0	1.0	0	2	1.0	2	1	0.9	0.9
6	E 9th St & New Hampshire St	6.8	0.7	0	1.0	0	2	1.0	2	1	0.9	0.9
7	W 6th St & Rockledge Rd	6.7	5.1	0	1.0	0	0	1.0	0	3	0.9	2.7
8	W 11th St & Vermont St	6.6	0.5	0	1.0	0	1	1.0	1	0	0.9	0
9	W 13th St & Kentucky St	6.5	2.7	0	1.0	0	2	1.0	2	1	0.9	0.9
10	W 6th St & Mississippi St	6.5	2.2	0	1.0	0	1	1.0	1	0	0.9	0
11	W 9th St & Tennessee St	6.5	7.5	0	1.0	0	1	1.0	1	1	0.9	0.9
12	W 6th St & Monterey Way	6.4	10.4	0	1.0	0	0	1.0	0	1	0.9	0.9
13	W 22nd St & Carolina St	6.3	0.0	0	1.0	0	2	1.0	2	0	0.9	0
14	W 19th St & Ohio St	6.2	2.0	0	1.0	0	2	1.0	2	1	0.9	0.9
15	W 10th St & Vermont St	6.1	0.5	0	1.0	0	1	1.0	1	1	0.9	0.9
16	W 11th St & Massachusetts St	6.1	3.8	0	1.0	0	1	1.0	1	1	0.9	0.9
17	W 7th St & Vermont St	6.1	2.0	0	1.0	0	1	1.0	1	1	0.9	0.9
18	Clinton Pkwy & Atchison Ave	6.0	1.7	0	1.0	0	0	1.0	0	4	0.9	3.6
19	E 8th St & New Hampshire St	6.0	0.8	0	1.0	0	1	1.0	1	0	0.9	0
20	W 23rd St & Louisiana St	5.8	19.0	0	1.0	0	1	1.0	1	0	0.9	0

				Fatal Crashes			School Proximity			Bicycle Crashes		
Ordered Hot Spots	Urban Intersections	EEACF	Weighted Priority Ranking Value Total	Crash Count	Weighted Value per Crash	Total Weighted Value	Number of Schools within 1000 ft	Weighted Value per School	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
1	E 23rd St & Haskell Ave	31.9	3.2	0	1.0	0	0	1.0	0	1	0.9	0.9
2	Clinton Pkwy & Iowa St	25.5	3.7	0	1.0	0	1	1.0	1	1	0.9	0.9
3	W 23rd St & Louisiana St	19.0	5.8	0	1.0	0	1	1.0	1	0	0.9	0
4	W 23rd St & Ousdahl Rd	16.3	5.7	0	1.0	0	1	1.0	1	1	0.9	0.9
5	W 19th St & Iowa St	16.3	1.3	0	1.0	0	0	1.0	0	0	0.9	0
6	W 6th St & Kasold Dr	13.8	4.1	0	1.0	0	0	1.0	0	0	0.9	0
7	W 23rd St & Massachusetts St	12.3	5.4	0	1.0	0	0	1.0	0	2	0.9	1.8
8	W 23rd St & Naismith Dr	11.9	3.7	0	1.0	0	0	1.0	0	0	0.9	0
9	Clinton Pkwy & Crestline Dr	11.5	2.9	0	1.0	0	0	1.0	0	1	0.9	0.9
10	W 25th St & Iowa St	10.9	9.2	0	1.0	0	0	1.0	0	1	0.9	0.9
11	W 15th St & Iowa St	10.5	2.3	0	1.0	0	0	1.0	0	0	0.9	0
12	W 6th St & Monterey Way	10.4	6.4	0	1.0	0	0	1.0	0	1	0.9	0.9
13	W 27th St & Iowa St	10.4	3.1	0	1.0	0	0	1.0	0	0	0.9	0
14	E 23rd St & Harper St	10.2	8.6	0	1.0	0	2	1.0	2	0	0.9	0
15	W 6th St & McDonald Dr	10.2	3.6	0	1.0	0	0	1.0	0	1	0.9	0.9
16	W 6th St & Lawrence Ave	9.2	5.3	0	1.0	0	0	1.0	0	5	0.9	4.5
17	Bob Billings Pkwy & Kasold Dr	9.2	2.0	0	1.0	0	0	1.0	0	0	0.9	0
18	W 23rd St & Alabama St	9.0	5.2	0	1.0	0	1	1.0	1	3	0.9	2.7
19	W 31st St & Iowa St	8.3	1.3	0	1.0	0	0	1.0	0	0	0.9	0
20	W 9th St & Kentucky St	8.2	5.5	0	1.0	0	1	1.0	1	0	0.9	0

Safety Audit Recommendation	Order Method	Overall Data Details for Hot Spots in Category	Fatal Crashes Range	School Count Range	Bicycle Crashes Range
			0-1	0-3	0-5

APPENDIX | HOT SPOTS - URBAN - URBAN INTERSECTIONS

Pedestrian Crashes			Park Proximity			Bike Facility Proximity			Bus Stop Proximity			Central Business District Proximity		
Crash Count	Weighted Value per Crash	Total Weighted Value	Park within 500 ft	Weighted Value per Park	Total Weighted Value	Has Bike Facility	Weighted Value if Present	Total Weighted Value	Number of Bus Stops	Weighted Value per Bus Stop	Total Weighted Value	Within CBD	Weighted Value if in CBD	Total Weighted Value
6	0.9	5.4	0	0.8	0	0	0.8	0	2	0.7	1.4	0	0.7	0
3	0.9	2.7	0	0.8	0	1	0.8	0.8	3	0.7	2.1	0	0.7	0
1	0.9	0.9	0	0.8	0	1	0.8	0.8	2	0.7	1.4	0	0.7	0
0	0.9	0	0	0.8	0	1	0.8	0.8	2	0.7	1.4	0	0.7	0
1	0.9	0.9	1	0.8	0.8	1	0.8	0.8	0	0.7	0	0	0.7	0
0	0.9	0	0	0.8	0	1	0.8	0.8	1	0.7	0.7	1	0.7	0.7
2	0.9	1.8	1	0.8	0.8	0	0.8	0	2	0.7	1.4	0	0.7	0
1	0.9	0.9	1	0.8	0.8	1	0.8	0.8	1	0.7	0.7	1	0.7	0.7
0	0.9	0	1	0.8	0.8	0	0.8	0	0	0.7	0	0	0.7	0
2	0.9	1.8	1	0.8	0.8	0	0.8	0	1	0.7	0.7	0	0.7	0
1	0.9	0.9	1	0.8	0.8	1	0.8	0.8	0	0.7	0	0	0.7	0
2	0.9	1.8	0	0.8	0	1	0.8	0.8	2	0.7	1.4	0	0.7	0
0	0.9	0	1	0.8	0.8	1	0.8	0.8	0	0.7	0	0	0.7	0
0	0.9	0	1	0.8	0.8	1	0.8	0.8	0	0.7	0	0	0.7	0
0	0.9	0	1	0.8	0.8	1	0.8	0.8	1	0.7	0.7	1	0.7	0.7
1	0.9	0.9	1	0.8	0.8	1	0.8	0.8	0	0.7	0	1	0.7	0.7
1	0.9	0.9	1	0.8	0.8	1	0.8	0.8	1	0.7	0.7	0	0.7	0
1	0.9	0.9	0	0.8	0	1	0.8	0.8	0	0.7	0	0	0.7	0
2	0.9	1.8	0	0.8	0	1	0.8	0.8	0	0.7	0	1	0.7	0.7
1	0.9	0.9	0	0.8	0	1	0.8	0.8	3	0.7	2.1	0	0.7	0

Pedestrian Crashes			Park Proximity			Bike Facility Proximity			Bus Stop Proximity			Central Business District Proximity		
Crash Count	Weighted Value per Crash	Total Weighted Value	Park within 500 ft	Weighted Value per Park	Total Weighted Value	Has Bike Facility	Weighted Value if Present	Total Weighted Value	Number of Bus Stops	Weighted Value per Bus Stop	Total Weighted Value	Within CBD	Weighted Value if in CBD	Total Weighted Value
1	0.9	0.9	0	0.8	0	0	0.8	0	2	0.7	1.4	0	0.7	0
0	0.9	0	0	0.8	0	1	0.8	0.8	0	0.7	0	0	0.7	0
1	0.9	0.9	0	0.8	0	1	0.8	0.8	3	0.7	2.1	0	0.7	0
0	0.9	0	0	0.8	0	0	0.8	0	4	0.7	2.8	0	0.7	0
0	0.9	0	0	0.8	0	1	0.8	0.8	0	0.7	0	0	0.7	0
2	0.9	1.8	0	0.8	0	1	0.8	0.8	0	0.7	0	0	0.7	0
2	0.9	1.8	0	0.8	0	1	0.8	0.8	0	0.7	0	0	0.7	0
1	0.9	0.9	1	0.8	0.8	1	0.8	0.8	1	0.7	0.7	0	0.7	0
0	0.9	0	0	0.8	0	1	0.8	0.8	1	0.7	0.7	0	0.7	0
6	0.9	5.4	0	0.8	0	0	0.8	0	2	0.7	1.4	0	0.7	0
1	0.9	0.9	0	0.8	0	1	0.8	0.8	0	0.7	0	0	0.7	0
2	0.9	1.8	0	0.8	0	1	0.8	0.8	2	0.7	1.4	0	0.7	0
1	0.9	0.9	0	0.8	0	1	0.8	0.8	2	0.7	1.4	0	0.7	0
3	0.9	2.7	0	0.8	0	1	0.8	0.8	3	0.7	2.1	0	0.7	0
3	0.9	2.7	0	0.8	0	0	0.8	0	0	0.7	0	0	0.7	0
0	0.9	0	0	0.8	0	1	0.8	0.8	0	0.7	0	0	0.7	0
0	0.9	0	0	0.8	0	1	0.8	0.8	1	0.7	0.7	0	0.7	0
0	0.9	0	0	0.8	0	1	0.8	0.8	1	0.7	0.7	0	0.7	0
0	0.9	0	0	0.8	0	1	0.8	0.8	0	0.7	0	0	0.7	0
1	0.9	0.9	1	0.8	0.8	1	0.8	0.8	0	0.7	0	0	0.7	0

Pedestrian Crashes Range	Park Count Range	No or Yes	Bus Stop Count Range	No or Yes
0-6	0 or 1	0 or 1	0-4	0 or 1

Lack of Traffic Signal Proximity			KU Sporting Event Proximity			Parked Vehicle Crashes			Lack of Lighting Crashes		
Does not have Traffic Signal	Weighted Value	Total Weighted Value	Has KU Sporting Event within 1/2 mile	Weighted Value per Event Location	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
0	0.7	0	0	0.6	0	1	0.5	0.5	0	0.5	0
0	0.7	0	0	0.6	0	1	0.5	0.5	0	0.5	0
1	0.7	0.7	1	0.6	0.6	2	0.5	1	1	0.5	0.5
1	0.7	0.7	0	0.6	0	1	0.5	0.5	1	0.5	0.5
1	0.7	0.7	0	0.6	0	1	0.5	0.5	1	0.5	0.5
1	0.7	0.7	0	0.6	0	2	0.5	1	1	0.5	0.5
0	0.7	0	0	0.6	0	0	0.5	0	0	0.5	0
1	0.7	0.7	0	0.6	0	2	0.5	1	1	0.5	0.5
1	0.7	0.7	1	0.6	0.6	2	0.5	1	1	0.5	0.5
1	0.7	0.7	0	0.6	0	2	0.5	1	1	0.5	0.5
0	0.7	0	1	0.6	0.6	2	0.5	1	0	0.5	0
0	0.7	0	0	0.6	0	2	0.5	1	0	0.5	0
1	0.7	0.7	0	0.6	0	2	0.5	1	1	0.5	0.5
1	0.7	0.7	0	0.6	0	2	0.5	1	1	0.5	0.5
1	0.7	0.7	0	0.6	0	1	0.5	0.5	1	0.5	0.5
0	0.7	0	0	0.6	0	2	0.5	1	0	0.5	0
0	0.7	0	0	0.6	0	2	0.5	1	0	0.5	0
1	0.7	0.7	0	0.6	0	0	0.5	0	1	0.5	0.5
1	0.7	0.7	0	0.6	0	2	0.5	1	1	0.5	0.5
0	0.7	0	0	0.6	0	2	0.5	1	0	0.5	0

Lack of Traffic Signal Proximity			KU Sporting Event Proximity			Parked Vehicle Crashes			Lack of Lighting Crashes		
Does not have Traffic Signal	Weighted Value	Total Weighted Value	Has KU Sporting Event within 1/2 mile	Weighted Value per Event Location	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
0	0.7	0	0	0.6	0	0	0.5	0	0	0.5	0
0	0.7	0	0	0.6	0	0	0.5	0	2	0.5	1
0	0.7	0	0	0.6	0	2	0.5	1	0	0.5	0
0	0.7	0	0	0.6	0	0	0.5	0	2	0.5	1
0	0.7	0	0	0.6	0	0	0.5	0	1	0.5	0.5
0	0.7	0	0	0.6	0	2	0.5	1	1	0.5	0.5
0	0.7	0	0	0.6	0	2	0.5	1	0	0.5	0
0	0.7	0	0	0.6	0	1	0.5	0.5	0	0.5	0
0	0.7	0	0	0.6	0	1	0.5	0.5	0	0.5	0
0	0.7	0	0	0.6	0	1	0.5	0.5	2	0.5	1
0	0.7	0	1	0.6	0.6	0	0.5	0	0	0.5	0
0	0.7	0	0	0.6	0	2	0.5	1	1	0.5	0.5
0	0.7	0	0	0.6	0	0	0.5	0	0	0.5	0
0	0.7	0	0	0.6	0	1	0.5	0.5	1	0.5	0.5
0	0.7	0	0	0.6	0	0	0.5	0	0	0.5	0
0	0.7	0	0	0.6	0	0	0.5	0	0	0.5	0
0	0.7	0	0	0.6	0	0	0.5	0	1	0.5	0.5
0	0.7	0	0	0.6	0	0	0.5	0	0	0.5	0
0	0.7	0	0	0.6	0	1	0.5	0.5	0	0.5	0
0	0.7	0	0	0.6	0	2	0.5	1	2	0.5	1

No or Yes	KU Sporting Event Count Range	Parked Vehicle Crashes Range	Lack of Lighting Crashes Range
0 or 1	0 or 1	0-2	0-3

APPENDIX | HOT SPOTS - RURAL - COUNTY INTERSECTIONS

				Fatal Crashes			Fixed Object Crashes		
Ordered Hot Spots	Rural County Intersections	Weighted Priority Ranking Value Total	EEACF	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
1	N 1600 Rd & E 50 Rd	9.1	0.8	0	1.0	0	6	0.8	4.8
2	N 1000 Rd & E 2200 Rd	8.6	0.4	0	1.0	0	5	0.8	4
3	N 500 Rd & E 2200 Rd	7.6	1.4	0	1.0	0	4	0.8	3.2
4	N 1100 Rd & E 1500 Rd	7.4	0.0	0	1.0	0	5	0.8	4
5	N 1000 Rd & E 1200 Rd	7.2	0.2	0	1.0	0	5	0.8	4
6	N 500 Rd & E 1500 Rd	7.2	0.2	0	1.0	0	2	0.8	1.6
7	N 500 Rd & E 1700 Rd	7.1	0.6	0	1.0	0	2	0.8	1.6
8	N 851st Diag Rd & E 251st Diag Rd	6.8	0.2	0	1.0	0	1	0.8	0.8
9	N 1175 Rd & E 1500 Rd	6.5	0.1	0	1.0	0	2	0.8	1.6
10	N 1600 Rd & E 600 Rd	6.4	0.4	0	1.0	0	1	0.8	0.8

				Fatal Crashes			Fixed Object Crashes		
Ordered Hot Spots	Rural County Intersections	EEACF	Weighted Priority Ranking Value Total	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
1	N 500 Rd & E 2200 Rd	1.390033	7.6	0	1.0	0	4	0.8	3.2
2	N 1600 Rd & E 50 Rd	0.752207	9.1	0	1.0	0	6	0.8	4.8
3	N 500 Rd & E 1700 Rd	0.606383	7.1	0	1.0	0	2	0.8	1.6
4	N 1600 Rd & E 100 Rd	0.511641	4.3	0	1.0	0	1	0.8	0.8
5	N 1600 Rd & E 700 Rd	0.510173	3.8	0	1.0	0	1	0.8	0.8
6	N 1000 Rd & E 2200 Rd	0.437097	8.6	0	1.0	0	5	0.8	4
7	N 1700 Rd & E 1600 Rd	0.421428	5.3	0	1.0	0	5	0.8	4
8	N 1600 Rd & E 318th Rd	0.394485	3.9	1	1.0	1	1	0.8	0.8
9	N 1000 Rd & E 850 Rd	0.394287	3.7	0	1.0	0	4	0.8	3.2
10	N 1600 Rd & E 600 Rd	0.381251	6.4	0	1.0	0	1	0.8	0.8

Safety Audit Recommendation	Order Method	Overall Data Details for Hot Spots in Category	Fatal Crashes Range	Fixed Object Crashes Range
			0-1	0-6

APPENDIX | HOT SPOTS - RURAL - COUNTY INTERSECTIONS

Overturning Crashes			Bridge Proximity			Animal Crashes			Adverse Weather Crashes		
Crash Count	Weighted Value per Crash	Total Weighted Value	Number of Bridges within 500 ft	Weighted Value per Bridge	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
2	0.8	1.6	0	0.8	0	0	0.7	0	2	0.6	1.2
0	0.8	0	0	0.8	0	3	0.7	2.1	0	0.6	0
1	0.8	0.8	0	0.8	0	3	0.7	2.1	0	0.6	0
0	0.8	0	0	0.8	0	2	0.7	1.4	0	0.6	0
0	0.8	0	0	0.8	0	0	0.7	0	2	0.6	1.2
0	0.8	0	0	0.8	0	5	0.7	3.5	1	0.6	0.6
0	0.8	0	1	0.8	0.8	3	0.7	2.1	1	0.6	0.6
0	0.8	0	0	0.8	0	5	0.7	3.5	0	0.6	0
0	0.8	0	1	0.8	0.8	2	0.7	1.4	2	0.6	1.2
0	0.8	0	1	0.8	0.8	4	0.7	2.8	0	0.6	0

Overturning Crashes			Bridge Proximity			Animal Crashes			Adverse Weather Crashes		
Crash Count	Weighted Value per Crash	Total Weighted Value	Number of Bridges within 500 ft	Weighted Value per Bridge	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
1	0.8	0.8	0	0.8	0	3	0.7	2.1	0	0.6	0
2	0.8	1.6	0	0.8	0	0	0.7	0	2	0.6	1.2
0	0.8	0	1	0.8	0.8	3	0.7	2.1	1	0.6	0.6
0	0.8	0	0	0.8	0	2	0.7	1.4	1	0.6	0.6
1	0.8	0.8	0	0.8	0	1	0.7	0.7	0	0.6	0
0	0.8	0	0	0.8	0	3	0.7	2.1	0	0.6	0
1	0.8	0.8	0	0.8	0	0	0.7	0	0	0.6	0
0	0.8	0	0	0.8	0	3	0.7	2.1	0	0.6	0
0	0.8	0	0	0.8	0	0	0.7	0	0	0.6	0
0	0.8	0	1	0.8	0.8	4	0.7	2.8	0	0.6	0

Overturning Crashes Range	Bridge Count Range	Animal Crashes Range	Adverse Weather Crashes Range
0-2	0-1	0-5	0-2

APPENDIX | HOT SPOTS - RURAL - COUNTY INTERSECTIONS

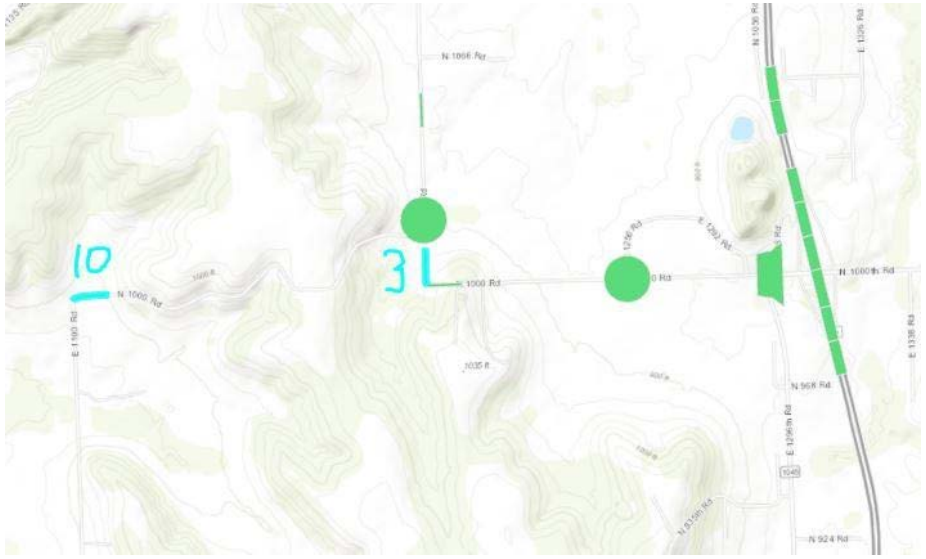
Railroad Crossing Proximity			Bicycle Crashes			Lack of Lighting Crashes		
Number of RR Corssings within 500 ft	Weighted Value per RR Crossing	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	5	0.5	2.5
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	4	0.5	2
0	0.6	0	0	0.5	0	4	0.5	2
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	4	0.5	2
0	0.6	0	0	0.5	0	5	0.5	2.5
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	4	0.5	2

Railroad Crossing Proximity			Bicycle Crashes			Lack of Lighting Crashes		
Number of RR Corssings within 500 ft	Weighted Value per RR Crossing	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	4	0.5	2
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	5	0.5	2.5
0	0.6	0	0	0.5	0	1	0.5	0.5
0	0.6	0	0	0.5	0	0	0.5	0
0	0.6	0	0	0.5	0	1	0.5	0.5
0	0.6	0	0	0.5	0	4	0.5	2

Railroad Crossing Count Range	Bicycle Crashes Range	Lack of Lighting Crashes Range
0-1	0-1	0-5

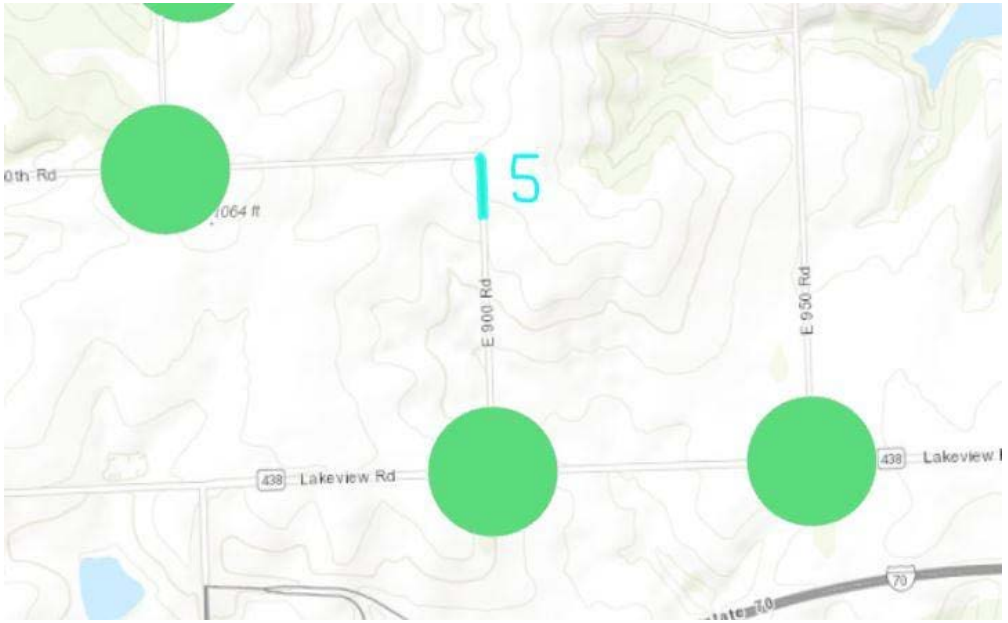
APPENDIX | HOT SPOTS - RURAL - COUNTY ROADWAYS 1

				Fatal Crashes			Fixed Object Crashes		
Ordered Hot Spots	Rural County Roadways	Weighted Priority Ranking Value Total	EEACF	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
1	N 1250 Rd, 0-0.1 mile east of E 1150 Rd	7.0	0.8	0	1.0	0	6	0.8	4.8
2	E 1150 Rd, 0-0.1 mile south of N 1250 Rd	6.8	0.8	0	1.0	0	6	0.8	4.8
3	E 1200 Rd, 0-0.1 mile north of N 1000 Rd	4.1	0.1	0	1.0	0	3	0.8	2.4
4	N 1550 Rd, 0-0.1 mile west of E 1625 Rd	2.9	0.3	0	1.0	0	3	0.8	2.4
5	E 900 Rd, 0-0.1 mile south of N 1850 Rd	2.9	0.0	0	1.0	0	3	0.8	2.4
6	N 700 Rd, 0.1-0.2 miles east of E 1600 Rd	2.8	0.1	1	1.0	1	0	0.8	0
7	E 1625 Rd, 0-0.1 mile south of N 1550 Rd	2.6	0.2	0	1.0	0	2	0.8	1.6
8	N 600 Rd, 0.2-0.3 miles east of E 475 Rd	2.4	0.0	0	1.0	0	0	0.8	0
9	W 1500 Rd, 0.2-0.3 miles north of N 1175 Rd	2.0	0.2	0	1.0	0	1	0.8	0.8
10	N 1000 Rd, 0-0.1 mile east of E 1100 Rd	2.0	0.0	0	1.0	0	1	0.8	0.8



APPENDIX | HOT SPOTS - RURAL - COUNTY ROADWAYS 1

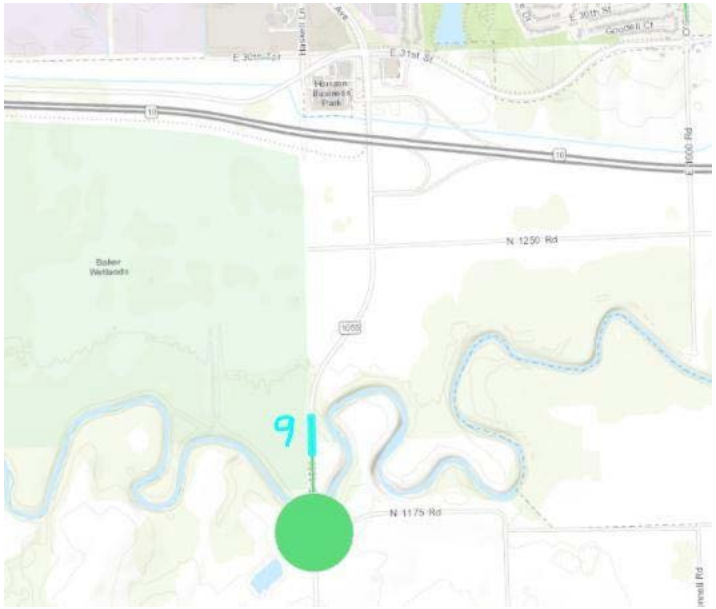
Overturning Crashes			Bridge Proximity			Animal Crashes			Adverse Weather Crashes		
Crash Count	Weighted Value per Crash	Total Weighted Value	Number of Bridges within 500 ft	Weighted Value per Bridge	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
0	0.8	0	0	0.8	0	1	0.7	0.7	0	0.6	0
0	0.8	0	1	0.8	0.8	1	0.7	0.7	0	0.6	0
0	0.8	0	0	0.8	0	1	0.7	0.7	0	0.6	0
0	0.8	0	0	0.8	0	0	0.7	0	0	0.6	0
0	0.8	0	0	0.8	0	0	0.7	0	0	0.6	0
0	0.8	0	0	0.8	0	1	0.7	0.7	1	0.6	0.6
0	0.8	0	0	0.8	0	0	0.7	0	0	0.6	0
0	0.8	0	0	0.8	0	2	0.7	1.4	0	0.6	0
0	0.8	0	0	0.8	0	1	0.7	0.7	0	0.6	0
0	0.8	0	0	0.8	0	1	0.7	0.7	0	0.6	0



APPENDIX | HOT SPOTS - RURAL - COUNTY ROADWAYS 1

Railroad Crossing Proximity			Bicycle Crashes			Lack of Lighting Crashes		
Number of RR Corssings within 500 ft	Weighted Value per RR Crossing	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	1	0.5	0.5
0	0.6	0	0	0.5	0	2	0.5	1
0	0.6	0	0	0.5	0	1	0.5	0.5
0	0.6	0	0	0.5	0	1	0.5	0.5
0	0.6	0	0	0.5	0	1	0.5	0.5
0	0.6	0	0	0.5	0	2	0.5	1
0	0.6	0	0	0.5	0	2	0.5	1
0	0.6	0	0	0.5	0	1	0.5	0.5
0	0.6	0	0	0.5	0	1	0.5	0.5

APPENDIX | HOT SPOTS - RURAL - COUNTY ROADWAYS 1



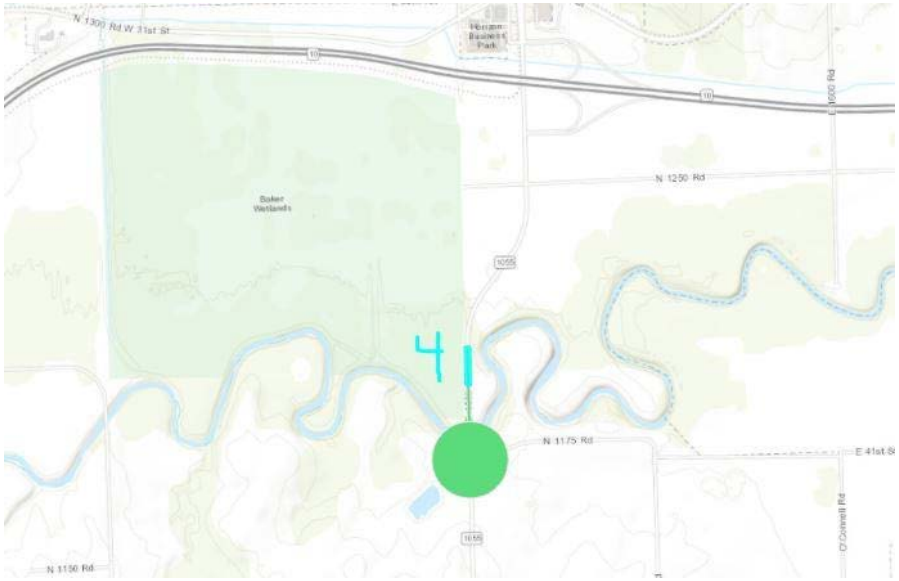
APPENDIX | HOT SPOTS - RURAL - COUNTY ROADWAYS 2

Ordered Hot Spots	Rural County Roadways	EEACF	Weighted Priority Ranking Value Total	Fatal Crashes			Fixed Object Crashes		
				Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
1	N 1250 Rd, 0-0.1 mile east of E 1150 Rd	0.8	7.0	0	1.0	0	6	0.8	4.8
2	E 1150 Rd, 0-0.1 mile south of N 1250 Rd	0.8	6.8	0	1.0	0	6	0.8	4.8
3	N 1550 Rd, 0-0.1 mile west of E 1625 Rd	0.3	2.9	0	1.0	0	3	0.8	2.4
4	W 1500 Rd, 0.2-0.3 miles north of N 1175 Rd	0.2	2.0	0	1.0	0	1	0.8	0.8
5	N 950 Rd, 0.2-0.3 miles east of E 700 Rd	0.2	0.0	0	1.0	0	0	0.8	0
6	E 1625 Rd, 0-0.1 mile south of N 1550 Rd	0.2	2.6	0	1.0	0	2	0.8	1.6
7	Baldwin City, High St, between 6th St and 7th St	0.1	0.0	0	1.0	0	0	0.8	0
8	N 1600 Rd, 0.1-0.2 miles west of E 318 Rd	0.1	1.2	0	1.0	0	0	0.8	0
9	E 1600 Rd, 0.7-0.8 miles north of N 450 Rd	0.1	0.7	0	1.0	0	0	0.8	0
10	N 900 Rd, 0.2-0.3 miles east of E 800 Rd	0.1	1.5	1	1.0	1	0	0.8	0

Safety Audit Recommendation	Order Method	Overall Data Details for Hot Spots in Category	Fatal Crashes Range	Fixed Object Crashes Range
			0-1	0-6

APPENDIX | HOT SPOTS - RURAL - COUNTY ROADWAYS 2

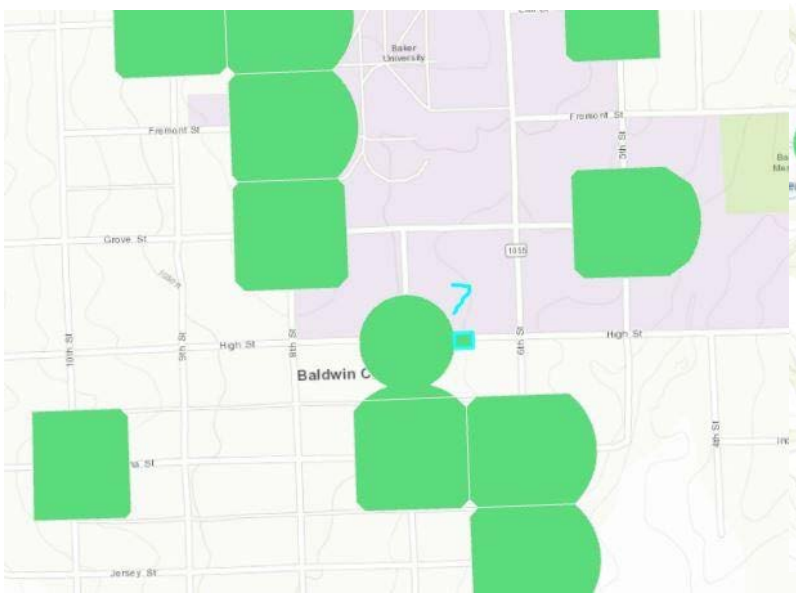
Overturning Crashes			Bridge Proximity			Animal Crashes			Adverse Weather Crashes		
Crash Count	Weighted Value per Crash	Total Weighted Value	Number of Bridges within 500 ft	Weighted Value per Bridge	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
0	0.8	0	0	0.8	0	1	0.7	0.7	0	0.6	0
0	0.8	0	1	0.8	0.8	1	0.7	0.7	0	0.6	0
0	0.8	0	0	0.8	0	0	0.7	0	0	0.6	0
0	0.8	0	0	0.8	0	1	0.7	0.7	0	0.6	0
0	0.8	0	0	0.8	0	0	0.7	0	0	0.6	0
0	0.8	0	0	0.8	0	0	0.7	0	0	0.6	0
0	0.8	0	0	0.8	0	0	0.7	0	0	0.6	0
0	0.8	0	0	0.8	0	1	0.7	0.7	0	0.6	0
0	0.8	0	0	0.8	0	1	0.7	0.7	0	0.6	0
0	0.8	0	0	0.8	0	0	0.7	0	0	0.6	0

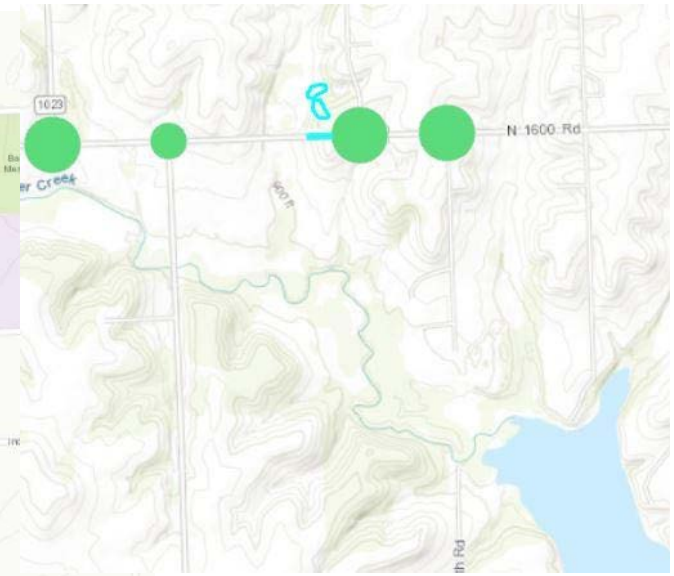


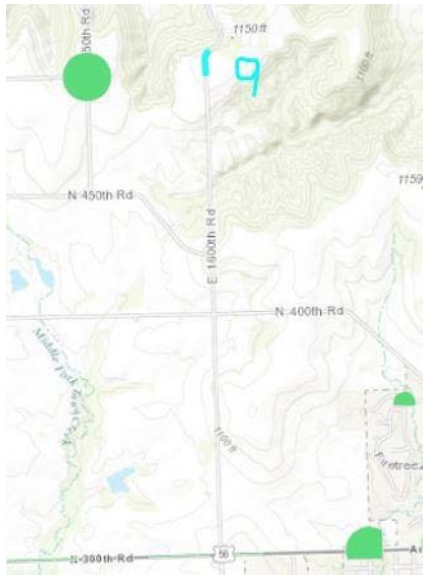
Overturning Crashes Range	Bridge Count Range	Animal Crashes Range	Adverse Weather Crashes Range
0-1	0-1	0-4	0-1

APPENDIX | HOT SPOTS - RURAL - COUNTY ROADWAYS 2

Railroad Crossing Proximity			Bicycle Crashes			Lack of Lighting Crashes		
Number of RR Corssings within 500 ft	Weighted Value per RR Crossing	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	1	0.5	0.5
0	0.6	0	0	0.5	0	1	0.5	0.5
0	0.6	0	0	0.5	0	1	0.5	0.5
0	0.6	0	0	0.5	0	0	0.5	0
0	0.6	0	0	0.5	0	2	0.5	1
0	0.6	0	0	0.5	0	0	0.5	0
0	0.6	0	0	0.5	0	0	0.5	1
0	0.6	0	0	0.5	0	0	0.5	0
0	0.6	0	1	0.5	0.5	0	0.5	0

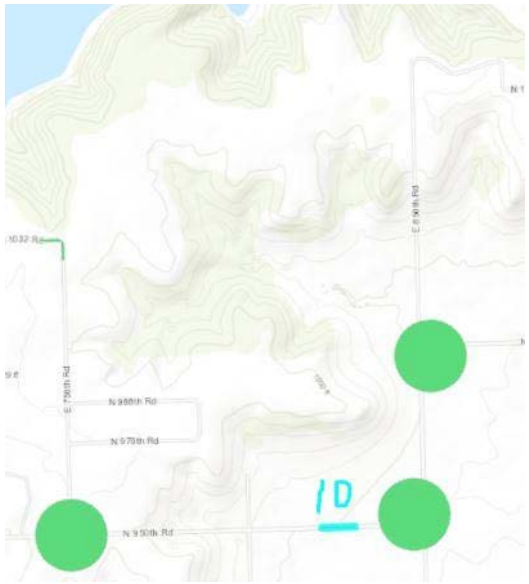






Railroad Crossing Count Range	Bicycle Crashes Range	Lack of Lighting Crashes Range
0-1	0-1	0-4

APPENDIX | HOT SPOTS - RURAL - COUNTY ROADWAYS 2



APPENDIX | HOT SPOTS - RURAL - STATE INTERSECTIONS

				Fatal Crashes			Fixed Object Crashes		
Ordered Hot Spots	Rural State Intersections	Weighted Priority Ranking Value Total	EEACF	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
1	US-56/N 300 Rd & E 1000 Rd	9.4	0.3	0	1.0	0	3	0.8	2.4
2	US-40/N 1701st Diag Rd & E 50 Rd	7.4	0.6	0	1.0	0	4	0.8	3.2
3	US-40/N 1800 Rd & K-32/Linwood Rd	7.2	0.7	0	1.0	0	3	0.8	2.4
4	US-40/N 1701st Diag Rd & E 200 Rd	6.4	0.5	0	1.0	0	5	0.8	4
5	US-40/N 1600 Rd & E 800 Rd	6.2	0.2	0	1.0	0	2	0.8	1.6
6	US-56/N 200 Rd & E 1950 Rd	5.0	0.5	0	1.0	0	0	0.8	0
7	US-40/N 1701st Diag Rd & E 700 Rd	4.8	0.4	0	1.0	0	0	0.8	0
8	US-56/N 300 Rd & E 1100 Rd	4.6	0.1	0	1.0	0	3	0.8	2.4
9	US-40/N 1701st Diag Rd & E 500 Rd	4.2	0.3	0	1.0	0	2	0.8	1.6
10	US-40/N 1600 Rd & E 779 Rd	3.9	0.3	0	1.0	0	2	0.8	1.6

				Fatal Crashes			Fixed Object Crashes		
Ordered Hot Spots	Rural State Intersections	EEACF	Weighted Priority Ranking Value Total	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
1	US-56/Ames St & 8th St	1.0	0.0	0	1.0	0	0	0.8	0
2	US-40/N 1800 Rd & K-32/Linwood Rd	0.7	7.2	0	1.0	0	3	0.8	2.4
3	US-24/US-40 & E 1500 Rd	0.7	1.4	0	1.0	0	0	0.8	0
4	US-40/N 1701st Diag Rd & E 50 Rd	0.6	7.4	0	1.0	0	4	0.8	3.2
5	US-40/N 1701st Diag Rd & E 200 Rd	0.5	6.4	0	1.0	0	5	0.8	4
6	US-56/N 200 Rd & E 1950 Rd	0.5	5.0	0	1.0	0	0	0.8	0
7	US-40/N 1701st Diag Rd & E 600 Rd	0.5	3.0	0	1.0	0	2	0.8	1.6
8	US-40/N 1701st Diag Rd & E 700 Rd	0.4	4.8	0	1.0	0	0	0.8	0
9	US-40/N 1600 Rd & E 700 Rd	0.3	2.8	0	1.0	0	1	0.8	0.8
10	Baldwin City, US-56 & 1st St	0.3	0.7	0	1.0	0	0	0.8	0

Safety Audit Recommendation	Order Method	Overall Data Details for Hot Spots in Category	Fatal Crashes Range	Fixed Object Crashes Range
			0	0-5

APPENDIX | HOT SPOTS - RURAL - STATE INTERSECTIONS

Overturning Crashes			Bridge Proximity			Animal Crashes			Adverse Weather Crashes		
Crash Count	Weighted Value per Crash	Total Weighted Value	Number of Bridges within 500 ft	Weighted Value per Bridge	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
3	0.8	2.4	1	0.8	0.8	1	0.7	0.7	1	0.6	0.6
1	0.8	0.8	0	0.8	0	1	0.7	0.7	2	0.6	1.2
0	0.8	0	0	0.8	0	4	0.7	2.8	0	0.6	0
1	0.8	0.8	0	0.8	0	0	0.7	0	1	0.6	0.6
0	0.8	0	0	0.8	0	3	0.7	2.1	0	0.6	0
0	0.8	0	0	0.8	0	5	0.7	3.5	0	0.6	0
2	0.8	1.6	0	0.8	0	3	0.7	2.1	1	0.6	0.6
0	0.8	0	0	0.8	0	1	0.7	0.7	0	0.6	0
2	0.8	1.6	0	0.8	0	0	0.7	0	0	0.6	0
0	0.8	0	0	0.8	0	1	0.7	0.7	1	0.6	0.6

Overturning Crashes			Bridge Proximity			Animal Crashes			Adverse Weather Crashes		
Crash Count	Weighted Value per Crash	Total Weighted Value	Number of Bridges within 500 ft	Weighted Value per Bridge	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
0	0.8	0	0	0.8	0	0	0.7	0	0	0.6	0
0	0.8	0	0	0.8	0	4	0.7	2.8	0	0.6	0
0	0.8	0	0	0.8	0	2	0.7	1.4	0	0.6	0
1	0.8	0.8	0	0.8	0	1	0.7	0.7	2	0.6	1.2
1	0.8	0.8	0	0.8	0	0	0.7	0	1	0.6	0.6
0	0.8	0	0	0.8	0	5	0.7	3.5	0	0.6	0
0	0.8	0	0	0.8	0	2	0.7	1.4	0	0.6	0
2	0.8	1.6	0	0.8	0	3	0.7	2.1	1	0.6	0.6
1	0.8	0.8	0	0.8	0	1	0.7	0.7	0	0.6	0
0	0.8	0	0	0.8	0	1	0.7	0.7	0	0.6	0

Overturning Crashes Range	Bridge Count Range	Animal Crashes Range	Adverse Weather Crashes Range
0-3	0-1	0-5	0-2

Railroad Crossing Proximity			Bicycle Crashes			Lack of Lighting Crashes		
Number of RR Corssings within 500 ft	Weighted Value per RR Crossing	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
0	0.6	0	0	0.5	0	5	0.5	2.5
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	4	0.5	2
0	0.6	0	0	0.5	0	2	0.5	1
0	0.6	0	0	0.5	0	5	0.5	2.5
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	1	0.5	0.5
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	2	0.5	1
0	0.6	0	0	0.5	0	2	0.5	1

Railroad Crossing Proximity			Bicycle Crashes			Lack of Lighting Crashes		
Number of RR Corssings within 500 ft	Weighted Value per RR Crossing	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
0	0.6	0	0	0.5	0	0	0.5	0
0	0.6	0	0	0.5	0	4	0.5	2
0	0.6	0	0	0.5	0	0	0.5	0
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	2	0.5	1
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	0	0.5	0
0	0.6	0	0	0.5	0	1	0.5	0.5
0	0.6	0	0	0.5	0	1	0.5	0.5
0	0.6	0	0	0.5	0	0	0.5	0

Railroad Crossing Count Range	Bicycle Crashes Range	Lack of Lighting Crashes Range
0-1	0-1	0-5

APPENDIX | HOT SPOTS - RURAL - STATE ROADWAYS 1

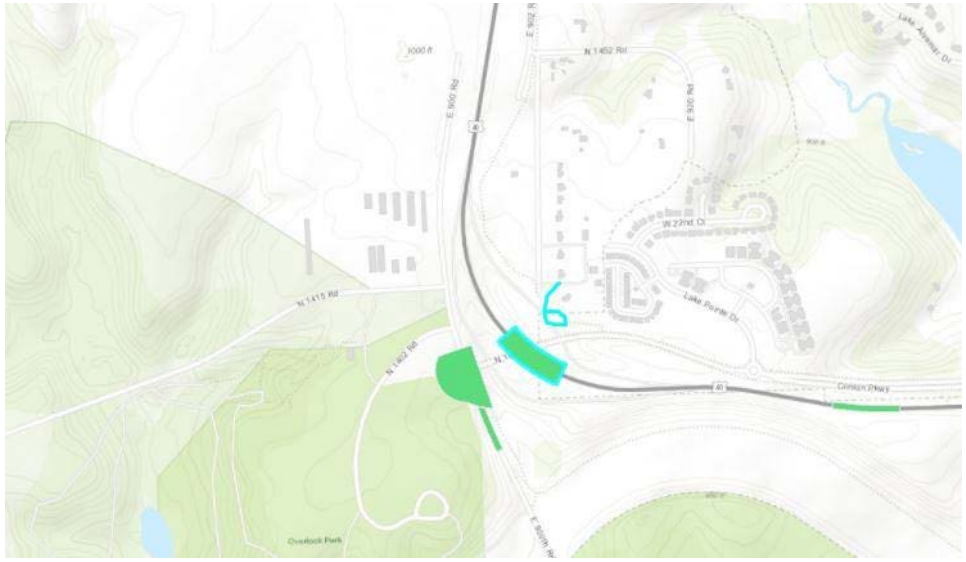
				Fatal Crashes			Fixed Object Crashes		
Ordered Hot Spots	Rural State Roadways	Weighted Priority Ranking Value Total	EEACF	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
1	K-10 at E 2000 Rd	12.5	0.3	0	1.0	0	5	0.8	4
2	K-10, Southern Exit and Entry Ramps to 6th St	10.7	1.3	0	1.0	0	4	0.8	3.2
3	K-10, Eastern Exit and Entry Ramps to N 1400 Rd	7.4	0.2	0	1.0	0	7	0.8	5.6
4	I-70 at K-10	7.3	1.7	0	1.0	0	4	0.8	3.2
5	K-10, Eastern Exit and Entry Ramps to N 1400 Rd	6.8	0.6	0	1.0	0	5	0.8	4
6	K-10 at Clinton Pkwy	6.4	1.0	0	1.0	0	5	0.8	4
7	I-70 at K-10	6.0	0.9	0	1.0	0	3	0.8	2.4
8	I-70 at K-10	5.2	0.8	0	1.0	0	5	0.8	4
9	I-70 at K-10	5.2	0.6	0	1.0	0	3	0.8	2.4
10	US-56 at N 1000 Rd	4.8	0.8	1	1.0	1	1	0.8	0.8

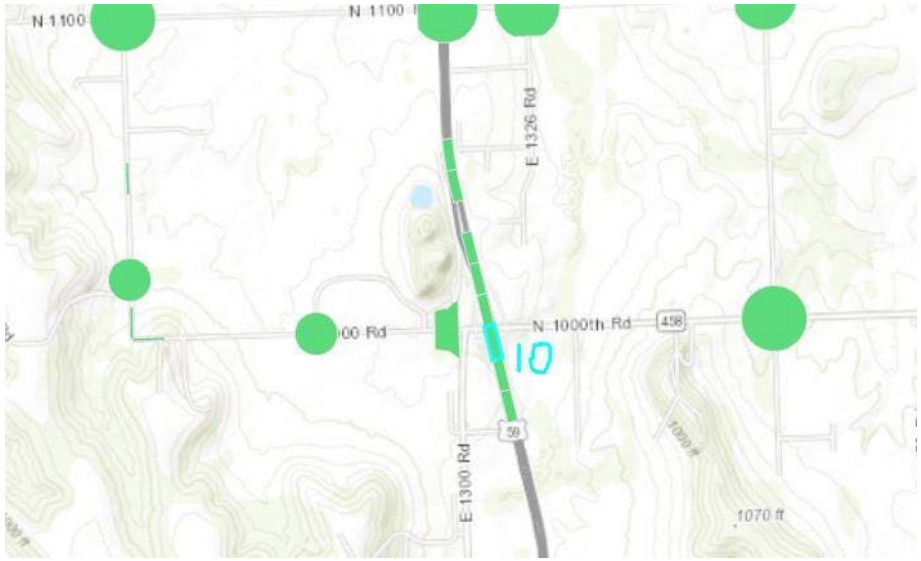
APPENDIX | HOT SPOTS - RURAL - STATE ROADWAYS 1

Overturning Crashes			Bridge Proximity			Animal Crashes			Adverse Weather Crashes		
Crash Count	Weighted Value per Crash	Total Weighted Value	Number of Bridges within 500 ft	Weighted Value per Bridge	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
0	0.8	0	0	0.8	0	3	0.7	2.1	4	0.6	2.4
0	0.8	0	0	0.8	0	5	0.7	3.5	5	0.6	3
0	0.8	0	0	0.8	0	1	0.7	0.7	1	0.6	0.6
0	0.8	0	0	0.8	0	2	0.7	1.4	2	0.6	1.2
0	0.8	0	0	0.8	0	1	0.7	0.7	1	0.6	0.6
0	0.8	0	0	0.8	0	0	0.7	0	4	0.6	2.4
1	0.8	0.8	0	0.8	0	1	0.7	0.7	1	0.6	0.6
0	0.8	0	0	0.8	0	1	0.7	0.7	0	0.6	0
0	0.8	0	0	0.8	0	1	0.7	0.7	1	0.6	0.6
0	0.8	0	0	0.8	0	2	0.7	1.4	1	0.6	0.6

APPENDIX | HOT SPOTS - RURAL - STATE ROADWAYS 1

Railroad Crossing Proximity			Bicycle Crashes			Lack of Lighting Crashes		
Number of RR Corssings within 500 ft	Weighted Value per RR Crossing	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
0	0.6	0	0	0.5	0	8	0.5	4
0	0.6	0	0	0.5	0	2	0.5	1
0	0.6	0	0	0.5	0	1	0.5	0.5
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	0	0.5	0
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	1	0.5	0.5
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	2	0.5	1




N 1100
N 1100
E 1326 Rd
00 Rd
N 1000th Rd
458
10
59
E 1300 Rd
1070 ft

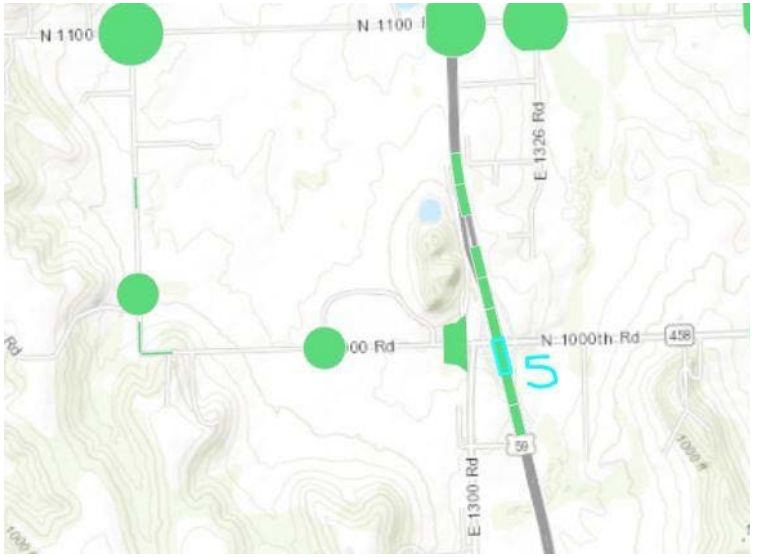
APPENDIX | HOT SPOTS - RURAL - STATE ROADWAYS 2

Ordered Hot Spots	Rural State Roadways	EEACF	Weighted Priority Ranking Value Total	Fatal Crashes			Fixed Object Crashes		
				Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
1	I-70 at K-10	1.7	7.3	0	1.0	0	4	0.8	3.2
2	K-10, Southern Exit and Entry Ramps to 6th St	1.3	10.7	0	1.0	0	4	0.8	3.2
3	K-10 at Clinton Pkwy	1.0	6.4	0	1.0	0	5	0.8	4
4	I-70 at K-10	0.9	6.0	0	1.0	0	3	0.8	2.4
5	US-56 at N 1000 Rd	0.8	4.8	1	1.0	1	1	0.8	0.8
6	US-59 South of US-56	0.8	4.5	0	1.0	0	0	0.8	0
7	I-70 at K-10	0.8	5.2	0	1.0	0	5	0.8	4
8	K-10, Western Exit and Entry Ramps to Iowa St	0.7	1.9	0	1.0	0	0	0.8	0
9	I-70 at K-10	0.6	5.2	0	1.0	0	3	0.8	2.4
10	K-10, Eastern Exit and Entry Ramps to N 1400 Rd	0.6	6.8	0	1.0	0	5	0.8	4

Safety Audit Recommendation	Order Method	Overall Data Details for Hot Spots in Category	Fatal Crashes Range	Fixed Object Crashes Range
			0-1	0-7

APPENDIX | HOT SPOTS - RURAL - STATE ROADWAYS 1

Overturning Crashes			Bridge Proximity			Animal Crashes			Adverse Weather Crashes		
Crash Count	Weighted Value per Crash	Total Weighted Value	Number of Bridges within 500 ft	Weighted Value per Bridge	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
0	0.8	0	0	0.8	0	2	0.7	1.4	2	0.6	1.2
0	0.8	0	0	0.8	0	5	0.7	3.5	5	0.6	3
0	0.8	0	0	0.8	0	0	0.7	0	4	0.6	2.4
1	0.8	0.8	0	0.8	0	1	0.7	0.7	1	0.6	0.6
0	0.8	0	0	0.8	0	2	0.7	1.4	1	0.6	0.6
1	0.8	0.8	0	0.8	0	3	0.7	2.1	1	0.6	0.6
0	0.8	0	0	0.8	0	1	0.7	0.7	0	0.6	0
0	0.8	0	0	0.8	0	2	0.7	1.4	0	0.6	0
0	0.8	0	0	0.8	0	1	0.7	0.7	1	0.6	0.6
0	0.8	0	0	0.8	0	1	0.7	0.7	1	0.6	0.6

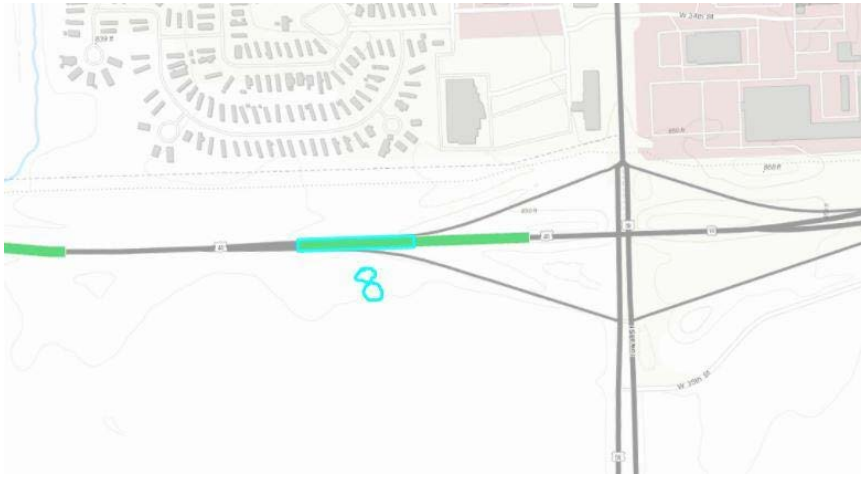


Overturning Crashes Range	Bridge Count Range	Animal Crashes Range	Adverse Weather Crashes Range
0-2	0	0-5	0-5

APPENDIX | HOT SPOTS - RURAL - STATE ROADWAYS 2

Railroad Crossing Proximity			Bicycle Crashes			Lack of Lighting Crashes		
Number of RR Corssings within 500 ft	Weighted Value per RR Crossing	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value	Crash Count	Weighted Value per Crash	Total Weighted Value
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	2	0.5	1
0	0.6	0	0	0.5	0	0	0.5	0
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	2	0.5	1
0	0.6	0	0	0.5	0	2	0.5	1
0	0.6	0	0	0.5	0	1	0.5	0.5
0	0.6	0	0	0.5	0	1	0.5	0.5
0	0.6	0	0	0.5	0	3	0.5	1.5
0	0.6	0	0	0.5	0	3	0.5	1.5

Railroad Crossing Count Range	Bicycle Crashes Range	Lack of Lighting Crashes Range
0	0-1	0-8


8


10
DOUGLAS
JOHNSON
W 103rd St
Cardinal Dr

Cost of Crashes in Kansas

Procedure Provided by Highway Safety Manual, 1st Edition, 2010

Crash Cost Estimates -

U.S.Bureau of Labor Statistics	2013	2017	Ratio
Consumer Price Index (CPI)	233.069	244.955	1.1
Employment Cost Index (ECI)	120.0	129.7	1.1

	2001	2013	2013	2017
Crash Type	**Percentage of Human Capital Crash Costs to Comprehensive Crash Costs**	**Comprehensive Crash Costs**	**Human Capital Crash Costs**	**Comprehensive Crash Costs**
Source	Highway Safety Manual, Appendix 4A	KDOT Memo to FHWA, 2013	("Percentage" * "Comprehensive 2013")	("Human Capital" * "CPI Ratio") + [("Comprehensive 2013" - "Human Capital") * "ECI Ratio"]
Fatal (K)	31%	$4,634,000	$1,439,824	$4,965,624
Disabling Injury (A)	52%	$3,913,000	$2,018,094	$4,169,090
Evident Injury (B)	53%	$78,300	$41,529	$83,390
Possible Injury (C)	63%	$41,350	$26,155	$43,912
Property Damage Only (PDO) (O)	86%	$3,200	$2,768	$3,376

KDOT Memo to FHWA 2013 chrome-extension://gbkeegbaiigmenfmjfclcdgdpimamgkj/views/app.html